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# INTRODUCTION

The 1998/99 Technical Annual Report presents the Department's performance in research and development in the Northern Territory in rural industries and fisheries. The rural industries in the Territory include the pastoral, horticultural and cropping sectors. Cattle production on pasture is a major component of the pastoral industry, which also includes buffaloes, crocodiles, poultry and camels. Fruits, vegetables, nursery and cut flowers are the major components of the horticulture industry. The cropping sector consists mainly of field crops, hay and seeds. The fishing industry includes harvesting of wild stock and aquaculture.

The 1998/99 wet season resulted in higher than average rainfall in the Top End and extended over a long period. This is the third season in a row with heavy rainfall. While no major flooding occurred, soil moisture levels were very high with water tables at the surface in some cases, resulting in some problems with crops in the ground, particularly peanuts. The Victoria River District again received good rainfall. However, the Barkly Tableland once again had a lower than average rainfall, continuing a series of poor years. The season in the Alice Springs region was once again very patchy and many properties continued in drought.

However, the heavy monsoon in the Top End resulted in good pasture growth and the hay-producing sector once again produced a record amount of animal feed. With the reduction in the live trade and corresponding lower demand for feed, cube manufacturers were able to select their raw material on quality. Indonesian trade in live cattle is recovering but may suffer as a result of the East Timor crisis. Fortunately, alternative markets remain strong, particularly Egypt, which is now a major importer of Territory cattle.

In horticulture, after registering a strong growth in 1997, production in 1998 was rather subdued due mainly to a poor mango season plus the effect of the exotic fruit fly (*Bactrocera philippinensis*) in the Darwin region. The total value of horticultural production, including the nursery and cut flower industry in 1998, is estimated at around \$59.5 million compared to \$61.7 million in 1997, a decrease of around 3.6%. The value of mango at \$18.9 million was down by 28.9% compared with the 1997 season. This was partly offset by increases in table grape production to \$10.2 million, up by 26%; and vegetable production to \$9.8 million, up by 38%, despite the adverse effect of the flood in Katherine. Current increases in plantings are expected to double the production of table grapes in the next two years, and treble the production of mango within the next five years.

Investment in aquaculture continued to increase in the Northern Territory and the flow on from this is expected in 1999/2000. Aquaculture production in 1998/99 remained at about \$58 million. The recreational and fishing tour operator sectors contributed over \$30 million over the same period. The recent "La Nina" and the "El-Nino" events had a negative effect on some wild stock commercial fisheries, the most significant being a 20% drop in the prawn catch to about \$40 million, but even that remains within recent historical trends. The value of other NT commercial fisheries has remained stable at around \$20m.

# PASTORAL

## PROGRAM: Agricultural Development

### SUBPROGRAM: Pasture Development

**Objective:**

*Expand the industry base through increased areas of pasture and improved industry skills and experience in managing pastures.*

**Overview - 1998/99**

A near record wet season was again experienced across the Top End.

This wet season was long and good for pasture yields, with good early rain in October in most districts and good late rain in March in Katherine and in April to the north. The run of good wet seasons has allowed the perennial grasses to build up reserves and show excellent growth and seeding.

With the good growing season and increased sowings of hay crops, particularly Cavalcade, hay production in the Top End will exceed the 42,000 tonnes produced in 1998. The three cubing plants are all making cubes for the live cattle export trade from local hay.

There were applications to produce certified seed on 237 hectares this year. Certified seed production, mainly Cavalcade, should again exceed 100 tonnes this year. Total seed production should be lower than the 238 tonnes produced in 1998.

Demand for extension/information on pastures and seeds was again at a record level during the year, with 10% more enquires than last year.

Trials conducted during the wet season showed that gamba grass could be effectively killed with the recommended rate of glyphosate application for spot spraying at 1%. This was the case from early in the wet season in December to late in the wet season in April. In the trials, all glyphosate rates between 0.5 and 3.0% killed all of the plants sprayed.

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### **PROJECT: Evaluation of New Pasture Lines and Seed Increase of Early Generation Seed of Released Pasture Cultivars (Existing Sowings)**

**Project officers:** B. Ross, E. Pickering, G. Hore and A. Cameron

**Location:** Paddocks 8 and 9, Berrimah Farm

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**Objective:**

*To evaluate new lines in a confined non-grazed environment, to bulk-up seed from promising lines for further evaluation and to bulk up early generation seed of pasture cultivars released in the NT.*

The section evaluates potential new pastures which may be of benefit to agriculture in the NT and maintains pre-basic and basic seed of pasture cultivars released in the NT.

**Method:**

The new seed introductions sown in the nursery during the current wet season are covered in the following trials.

**Results:**

A pre-basic seed crop of cavalcade was grown in Pdk 9. 22kg of seed was harvested during July 1998. More seed will be harvested in 1999.

A pre-basic seed crop of Bunday was grown in Pdk 9. Seed was harvested in July 1999.

Approximately 25 kg of pre-basic seed was harvested from the stand of Arnhem in Pdk 8.

(a) 1994/95 Wet Season Sowing

*Paspalum atratum* and *P. guenoarum* are the only lines that have persisted. They were fertilised this year, and seed is being collected in case further evaluation should be required.

(b) Other existing sowings

Plots of Jarra (*Digitaria milanijana* cv Jarra) have been maintained. A plot of *Leucaena diversifolia* was sprayed with Starane and 2,4-D + diesel. Other leucaena plants along fences were also sprayed and removed.

## PROJECT: Chemical Control of Kent Gamba Grass

Project Officers: A. Cameron, J. Pitt, B. Ross and G. Hore

Location: Berrimah Farm

### Objective:

*This study is being conducted to determine herbicide formulations, which can be used to control gamba grass tussocks.*

### Background:

Kent gamba, a tall tussock pasture grass has established along roads and on vacant disturbed country. Grading, slashing and mowing assist its spread.

In those situations it can grow unchecked and produce a high fuel load and intense fires.

Current recommended control methods are to slash or mow followed up by spot spraying with glyphosate (1%).

### Method:

Three trials were conducted on rates, placement and tussock size using Velpar. These trials were done twice, in December, and again in January, because the first time of application was the day before Cyclone Thelma, which dropped 600mm of rain on the trial area, washing away the Velpar from the treated tussocks.

### Results:

A *Velpar Rates*

The results are presented in Table 1.

**Table 1: The effect of rates of application of Velpar on Gamba grass**

<i>Treatment Velpar/plant (ml)</i>	<i>Height cm</i>	<i>Basal Diameter cm</i>	<i>Plant Volume litres</i>	<i>Mortality %</i>
0	135	27	76	0
0.5	100	23	52	0
1	85	18	24	0
2	90	18	28	0
3	40	5	4	50
4	40	5	4	50

*B Velpar Placement*

The results are presented in Table 2 for a 3ml application of Velpar.

**Table 2: The effect of placement of Velpar on Gamba grass**

<i>Treatment</i>	<i>Height cm</i>	<i>Basal Diameter cm</i>	<i>Plant Volume litres</i>	<i>Mortality %</i>
Nil	130	36	137	0
1 spot centre	70	10	17	0
1 spot outside	90	18	28	0
2 spots outside	35	9	14	0
3 spots outside	55	12	21	0
4 spots outside	30	2	0	0

*C Velpar on Tussock Size*

The results are presented in Table 3 for a 2ml application of Velpar.

**Table 3: The effect of 2ml application of Velpar on gamba grass tussocks**

<i>Tussock Size</i>	<i>Height cm</i>	<i>Basal Diameter cm</i>	<i>Plant Volume litres</i>	<i>Mortality %</i>
Up to 20cm	35	3	1	50
20 – 30cm	60	5	2	25
30 – 40cm	75	23	80	25
Over 40cm	100	43	171	0

*D Glyphosate Early*

All of the 6 glyphosate treatments between 5ml/l and 30ml/l applied in December killed all of the plants sprayed, giving 100% mortality.

*E Glyphosate Late – Mature plants*

All of the 6 glyphosate treatments between 5ml/l and 30ml/l applied in April killed all of the plants sprayed, giving 100% mortality.

*F Glyphosate Late – Slashed regrowth*

Results for regrowth 2 weeks after slashing sprayed with glyphosate in April are presented in Table 4.

**Table 4: The effect of glyphosate on gamba grass**

<i>Treatment ml/l glyphosate</i>	<i>Height cm</i>	<i>Basal Diameter cm</i>	<i>Plant Volume litres</i>	<i>Mortality %</i>
4 spots outside	30	2	0	0
0	51	35	49	0
5	24	7	3	0
10	0	0	0	100
15	3	0	0	75
20	0	0	0	100
25	5	1	0	25
30	0	0	0	100

**Discussion:**

As in last year, Velpar did not kill the tussocks as well as expected. The problem is in the distribution of the Velpar. In most cases, not all of the tillers were killed. The surviving tillers were not vigorous, as shown by reduced tussock heights, basal diameters and volumes, but they may have recovered to regenerate the tussock next wet season. We need to examine ways such as splat nozzles, higher volumes and granules to get the Velpar better distributed around the tussocks.

On the other hand, glyphosate gave 100% mortality at all of the rates applied to whole plants in December and April. The recommended rate of glyphosate for spot spraying at 1% is adequate to kill Gamba grass tussocks during the wet season. The use of a wetting agent may have been part of the reason for a better kill this year compared to last wet season.

The mortality rates were lower where 2 week-old regrowth was sprayed with glyphosate and tussock size was greatly reduced. This may have been because some of the slashed tillers had not regrown in the two-week period. A delay of 4 weeks before spraying may have allowed a better kill.

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## **PROJECT:           Assessment of Newly Released Australian Pasture Cultivars Under NT Conditions**

**Project Officers:**   **B. Ross and G. Hore**

**Project Location:**   BF (1999)

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**Objective:**

***To determine if forage cultivars released commercially elsewhere in Australia are suitable for use in the NT.***

**Background:**

Many pasture, hay and forage cultivars released commercially in Queensland are suited for use in the NT. Some are not by virtue of their time to maturity, lack of dry season drought tolerance or high soil nutrient requirements. As most cultivars are marketed widely throughout northern Australia, it is necessary to evaluate new releases under Northern Territory conditions. From time to time, industry interest in "old" cultivars requires evaluation or re-evaluation of such cultivars.

**Method:**

Newly received seed is grown in a confined non-grazed environment, for evaluation and to multiply seed for further evaluation. In 1998/99 trials included:

- Bambatsi panic (*Panicum coloratum* var. *Makarikariense*) cv Bambatsi (also known as Makarikari grass). Bambatsi panic has been the subject of recent interest and experimental and commercial sowings as a component of the pasture rotation phase on grey clay cropping soils in 600 - 750 mm rainfall areas of Queensland.
- *Paspalum atratum* cv Hi Gane is the Australian release of the US cultivar "Suerte" which is used extensively in Florida. Hi Gane was released in Queensland in 1998 as a potential pasture grass for the coastal region. A similar *P. atratum* accession ATF1054 has persisted and grown well at Berrimah.
- *Paspalum nicorae* cv Blue Dawn is being marketed in southeast Queensland as a turf/ground cover.
- *Aeschynome villosa* cv Reid is the early maturity component of the commercial seed mix "Villomix". It is being evaluated in the NT as one of a number of legumes, which may have potential as pasture or ley legumes in newer intensive agricultural areas of the NT, such as the Sturt Plateau.
- *Urochloa mosambicensis* cv Saraji was developed at Saraji mine in central Queensland as a ground cover species for re-vegetation but may also be useful as a grazing plant in lower rainfall environments than the existing Sabi grass cultivar, Nixon (*U. mosambicensis* cv *Nixon*).

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**PROJECT:           Assessment of Pasture Cultivars on  
Pre-release in Queensland**

**Project Officers:   B. Ross and G. Hore**

Project Location    BF (1999)

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**Objective:**

*To determine whether forage cultivars commercially released elsewhere are suitable for use in the NT.*

**Background:**

Because of some similarities in climate and industry in parts of Queensland and the NT, the results of plant evaluation programs in Queensland may be of relevance to NT producers. By evaluating potential cultivars, which have reached the pre-release stage of evaluation elsewhere, we can gather sufficient information to determine whether these plants have a role in the NT before they come on the market.

**Method:**

Newly received seed is grown in a confined non-grazed environment, for evaluation and to multiply seed for further evaluation.

The 1998/99 sowings include:

- *Paspalum nicorae* CPI 27707 along with CPI 21370 (now cv "Blue Dawn") were placed on pre-release in Queensland in 1991. They are being considered in southeastern Queensland as potential high use pastures with weed competition abilities and for amenity planting.
- *Arachis pintoii* ATF 2320 is a high quality, high yielding forage peanut.

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**PROJECT:           Evaluation of Short Season Legumes**

**Project Officers:   B. Ross and G. Hore**

Project Location:   BF (1999)

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**Objective:**

*To evaluate short-season legumes for the NT.*

**Background:**

As more intensive agriculture extends into lower rainfall areas of the NT, there is a need for hay crops and ley legumes suitable for these environments. Cavalcade, the predominant hay crop in the NT is limited by its relatively late flowering time to regions with a wet season of at least 5-6 months, which makes regeneration from seed in a dryland situation risky in areas south of Katherine.

**Method:**

The first phase of the evaluation is to multiply scarce seed to obtain enough seed for regional evaluation to be undertaken. At the same time these accessions are screened under favourable conditions (irrigated and fertilised) and those which are obviously unsuitable are eliminated from further evaluation.

Small quantities of seed received from researchers interstate were germinated in seedling mix in the shadehouse and transplanted to the field as spaced plants at 4-6 weeks of age. Thirty three accessions from the genera *Aeschynomene*, *Arachis*, *Centrosema*, and *Desmanthus* were received; thirty made it to the field as three of the first sowings of *Arachis* failed to germinate, most likely due to the age of the seed supplied (10 years).

A series of measurement is taken monthly throughout the growing season. Seed is being collected, cleaned and stored.



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**PROJECT: Drought Tolerant Grasses****Project Officers: B. Ross and G. Hore****Project Location: BF (1999)**

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**Objective:**

***To evaluate a range of drought tolerant grasses for their potential use as pasture or ley cultivars in regions of the NT receiving less than 900mm annual rainfall.***

**Background:**

As more intensive agriculture extends into the lower rainfall areas of the NT, there will be a tendency for more cattle to be run on smaller areas, requiring more productive and resilient grasses than are used at present. The use of a ley phase in cropping systems will require grasses, which can be established and become productive in a short space of time.

**Method:**

In addition to Saraji, Bambatsi and *Paspalum nicorae*, all of which may fit the objective of this evaluation, four other grass accessions from the genera *Chrysopogon*, *Panicum* and *Digitaria* were established in the 1998/99 wet season as spaced plants to obtain seed for further evaluation.

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**PROJECT: Gamba Grass Mapping****Project Period: 1999-2001****Project Officer: B. Ross****Project Location: Darwin and Katherine Regions**

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**Objective:**

***To map the results of gamba grass surveys undertaken by Weeds Branch, Agriculture Branch, and Specialist Weed Control Pty Ltd.***

**Background:**

In the last two years several groups have surveyed Gamba grass occurrence along roadsides in parts of the Top End. Many individuals and organisations have expressed interest in the results of these surveys.

This small project was undertaken using ArcView 3.1 to see if the various surveys could be reconciled and to provide a visual record of the gamba grass survey and control demonstration project.

**Progress:**

Data entry is complete and checking and cleaning continues. A poster of preliminary results was presented at the NARGIS'99 Conference. Final results of the 1998 and 1999 surveys will be presented in October 1999.

The maps will be updated following future surveys.

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**PROJECT: Characteristics of Tropical Tall Grasses**

**Project Period: 1999-2002**

**Project Officers: G. Hore and B. Ross**

**Project Location: Darwin area**

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**Objective:**

***To document and assist others to identify common native perennial tall grasses found in the Darwin region.***

**Background:**

Current publications on the flora of the Top End contain descriptions and illustrations of some, but not all, of the perennial tropical grasses commonly found in the Darwin region.

From time to time it is necessary to be able to recognise various tropical tall grasses, eg when mapping/controlling Gamba grass, several native perennial grasses may be mistaken for gamba.

It is also necessary to understand the ecology of these grasses. We need to be able to predict the impacts of changes in their management, eg the increase in haymaking from native grasses for sale as garden mulch, amenity mowing, vegetation slashing as a fire hazard reduction measure and fire hazard reduction burning, and weed control. The effects of grazing by cattle and horses also need to be considered.

There is also currently a growing interest in native grasses from the general public and from organisations involved in revegetation, and amenity planting including roadside revegetation.

**Method:**

From February to June 1999, in the course of other duties, tall perennial grasses encountered were collected, identified and recorded.

Seed of	<i>Alloteropsis semialata</i>	(Cockatoo grass)
	<i>Heteropogon triticeus</i> ,	(Giant spear grass)
	<i>Sorghum plumosum</i> ,	(Perennial sorghum)
	<i>Mnsithea rottboelloides</i>	(Northern Cane grass)
	<i>Chrysopogon latifolius</i>	(Ribbon grass)

was collected in the field and stored in preparation for sowing demonstration plots of these species next wet season.

An area adjacent to the Seeds Laboratory at Berrimah Farm was obtained for use as a demonstration area.

## SEED TESTING LABORATORY

During the year 275 lots or consignments were submitted for testing. There were more samples submitted for germination and certification, with more producers farming in the NT and more seed harvested than in 1996.

The following tests were carried out on the submitted lots:

Test	No. of tests
Certification	12
Purity	20
Germination	138
Bulk Search	70
Seed Mass	8
Quarantine Inspection & Identification	516
Other	
Phytosanitary Certificate Inspection	6
Weed Seed Count	5
Identifications	5
Total Seed Weight	5
<b>Total</b>	<b>785</b>

## SUBPROGRAM: Agroforestry

**PROJECT: Agroforestry**

**Project Officers: D. Reilly and B. Robertson**

**Project Location: BARC, DDRF & Private Properties**

### Objective:

**To conduct species evaluation trials on various sites which address a number of criteria to meet industry requirements for both long and short rotation crops.**

### Materials and Method:

Trial plantings of tropical hardwood species were initiated in August 1995 at Berrimah Farm when the Agroforestry Section was being developed by DPIF. The initial planting was of 7 species replicated 5 times in rows of 10, at 3m x 3m spacing with 3m buffer rows surrounding. In total there were 656 stems, (3m x 3m spacing = 1100/ha). Growth rates are measured annually.

Subsequently a number of trials have been implemented to evaluate production levels on various soil types of species already studied and new species, under differing regimes. The success rates of establishment, persistence and growth rate are being monitored. The sites at both DDRF and BARC can be utilised for both research and demonstration purposes with details of results made available to interested clients.

In December 1996, the BARC tree trial was expanded to include another 12 species and some of their provenances. These species were planted at varying spacings in 3 replications.

The spacings were:       3.0 m x 1.5 m  
                                   3.0 m x 2.5 m  
                                   3.0 m x 3.0 m

The species include *Gmelina schelecteri*, *Eucalyptis maculata*, *Swietenia humilis* (chol), *Swietenia humilis* (coma), *Samanea saman*, *Enterolobium cyclocarpum*, *Acacia aulaucocarpa*, 17867 and 19301, *Acacia auriculiformis*, 18102 and 19253, *Acacia mangium*, 17868 and 18994, *Swietenia macrophylla*, *Castanospermum australe* and *Flindersia brayleana*. All plantings received supplementary irrigation from May through to November. Refer to table No. 4.

Table 1:	BARC trial planted August 1995	1 <sup>st</sup> measurement August 1996
	irrigated for first two years	2 <sup>nd</sup> measurement August 1997
		3 <sup>rd</sup> measurement December 1998

Species	Survival % 1996	Survival % 1997	Average Ht 1996	Average Ht 1997	Average Ht 1998
<i>Blepharocarya involucrigera</i>	46	42	177	273.3	370
<i>Cedrela odorata</i>	96	96	273.8	443.1	620
<i>Eucalyptus pellita</i>	80*	96*	233 *	370.4 *	355 *
<i>Flindersia australis</i>	90	80	202	275.0	385
<i>Pleiginium timorense</i>	100	90	267	436.1	615
<i>Syzygium nervosum</i>	92	90	149	231.0	310
<i>Syzygium forte</i>	100	96	158.6	256.5	380

\*Dead plants replaced with new seedlings

Table 2: Timber Species - DDRF trial planted December 1995, 2nd measurement 6/5/97.

Species	Treatment	Survival %	Average height (cm)
<i>Flindersia australis</i>	irrigated	68%	1730
	dryland	1%	922.5
<i>Eucalyptus pellita</i>	irrigated	64%	1251
	dryland	43%	1067
<i>Syzygium forte</i>	irrigated	73%	1022
	dryland	60%	878
<i>Pleiginium timorense</i>	irrigated	83%	1186
	dryland	60%	990
<i>Syzygium nervosum</i>	irrigated	65%	758
	dryland	n/a	n/a
<i>Castanospermum australe</i>	irrigated	13.3%	602
	dryland	0	0
<i>Toona australis</i>	irrigated	43%	1904
	dryland	0	0
<i>Cedrela odorata</i>	irrigated	86%	2607
	dryland	0	0

The dryland component of this trial has been abandoned (OCT '98) due to poor performance at this site.

Table 3: Multipurpose trees, DDRF trial planted December 1996, 2nd measurement at 6/5/97.

Species	Treatment	Survival	Average Height (cm)
<i>Maranthes corumbosum</i>	Irrigated	58	1372
	Dryland	12	1040
<i>Bauninia</i>	Irrigated	79	1280
	Dryland	8	1230
<i>Pterocarpus indicus</i>	Irrigated	54	2093
	Dryland	37	1709
<i>Khaya senegalensis</i>	Irrigated	70.6	2108
	Dryland	12.3	1457
<i>Tamarindus indica</i>	Irrigated	96	1245
	Dryland	41	912
<i>Brachychiton diversifolius</i>	Irrigated	75	1016
	Dryland	70	1040
<i>Terminalia microcarpa</i>	Irrigated	79	1679
	Dryland	8	1565
<i>Peltophorum pterocarpum</i>	Irrigated	79.3	1821
	Dryland	41.6	1675
<i>Albizia lebek</i>	Irrigated	100	2531
	Dryland	91.6	1735
<i>Cupaniopsis anacandoides</i>	Irrigated	92	1397
	Dryland	29	973

Further measurements are to be carried out later in 1999.

**Table 4: BARC mixed timber species planted December 1996. Measured Dec. 1997**

SPECIES	SURVIVAL % 1997	SURVIVAL% 1998	AVERAGE HEIGHT(cm) 12 Mths	AVERAGE HEIGHT (cm) 24 Mths
<i>Gmelina schlechteri</i>	100	98.5	240.3	365.2
<i>Eucalyptus maculata</i>	70	45.8	163	269
<i>Swietenia humilis(chol)</i>	92	83.3	124	310.1
<i>Samanea saman</i>	100	100	206	358.5
<i>Acacia aulacocarpa</i>	100	93.1	292	433.2
<i>Eneterolobium cyclocarpum</i>	93	91.7	261	382.8
<i>Acacia mangium</i>	99	84.7	367	589.4
<i>Flindersia brayleana</i>	73	60.9	93.3	218.6
<i>Acacia auriculiformis</i>	100	98.6	352	506.4
<i>Swietenia macrophylla</i>	100	84.7	114	277
<i>Swieteria humilis (coma)</i>	89	80.6	116	284.2
<i>Castanospermum australe</i>	67	48.6	81.3	162.7

In December 1997 a small tropical hardwood trial was established at Ranku on Bathurst Island in co-operation with Sylvatech who have an agreement with the Tiwi people to plant a 200 hectare pilot project. The Sylvatech project is mainly concerned with the fast growing *Acacia mangium* species for wood chip production. The DPIF trial is looking at high value hardwoods on the same site and has used species already in trials at DDRF and BARC. These include: *Cedrela odorata*, *Swietenia humilis (coma)*, *Flindersia australis*, *Eucalyptus brassiana*, *Eucalyptus pellita*, *Eucalyptus camaldulensis*, *Swietenia macrophylla* and *Swietenia humilis (chol)*. The trees have been planted in 3 randomly allocated replications and are all spaced at 3m x 3m, giving a planting density of 1111 stems per hectare. This trial has been observed and measured only once since established at 6 months old. The best performing species at that stage were the 3 Eucalypts on 11/6/98.

In December 1998, a similar trial to that described above was established at Rolla Plains on Melville Island where the most recent Sylvatech development is taking place. Planting design at Rolla Plains was similar to that at Ranku the previous year. *Eucalyptus brassiana* was unavailable and was replaced with *Khaya senegalensis*, (African mahogany). This trial is now 8 months old and will be measured later this year. DPIF staff were back on this site once since planting and there was no opportunity at that time to record growth.

The most recent trial established was at DDRF on Blain soil, (replacing the irrigated timber component of the December 1996 planting), to evaluate Teak, *Tectona grandis* in that area and on that well-drained soil.

The trees were planted in blocks of 5m x 5m with 3 different treatments and replicated 3 times. The 3 treatments are:

- Open root- shoots cut and roots trimmed (Stumped)
- Grown in 1 litre bags
- Grown in *plantek* trays 35.

A two-row buffer was planted around the outside of the trial area using the same seed source.

Trees were planted into ripped rows that had previously been sprayed with herbicide for pre-planting weed control. The ripped rows were 3m apart and the trees were planted at 2m intervals within the rows. The trial was started on two separate planting dates (28/01/99 and 3/2/99) because a number of seedlings were too small for transplanting on the first date. Fertilising took place on 3/2/99 when each tree received 200 grams of mixed fertiliser with trace elements.

The trial was measured on the 9<sup>th</sup> of August 1999, when the treatments were assessed for survival and growth. Minor pruning was also undertaken at this time to remove any multiple leaders so as to encourage good straight growth of a single stem. Results are shown in the table below.

**Table 5 *Tectona grandis* Planted 17/12/98 and 28/1/99 @ DDRF, measured 9/8/99**

TREATMENT	SURVIVAL %	AVERAGE HEIGHT (cm)
Stumps	81%*	22.4*
1 Lt Bags	100%	99.5
Plantek trays	95%	74.2

\*The lower survival rates and the reduced growth rates for the 'stump' treatment was due to the poorer quality planting material used to make up numbers. Many of the stumps were far too small to be planted out, but as the 'wet season' progressed, time was crucial to establish a rain-fed trial.

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**PROJECT: Top End Regional Tropical Hardwood Forestry**

**Project Officers: D. Reilly, B. Robertson, K. Neitzel and M. Clark**

**Project Location: Four sub-regions of Top End: the Lower Mary River, the Katherine, the Daly Region and the Darwin Rural area on private properties**

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**Objective:**

*The Top End Regional Tropical Hardwood Forestry project, funded by The Natural Heritage Trust, has completed the first of a three-year tree planting program. The project began in June 1998 following expressions of interest from landholders who wished to participate in the project by allocating one to two hectares of their land to tree planting trials. More than twenty applicants responded from the four identified sub-regions of the Top End. Eight sites were chosen by the Steering Committee. The successful applicants were notified and land preparation, fencing and irrigation work began. The unsuccessful applicants were encouraged to re-apply for the following year's planting.*

**Method:**

The following table shows the sites chosen and the tree species planted at each of the seven sites. (The eighth site, at Annaburroo Station, could not be planted due to heavy early rains, which prevented site preparation). A site in the Lower Mary River region, at the Humphris' property, also experienced unusually high rainfall for the season and some of the planted trees had an up hill battle for survival. The Daly Mission site, although planted properly and at the right time, has had two fires and a slashing, which have led to reduced survival of the trees.

Table 1. NHT JVP Farm Forestry Tropical Hardwood Project: 1<sup>st</sup> year plantings (number of each species planted at each site.)

	SPECIES	Darwin Rural Area		Douglas/Daly Region		Katherine Area		Lower Mary River	
		Fred's Pass	Duminski	Daly Mission	Salzgeber	Walsh	Parker	Humphris	An'roo
1	Black Bean <i>Castanospermum australe</i>		196	186				196	
2	West Indian Cedar <i>Cedrela odorata</i>	190		196		196	186	196	
3	Indian mahogany <i>Chukrasia velutina</i>	196	186		196	49	49		
4	Rosewod <i>Dalbergia macrocarpus</i>					49	49	196	
5	Red Mahogany <i>Eucalyptus pellita</i>		196			49	49	196	
6	African Mahogany <i>Khaya senegalensis</i>	196	196	196	196	196	196	196	
7	Padauk <i>Pterocarpus indicus</i>	196			196	49	49		
8	American Mahogany <i>Swietenia macrophylla</i>					196	196		
9	<i>American Mahogany Swietenia humilis</i>	196	196	196	196	196	196	196	
10	Teak <i>Tectona grandis</i>			175	196				
11	Talisai <i>Terminalia belerica</i>	196	196	196	196	196	196		
12	Red Cedar <i>Toona ciliata</i>					49	49		
13	Mangium <i>Acacia mangium</i>					20	12		
	Total	974	980	1145	1176	1098	1080	1176	0

Measurements and assessments at all sites have been undertaken and will be reported in the near future.

Many letters of interest have been received by the Steering Committee for this wet season's planting, (1999/2000). A further eight sites will be planted this season with a greater emphasis on native species and variation on planting designs to include wind break and buffer plants.

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**PROJECT: Species Testing and Genetic Improvement of Forest Trees for the Northern Territory RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program**

**Project Officers:** D. Reilly, B. Robertson, with Dr G. Nikles and K. Robson of the Queensland Forestry Research Institute.

**Project Location:** Top End of the NT and two sites in Northern Queensland.

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**Objective:**

***This research is an essential step in the development of a farm forestry industry in the Northern Territory and aims to provide information on the adaptability and potential growth rates of existing high quality acacia and eucalypt genotypes on a range of sites in the region. Outputs include genetic development facilities suitable for seed production, the selection of superior plants for further breeding work, maintenance of the QFRI's acacia and eucalypt genetic facilities in North Queensland and improving expertise of DPIF staff in genetic improvement and tree breeding.***

**Method:**

The project will develop high-yielding forest tree varieties. It will comprise: parallel testing of 'best bet' taxa (species, provenances and hybrids), development of commercial varieties matched to sites, from the superior taxa; infusion of new genetic material including various locally-selected trees; and on-going breeding for refinement of superior varieties. The approach also incorporates best practices in all aspects of the project, and maximises the publicity and effective 'take up' of the results.

Species and genotypes available for testing now include:

- *Acacia crassicarpa*, *A. auriculiformis*,
- *A. aulacocarpa* (seed and cuttings from selected trees from PNG and FNQ 1<sup>st</sup> and 2<sup>nd</sup> generation seed and clonal seed orchards)
- *A. mangium* (seed from selected trees in orchards)
- *Eucalyptus pellita* (seed from best trees in Melville Island and north Queensland seed orchards)
- *E. camaldulensis* (seed from best performing families in Thailand)

Genetic resources that will be available within 2 years

- *A. mangium* x *A. auriculiformis* hybrids
- *A. crassicarpa* x *A. aulacocarpa* hybrids
- *E. pellita* clones from selected best individuals

The main components of the strategy are:

1. Development and testing facilities on five sites representative of areas with farm forestry potential in the NT. Each site would be approximately 3-5 ha.
2. Maintenance of existing acacia and eucalypt facilities in north Queensland
3. On-going maintenance and measurement selection and redeployment of material.
4. Training and staff development
5. Communication



## SUBPROGRAM: Irrigation Development

### Overview:

The irrigation development sub program is a relatively new component of Agricultural Development. It has been established in response to the growing interest in irrigated field crops in the Top End. Structured R&D into irrigated field crops, as distinct from horticultural crops, has been conducted for only the past 2 to 3 seasons. Consequently, little research data or experience exists on the production of irrigated field crops in this environment. The program objective is to research, develop and extend viable and sustainable irrigation systems and practices. Its focus is to generate accurate and relevant information based on applied research, resulting in specific recommendations for local production systems. Improved understanding, better planning and management and more productive irrigation systems are the desired outputs. Current R&D activities revolve around peanut and maize agronomy on Blain soils, assessment of soil moisture monitoring technology and crop water requirements, water scheduling, herbicide evaluation for peanuts and variety evaluation. Extension is an increasing component of this program. Maintenance of basic and certified crop legume seed is also part of this program.

### Peanuts:

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#### **PROJECT: Fertiliser Placement and its Effect on Yield and Quality of Irrigated Peanuts**

**Project Officers:** C. Martin, C Ham and S. Lucas

**Project Period:** April 1998-1999

**Project Location:** Douglas Daly Research Farm Irrigation Area Circle 1

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### Background:

Peanut nutrition on Blain soils was investigated in the 1980's. Critical nutrient levels were established however, the placement of fertilisers has not been investigated.

Phosphorus (P) is banded in many cropping situations. This assists with availability and subsequent uptake of P and is more efficient than broadcasting. P is immobile; therefore banding allows the plant to access the element early in its development. There is some evidence that banding of P may not be necessary in peanuts. Therefore, the efficacy of banded compared to broadcast P needs to be determined.

### Design:

The trial is a randomised, factorial, split plot of four replications.

Each plot is eight rows wide and approximately 50 meters long. Each plot received 30 kg of P as Goldphos. There are four treatments. Each plot is split into a plus-iron and a minus-iron treatment.

- (1) Broadcast 30 kg/ha P.
- (2) Single band 30 kg/ha P approximately 10 cm below planting depth.
- (3) Double band 30 kg/ha P approximately 10 cm below planting depth and 10 cm apart.
- (4) Broadcast 30 kg/ha P and no gypsum applied.

Sowing was carried out on May 30-31, 1998 at a rate of 178,100 seeds per ha. The established plant population was 92,666/ha. Total water applied was 6.8 ML/ha, which was supplied by overhead (centre pivot) irrigation.

Fertiliser used: HI Fert Goldphos 20 @ 180 kg/ha 0:16:0:20

MOP @ 60 kg/ha.

Gypsum @ 750 kg/ha

Librel Chelated Trace Elements @ various rates.

The hand harvest was completed two weeks before the actual bulk harvest. The bulk harvest was delayed by rain. The rain caused large digging losses (up to 60%) and high levels of aflatoxin.

**Results:**

**Table 1. Means:**

<b>Fertiliser</b>	<b>Yield t/ha</b>	<b>Dry Matter kg/4m row</b>	<b>Jumbo</b>	<b>Grade One</b>	<b>Grade Two</b>
Broadcast	6.55	2.55	51.56	10.44	7.20
Double	6.57	2.50	48.40	10.89	8.52
No Gypsum	6.88	2.76	51.54	10.81	7.41
Single	6.69	2.56	50.36	10.95	7.12
LSD (p=0.05)	0.713	0.620	9.427	2.342	1.870
p-value	0.714	0.783	0.856	0.959	0.351

<b>Iron</b>	<b>Yield t/ha</b>	<b>Dry Matter kg/4m row</b>		<b>Jumbo</b>	<b>Grade One</b>	<b>Grade Two</b>
No	6.65	2.714	a*	50.69	10.65	7.64
Yes	6.69	2.472	b	50.24	10.89	7.49
LSD (p=0.05)	0.566	0.201		3.566	1.374	2.077
p-value	0.888	0.022		0.785	0.706	0.873

\*Means with different letters are significantly different.

**Table 2: Water use efficiency from selected plots.**

<b>WATER USE EFFICIENCY</b>	<b>YIELD kg</b>	<b>mm</b>	<b>WUE Kg/mm</b>
Highest Yielding Plot	7800	680	11.5
Actual Machine Harvest	2980	680	4.4
Lowest Yielding Plot	5100	680	7.5

**Conclusion:**

There was no significant difference in peanut yield or quality between treatments. The no-gypsum treatment did not show any significant difference in yield or grade. Ca is important to kernel and pod production. Insufficient Ca results in “pops” or unfilled shells. The soil Ca level (1-2%) and the Ca provided in the basal Goldphos (18% Ca) application may have been sufficient to satisfy the needs of the crop in this instance. The applications of iron chelate had no effect on yield, however it had a small but significant, negative effect on dry matter.

This experiment suggests that if soil nutrition is adequate in the first instance, there may not be a significant enough response to justify the cost and effort in banding fertiliser. At this stage, it is not recommended to reduce the application of gypsum, until further work on gypsum response is carried out. Trace element supply, availability and uptake needs to be monitored more closely, especially as water and soil pH tend to increase under irrigation in this environment.

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**PROJECT:        Herbicides for Peanut Production****Project Officers:    C. Ham, R. Eastick, N. Hartley, S. Lucas and F. O’Gara****Project Period:     1998-2000****Project Location:    Douglas Daly Research Farm Irrigation Area Circle 5**

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**Objective:**

*To identify herbicides suitable for peanut production in the NT, and to evaluate their efficacy on a range of weeds. To aid in obtaining registration of Flame<sup>®</sup> in peanuts, in conjunction with Cyanamid Pty Ltd. and the Peanut Company Australia (PCA).*

**Background:**

Wood (1970) conducted early research on herbicides for peanuts in the NT. Young and Flint assessed herbicides in the 1980’s. Agricultural chemicals are constantly changing, with new products being continually introduced. New ‘age’ chemicals such as the imadazolinone group of herbicides which includes Spinnaker<sup>®</sup> (imazethapyr), Flame<sup>®</sup> (Cadre<sup>®</sup> /AC 263,222/imazameth/imazapic) and Raptor<sup>®</sup> (AC299,263 / imazamox) are some of the new chemicals which need to be evaluated under local conditions.

The current interest in irrigated peanut production requires an effective weed management strategy, which includes herbicide use. This trial aims to evaluate a range of herbicides and herbicide combinations for weed control in dry season peanut production. The trial will also provide data required for registration of Flame<sup>®</sup> in peanuts.

**Design:**

The experiment is a randomised complete block consisting of 13 treatments with four replicates. Plot size is 10m by 8 rows (90cm spacing).

Table 1. Treatments:

No.	Herbicide Treatment	Active ingredient	Rate Applied/ha (product active ingredient)	Timing
1	Crop Only			
2	Weed only			
3	Crop and Weed (Untreated)			
4	Spinnaker pre-em	Imazethapyr 240 g/l	400 ml (96 ml a.i.)*	Immed. After sowing
5	Spinnaker post-em	Imazethapyr 240 g/l	400 ml (96 ml a.i.)	Weeds at 3-5 leaf stage (@2 weeks after sowing)
6	Flame pre-em	Imazapic 240 g/l	200 ml (48 ml a.i.)	Immed. After sowing
7	Flame post-em	Imazapic 240 g/l	200 ml (48 ml a.i.)	Weeds at 3-5 leaf stage (@2 weeks after sowing)
8	AC 299,263 pre-em	Imazamox 700 g/kg	50 g 35 g a.i.	Immed. After sowing
9	AC 299,263 post-em	Imazamox 700 g/kg	50 g 35 g a.i.	Weeds at 3-5 leaf stage (@2 weeks after sowing)
10	Basagran, Blazer and Trifolamine post-emerg	Bentazone 480 g/L Acifluorfen 224 g/L, 2,4-DB 500 g/L	1 L (480 ml a.i.), 1L (224 ml a.i.) 1L (500 ml a.i.)	Weeds at up to 10 leaf stage (@ 3 weeks after sowing)
11	Gramoxone post-em	Paraquat 200 g/L a.i.	800 ml (160 ml a.i.)	Weeds at up to 10 leaf stage (@ 3 weeks after sowing)
12	Cyanamid Flame post-em Low	Imazapic 700 g/kg	140 g (98 g a.i.)	Just prior to flowering (@35 days after sowing)
13	Cyanamid Flame post-em High	Imazapic 700 g/kg	280 g (196 g a.i.)	Just prior to flowering (@35 days after sowing)

\*a.i. = active ingredient

### Evaluation:

Treatments will be assessed for their effect on peanut yield and quality. Four meters of plot will be dug and threshed for analysis. The Peanut Company of Australia (PCA) will conduct a grading analysis based on commercial standards.

A phytotoxicity and visual weed control rating will be conducted on all treatments to assess crop damage and weed control. Population counts will be done at 2 weeks after sowing in conjunction with the 1<sup>st</sup> phytotoxicity ratings. Ratings will also be done one and two months after sowing. Kernel, plant dry matter and weed biomass will be measured and analysed for each treatment at maturity.

### Residue sampling:

Treatments 3, 12 and 13 will have additional sampling. This will consist of:

Foliar sampling (1 kg whole plant) at 0, 2, 4, and 6 weeks after application.

Hulls, nuts, hay/straw will be collected at harvest.

These samples will be sealed and frozen at -18 Degrees C for residual herbicide content.

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**PROJECT: Evaluation of Four Peanut Varieties****Project Officers: C. Ham, S. Lucas and F. O'Gara****Project Period: 1998 -2000****Project Location: Douglas Daly Research Farm Irrigation Area Circle 5**

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**Introduction:**

This evaluation will examine the following varieties:

1. VB 97
2. B98-37 L8
3. A140 L31
4. Flo-runner

**Background:**

Peanut variety evaluations were conducted in the mid 1980's. Since then, a range of new varieties has become available. The varieties in this evaluation have been sourced from the USA and QDPI breeding programs. There are three representatives from both the bunch (erect) type and one runner (prostrate) type growth habit.

**Cultivar Description:**

- VB 97 is derived from a US line and has the advantage that under Qld conditions it matures two weeks earlier than NC 7.
- B98-37 L8 is earlier maturing again with high kernel percentage.
- A140 L31 is a high yielding bunch type peanut with resistance to CBR and mild resistance to leaf spot.
- Florunner is the benchmark variety. It is used extensively in Australia and the USA. It was released in 1969 and has enjoyed widespread popularity for its ability to survive under different conditions. It is a long season crop particularly under irrigation in the dry season and shorter season varieties are desired in certain situations.

**Objective:**

***To evaluate potentially new peanut varieties for NT production systems and compare their performance and agronomic characteristics with the standard commercial variety, under local conditions.***

**Method:**

Due to limited seed, the 1998 wet season trial was not a replicated observation. The plots consist of two rows of each variety.

The 1999 dry season evaluation replicated each variety three times. Established plant populations for each variety is approximately equal. Assessment will be based on flowering times, crop phenology, dry matter production and kernel yield and quality. Sub-samples from harvested plots will be graded by PCA to commercial standards to assess kernel size and quality.

**Evaluation:**

Yield will be assessed by hand harvest. A sample size of four meters of row from each replicate will be taken. These will be dried, weighed and threshed. The plots will also be used as a source of seed for future work. All seed will be hand harvested to prevent cross contamination of varieties.

**Results:**

1998 plots were not replicated. Yields were calculated from an area of two rows wide and 15 meters long.

Table 1: Results from 1998 Variety Evaluation.

VARIETY	DRY MATTER			NUT IN SHELL YIELD		
	kg/plot	kg/m/row	Yield t/ha	kg/plot	kg/m/row	Yield t/ha
<i>A140 L 31</i>	16.8	0.70	7.8	11.4	0.48	5.3
<i>VB 97</i>	10.4	0.43	4.8	12.6	0.53	5.8
<i>B 98</i>	9.2	0.38	4.3	6.2	0.26	2.9
<i>FLO-R</i>	11.8	0.49	5.5	14.1	0.59	6.5

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**PROJECT: Irrigated Maize Production on Blain Soils at Douglas Daly Research Farm**

**Officers: F. O’Gara, C. Ham and S. Lucas**

**Period: 1999 Dry Season**

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**Background:**

Commercial field crop irrigation is largely focused on peanut production on sandy surfaced soils. There is a need to develop a viable rotation that will assist in disease and pest management of peanuts. Maize has often been suggested as the ideal crop to rotate with peanuts, as both crops should complement each other. Maize is a potentially high return crop and should assist in the management of the pest and disease complex of peanuts. Maize should also benefit from the organic nitrogen fixed by peanuts.

Maize has been grown successfully on heavier clay loam soils, and is currently produced under irrigation on Tippera soils in Katherine. Maize has always performed poorly on the sandy textured soils of the Daly Basin. Local recommendations suggest maize be restricted to the heavier red earths. Maize has a high requirement for nutrients and is particularly sensitive to zinc deficiency. Blain soils are inherently deficient in most essential plant nutrients. Consequently, maize grown on sandy soils, has always exhibited acute nutrient deficiencies.

**Objective:**

***The first objective is to ascertain whether the apparent nutrient deficiencies could be managed and if it is agronomically possible to produce acceptable maize yields on Blain soils under irrigation. The second objective is to determine the most suitable, commercially available cultivars for local conditions. The third objective is to develop a better understanding of irrigated maize agronomy on sandy soils in this environment.***

**Method:**

Nine maize varieties were planted into a conventionally tilled and prepared seedbed under the centre-pivot at DDRF. Planting was carried on March 25 with an eight row Mason Maxi-Strike planter. The planting components consisted of twin opening disks, between which the seed dropped. Twin inclined press-wheels provided seed coverage. Soil tests indicated low levels of sulfur, potassium, magnesium and zinc.

**Table 1.**

Levels	Nutrients					
	Potassium	Magnesium	Phosphorus	Sulphur	Zinc	Copper
	80 mg/kg	50 mg/kg	15 mg/kg	2.1 mg/kg	1.7 mg/kg	1.3 mg/kg

Pre-plant fertiliser was broadcast and worked into the soil at the rate of 148 kg N, 39 kg P, 27 kg S, 150 kg K, 84 kg Mg and 10.5 kg Zn per hectare. An additional 9-kg, 19 kg, 10 kg, 2.5 kg, 2.5 kg of N, P, S, Cu and Zn/ha respectively, was applied at planting through the fertiliser boxes on the planter. Urea, Zn and boron were applied by fertigation through the growing season. Insect pressure was high throughout the season and necessitated control on three occasions.

Despite the high fertiliser inputs, the maize showed nutritional deficiency symptoms immediately after emergence and up to about the three-leaf stage. Urea and zinc was applied by fertigation in week three. The crop eventually performed well. The problem was traced to uneven application of fertilizer at planting, caused by a design fault on the fertiliser metering system.

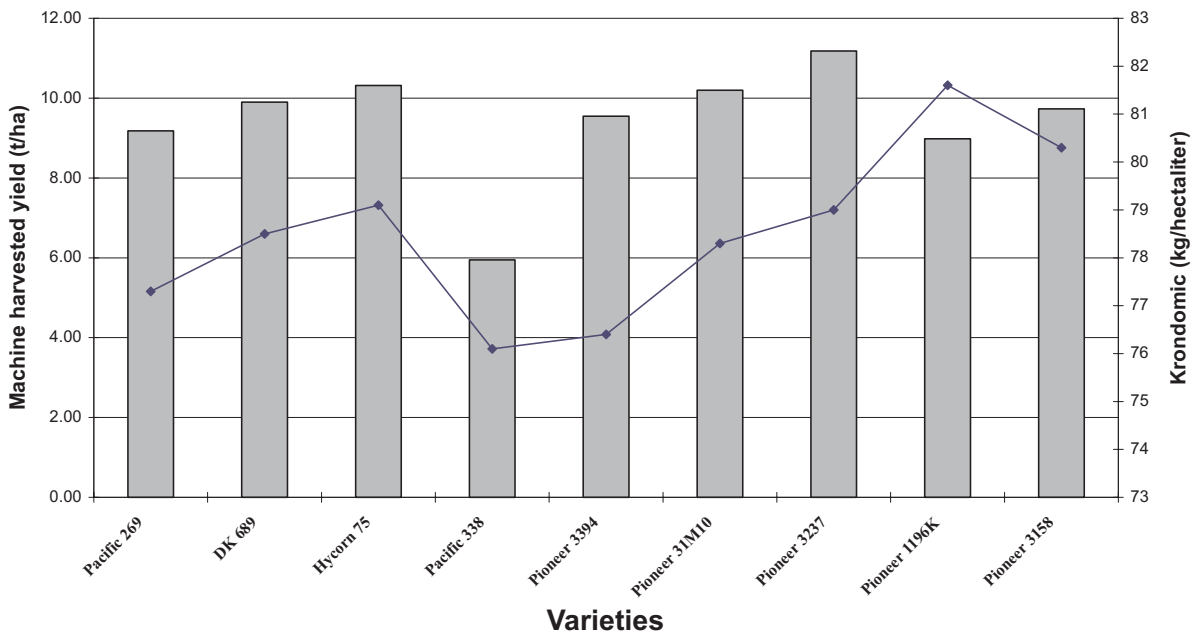
The experimental design was a randomised complete block with four replicates of each variety. Each replicate consisted of four rows. A sub-plot of 30 meters was hand thinned to the plant population recommended by the seed companies. Leaf samples were taken at the five-leaf stage, mid-season and at silking. Hand and machine harvests, grain weight and nutrient removal in the grain and stover will be assessed.

**Varieties evaluated:**

<b>Pacific Seeds</b>	<b>Pioneer Seeds</b>	<b>DeKalb</b>
PAC 269	PIONEER 3394	DK 689
HYCORN 75	PIONEER 31M10	
PAC 338	PIONEER 3237	
HYCORN 90 (observation)	PIONEER 1196K	
	PIONEER 3158	

**Results:**

**Irrigated Maize Evaluation at Douglas Daly 1999**



## **SUBPROGRAM: Farming Systems**

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**PROJECT: Douglas Daly Research Farm Weather Recording**

**Project Period:** Ongoing

**Project Officers:** P. Shotton and L. Hausler

**Location:** Douglas Daly Research Farm.

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**Objectives:**

*To observe, monitor and record daily weather information from the Douglas Daly Research Farm manual and automatic weather stations.*

**Method:**

Manual meteorological observations include a daily measurement at 9am of cloud type and amount, visibility, evaporation, wind run, wet and dry bulb temperatures, minimum and maximum temperatures, past and present conditions and rainfall.

The automatic weather station records the following each 10 minutes, hourly and 3 hourly: wind run, wind speed and direction, dew point, wet and dry bulb temperatures, minimum and maximum temperatures, rainfall and barometric pressure.

**Results:**

All past DDRF weather information has been recorded and available on request. Daily weather data is also sent to the Bureau of Meteorology.

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**PROJECT: Evaluate the Effects of No-tillage and Conventional Tillage Practices on Yield of an Annual Grain and Grain Legume Rotation and its Long Term Effects on Soil Properties**

**Project period:** 1984 - 2000

**Project Officers:** P. Shotton, K. Thiagalingam and B. Lemcke

**Location:** Douglas Daly Research Farm

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**Objectives:**

*To monitor and evaluate the long term effects of tillage versus no-tillage practices on Tippera soil in terms of soil properties, weed infestation, grain yields and insect activity.*

**Background:**

The project was started in the 1984-85 wet season with a maize/soybean rotation and tillage treatment with the original objectives completed in 1988. Long-term soil changes were evaluated in 1992 and all the bays were cultivated in 1993. In the 1994-95 season a mungbean/sorghum rotation crop was grown under the two tillage systems. In the 1996-97 wet season centrosema pascuorum cv. cavalcade was planted and harvested as a hay crop. During the 1997-98 and 1998-99 seasons, maize and soybean crops were grown.



**Method:**

Total trial area	2 hectares.
Tillage plot size	0.33 hectares.
Fertiliser for 1998/99 season	200 kg/ha Pasture Gold
Weed control	Spinnaker 400 mil. /ha post planting / pre-emergent. Glyphosate 3.5 l/ha pre-planting.
Planting:	Leichhardt soybeans were planted at 50 kg/ha in 75 cm rows on 21/12/98.
No-Till Plots	Sprayed with Glyphosate at 3.5 l/ha pre-emergent.
Conventional Plots	Disc ploughed and cultivated twice prior to planting.

**Results:**

Although the conventional till bays germinated and established better than the zero till bays, a dry spell during January caused various plant diseases, which reduced plant population in both treatments. The average plant population in both the conventional till and zero till areas was 109,000 plants per hectare.

Throughout the 1998-99 wet season weed infestation was much greater in the conventional till bays, with major competition from buffalo clover (*Alysicarpus vaginalis*), cavalcade centro (*Centrosema pascuorum*), sicklepod (*Senna obtusifolia*) and nutgrass (*Cyperus rotundus*). Small amounts of summer grasses (*Brachiaria spp* and *Digitaria spp*) were also present.

The zero-till bays also had similar weeds throughout each bay but much less of each except for centro, which was more prevalent throughout the bays.

Machine harvesting was not possible due to the presence of cavalcade and sicklepod growing over the soybean plants and causing header problems with wrapping and blockages to the header.

A hand harvest was used to establish potential yields of each bay. The average yields for the zero till areas were 3,275 kg/ha and the conventional till areas 2,189 kg/ha.

Bay	Treatment	kg/ha
1	Conventional	1 896
2	Zero Till	2 357
3	Zero Till	3 149
4	Conventional	2 480
5	Zero Till	3 319
6	Conventional	2 192

No insect comparisons were undertaken during the 1998-99 season for the treatments.

Soil samples are being currently analysed by the DPIF Chemistry section for pH, OC, Ca, K, Mg, P, S, N, Cu, and Zn. The results of the analysis will be compared.

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**PROJECT: Grain Sorghum Varieties for the Douglas Daly District**

**Project Period: 1992 to 2000**

**Project Officer: P. Shotton, T. Price and DDRF staff**

**Project Location: Douglas Daly Research Farm**

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**Objective:**

***To grow and trial new and commercially available grain sorghum varieties at the Douglas Daly Research Farm and monitor which varieties are suitable for the district.***

**Background:**

Over the past seven years replicated sorghum variety trials have been conducted at the Douglas Daly Research Farm. For the 1998-99 trial, the Pioneer and Pacific seed companies supplied sorghum seed. Varieties under evaluation include those that have shown promise in past years and new lines, which may suit Top End conditions. Trial results will provide information for Top End sorghum producers on commercially available sorghum seed varieties.

**Method:**

Trial location: Paddock 10A, DDRF

Trial area: 3.5 ha

Varieties: 13

Trial design: Randomised block with 5 replications

Weed control: Glyphosate 2 l/ha  
Atrazine 2 l/ha  
Dual 2 l/ha  
Post emergent application of Starane @ 300 ml/ha

Fertiliser: 200 kg/ha 19-13-0-10  
100 kg/ha urea  
75 kg/ha muriate of potash

Each plot is monitored and evaluated for plant population, insect and pest occurrence, plant height, head type, resistance to head mould and leaf disease, plant lodging, hand harvest yield and machine harvest yield, flowering and maturing dates and stubble quality and harvesting difficulties.

This season the wet conditions in March and April caused problems with head moulds, leaf disease and insect problems. Grain of some of the earlier maturing varieties began sprouting in the head prior to harvest.

Results are shown in Table 1.

**TABLE 1** 1998 - 99 Sorghum Evaluation Trial  
Location : Douglas Daly Research Farm. N.T.  
Paddock 10 A.

Variety	Company	First Flower (DAP)	50% Flower (DAP)	Head Type (o,so,sc,c)	Lodge (1 to 5)	Height (cm)	Head Mould (1 to 5)	Head Exert (1 to 5)	Leaf Disease (1 to 5)	Hand Harvest (Kg/Ha)	Plant Pop. (PPH)	Machine Harvest (Kg/Ha)
MR 31	Pacific	53	56	O	5	120	2	3	2	3831	80,000	1803
Graze N Sile	Pioneer	60	64	SC	4	210	3	3	4	5441	82,000	3382
Pac 2391	Pacific	58	62	SO	5	130	3	2	3	4026	44,000	2543
8527	Pioneer	60	63	SC	5	135	3	3	3	3272	103,000	3120
MR Bonus	Pioneer	60	63	C	5	130	3	3	3	4303	88,000	3234
Goldrush	Pacific	49	52	O	5	110	2	3	1	2848	60,000	1903
8118	Pioneer	55	61	SC	5	150	4	3	3	5017	128,000	4315
DK 35	Pacific	48	51	SC	5	105	2	2	1	3192	110,000	2059
Magnum MR	Pioneer	52	55	SC	5	115	1	2	1	3965	99,000	2316
Pac 2392	Pacific	54	59	SC	5	125	2	3	2	3356	103,000	1961
Chopper	Pacific	59	63	SC	4	215	4	3	3	4787	78,000	3297
MR Buster	Pacific	54	57	SC	5	115	3	2	3	3969	74,000	2585
XS 779	Pioneer	58	62	C	5	130	2	3	4	3829	66,000	2291

Head Type  
O = Open  
SO = Semi Open  
SC = Semi Closed  
C = Closed

Lodge  
1 = Severe Lodging  
5 = No Lodging

Mould  
1 = Severe Head mould  
5 = No Head mould

Head Exertion  
1 = Poor Exertion  
5 = Good Exertion

Leaf Disease  
1 = Severe Leaf Disease  
5 = No Leaf Disease

## PROJECT: Ley Farming Systems Trial

**Project Officers:** R. Eastick, B. Lemcke, P. Shotton, DDRF Farm Staff and L. Huth

**Project Period:** 1995 - continuing

**Project Location:** DDRF

### Objective:

**To evaluate a sustainable farming system which integrates pasture, crop and cattle production.**

An integrated farming system allows flexibility in use of resources such as machinery and labour, spreads risk for commodity price changes, plus a crop/pasture rotation provides options for weed control and grazing management. This project incorporates a 2-year pasture production phase (either cavalcade only or mixed sabi/cavalcade pasture), grown in rotation with a sorghum crop. In any season, there is a phase with sorghum stubble, a phase of first year newly establishing pasture, and a phase of second year established pasture. Weaners are introduced to either the improved pasture or the sorghum stubble, and weight gains recorded over the Dry season, aiming to reach a turn-off weight by the Wet season. This grazing management and the crop/pasture rotation influences the plant population dynamics of the paddocks. Vegetation monitoring assesses these changes.

Thus, the trial evaluates pasture and crop establishment and production under no-till farming practices.

### Method:

The 1998/99 season weaners were allocated to treatment paddocks on 1<sup>st</sup> June 1998. Cattle were weighed monthly. Phase 1 (paddocks 1-6) weaners were grazing the first year on mixed pasture (1-3) and cavalcade only (4-6) which had self sown after the previous year of sorghum stubble.

Phase II (paddocks 7-12) weaners were introduced to sorghum stubble with regenerating cavalcade only (10-12) and sabi/cavalcade (7-9).

Phase III (paddocks 13-19) were second year mixed sabi/cavalcade pasture (paddock 16-18) or cavalcade only (Paddock 13-15) and were stocked until November. A sorghum crop was then planted and harvested in May 1999.

Vegetation is assessed twice yearly, in May (at the end of the Wet season prior to weaners being introduced) and in November (at the end of the Dry season). Botanal  $\hat{a}$  is used to record species presence (percentage of weed and desirable species) and yield.

Cattle were turned off to market during March and April 1999.

**Results:**

Some areas of all these paddocks were inundated for a long period after the January '98 flood. Deeper areas of sorghum and other plants were totally killed. However sabi and cavalcade both regenerated quickly.

Tables 1 and 2 give weight gains in ascending order for the Dry season and 9 months.

Table 1. Weight gain (kg/head) for Dry season grazing 1 <sup>st</sup> June-21 <sup>st</sup> Oct (143 days)			
Pdk No	Pasture treatment	Stocking rate	Weight gain (kg/head)
4	Cav 1 <sup>st</sup>	Low	-1.7
5	Cav 1 <sup>st</sup>	High	-1.0
3	Mixed 1 <sup>st</sup> yr	High	+1.4
15	Cav 2 <sup>nd</sup> yr	High	+3.1
14	Cav 2 <sup>nd</sup> yr	Med	+4.4
13	Cav 2 <sup>nd</sup> yr	Low	+5.7
1	Mixed 1 <sup>st</sup> yr	Med	+7.9
7	Sorg/Mixed	Med	+9.0
2	Mixed 1 <sup>st</sup> yr	Low	+10.3
8	Sorg/Mixed	Low	+12.5
9	Sorg/Mixed	High	+13.2
6	Cav 1 <sup>st</sup> yr	Med	+15.6
16	Mixed 2 <sup>nd</sup> yr	Med	+21.7
17	Mixed 2 <sup>nd</sup> yr	High	+22.6
11	Sorg/Cav	High	+23.8
12	Sorg/Cav	Med	+21.7
18	Mixed 2 <sup>nd</sup> yr	Low	+36.2
19	Sorg cont	Low	+39.0
10	Sorg/cav	Low	+42.8
Spares Jarra/Leucaena		Low	+36.7

Table 2. Weight gain (kg/head) for 9 months June 98-March 99		
Pasture treatment	Stocking rate	Weight gain (kg/head)
Cav 2 <sup>nd</sup> yr	Low	+64.3
Cav 2 <sup>nd</sup> yr	Med	+66.1
Cav 1 <sup>st</sup> yr	Low	+85.2
Mixed 2 <sup>nd</sup> yr	Med	+88.1
Mixed 2 <sup>nd</sup> yr	High	+90.7
Cav 1 <sup>st</sup> yr	High	+91.3
Cav 2 <sup>nd</sup> yr	High	+95.0
Sorg cont	Low	+101.3
Cav 1 <sup>st</sup> yr	Med	+103.6
Sorg/Cav	Med	+105.6
Sorg/Cav	High	+110.7
Mixed 1 <sup>st</sup> yr	Med	+114.0
Sorg Mixed	Low	+115.2
Sorg Mixed	Med	+115.8
Sorg Mixed	Low	+120.0
Mixed 1 <sup>st</sup> yr	High	+123.3
Mixed 2 <sup>nd</sup> yr	Low	+128.2
Spares Jarra/Leucaena	Low	+129.3
Sorg mixed	High	+130.5
Mixed 1 <sup>st</sup> yr	Low	+132.2

**Vegetation:**

Sabi and cavalcade again regenerated well from the seed bank after the sorghum phase - no resowing costs were incurred. Due to poor establishment of the sorghum (buffalo planter) it was resown using the Mason Drill for more satisfactory results.

**Weight gain results:**

There is a trend of increased live weight gains per head in paddocks, which have sorghum stubble, or low stocking rates. Animals in cavalcade paddocks tend to gain weight well up until August but fall away quickly after that as feed quality and quantity deteriorate with increased temperatures, and dew and early rains.

Cattle were turned off during March and April (2 shipments) for the export trade. This season the low stocking rate mixed pasture group (1<sup>st</sup> year) was the best performer - the stock stayed in the paddocks for the total period. Other groups were destocked and used as mulch removers in paddocks that needed to be sown to sorghum. This generally resulted in reduced weight gains because mainly summer grass was grazed at high stocking rates.

**Sorghum Yield:**

During the 1999 wet season, sorghum was grown zero-till on paddocks 13-19. Paddocks 13-15 follow cavalcade pastures for 2 years and 16-18 mixed sabi/cavalcade for 2 years. The initial planting established poorly and was resown. A better result was obtained but plant populations were still low. Yields are given in the table below. Paddock 19 is continuous sorghum cropping with 50% conventionally tilled and 50% zero-tilled.

<b>Paddock</b>	<b>Sorghum Yield kg/ha</b>
13	2066
14	1880
15	1915
16	2035
17	2155
18	1466
19 Conventional	2334
19 Zero-till	1575

Establishment is a perennial problem with these pastures particularly where sabi grass has been dominant such as in paddock 18. Urea fertiliser is applied at 90kg/ha top dressed, plus starter nitrogen at 38kg/ha. Yields would be improved if there were good plant populations at establishment.

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**PROJECT: Weed Management Strategy Demonstration Site**

**Project Officers:** R. Eastick, N. Hartley, P. Shotton and B. Lemcke

**Project Period:** 1996-2001

**Project Location:** DDRF (Bay 11)

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**Objective:**

***To demonstrate a "best bet" pasture rehabilitation weed management strategy.***

The area had cavalcade pasture for a number of years before the start of this project. Weeds invaded it, resulting in poor pasture. This project aims to demonstrate a strategic weed management plan involving a 5-year crop/pasture rotation. This will evaluate the increase in productivity of the pasture each year, and ultimately enable the area to be re-sown to cavalcade. The paddock area is approximately 5 ha.

**Method:***1995/96*

The area was under Cavalcade with large amounts of weeds.

*1996/97*

The area was cultivated, sown to Jumbo sorghum, atrazine pre- and post- emergent applied; fertiliser applied (200 kg/ha of 0-18-0-10) and eventually harvested in early April. No nitrogen fertiliser was required. Yields of 12 t/ha of hay were achieved.

*1997/98*

The area was cultivated and sown to sabi (6 kg/ha of hulled seed) in mid-January, and fertiliser applied at 37 kg/ha Pasture Gold 0-14-0-17 + trace. Sabi established well. Broadleaf weeds also emerged, so the area was sprayed with Diuron at 41/ha in mid March.

*1998/99*

Cattle were introduced on 17/6/98 (5head/ha) and grazed continuously except for a 2 week period in January (6-20) when the pasture was fertilised with 100 kg Pasture Gold 0-14-0-17 and sprayed with 2 l/ha Diuron and 2 l/ha 2,4.D Amine to control broadleaf weeds. On 28/1/99 two extra steers were put in Bay 11 (from 5 head to 7 head). Each weighed 234 kg.

### Cattle Weight Gain

	Live weight June 98	Live weight June 99	Mean Live weight Gain
5 cattle	120	296.8	176.8 kg
	Jan 99		
2 cattle	234	315.5	81.5 kg

The area was Botanalled â in May 1997 (after harvest), November 1997 (to monitor emerging weeds with the start of the Wet), February 1998 (to record Sabi establishment and weeds emerging) and June 1998 (to record pasture species population before cattle were introduced). December 1998 and May 1999 pasture recordings were also carried out.

Cattle weights were recorded every 2 months.

This strategy has so far considerably reduced the weed burden, and increased the productivity of the paddock. Weed control utilising a competitive cereal crop, followed by a grass only pasture, has enabled a dramatic reduction in broadleaf weeds, which were the major problem in the previous cavalcade pasture. Sabi is now at over 95% of the pasture, and producing a yield of 4 t/ha when the cattle were introduced.

During the 99 wet season pasture yields have increased and the percentage of sabi also increased. Broadleaf weeds were reduced to insignificant levels by the end of the 99 wet season. The strategy is now to complete a further wet season of grazing and weed control and then to resow no-till back to cavalcade in the 2000-2001 Wet season to complete the cycle, and then monitor weeds in the newly established cavalcade and progressively over the next wet season.

## **SUBPROGRAM: Cotton Industry Development**

### **Objective:**

*To develop agronomic and pest control systems necessary to grow cotton commercially and satisfy national environmental guidelines.*

## **PROJECT: Cotton Industry Development**

**Project Period:** 1994 to 1998

**Project Officers:** C. Martin, M. Kahl, N. Hartley and G. Schultz

**Project Location:** Katherine Research Station (KRS) and Douglas Daly Research Farm (DDRF)

### **Objective:**

- 1. To identify, in terms of yield, quality and maturity, the most appropriate cotton plant types or varieties for dry season production.**
- 2. To develop a sustainable, agronomic package for dry season production based on Ingard varieties to control Lepidopteran pests.**
- 3. To develop suitable irrigation systems and scheduling for light and heavy soils.**
- 4. To ensure that the acquired knowledge of varieties, physiology, agronomy, and pest management will hasten cotton industry development through its integration into a technological package for irrigated, dry season cotton production.**
- 5. To identify suitable soils and regions for cotton production and motivate government to hasten land release for agricultural development.**

### **Background:**

With ministerial approval, DPIF is collaborating with WADA and CSIRO and Colly Cotton in a project to investigate the potential for the establishment of a cotton industry in northern Australia. The proposed industry will be based on an irrigated crop grown in the dry season to minimise insect problems that caused the failure of a cotton industry at Kununurra in the 1970's. A possible drawback to cotton grown in the dry season is a

reduction in quality brought about by low temperatures. Preliminary experiments at Kununurra and Katherine indicate that high yields of good quality cotton, with reduced insect pressure, could be grown in the dry season. This work has attracted favourable reports from industry leaders (scientists, farmers and manufacturers) from NSW and Qld.

### **Method:**

#### **Experimental:**

##### *1997/98*

The aims of the 1997/98 experimental work were to:

- i) Sow a large area (10 ha at KRS and 1 ha at DDRF) of Ingard cotton (L 23i) to observe its effectiveness in reducing the number of sprays required for *Helicoverpa* control.
- ii) Test some promising varieties identified from previous seasons.

The total area comprised 3.5 ha of cotton at KRS under a lateral move irrigator, and 0.75 ha at DDRF on drip irrigation. The variety sown except for the variety trial was L23i. Sowing dates were 10 March 1998 at DDRF, 15 May 1998 at KRS and 18 May 1998 bulk KRS variety.

##### *Variety experiment*

Seven Ingard and one conventional variety, replicated 4 times, were used: Siokra L23, 94409 (Siokra L23i), 94526, 96402, 96403, 96404, 96405, 96406.

##### *Irrigation scheduling*

All cotton was irrigated twice a week (Mondays. and Thursdays.) Using crop factors of: 0.4 to squaring, 0.7 to first flower, 1.1 to 10% open bolls, and 0.7 to harvest.

##### *1998/99*

The aims were the same as for 1997/98 except that cotton was grown only at KRS. A 16 ha area was sown under the lateral move and 4 ha under Netafim drip tape. It was intended to apply different watering frequencies to the drip-tape cotton, but because of limitations on the bore water supply, it was irrigated only twice a week. The bulk area was sown on 15 May 1999, and the trial of 10 varieties, on 18 May 1999.

Land- preparation was a problem because of the heavy traffic needed to extend the irrigator and install the water supply. It was, however, ripped and sown with very little mulch cover and an extremely uneven surface.

### **Measurements:**

Plant development and the incidence of insects were monitored using the entomologic program developed by CSIRO.

### **Data analysis:**

Data were analysed by analysis of variance and regression techniques.

### **Progress Report:**

##### *1997/98 season*

A summary of 5 years experimental results is shown in Table 1, and results from the variety trial are shown in Table 2.

Table 1. Summary of data from 5 seasons' cotton experiments in the Northern Territory

Year sown	1994	1995	1996	1997	1998 KRS	1998 DDRF
Sowing date	18/4	17/3, 4/4	26/3	27/3	15/5	10/3
Varieties	CS50, L23, CS8S	CS50, L23	CS50 + variety trial	L23i + variety trial	L23i + variety trial	L23i
No. insect sprays <sup>1</sup>	6 (5)	4 (2)	9 (6)	4 (2)	2 (1)	7 (7)
Irrigation	overhead	overhead	surface drip	surface drip	lateral move	surface drip
Yield (bales/ha)	10	9.5, 11.1	10	10.5	9	4 to 8
Harvest	hand	hand	hand	machine	machine	hand
Area (ha)	small plot	small plot	1	1	4	1

<sup>1</sup>Total number of sprays with the number of *Helicoverpa* sprays in brackets.

Table 2. Yield and quality data from the variety trial at Katherine Research Station in 1998

Variety	Yield Bales/ha	Turnout %	Length inches	Elongation %	micronaire mg/in	sfi	Strength g/tex	Uniformity %
94409	10.8	43.9	1.150	7.5	4.50	3.08	30.80	84.3
94526	9.6	43.6	1.127	7.5	4.10	3.30	31.50	83.7
96402	10.3	43.4	1.139	7.5	4.64	2.67	31.61	84.2
96403	9.7	43.3	1.123	7.1	4.81	3.77	29.41	83.7
96404	10.5	43.3	1.180	6.9	4.50	2.27	32.00	84.6
96405	9.9	42.9	1.107	7.6	3.97	3.55	29.95	83.3
96406	9.6	42.0	1.127	7.6	4.03	3.22	30.33	84.2
L23	10.3	45.5	1.123	7.1	4.55	2.08	31.80	84.4
LSD @ P < 0.05	NS	1.3	0.027	NS	0.42	0.86	0.96	NS

In the 1997/98 season cotton at DDRF was planted early but at KRS it was sown far too late because of delays due to flooding and making the lateral-move irrigator functional. Despite these problems high yields of good quality cotton were obtained at KRS with only 2 insect sprays (Tables 1 and 2). Compared to KRS, DDRF suffered very high insect pressure, which was expected, as temperatures at DDRF were higher than at KRS.

The quality of the 24 bales processed by the Kununurra gin was as follows:

Staple:	35	no penalty
Micronaire	4.5	no penalty
Strength	30	no penalty
Uniformity	82.2	no penalty
Colour	White middling (9 bales)	
	White strict low middling plus (13 bales)	
	Light spotted strict low middling (2 bales)	

#### 1998/99 season

The teething problems with the new irrigator meant that we were always behind time in satisfying the water and nutrient requirements of the crop; in addition, there were about 70 days with minimum temperatures below 12° C, which caused heavy boll loss; consequently yields will probably be low.



## **SUBPROGRAM: Livestock Management**

### **PROJECT: Tender Buff Development and Supply**

**Project Officers:** B. Lemcke, E. Cox, E. Conway and L. Huth

**Project Period:** 1993-2000

**Project Location:** Beatrice Hill Farm

#### **Objective:**

*To promote the TenderBuff Quality Assurance Program and supply the local and interstate markets with quality buffalo meat.*

#### **Background:**

The Program was initially started to provide higher returns to producers whose buffalo numbers were small, post-BTEC. It was seen as a serious substitute for the feral fillet market to restaurants using a much larger range of cuts. DPIF conducts the project in cooperation with the NT Buffalo Industry Council, and also carries out the Q.A. and branding of carcasses at the abattoir. The price paid to the producer remains at \$3.10/kg, hot standard carcass weight (HSCW). There are 5 specifications for the carcass to receive the TenderBuff strip brand.

Low beef prices continue to affect local demand for Tenderbuff. To maintain a steady supply after destocking at CPRS, animals are now sourced mainly from commercial properties and existed at Beatrice Hill Farm. With its extensive floodplain and ponded pastures, Beatrice Hill Farm is able to fatten stock all year round and is only a 45-minute drive from the Litchfield abattoir.

Unlike in the past, supplies have been continuously available in the Top End over the last two years, which has given wholesalers greater confidence.

TenderBuff has lower cholesterol and fat than beef. These nutritionally important attributes can be used to promote the product.

#### **Method:**

The current specifications are:

1. 150-300 kg HSCW
2. 3-12 mm fat at p8 site
3. No permanent teeth
4. Electrically stimulated carcass
5. pH of muscle after 18 hours < 5.8

DPIF officers monitor the TenderBuff animals through the abattoir on slaughter day and also carry out the chiller assessment the following day.

The producer pays the abattoir a kill fee of \$65. The discount grid determines the sale price to the wholesaler of animals, which do not comply with the 5 specifications.

A large number of the carcasses supplied in 97-98 were TB destock buffalo from Beatrice Hill Farm (both male and female). A small proportion of these were Riverine cross animals that were also part of the destock.

#### **Results:**

The last of the destocked buffalo from CPRS were processed in October 98 and since then the majority of Tenderbuff has been sourced from Marrakai station stock after agistment at Beatrice Hill Farm.

The total quantity of meat supplied has increased over the year because of the influence of the Riverine crossbred animals on the mean live weight gains as shown in Table 1.

**Table 1. Carcase and Production Parameters for TenderBuff**

	July-December	January-June	July-December	January-June
	1997	1998	1998	1999
No of Head	69	50	90	48
Mean HSCW (kg)	182.4	226.9	200.3	216.0
Mean Eye Muscle Area (cm <sup>2</sup> )	51.2	66.5	54.71	57.7
Mean pH	5.67	5.61	5.53	5.58
Mean Carcase Length (cm)	100.1	105.9	101.9	103.3
Mean Gross \$	565.4	680.60	595.19	656.43
Mean Grid \$/kg	3.10	3.00	2.99	3.05
Mean p8 fat (mm)	4.6	7.3	5.1	5.4
Mean Dressing %	47.5	50.1	50.5	48.2
% River Cross	( <sup>2</sup> / <sub>69</sub> ) = 3%	( <sup>23</sup> / <sub>50</sub> )=46%	( <sup>16</sup> / <sub>90</sub> )=17.8%	( <sup>8</sup> / <sub>48</sub> )=16.7%

The effect of the larger number of Riverine crossbred animals in the January-June 1998 period can be seen in the higher carcase weights, much higher eye muscle areas, increased carcase length and increased fat and dressing percentages. The butchers easily recognised the superior quality of the crossbred carcasses upon delivery and the consumers are also commenting on the improved eating quality.

**Table 2. Comparison between carcasses from the Riverine cross stock and Swamp buffalo (January - June 1999)**

No of Head	Riverine Cross	Swamp
	8	40
H.S.C.W (kg)	253.9	208.4
P8 Fat (mm)	6.75	5.1
Rib Fat (mm)	7.63	7.3
Length (cm)	107.75	102.45
Gross \$	744.60	638.80
Grid \$/Kg	2.95	3.07
Dressing %	50.52	47.7
Eye Muscle Area (cm <sup>2</sup> )	69.0	55.45
pH	5.56	5.58

The ages of the Riverine cross bulls were younger and resulted in \$100 better return per head to the producer. Yields for the wholesaler would have also been higher for the Riverine crosses.

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**PROJECT: Crossbreeding with Riverine Buffalo****Project Officers: B. Lemcke, E. Cox, E. Conway, BHF and Beatrice Hill Farm****Project Period: 1994-2000****Project Location: Beatrice Hill Farm and Berrimah Farm**

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**Objective:**

- 1. To determine the merits of crossbreeding and upgrading to Riverine buffalo for the NT buffalo industry.**
- 2. To distribute suitable progeny from the program to industry for breeding or for the supply of TenderBuff.**
- 3. To demonstrate sustainable buffalo production systems.**

**Background:**

It was the long held dream of pioneer buffalo researcher Don Tulloch to introduce Riverine blood into the Australian swamp buffalo population. The dream was finally realised in 1994 with the first two imported bulls, followed over the next 3 years by a further four heifers and two bulls. A crossbreeding program was commenced and the progeny monitored. Progeny were also put through the TenderBuff system. The purebred group has been increased and two imported bulls have died, one accidentally and the other due to TB exposure.

**Method:**

Purebred animals are held at both Beatrice Hill and Berrimah Farm. Crossbred animals are located at Beatrice Hill Farm. Half bred cows and heifers are mated to the bull OJ and swamp and purebred cows are mated to the bull Hillary. The bull Bill, who was exposed to TB infected cows was trained to an artificial vagina and subsequently approx 1200 straws of semen were collected from it and deep frozen in liquid nitrogen.

**Results:**

Growth rates in crossbred and purebred progeny are both high with 300-kg live weights reached by 12 months of age.

The herd on the 30<sup>th</sup> June 1999 contained the following stock.

*Purebreds*

2 Bulls      Bill was processed at abattoir but no TB infection was confirmed.  
 6 Cows  
 5 Yearlings (3 G and 2 E)  
 2 Calves    (1 G and 1 E)

**13 Head***Crossbreds*

## F1

25 Cows  
 12 yearling and 2 year old males  
 13 Weaners

*¾ Progeny*

9 Yearlings - 4 male, 5 female (2 on loan, 2 on BHF)  
 1999 calves - 23 calves - (9 Bulls)

*Swamp females*

Ex Beatrice Hill south - 17 head. (Yearlings) Further purchases are anticipated to build up the number of swamp breeders to between 30-40 head to produce future F1 progeny.

**Riverine Crossbreeding Comparisons:**

The entire CPRS Buffalo Herd has been processed through the abattoir for Tenderbuff following the outbreak of TB. This provided us with a large body of data for comparison on live weight, dressed weight, and carcass information. Although ages were similar, it was not possible to compare animals at similar live weights because of the heavier weights of the crossbred progeny at slaughter,

**Table 1. A summary of the main results**

	<b>1996 CPRS buffalo herd progeny slaughtered in 1998</b>		
	<b>Riverine crossbred</b>	<b>Swamp</b>	<b>% Difference to Swamp</b>
Total No	31	90	
Days to slaughter	758	863	-12%
Live weight gain (g/d)	659	426	+43%
Dressed wt gain (g/d)	340	230	+48%
Dressing %	51.8	50.2	+1.6%
Mean live weight at slaughter (kg)	495	396	+25%
Mean carcass weight (kg)	256	198	+29%
P8 fat (mm)	10.1	4.9	+108%
Eye muscle area (cm <sup>2</sup> )	74.9	54.4	+38%
Carcass length (cm)	106.9	101.5	+5%
Muscle pH	5.60	5.53	+1.2%

There were some factors, which complicated the comparison, in that 18 females that would normally have been killed earlier were kept back for multiple ovulation studies. Inclusion of these animals would have increased mean live weights, fat depth and days to slaughter. The Riverine crossbreeding data was also analysed to see whether there were any differences in progeny performance of the two imported bulls, "Bill" and "Hillary". The results are shown in Table 2.

**Table 2. Differences between the progeny of "Bill" and "Hillary"**

	<b>BILL</b>	<b>HILLARY</b>
Days to slaughter	757	759
Birth to slaughter		
Live weight gains (g/d)	660	658
Birth to slaughter		
Dressed weight gains (g/d)	343	337
Hot carcass wt (kg)	258	254
P8 Fat (mm)	10.6	9.6
Rib Fat (mm)	10.1	8.3
Eye Muscle area (cm <sup>2</sup> )	76.1	73.6
Length Carcass (cm)	106.5	107.4
Dressing %	52.2	51.4
Final live weights (kg)	494.8	494.3

Despite the differences in the two bulls, there was very little difference between the performance of their progeny. Most of the differences are only very slightly in favour of Bill's progeny.

There is now some growth rate data (Table 3) for a small number of  $\frac{3}{4}$  Riverine progeny.

**Table 3. Growth rates of crossbred Riverine progeny**

	Pre -weaning Growth Rate	Post weaning *
Growth Rate		
Male (g/d)	805.8	504.3
Female (g/d)	749.5	416.2
Probability Difference between sexes	p=0.12	p=0.064
All progeny (g/d)	778	455

\* The post weaning growth rates are dry season values (June - November 98).

**Purebred:**

Five purebred Riverine progeny were weaned in March 1999. These animals were 8 to 12 months old and weighed from 270 kg to 325 kg at weaning. This represents a preweaning growth rate of 0.8 to 0.98 kg/head/day.

Three bulls were lent to various properties this year. Two F1 and 2,  $\frac{3}{4}$  bulls are out on properties, as well as 3 F1 bulls from last year. It is hoped that some data will become available in the long term on performance of  $\frac{1}{4}$  and  $\frac{3}{8}$  progeny under commercial conditions.

All crossbred animals with more than  $\frac{1}{2}$  Riverine blood are performing extremely well so far compared to the swamp breed animals, which augers well for the buffalo industry in the future.

**PROJECT: Develop the Reproductive Technology and Knowledge in Water Buffalo to Allow Increased Productivity From Crossbreeding Swamp and Riverine Buffalo**

**Project Period:** May 97 - December 1999

**Project Officers:** B. Tatham (IIAD Agric Victoria), R. Pashen (Australian Animal Genetics), B. Lemcke, G. Jayawardhana, E. Cox, T. Olm and E. Conway

**Location:** Beatrice Hill Farm and Institute for Integrated Agricultural Development, Rutherglen Victoria

**Objective:**

*To develop artificial breeding techniques in the water buffalo to facilitate faster penetration of the Riverine strain into the Australian swamp buffalo population.*

**Background:**

Following a request from the Victorian buffalo industry to Agriculture Victoria, a RIRDC funded proposal was put to the NT BIC and DPIF and was approved by RIRDC. The main work on multiple ovulation has been started in the NT with Dr Rob Pashen designing a drug regime and flushing the animals on day 7 or 8 after ovulation and insemination.

**Method:**

Two trial attempts were made initially, using FSH/LH combination regimes with CIDRs or Desorelan implants. Some multiple ovulations were occurred, however consistent responses within treatments were not achieved.

Observations were made on a large hose of PMSG on a batch of cows going to the abattoir and consistent multiple follicle initiation was observed.

**Results:**

Around 1200 straws of purebred buffalo semen from Turkey Creek "Bill" were successfully frozen for later use, before he was slaughtered in October 1998. His semen was used in one of the multiple ovulation trials and 5¾ Riverine embryos were frozen down in liquid nitrogen for later implantation.

**Artificial insemination:**

Two Riverine cows at Berrimah Farm were inseminated following the death of "Diego", one of the imported bulls. One of the ear implants caused the ear to swell and was not removed from cow No2. Cow No1 was successfully inseminated and tested positive for pregnancy at 2 months. The other cow will be inseminated a second time.

The BHF cows have been rejoined with Hillary to produce new progeny in 2000. The three yearling purebred bulls (1998 progeny) have been nose-ringed for future training purposes, particularly for future semen collection.

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**PROJECT: Pasture Species Evaluation Under Grazing at DDRF**

**Project Officers: B. Lemcke, D. Reilly, DDRF Staff and L. Huth (Botanal)**

**Project Period: Continuing**

**Project Location: DDRF**

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**Objective:**

***Evaluate pasture species and mixtures under a continuous grazing regime on Blain Soil at DDRF for their persistence, productivity and contribution to cattle performance.***

**Background:**

Promising newly introduced pasture species are evaluated under grazing at DDRF to determine their potential in the Douglas Daly environment.

**Method:**

The pastures are grazed in 4 ha paddocks by Brahman weaner steers at 1 head/ha year round. Steers are allotted to paddocks in June/July (post weaning) and remain in the grazing trial until the following June. The exception is paddock 49, which is becoming grass dominant and is poorly utilised. It therefore has two extra animals to increase the stocking rate. Paddocks are top-dressed annually with a phosphorus-based fertiliser. This year Goldphos 20 was used at 50 kg/ha. During the wet season various weed control measures were undertaken where required, usually spot spraying for broadleaf weed control. A single urea application at 100 kg/ha was applied to paddock 45 (pangola), because a lower production in previous years.

The animals were supplemented ad-lib with Uramolâ blocks during the dry season and with Phosriteâ blocks in the wet season, with consumption measured monthly.

Cattle were weighed monthly, given a condition score and P8 (rump) fat measurements were commenced in the late December recording and continued till the end of the season (June 99).

Pasture composition and yield were assessed twice during the year. An early wet season measurement and composition was taken on 25<sup>th</sup> December 1998. A post wet-season assessment was made on the 4-7 May 1999.

Silk sorghum was resown this season in December in paddock 43 as no perennial plants survived the previous dry season. It may have been due to restocking too late to stop the sorghum from attaining full maturity.

**Results:**

Table 1. Pasture Composition (using the Botanal method)

<b>Pdk No.</b>	<b>Pasture Type</b>		<b>Grass (%)</b>	<b>Legume (%)</b>	<b>Weed (%)</b>	<b>Total (kg/ha) DM</b>
43	Silk Sorghum/Maldonado/ Cavalcade/Blue Pea	12/98	86.0	2.6	11.4	725
		5/99	63.9	31.0	3.1	9925
44	Leucaena/Pangola	12/98	99.2	0.8*	0.2	2480*
		5/99	97.1	2.6*	0.2	5650*
45	Pangola/Verano	12/98	98.8	1.2	0.1	2870
		5/99	99.6	0.4	0	7010
46	Sabi/Verano	12/98	99.7	0.1	0.1	2745
		5/99	99.6	0.3	0.1	4860
47	Jarra	12/98	99.7	0	0.3	2915
		5/99	99.7	0.2	0.1	6350
48	Kazungula setaria	12/98	70.2	2.9	16.9	3385
		5/99	99.1	0.9	0.1	5055
49	Buffel/Blue Pea	12/98	99.8	0.2	0	5130
		5/99	99.1	0.9	0	7280
51	Strickland	12/98	96.5	0.9	2.5	4665
		5/99	95.3	0.2	4.4	6795
52	Arnhem/Oolloo	12/98	92.5	5.1	2.4	1430
		5/99	86.1	2.9	11.0	3830
531	Buffel/ Sabi	12/98	99.2	0.2	0.6	2300
		5/99	98.1	1.1	0.7	4860
532	Buffel/Sabi/+ Blocks	12/98	99.4	0	0.5	2630
		5/99	99.6	0.4	0	5240
533	Buffel/Wynn/Sabi	12/98	88.6	10.1	1.3	2380
		5/99	83.5	14.5	2.1	5195
534	Leucaena <sup>1</sup> / <sub>2</sub> rows/Buffel	12/98	91.9	6.4*	1.6	2040*
		5/99	91.2	5.3*	3.6	4520*

\*Does not include the substantial legume component provided by the rows of leucaena in these paddocks

Table 2. Mean live weight gain per animal (kg)

Paddock No.	Pasture Type	June 98 - Nov 98 End/Dry	Nov 98 - April 99 End/Wet	April 99 - June 99 End/June	TOTAL June 98 - June 99
43	Silk Sorghum/ Legumes	+16.1	140*	31.8	187.9*
44	Leucaena/Pangola	+17.9	160.8	35.3	213.9
45	Pangola/Verano	+10.5	159.5	19.0	189.0
46	Sabi/Verano	+21.4	127.5	10.8	154.3
47	Jarra	+29.1	140.0	13.5	174.9
48	Kaz setaria/Sabi	+17.8	135.5	25.3	189.9
49	Buffel/Blue pea	+30.4	132.4	30.0	180.1
51	Strickland	+21.0	141.5	21.3	193.1
52	Arnhem/Oolloo	+14.1	156.5	41.0	209.5
531	Buffel/Sabi/No blocks	+14.1	135.0	20.0	169.1
532	Buffel/Sabi/+ Supp blocks	+21.1	150.8	27.5	204.4
533	Buffel/Sabi/Wynn	+14.8	146.3	23.8	184.8
534	Leucaena/Buffel/Sabi	+32.0	161.8	30.8	224.5
					190.4

\*Cattle in the silk paddock were removed between December 98 and February 99 for new sowing.

The mean gain in weight per animal for 97-98 was 167.3 kg. This is a 13.8% increase over the previous year. This is due to a more favourable, longer wet season at DDRF this year.

Four paddocks achieved mean annual weight gains exceeding 200 kg/ha/year. These include 3 paddocks with a significant legume content, two with leucaena and the other Oolloo.

No groups lost weight by the end of the dry in 98-99, in contrast to the previous year, when 67% of animals had lost weight.

Table 3. Supplement block consumption (g/d)

Dry Season Uramol® July-Oct 98 and Wet Season Phosrite® Nov 98 - Jun 99

Paddock	Dry Season	Wet Season
43	70	135
44	83	8
45	128	13
46	107	61
47	162	128
48	65	126
49	130	83
51	95	101
52	91	92
532	115	125
533	84	119
534	94	87
mean 98/99	102.0 g/d	89.3 g/d
mean for 1997/98	134.3 g/d	119.3 g/d
Difference from 97-98	-24%	-25%

Consumption rates for both were consistently lower than for the previous year.



**Block vs no block treatment**

Paddocks 531 and 532 were of similar plant species. Steer group 532 was provided with blocks year round and group 531 was not. Animals were changed fortnightly between paddocks to minimise paddock effects.

Uramol was fed between July and October and gave a weight advantage of 12.0 kg/head at a cost of \$13.10 (based on a price of \$88/100 kg block).

Phosrite was fed between November and June and gave a 23.3 kg/head advantage at a cost of \$34.48 (based on a price of \$95/100 kg). The response in weight gains to supplementation is much the same as for 97/98. However, it was higher during the dry season. A total supplement cost of \$47.58 gives break-even cost of \$1.35/kg live weight gain for supplement alone.

The carcase weight difference between the two groups was 13.5 kg (182 vs 195.5 kg) which equates to \$3.52/kg carcase wt gain. This is only 38.2% of the live weight difference.

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**PROJECT:       Livestock Export Feeds Trial**

**Project Officers:**   B. Lemcke, R. Eastick, T. Olm, and C. Wright

**Project Period:**    November - December 1998

**Project Location:**   Berrimah Farm

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**Objective:**

*To evaluate recycled paper pellets as a possible ration on board ships for export cattle.*

**Background:**

Following a request from Fibrecycle Pty Ltd, the Livestock Management group evaluated recycled paper-based rations for use as a feed for cattle on ships. Brahman and drought master cross steers from the research station herds were used for the trial.

**Method:**

Two recycled paper formulations, *Fibrecycle A* and *Fibrecycle B* and two cubed hay feeds were used to compare the performance of young (0 to 2-tooth) steers in replicated groups of 6 in the Berrimah Farm yards (Total of 8 groups). The animals were weighed empty at Beatrice Hill yards after overnight fasting (no food and water) and trucked to Berrimah. They were fed on the rations over a period of one month. Fresh feed was presented twice daily (except on weekends) with feed and residues weighed daily. Stock were weighed twice weekly to monitor weight gains. Animals were fasted overnight before the final weights were taken. The four rations were:

Fibrecycle A

Fibrecycle B

Hycube cubes (ex Vic - Hunter River lucerne)

Norfeed cubes (locally manufactured cavalcade based)

**Results:**

There was little acceptance of the paper-based rations by the cattle. Only small quantities were eaten - less than 1 kg/head/day and so cattle lost weight and had to be taken out of the trial and put back in a paddock to recover before significant damage occurred. Steps were taken to try to increase paper consumption, including the addition of molasses and mixing in some hay cubes. The molasses appeared to have no effect and the cattle cleverly separated and consumed the hay cubes whilst not increasing consumption of paper pellets. There were two steers in one of the Hycube groups that also did not consume the feed. This was strange in that the Hycube cubes were generally consumed by other animals in higher quantities than all the other feeds.

Table 1. The mean performance of animals on the different feeds

Formulation		Feed Consumption over 29 days (kg/head)	Weight Gain kg/head	FCE - Feed conversion efficiency-feed consumed/kg live weight gain
Paper A	Group 1	17.5 (17days)	-34.1	-
	Group 2	14.3 (10 days)	-10.7	-
Paper B	Group 1	9.1 (10 days)	-17.8	-
	Group 2	16.1 (17 days)	-30.1	-
HYCUBE	Group 1	319.0 kg	+29.8	+10.7
	Group 2	320.7 kg	+44.5	+7.2
NORFEED	Group 1	236.5 kg	+30	+7.9
	Group 2	260.4 kg	+43.7	+6.0

Table 2. Feed analysis

	Norfeed	Hycube	Paper A	Paper B
Dry Matter %	92.4	91.0	86.7	86.2
Crude Protein %	7.8	13.4	14	21.2
ADF %	42.9	30.9	50.4	49.2
Digestibility %	45	57	51.7	52.3
ME (MJ/kg/DM)	6.2	8.1	7.2	7.3

Despite Hycube being the poorest feed according to the in vitro feed analysis, there was no significant difference in the weight gain between the groups fed Hycube and Norfeed feeds. Local hay cube quality has also improved since that period so that there appears to be no advantage in feeding the interstate cubes. Moreover the cattle had better feed conversion efficiencies on the local cubes and consumed lesser quantities although this was not statistically significant. This would have implications for quantities required for the voyage and the amount of pen cleaning required during a voyage. The local feed should also be cheaper than the interstate product. Much more work needs to be done on the recycled paper pellets to make them more palatable to northern cattle. The animals simply did not consume sufficient quantities to even maintain weight. The pellets were not sufficiently palatable to even entice hungry stock.

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**PROJECT: DDRF Breeder Herd Management**

**Project Officers: G. Jayawardhana, T. Olm, P. Hausler, P. Lawler, S. Izod, R. Muirhead, C. Hazel and L. Hausler**

**Project Location: Douglas Daly Research Farm**

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**Background:**

The past results of this project were reported in last years Technical Annual Report.

**Objective:**

***Explore and validate methods of maximising sustainable production from a breeder herd under improved management and nutrition in the Top End of the NT.***

**Method:**

Three hundred animals including 50 yearling heifers are joined each year. After joining, non-pregnant animals are culled and the herd is reduced to 250. This is a demonstration of a system where only productive animals are kept each year - no passengers.

The pregnancy rates of the various age groups in this herd for 1999 are detailed below.

Table 1. Percentage of cows mated (by age) which were pregnant

Cow Age (yrs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
% Pregnant	53	88	80	84	88	100	100	89	88	100	78	100	86	67	-	100

The average pregnancy rate of the cows excluding yearlings was 88%. The bull ratio was 4.3% for cows of two years and over and the average weaner weight (excluding AI calves conceived before the normal mating) was 186kg.

A breed cow computer model simulation of the current management system at DDRF includes culling non-pregnant animals, segregating young breeders from locally bred bulls and yearling mating, showed a 23% improvement in gross margins in comparison to the pre 1995 management method.

**Mature cow weight**

This year all the cows in the herd were weighed after an overnight fast and had their fat levels measured at the P8 rump fat site to work out their mature weight. The two factors that need to be corrected when working out mature weight are pregnancy and fatness. We subtracted the weight of the pregnancy by the following amounts for each stage. This calculation is for a *Bos Indicus* (Asian) cow with a calf weighing 29kg at birth.

- 3 months – 4kg
- 4 months – 6kg
- 5 months – 10kg
- 6 months – 15kg
- 7 months – 23kg
- 8 months – 35kg
- 9 months – 51kg

To work out the correction for fatness, the empty weight (corrected for pregnancy) of cows 5 years or older with a fatness greater than 0mm was plotted against fatness and a regression equation was calculated. Cows with no fat were not used for this calculation because they can have a wide variation in weight due to muscle wasting.

$$\text{Empty Live Weight (kg)} = 2.9 (\text{P8 fat in mm}) + 414$$

This means that the average mature cow in this herd weighs 414kg at 0mm of fat.

It allows for a formula to be developed to calculate the mature weight at zero fatness of any cow in this herd as long as her fatness and pregnancy are known and her fatness is greater than zero.

If the constant 2.9 is expressed as a percentage of body weight it becomes

$$\begin{aligned} & \frac{2.9 \times \text{empty live-weight}}{414} \\ & = 0.007 \times \text{empty live-weight.} \end{aligned}$$

So the equation for determining empty live weight at zero fat and pregnancy becomes

$$\text{Empty Live-weight (ELW) at 0 fat and pregnancy} = \text{ELW} - (\text{P8 fat} \times 0.007 \times \text{ELW})$$

Where ELW equals empty live weight minus pregnancy weight.

When this is calculated the mature weights of all cows in the herd can be compared on a level playing field.

**Experiment 1: Pre-mating predictors of bull fertility**

**Objective:**

**Assess pre-mating predictors of fertility in bulls and their relationship to pregnancy in cows. The process, started in 1995, uses DNA finger printing, serving capacity tests, semen evaluation (including levels of heparin binding protein) and physical evaluation.**

**Method:**

Bull traits were recorded as shown in the table below. The first time they were assessed, blood samples were taken for DNA typing and Pompe's testing and semen samples for heparin binding protein analysis.

Their serving capacity was tested pre and post mating with a group of unrestrained heifers in heat. We are trying to develop a serving capacity test that works with Brahman bulls as the method used with British bulls has failed.

The calves were bled at branding in March for DNA testing and parentage determination. The proportion of calves that each bull sired in the 1998 mating-season is shown in the table below.

**Bull characteristics and percentage calves sired in the 1998 mating**

Mating groups for 23<sup>rd</sup> December 1997 to 14<sup>th</sup> April 1998.

Cow Group	Bull ID	Age	Wt at Joining	Scrot. Circ.	%Ab Sperm	BBSE	Libido Score	No. Calves	% of Group
1 Older cows	28	5	760	36.8	5	92	3	6	5.0
	30	6	766	39.3	30	87	8	11	9.1
	33	5	712	39.4	70	66	4	0	0.0
	34	5	668	40.5	10	98	8	48	39.7
	35	4	664	40.9	5	99	4	25	20.7
	36	4	698	37.9	15	95	10	22	18.2
	3815	3	616	37.8	5	100	10	9	7.4
2 2 & 3 year olds	4017	2	536	36.6	10	97	10	10	27.0
	4026	2	478	38.0	25	85	8	15	40.5
	4038	2	498	39.5	30	82	8	0	0.0
	4078	2	470	33.8	30	76	3	12	32.4
3 Yearling heifers	4310	1	287	28.4	80	All	6	3	75.0
	4319	1	316	31.0	95	too	6	0	0.0
	4332	1	290	28.2	100	young	6	1	25.0

The breakdown of bulls by proportion calves sired in 95, 96, 97 and 98 is shown below:

% of calves	No. of bulls at each output level														
	Group 1				Group 2				Group 3				Group 4		
Year -	95	96	97	98	95	96	97	98	95	96	97	98	95	96	97
0-5	1	1	3	2			1	1	1	3	2	1	2	5	6
6-10	1	1	1	2							2		3		*
11-20	3*	2*	2*	2*			1		2	*		*	2*	2*	2
21-30	2	1			1	1*	1	1*	*	1		1			2
31-40		1		1	2*		1*	2			1	*			1
41-50							1				1		1		
51-60			1			1			1						1
61-70															
71-80										1		1			

\* Point where bulls would have gained an even distribution of calves (average level for group).

The conception patterns of the two largest cow groups in 1998 are shown in the following tables.

Conception pattern for cows mated to group 1 bulls in 1998

Time of Conception	Bull Number							All Bulls	
	28	30	33	34	35	36	3815	n	%
Early Jan	1	1	-	13	6	5	5	31	26
Mid Jan	1	3	-	9	3	3	1	20	16
Late Jan	2	2	-	6	2	5	1	18	15
Early Feb	-	-	-	8	4	4	-	16	13
Mid Feb	1	-	-	4	3	1	2	11	9
Late Feb	-	3	-	3	3	1	-	10	8
Early March	-	1	-	3	3	1	-	8	7
Mid March	-	-	-	-	-	-	-	0	0
Late March	1	-	-	1	-	1	-	3	2
Early April	-	1	-	1	1	1	-	4	3
<b>Total n</b>	<b>6</b>	<b>11</b>	<b>0</b>	<b>48</b>	<b>25</b>	<b>22</b>	<b>9</b>	<b>121</b>	
<b>Total %</b>	<b>5%</b>	<b>9%</b>	<b>0%</b>	<b>40%</b>	<b>21%</b>	<b>18%</b>	<b>7%</b>		<b>100%</b>

Conception patterns for cows mated to group 2 bulls in 1998

Time of Conception	Bull Number					
	4017	4026	4038	4078	n	%
Early Jan	-	1	-	1	2	5
Mid Jan	2	2	-	3	7	19
Late Jan	-	1	-	1	2	5
Early Feb	3	1	-	2	6	16
Mid Feb	1	2	-	1	4	11
Late Feb	1	-	-	-	1	3
Early March	-	1	-	1	2	5
Mid March	1	3	-	-	4	11
Late March	1	2	-	2	5	14
Early April	1	2	-	1	4	11
<b>Total n</b>	<b>10</b>	<b>15</b>	<b>0</b>	<b>12</b>	<b>37</b>	
<b>Total %</b>	<b>27%</b>	<b>40%</b>	<b>0%</b>	<b>32%</b>		<b>100%</b>

These figures seem to indicate that the bulls of low siring ability sire a few calves but cannot increase their performance at times when more cows are in heat. The high calf siring bulls seem to be able to increase their performance when more cows are available.

**Analysis:**

An important siring ability at this point appears to be affected by percentage normal sperm. This is a significant finding here and in Queensland. When this is combined with the fact that most of the calves are sired by relatively few bulls, it should be possible to reduce bull numbers in herds where semen tested bulls are used.

However, only a small number of bulls have been assessed at this site and it's possible that other predictors will emerge in the future.

If we succeed in developing these pre-mating predictors, it will enable producers to pick the high calf siring bulls before mating and thus reduce their bull numbers.

The results of this experiment are important to any property with Brahman bulls anywhere in the NT cattle industry.

**Experiment 2. The effect of yearling mating on herd productivity (1994-2000)**

**Objectives:**

- 1. To develop a method of successfully mating Brahmans as yearlings under improved pasture conditions in the Top End of the NT.**

## 2. To assess the effect of yearling mating on cow lifetime productivity.

### Introduction:

Swans Lagoon researchers have found that initial mating as yearlings of Brahman cross heifers, which are supplemented in the dry season as weaners may increase lifetime calf output by 0.4 calves with astute mating management.

Under improved pasture conditions in the Top End Brahman heifers can reach 400kg at mating at two years. This suggests the possibility of gaining an extra calf by early mating. If the calving rate of yearlings is sufficiently high, it may be possible in future years to cull heifers, which do not become pregnant as yearlings.

### Method:

Yearling heifers were artificially inseminated in mid December and were then mated to 8 to 10% yearling Brahman bulls for three months from the start of January to the start of April. The heifers that do not become pregnant are culled if possible. The empty heifers that did not calve as yearlings are culled. The yearlings drop their calves in the heifer group and are control mated again at two year. The cow and calf performance, the calving difficulties and mortalities are assessed.

### Results:

The results to date are summarised in the table below.

<u>Animals</u>	No.	Joining weight (kg)	Yearling preg rate (no.)	Dystocia rate of pregs (No.)	Preg rate of lact. Heifers (No.)
No. 4 Tuli X	11	237	64% (7)	0% (0)	57% (4)
No. 4 Boran X	11	221	55% (6)	33% (2)	100% (4)
No. 4 Brahmans	28	217	25% (7)	14% (1)	80% (4)
All No. 4 Heifers	50	222	40% (20)	14% (3)	70% (12)
No. 5 Heifers	46	265	63% (29)	21% (6)	85% (20)
No. 6 Heifers	54	248	63% (34)	30% (10)	46% (11)
No. 7 Heifers	22	252	41% (9)	11% (1)	63% (5)
No. 8 Heifers	38	264	53% (20)	-	-
Total and Averages	210	249	53% (112)	22% (20)	68% (48)

The heifers that were born in 1997 and which became pregnant, were given good feed (sorghum stubble) over the first two trimesters following southern recommendations. One heifer out of this group had trouble. She was the last heifer to calve and calved well into the wet season, thus having a flush of feed in the last third of pregnancy. So the answer may be to mate yearling heifers for a short duration so that they calve before the wet and to give them good feed for the first two thirds of pregnancy. However, the number in this group is so small (9) that the result will have to be repeated to be meaningful.

The heifers born in 1998 have been reared under adequate feed conditions and, if results can be repeated, we may have found a solution to the problem.

If it is possible to solve the dystocia problem, yearling mating has the potential to give a major increase to herd efficiency as it means all the females in the herd are productive and purely grower heifers are not utilising pasture which can be used by a breeding animal. A roughly 20% increase in weaner number is possible in a yearling mated system versus a 2 year old mated system with cull heifers turned off at yearling.

### Experiment 3. Production in aged cows:

Cows will not be culled for age unless they miss or lose a calf, have calving trouble, or die. Mortality and

fertility of these cows, which remain in the herd, will be assessed to see how long productive Brahman cows can be kept and actually when they stop being productive.

**Results:**

In the four years from 1995 to 1998, the annual cull rate for functional problems such as losing a calf, being non-pregnant or having a semi-functional udder was:

3 - 9 years of age (718 records) – 12%

10 - 13 years of age (156 records) – 20%

14 - 15 years of age (10 records) – 60%

This preliminary data indicates that, in this environment, might be a good time to cull for age at 13.

**Experiment 4. Locally bred bull demonstration:**

In herds where purchased bulls without Breedplan EBV (estimated breeding value) figures are used, little genetic progress can be made. Bulls bought purely on looks are genetically unknown quantities. Also, bull sellers retain their best bulls so the only way to gain the best genetic material is to breed bulls on the farm. The use of artificial insemination allows access to well bred bulls from both Australia and the USA at a reasonable cost. Their progeny can then be compared with those of the herd bulls. The best can be selected in our own environment at the age when their sons will be turned off.

To this end all replacement heifers will be artificially inseminated with good quality Brahman semen. The calves will be assessed in comparison with our own bulls. The superior animals will be retained as bulls.

The performance records of all the bull calves will be correlated with the performance of their fathers. This will act as both a progeny test for our adult bulls and an indication of the heritability of the pre-mating predictors of bull fertility looked at by the MRC funded Bullpower project.

**Results:**

From 1995 to 1999 between 28 and 52 bull calves were kept entire at branding. They were selected on Brahman content, conformation, presence of two palpable testicles, temperament and colour. The final selection was done prior to mating on a 400-day weight, testicular circumference, temperament, and conformation, semen test results and negative Pompe's carrier status. These bulls should be genetically superior as their mothers and grandmothers were selected for reproduction for a number of years. The use of AI bulls should preclude inbreeding. The best ten percent of these young bulls are used in the herd. The 10% retention gives fairly high selection intensity.

We emphasised on reproduction in our selection because work reported by the Animal Genetics and Breeding Unit and NSW Department of Primary Industry at Armidale, indicates the return in dollars for percentage of calves weaned per cow is twice as much as growth rate and twenty times as much as carcase merit for comparative increments of improvement. However, reproduction is highly influenced by environmental factors and is of low heritability. But both scrotal circumference and serving capacity are of medium to high heritability ranging from 20-50% and 30-70% respectively.

The emphasis on 400-day growth is for the following reasons:

1. Selection for weight gain in the dry season, when feed is not of optimum quality or quantity, gives some selection for improved feed conversion ratio. Animals selected for weight gain under conditions of unlimited, high quality feed are more susceptible to weight loss in sub-optimal conditions as their weight gains are a function of increased intake.
2. It assesses the early weight gains, which are important for live export steers.
3. When combined with testicular circumference figures, it selects early maturing bulls whose daughters should be more fertile.
4. It fits in well with the yearling-mating program. Bull selection occurs just prior to mating.

The success of this program to date can be assessed by the Breedplan EBV's of the local bulls.

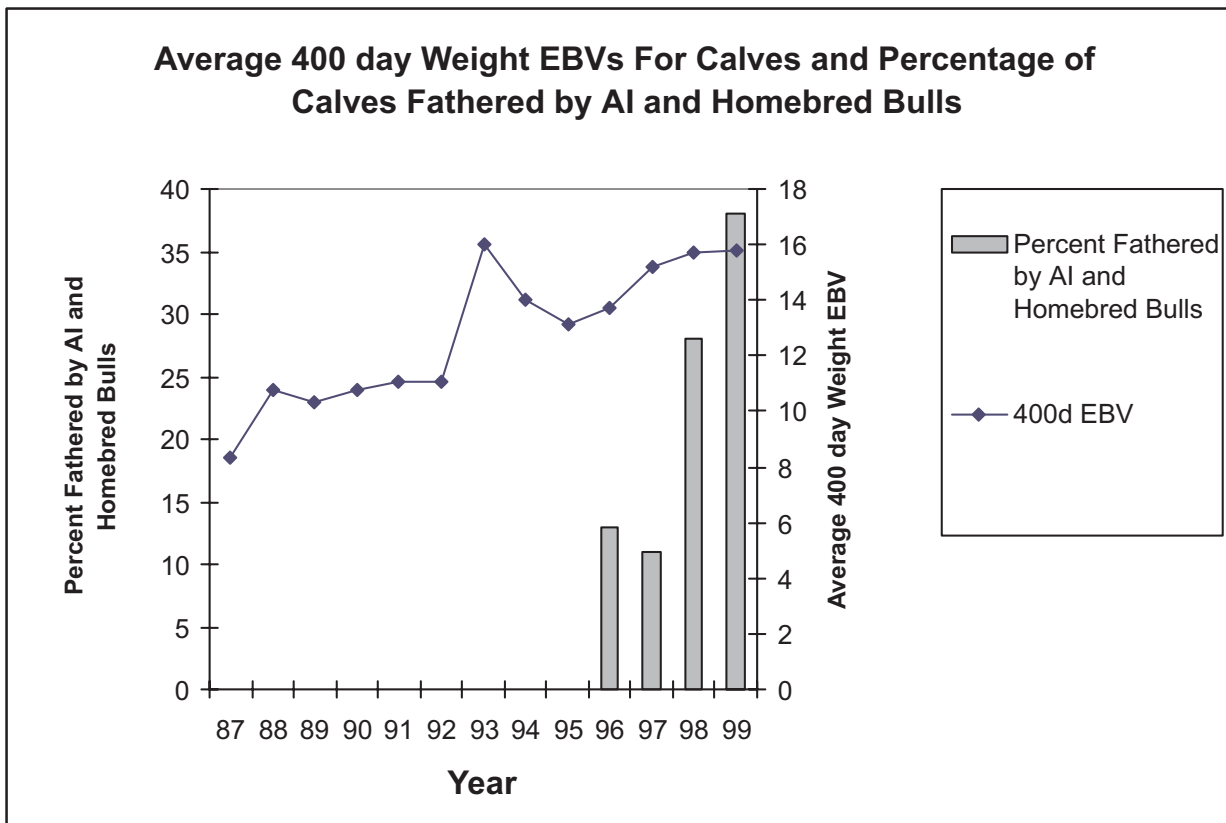
The average EBV's of the bought herd bulls and the locally produced bulls are as follows:

	No.	Birth weight	200day milk	200day growth	400day weight	600day weight	Scrotal size
Average Bought	18	+1.0	-2.6	+8	+13	+14	0.0
Average local	16	+1.7	+0.3	+14	+22	+28	+1.7
DDRF 4017	1	+3.2	0	+26	+38	+48	+2.5

One of the local bulls, DDRF 4017, has exceptional figures. His 400-day weight EBV's are within the top 10 on the 1998 Brahman Group Breedplan Sire Summary.

The retained local bulls have average 400 day weight EBVs 9kg heavier and scrotal circumference EBVs 1.7 cm larger than the average of the bought bulls used since 1994. The real effect of this program will be seen when the progeny of the local bulls are assessed.

The following graph shows the average 400 day weight EBV of each year's calves since the start of this herd.





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**PROJECT: Comparison of an HGP Implant and Control Steers on a Commercial Property in the Top End**

**Project Officers:** G Jayawardhana, J. Little (station manager) and Opium Creek Station Staff

**Project Period:** 1999

**Project Location:** Opium Creek Station

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**Objectives:**

*To examine the relative profitability of Hormonal Growth Promotant (HGP) implanted steers and untreated steers under floodplain fringe pasture conditions in the Top End of the NT.*

**Method and results:**

We compared the growth rates of steers implanted with Revalor G and untreated control steers at Opium Creek Station in the Top End. All the animals were weighed on 14/04/99 and the implants were put into the treatment group. They were then released into a paddock on the fringe of the floodplain containing a mixed pasture of Humidicola, Gamba grass and Marine Couch. They were mustered and weighed one hundred days later, on 23/07/99. The results are summarised below.

Treatment	No.	Av. wt 14/04/99 (kg)	Av. wt. 23/07/99 (kg)	Av. wt. Gain (kg)	Wt gain over Steer control (kg)
Revalor G	14	311.3	350.3	39.0 a	19.4
Steer Controls	14	314.5	334.1	19.6 b	0

Average weight gains followed by different letters are significantly different at the 1-% level.

The steers implanted with Revalor G grew significantly quicker than the untreated controls.

Revalor G costs \$3.55 (applicator \$95). If the cost of the applicator is spread over 500 head and animals are worth \$1.20/kg, the implant would cost \$3.74 (without labour costs) and the extra weight gain would be worth \$23.28. The per head profit over the control steers would be \$19.54.

**Acknowledgments:**

We would like to thank the staff of Opium Creek station who provided the labour and resources for this trial and Carole Wright, the DPIF biometrician who provided statistical advice.

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**PROJECT: Long Term Storage of Genetic Material**

**Project Officers:** T. Olm and G. Jayawardhana

**Project Period:** Ongoing

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**Objective:**

*Provide industry with an accessible storage facility for the cryopreservation of superior genetic material and current information on available genetics and sources of supply.*

**Background:**

As part of our commitment to the genetic improvement of the NT livestock industries a cryogenic storage facility was established for preserving livestock genetic material. This facility acts as an intermediary between DPIF, interstate and international suppliers and producers. It allows industry immediate access to a greatly expanded gene pool and provides a storage and backup service for local (NT) producers. We also maintain relationships with all the groups selling genetic material in Australia.

**Results:**

There are currently over 15,000 doses of cattle, buffalo and goat semen stored in this facility with a conservative value of around \$300,000. This year we assisted several producers to run AI programs by lending liquid nitrogen canisters and coordinating the movement of semen from interstate and within the Territory.

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**PROJECT:       Animal Advisory Management**

**Project Period:     Ongoing**

**Project Officers:   G. Jayawardhana and T. Olm**

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***Objectives:***

***To advise and train producers on methods of increasing animal production efficiency and promote the use of these methods.***

To disseminate our research results to producers.

**Results:**

A pregnancy testing school was held at DDRF in 1998 with Mark Adams from Tennant Creek Pastoral and 12 others. In 1999 one pregnancy testing school was held at Elsey station with Neil MacDonald from Katherine Pastoral with 13 people trained. Another was held at Legune station with 11 people trained. Two other schools are planned for Mistake Creek station and DDRF in October 99.

## PROGRAM: Meat and Livestock

### Introduction:

This segment of the Meat and Livestock Program comprises three sub-programs, only two of which are currently funded. The unfunded sub-program was proposed in the review of the Meat and Livestock Program in 1998/99 and at present has no approved projects.

### Objective:

**To identify by the year 2003, cost-effective production systems and techniques that enable a sustainable 50% increase in the number of young NT-bred feeder cattle that reach SE Asian or Australian feedlot specifications within 12 months of weaning.**

It consists of three subprograms:

1. Meeting Market Specifications (funded).

To identify the live animal/carcase specifications of available markets in terms of age, sex, weight, fatness and genotype and evaluate alternative methods of cost-effectively and sustainably meeting these specifications under a range of environmental conditions.

2. Improving Breeding Herd Efficiency (funded).

To identify current levels of breeding herd efficiency (kg calf weaned/100kg cow mated), throughout the NT and evaluate and document cost-effective production systems capable of providing at 10% increase in this efficiency index in the NT breeding herd by the year 2003.

3. Breeding and Selection, Technology Training and Research and Development.

To develop and coordinate development and training activities for technologies associated with improved breeding management and herd selection and to ensure appropriate genotypes are available for other Meat and Livestock sub-programs.

The current projects in the two funded sub-programs are listed below under the relevant regional headings.

### SUBPROGRAM: Meeting Market Specifications

#### PROJECT: Utilisation of Surplus Heifers

*(a) Genotype Comparison (Response to 25% Charolais genes)*

**Project Officers:** P. Ridley, D. LaFontaine and Douglas Daly Research Farm (DDRF) Technical Officers

**Project Duration:** 1997/98 and 1998/99

**Project Location:** DDRF

#### Objective:

**To measure the effect of an infusion of 25% Charolais genes in a Brahman herd on the weight gain and final P8 fat depth of cull weaner heifers (1999/00)**

#### Background:

With an increasing adoption by industry of the Kidman Best Bet breeder management package in the Katherine Region, breeding herd fertility has improved. This has resulted in significant numbers of heifers surplus to replacement requirements. It has been estimated (Ridley, 1993) that 16000-19000 heifer-weaners weighing 100-160kg will become available each year. This project provides data on one alternative use to retaining them on their property of origin. This use could replace most of the beef imported into the NT from elsewhere in Australia during the April - July period.

**Method:**

- $n = 52$ , first weaning round (May) cull heifer weaners (100-170kg) from the Kidman genotype comparison,
- two years' data, 2 replicates, 2 genotypes with plots re-randomised between years,
- Stocking rate on buffel pasture at 1.32hd/ha with all heifers remaining on their plots to the end of their first post-weaning Wet (May).

Results:

<i>Genotype</i>	<i>Dry Gain Kg</i>	<i>Wet Gain kg</i>	<i>Whole Gain* kg</i>	<i>Final P8mm</i>	<i>Efficiency (kg gain/ha/yr)</i>
<i>Brahman</i>	-1.0	+156.3	+141.0	9.2 (92)	186.2
<i>¼ Charolais</i>	+1.0	+175.5	+159.5	6.7 (57)	210.7
<i>Response</i>	+2	+19.2 +12.3%	+18.5 +13.2%	-2.5 -27.1%	+24.5 +13.2%

\* Whole-of-year gain based on empty live weights. Values in brackets are the % of heifers with 6mm or more ultrasonic back fat (5mm or more P8 carcass fat).

**Conclusions:**

The difference in performance between the two genotypes during the Dry was negligibly small.

There was a significant growth response in the ¼ Charolais heifers (+18.5kg +13.2%) which resulted in higher efficiency (24.5kg gain/ha/yr) over the whole year.

Ultrasonic measurement of fat depth at the P8 site indicated that 92% of the Brahman heifers were fat enough for slaughter for the NT chilled beef trade (> 5mm carcass P8 fat depth) while only 57% of the ¼ Charolais heifers met this threshold.

Using the prediction equation for Brahman heifers established in Projects 8.4.4 and 8.4.8 and the final age (16.2mo) and fat measurement (6.7mm) from the ¼ Charolais heifers, it was estimated that the ¼ Charolais heifers were 22kg (8.0%) heavier than the Brahman heifers.

$$\begin{aligned}
 \text{ELW} &= 2.1 (\text{P8mm}) + 9.4 (\text{age month}) + 108.6 & r^2 &= 0.77 \\
 &= (2.1 \times 6.7) + (9.4 \times 16.2) + 108.6 \\
 &= 274\text{kg}
 \end{aligned}$$

This suggests that the infusion of 25% Charolais genes into a Brahman herd may increase the mature size of females by 8%. Such an increase has important implications on both feedlot turnoff weights at target fatness and breeding herd efficiency (kg calf weaned/100kg cow mated),

With 16000-19000 cull Brahman weaner heifers (120-170kg) in the VRD/Gulf each year, there is a major potential opportunity for supplying the NT's chilled beef requirements during the period April - July inclusive from improved pasture in the Daly Basin. This is also the period of highest beef prices in southern Australia, which is the source of most of the NT's chilled beef.

## PROJECT: Utilisation of Surplus Heifers

*Supplementation Comparison (deletion of Uramol or Phosrite)*

**Project Officers:** P. Ridley, D. LaFontaine and DDRF Technical Officers

**Project Duration:** 1997/98 and 1998/99

**Project Location:** DDRF

### Objective:

**To measure the effect on growth of deleting Uramol or Phosrite from the normal supplementation regime of cull heifers grazing buffel pasture (1999/00).**

### Background:

There is a paucity of published information on the response and cost-effectiveness of commonly used dry season (Uramol) and wet season (Phosrite) supplements when fed to weaners grazing grass-only improved pasture in the absence of nitrogen fertilisers.

There is evidence that nutritionally induced improvements in live weight in Brahman weaners at the end of first post weaning dry season are significantly reduced by the end of the following Wet.

This project provides information on these two issues with respect to cull weaner heifers.

### Method:

$n = 76$ , first weaning round (May) cull heifer weaners (100-170kg) from the Kidman Genotype Comparison;

Two years' data, 2 genotypes, 3 supplementation regimes with plots re-randomised between years;

Stocking rate on buffel pasture = 1.32hd/ha with all heifers remaining on their plots to the end of their first post-weaning wet (May);

Supplementation treatments:

<i>Treatment</i>	<i>Dry</i>	<i>Wet</i>
1	Uramol	Phosrite
2	Uramol	Nil
3	Nil	Phosrite

### Results:

<i>Gain</i>	<i>Genotype</i>	<i>Supplements</i>			<i>Response</i>	
		<i>1</i>	<i>2</i>	<i>3</i>	<i>Uramol</i>	<i>Phosrite</i>
Dry (kg)	Brahman	+3.0	+4.5	-9.5	+12.5	-
	¼ Charolais	+4.0	+2.5	-7.5	+11.5	-
	Average	+3.5	+3.5	-8.5	+12.0	-
Wet (kg)	Brahman	+152.5	+135.0	+168.0	-	+17.5
	¼ Charolais	+175.0	+136.0	+176.0	-	+39.0
	Average	+163.8	+135.5	+172.0	-	+28.3
Annual (kg)	Brahman	+145.0	+128.0	+145.5	0	+17.0
	¼ Charolais	+162.0	+125.0	+153.0	+9	+37.0
	Average	+153.5	+126.5	+149.3	+4.5	+27.0

### Conclusions:

There was a significant (12.0kg) response to Uramol in the Dry (treatment 1 vs 3) with a negligibly small difference due to genotype;

There was a significant (28.3kg) response to Phosrite in the Wet (treatment 1 vs 2) with ¼ Charolais showing more than twice the response of Brahman heifers (+28.7% or +39kg vs +13.0% or +17.5kg);

The whole-of-year response to Phosrite in the ¼ Charolais heifers (+37.0kg or 29.6%) was significantly larger than in the Brahmans (+17.0kg or 13.3%);

There was no residual response to Uramol at the end of the year in Brahman heifers while the 9kg (78.2%) residual response in the ¼ Charolais was of questionable net financial benefit.

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**PROJECT: The Effects of Genotype (4) Sex (3) and Age on Live Weight and Carcase Weight at Target P8 Fat Depth**

**Project Officers: P. Ridley, D. LaFontaine, J. Wheeler and Katherine Research Station (KRS) Technical Officers**

**Project Duration: 1997/98 and 1999/00**

**Project Location: KRS**

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**Objective:**

***To construct maturity type growth curves for young cattle varying widely in mature size from their early adolescent stage of growth (10 months) to early adulthood (36 months).***

**Background:**

The purpose of this work is to expand on the results from Project 8.4.8 and construct maturity type growth curves from adolescence (10-20 months) to young adulthood (36+ months), for a range of maturity types.

Improving nutritional management in Brahman herds in the VRD/Gulf since the early 1990's has resulted in ages at which most cattle reach live export feeder weight specifications decreasing from 30 months or more, to 18-20 months.

Project 8.4.8 showed that in the 10 month period from 10-20 months age, young Brahman steers at say 5mm P8 fat depth needed to increase in weight by 110kg (or 12 x 11 = 132kg/year) to maintain their P8 fat depth.

As a consequence of these two factors, increasing numbers of NT sourced feeder cattle being fed for fixed periods and/or to fixed slaughter weights, are proving to be seriously over fat for wet market requirements in SE Asia. Slaughter at lighter weights is not an acceptable solution.

This project is part of an integrated set of activities which are exploring the economic and biological consequences of a shift to larger, later maturing cattle for the live export trade, as a solution to this over fatness problem. The use of bulls, rather than steers, is another option that is being explored because it involves no change in cow size.

**Method:**

- A small six pen feedlot at KRS is being used to manipulate the weight of groups of young cattle of seven sex x genotype combinations, to meet target fatness (P8 = 10mm range 5-15mm) at a range of ages.
- The seven sex x genotype combinations (maturity types) being fed in the KRS feedlot and slaughtered at P8 = 10mm (group average) are:
- Droughtmaster steers only,
- Brahman bulls, steers and heifers,
- ¼ Charolais bulls, steers and heifers.

All cattle are fed the same 65% sorghum based ration and there is a wide range in time taken (2½-5½ months) by different sex x genotype sets, to reach P8 = 10mm group average. Ultrasonic equipment is used to determine when each group reaches this target, and is ready for slaughter,

- Project cattle are slaughtered at a local abattoir to provide hot carcase weight and cold P8 fat measurements and shin samples are taken for dissection to provide estimates of total carcase muscle, bone and fat content.

**Results:**

- Four preliminary maturity type growth curves have been constructed with the earliest (Brahman females) being based on a very complete data set from 10 months to 10 years age. These maturity type curves and the sex x genotype sets which they characterise are:
  1. Early: Brahman heifer
  2. Early/mid: Brahman steers  
Droughtmaster steer  
¼ Charolais heifer
  3. Late/mid: Brahman bull  
¼ Charolais steer
  4. Late: ¼ Charolais bull
- This information will become the basis of a new technology transfer project to improve the capacity of SE Asian feedlot operators to describe the specifications (age, weight, maturity type) they need in feeder cattle. It will help the NT beef industry to meet their turnoff specifications (P8 fat range and live or carcass weight range), given the plane of nutrition (ie. growth rate) they expect to provide.

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**PROJECT:           Backgrounding Feeder Cattle for Live Export**

*The Effects of Genotype (4), Weaning Round (2) and Management System (2) on Native Pasture (Mt Sanford)*

**Project Officers:   P. Ridley, D. LaFontaine, M. Cobiac and Technical Officers in the Katherine Region**

**Project Duration:   1999/00 to 2002/03**

**Project Location:   Mt Sanford Station**

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**Objective:**

***To measure the effects of genotype, weaning round, management system and weaning weight range (2002/03) on:***

- ***efficiency (kg gain/km<sup>2</sup>/yr),***
- ***wet season growth rates,***
- ***proportion of carry over cattle,***
- ***final P8 fat depth.***

**Background:**

There is a paucity of information on the performance of young commercial Brahman cattle on native pasture in the Victoria River District (VRD), up to the end of their first post-weaning Wet (ie. the proportion of carry over steers from each annual crop of weaners).

Mitchell grass constitutes a major pasture community in the VRD that is well suited to the growing phase of beef production.

This experiment is the first occasion when a project has incorporated estimated safe carrying capacity, full supplementation, saved pasture and rotational use of fire as a management package in a post weaning feeder steer production system (ie. the Best Bet system).

This project will provide part of the mosaic of information required to compare the financial effects of shifting to a two-stage beef industry in the northern half of the NT (breeding only on native pasture and growing and fattening on improved or subcoastal flood plain pastures in higher rainfall areas).

**Method:**

- Two 6km<sup>2</sup> plots of Mitchell Grass have been fenced and provided with water at the Mt Sanford site;
- Each plot contains the following steer weaners in the genotype and weaning round (WR) comparisons:

<i>Origin</i>	<i>Breed</i>	<i>WR1</i>	<i>WR2</i>
Mt Sanford	Brahman	10	4
Kidman	Brahman	10	4
Kidman	¼ Charolais	10	4
Kidman	Droughtmaster	10	4

- Each plot also contains the following steer weaners in the weaning weight (WW) range and (WR) comparisons:

<i>Origin</i>	<i>Breed</i>	<i>WW range (kg)</i>	<i>WR1</i>	<i>WR2</i>
Mt Sanford	Brahman	100-140	20	7
		181-220	-	7
		221-260	20	-

- The estimated safe carrying capacity based on several years' pasture measurement and long term rainfall data is 110hd/6km<sup>2</sup>,
- The Basic management system includes full supplementation (Uramol and Phosrite) no internal fencing and estimated safe carrying capacity in one plot, while in addition to these specifications, the other plot, using the Best Bet system also includes three equal sized subdivisions to facilitate both pasture saving and a controlled fire regime (one sixth of the plot each year, rotating through the whole plot over six years),
- The output variables will be:
  - efficiency (kg gain/km<sup>2</sup>/yr),
  - proportion of carry over steers (those not making 280kg by the end of their first post weaning Wet),
  - wet season growth,
  - final P8 fat depth.
- This project commenced with the entry of first weaning round weaners in June 1999 and is planned to last for four annual cycles of production. All cattle will be removed from the plots at the end of their first post-weaning Wet (ie. at the end of the production cycle).

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**PROJECT:           Backgrounding Feeder Cattle for Live Export**

*Effects of Genotype (4), Stocking Rate (4) and Sex (2) on Buffel Pasture (DDRF)*

**Project Officers:   P. Ridley, D. LaFontaine and DDRF Technical Officers**

**Project Duration:   1999/00 to 2002/03**

**Project Location:   DDRF**

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**Objective:**

**To measure and report on the effect of genotype, stocking rate and sex on:**

- **efficiency (kg gain/ha/yr)**
- **Dry, Wet and whole of year growth rates,**
- **initial and final feed on offer (kg/ha in May),**
- **proportion of carry over cattle,**
- **final P8 fat depth.**



**Background:**

No information is available on the long-term effects of stocking rate on animal and pasture performance of steer and heifer weaners grazing grass only (buffel) pastures.

This project will also provide part of the mosaic of data required to compare the financial effects of shifting to a two-stage beef industry in the northern half of the NT. This will involve breeding only on native pasture and growing and fattening on improved or sub-coastal flood plain pastures in higher rainfall areas.

**Method:**

- The design and number of animals per genotype x stocking rate set are shown in the table below ( $n = 208/\text{yr}$ ):

Origin	Genotype	Stocking Rate hd/ha		
		1.15	1.48	1.64
Mt Sanford	Brahman	7+7	9+9	10+10
Kidman	Brahman	7+7	9+9	10+10
Kidman	¼ Charolais	7+7	9+9	10+10
Kidman	Droughtmaster	7+7	9+9	10+10

The two replicate blocks are confounded with sex (steer and heifer) and this confounding alternates between each of the four years.

- The output variables will be:
  - efficiency (kg gain/ha/yr),
  - final weight gain/hd,
  - final P8 fat depth/hd,
  - final weight/hd.
- This project commenced in June 1999 with the entry of first weaning round weaners and is planned to last four annual cycles of production. All cattle will be removed from the plots at the end of each wet season (May).

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**PROJECT:           Backgrounding Feeder Cattle on Buffel Pasture**

*(a)   Genotype and Sex Effects*

*(b)   Supplementation Responses*

**Project Officers:   P. Ridley, D. LaFontaine and DDRF Technical Officers**

**Project Duration:   1997/98 and 1998/99**

**Project Location:   DDRf**

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**Objectives:**

**a) To measure the effect of five alternative sex x genotype combinations on:**

- **efficiency (kg gain/ha/yr),**
- **growth rates,**
- **final P8 fat depth.**

**b) To measure the effect of three supplementation regimes on:**

- **efficiency (kg gain/ha/yr),**
- **growth rates,**
- **final P8 fat depth.**

**All data for this project has been collected but not yet collated or analysed. Next year's Technical Annual Report will contain this information.**

**PROJECT: The Interrelationship Between Weight, Age and Fatness in Young Brahman Cattle**

**Project Officers:** P. Ridley, D. LaFontaine, J. Wheeler and KRS Technical Officers

**Project Duration:** 1997/98

**Project Location:** KRS

**Objective:**

**To analyse the interrelationship between weight, age and fatness during the adolescent growth phase in Brahman steers and heifers.**

**Background:**

In the early 1990's an increasing proportion of Brahman cattle reached the live weight specifications required in the live export feeder trade by the end of their first post-weaning wet season. After spending a standard period in SE Asian feedlots, an increasing proportion of such animals are becoming too fat for wet market requirements.

This project was undertaken to measure the interrelationship between weight, age and fatness and thus demonstrate and quantify the extent to which the Brahman is too early maturing (ie. its mature size was too low) to meet market specifications in this context.

The Brahman used in this project were bred from purebred (not stud) cows purchased in Queensland for the Kidman Genotype Comparison. They are therefore representative of the genotype towards which the NT Brahman herd is heading.

**Method:**

- Young Brahman steers and heifers were placed in a feedlot in June 1997 and fed with ration based on 65% sorghum grain, after a three week adaptation period (initially 20% grain),
- The experimental design used to generate cattle of a wide range of age, fatness and live weight for slaughter is shown in the table below:

<i>Sex</i>	<i>Target Slaughter P8 (mm)</i>	<i>Weaner Numbers hd</i>	<i>Yearling Numbers hd</i>
<i>Steer</i>	5	5	5
	10	5	5
<i>Heifer</i>	5	5	5
	10	5	5

- The weaners and yearlings were from the first weaning rounds of the Kidman Genotype Comparison in 1997 and 1996 respectively (ie. 12 months difference in age between the two sets), with weaning weights in the 100-160kg range,
- The ranges for the main specifications at slaughter were:

Liveweight	kg	189-410
Carcase weight	kg	103-233
P8 fat depth	mm	1.0-16.0
Age	months	9.8-21.6

**Results:**

- Statistically highly significant ( $P < .001$ ) regression equations to predict the empty live weight (ELW) of steers ( $ELW_S$ ) and heifers ( $ELW_H$ ) were derived from this data:

$$ELW_S = 4.6 (P8, mm) + 9.9 (Age, mo) + 116.3 \quad r^2 = 0.89$$

$$ELW_H = 5.2 (P8, \text{ mm}) + 6.1 (\text{Age, mo}) + 141.8 \quad r^2 = 0.63$$

- For hot carcass weights (HCW) the prediction equations were:

$$HCW_S = 2.7 (P8, \text{ mm}) + 6.1 (\text{Age, mo}) + 55.6 \quad r^2 = 0.92$$

$$HCW_H = 3.0 (P8, \text{ mm}) + 3.3 (\text{Age, mo}) + 78.13 \quad r^2 = 0.64$$

- If age was deleted from these prediction equations, there was a large drop in  $r^2$  values although the relationship was still statistically significant ( $P < .01$ ). For example:

$$HCW_S = 8.1 (P8, \text{ mm}) + 118.4 \quad r^2 = 0.46$$

#### Conclusions:

- The difference in the  $r^2$  values between the steers and heifers was due to one 'outlier' in the heifers,
- The steer equations imply that adolescent Brahman steers:
  - can only gain about  $9.9 \div 30 = 0.33\text{kg/d}$  without increasing their P8 measurement,
  - each mm change in P8 measurement results in approximately 4.6kg difference in empty live weight,
- As more Brahman cattle reach live feeder export weight specifications by the end of their first post-weaning Wet, an increasing proportion will be unsuitable for slaughter for wet markets in SE Asia if current feeding periods and growth rates are maintained. Reduced growth rates will increase cost/kg gain and Indonesian import licenses require standard feeding periods. Value adding to cover shipping costs tends to encourage the maximisation of weight gain when feed costs are favourable.

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## PROJECT: The Effect of Castration and Short Scrotum (SS) Treatments on Pre-Weaning and Post-Weaning Growth in Commercial Cattle

**Project Officers:** P. Ridley, D. LaFontaine and DDRF Technical Officers

**Project Duration:** 1997/98 to 1998/99

**Project Location:** Camfield Station (pre-weaning) and DDRF (post-weaning)

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#### Objective:

**To measure and report (1999/00) on the effects of castration and short scrotum treatments in commercial Brahman cattle on:**

- **pre-weaning growth,**
- **post-weaning growth,**
- **final weight and P8 fatness.**

#### Background:

A vertically integrated major NT cattle producing company with a feedlot and butcher shop in SE Asia reported a developing problem of too fat steers when slaughtered for use in its own butcher shops after a normal period of fattening.

The Department was asked to recommend a solution to this problem and the company agreed to participate in a field test of two bull treatments as a solution.

#### Method:

- In October 1997 (second weaning round) at Camfield Station, 100-150kg calves were allocated to the three treatments and returned to their mothers. They were weaned at the first weaning round in 1998 (late June) and transported to Douglas Daly Research Farm. They were then weighed in late July after access to plentiful buffel pasture.

These cattle were stocked at 1hd/ha in 3 replicates per sex treatment ( $n = 54$ ) and weighed at approximately monthly intervals until late May 1999.

**Results:**

<i>Sex</i>	<i>Oct 97</i>	<i>Jul 98</i>	<i>Gain 1</i>	<i>May 99</i>	<i>Gain 2</i>	<i>Gain 1 + 2</i>
<i>Steer</i>	122kg -	260kg 4.6mm	138kg -	402kg 11.5mm	142kg -	280kg -
<i>Bull</i>	121kg -	265kg 1.5mm	144kg -	422kg 7.0mm	177kg -	321kg -
<i>SS Bull</i>	122kg -	272kg 2.0mm	150kg -	453kg 7.0mm	188kg -	331kg -
<i>Age</i>	5mo	15mo		25mo		

Gain 1 = pre-weaning native pasture VRD.  
 Gain 2 = post-weaning buffel pasture DDRF.  
 mm = P8 fat depth in millimetres.

**Conclusions:**

- If steer calves are not weaned down to 100kg at the second weaning round they will be:
  - moderately fat at weaning (5mm),
  - too fat at the end of their first post-weaning Wet (11.5mm) for use as feeder steers for wet-market output.
- Leaving calves entire in October 1997, at 25 months age resulted in:
  - a significant reduction in fatness (4.5mm, -40%, P<.001),
  - a significant increase in empty live weight (35.5kg, 9%, P<. 001).

The greater weight of the SS Bulls compared to the Bulls was unexpected, was not statically significant and was probably a sampling effect.

The reduction in fatness in entire animals was not enough to eliminate the overfatness problem in the 25 month-old feeder cattle. These bulls should have been shipped to SE Asia early in January when their P8 measurement was less than 2mm and their weights were closer to market requirements (361kg full or 332kg empty).

- When the weight of the steers was adjusted for the fatness difference between them and the bulls, using the prediction equation developed in Project 8.4.8 ( $4.6 \times 4.5 = 21\text{kg}$ ) the bulls were

$$(422 + 453) - (402 - 21) = 56.5\text{kg}$$

heavier than the steers. This is very close to the bull steer difference measured in Kidman Brahman in Project 8.4.4 (60kg) and infers little difference in mature size between the two samples of Brahman.

When the age and fatness of the Camfield steers were inserted in to the 8.4.4 prediction equation to estimate empty live weight,

$$\begin{aligned} \text{ELW} &= 4.6 (\text{P8, mm}) & + & 9.9 (\text{Age, mo}) & + & 116.3 \\ &= (4.6 \times 11.5) & + & (9.9 \times 25) & + & 116.3 \\ &= 417\text{kg} \end{aligned}$$

This calculated value was 4% greater than the measured value. This result also infers little difference in mature size between the two samples of Brahman.

- Leaving 100-150kg calves on their mothers at the second weaning round results in:
  - 'weaners' that are well over 12 months old at 'weaning',
  - hidden adverse effects on either the survival of their dams, or their dams' inter-calving interval, or the survival of the next calf or a combination of these effects. The net unmeasured effect will be lower weaning percentage and lower weaning weights in the future.

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**SUBPROGRAM: Improving Breeding Herd Efficiency**


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**PROJECT: Techniques For Assessment of Nutrient Deficiencies**

**Project Officer:** N. MacDonald

**Project Duration:** 1993 to 1999

**Project Locations:** KRS, DDRF and Victoria River Research Station (VRRS)

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**Objective:**

*To examine existing techniques for determining nutrient deficiencies in cattle, identifying any worthy of further application.*

*To train extension officers in the techniques found to be of practical use.*

*To further develop new diagnostic techniques in cooperation with researchers elsewhere.*

**Background:**

In previous years, this project has investigated the assessment of fluorine, phosphorus and protein. Most of this work has been carried out jointly with external partners, principally CSIRO and QDPI, and has received some external funding from MLA. Some of the fieldwork is carried out by final year undergraduate students from the University of Queensland. An assessment of use of faecal near-infra-red reflectance spectroscopy (NIRS) commenced in 1997 and continued this year. From the 1997-98 study, it was concluded that NIRS estimated the protein content of the diet of grazing cattle as accurately as any chemical method. Once fully established, it should be faster and cheaper than chemical analysis and therefore has considerable commercial potential. The focus this year moved to the estimation of digestibility.

**Developments in 1998-99:**

A student from the University of Queensland, Claire Hill, investigated the accuracy of faecal near infrared reflectance spectroscopy (NIRS) as a rapid and cost-effective method of assessing the digestibility and intake of grazing animals. Digestibility and intake are both hard to measure in any other way, so the trial set out to correlate the growth rate the growing animals with the NIRS estimate of the intake of digestible organic material. To get three different patterns of growth, two replicate groups of ten heifers were studied at Kidman Springs, Katherine Research Station and Douglas Daly Research Station. The fieldwork has been successfully concluded and laboratory analyses are underway. A final report is expected in November 1999.

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**PROJECT: Productivity of Different Breeder Genotypes**

**Project Officer:** M. Cobiac

**Project Duration:** 1995 to 2000

**Project Location:** VRRS

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**Objective:**

*To compare the breeding herd efficiency of three genotypes of cows (Brahman, Droughtmaster and F1 Brahman X Charolais).*

*To produce progeny (Brahman, Droughtmaster and 3/4 Brahman: 1/4 Charolais) that are tested for growth and their ability to meet future market specifications in a feedlot.*

**Background:**

The herds were established in late 1995, and were pregnant at the time of their arrival at Kidman Springs. Thus 1996 results do not form part of the trial. The 1997 and 1998 results showed the Droughtmasters performing best with an average weaning percentage of almost 90%. The two Brahman groups had a weaning percentage of

80%, and the F1 cows averaged 84%. In terms of breeding herd efficiency the Droughtmasters were still in front with an average of 39kg/100kg cow. The other groups were similar at around 32kg/100kg cow. The Droughtmaster performance may be helped by greater selection and by their previous history at Kidman Springs. There is evidence that they have a better paddock. Results from the indicator steers appear to confirm this paddock effect. Indicator steers in each paddock will be used to adjust the results for paddock differences. The main conclusion from the work so far, is that the breeder performance for all the groups is good. If market forces were to favour a larger and later maturing breed (such a Charolais X) then these animals can be successfully run in the Victoria River District if given appropriate management. However these herds have not yet been tested over really hard years.

#### **Developments in 1999:**

From the May 1999 muster, the following results were obtained:

<i>Genotype</i>	<i>Brahman</i>	<i>D/master</i>	<i>F1 bull X Br cow</i>	<i>Br bull X F1 cow</i>
<i>Av cow wt (May 99)</i>	451 kg	435 kg	431 kg	462 kg
<i>Av weaner wt (May 99)</i>	192 kg	183 kg	199 kg	186 kg
<i>Estimated weaning % 1999</i>	73%	76%	85%	75%

The main change in the trial this year was that the number of breeders in each paddock was adjusted to reflect differences in the mature size of breeders. The F1 cows are approximately 15% heavier than the two other genotypes so their number was cut from 130 to 113 in the paddock to maintain similar grazing pressure.

This project is due for review in late 2000.

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## **PROJECT: Best Bet Breeding Herd**

**Project Officer: M. Cobiac**

**Project Duration: On-going**

**Project Location VRRS**

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#### **Objective:**

***To refine the DPIF's recommendations for running breeders on semi-arid native pastures, to ensure that these recommendations are sustainable, and to write up a comprehensive account of the Best Bet system and its results at Kidman Springs.***

#### **Background:**

The Best Bet system was introduced into Kidman Springs breeder herd in 1990 with dramatic results - breeder mortality was cut from an average of 12% to less than 3%, weaning rate was raised from about 50% to over 80%. These results were consistently maintained until 1995 even over some years of very low rainfall. The system includes stocking rates of 6-7 head /sq. km., weaning to 100 kg twice a year, separate heifer management and year round mineral supplementation.

The main omission from earlier work on the Best Bet System was documentation of the sustainability of the grazing pressure on pastures. Since supplementation results in bigger cows, more calves and heavier weaners, the Best Bet System grazing pressure has been increased without there being a change to the stocking rate. To assess the impact of this, the pastures in Conkerberry paddock have been measured twice a year since 1995. This is a long-term project as any vegetation changes due to grazing are likely to be gradual and hard to distinguish from seasonal effects.

#### **Developments in 1998-99:**

Work continued on this project. Its results will be analysed and reported in a major report due in 2000. There are no obvious signs that the stocking rate in Conkerberry paddock is too high, but the seasons since 1995 have been quite favourable. Statistical analysis of the results of the Best Bet Herd has been completed. A program for a major publication on the Best Bet System has been drawn up, but the draft has not yet been finished.

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**PROJECT: Breeder Productivity Across North Australia****Project Officer: N. MacDonald****Project Duration: 1998 to 2000****Project Location: Territory Wide**

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**Objective:**

*To bring out a major publication, jointly with QDPI and funded by MLA, summarising present levels of breeder productivity across the north. This publication will be aimed at producers, advisers and scientists and will also act as a database of all recent published research.*

**Background:**

The last ten years has shown a revolution in levels of breeder productivity in the Territory and other areas in North Australia because of improved management and better adapted cattle. The results of the Best Bet Herd at Kidman Springs (1990-95) are a prime example. However, publication of levels of breeder productivity is lagging far behind. Often the latest published figures date from the 70's and 80's, and come from experiments rather than typical herds run under current best practice. A joint effort with QDPI and MLA is setting out to correct this.

**Developments during 1998-99:**

In May 1999, the first draft of a document collating the trial work carried out in Queensland, the Northern Territory and Western Australia in the last ten years was completed and reviewed. There is a lot more work to be done to turn this into a good publication. So it was decided to try to complete a summary of each region by August 1999 and then complete the collation by the end of 1999.

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**PROJECT: Seasonal Calving Study****Project Officers: M. Adams and D. Savage****Project Duration: 1996 to 2000****Project Location: Avon Downs Station, Barkly**

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**Objective:**

*To monitor the reproductive performance and some associated variables in a group of replacement breeders on native pasture in the Barkly Tableland.*

**Background:**

The replacement breeder phase lasts from the time a selected heifer is weaned until she weans her own first calf.

There is no recent published information on this phase of beef production in commercial herds in the Barkly Tableland.

The replacement breeder phase of beef production is particularly important in the financial performance of a breeding enterprise, because of its low inherent efficiency (kg calf weaned/100kg of female inventory). It can have a major effect on subsequent adult breeder performance as a consequence of first calving occurring over a period when seasonal rainfall is normally insufficient to support enough pasture growth to minimise the period of lactational anoestrus. Inadequate nutrition at this time results in:

- low remating conception rates in the first six months after the start of calving, and/or
- Low body reserves at the first weaning round (April - June) when first calvers should have their calves weaned. Extended inter-calving intervals and/or premature death may then result from low body reserves at this time.

**Method:**

A herd of approximately 1000 Saint Gertrudis heifers not previously intentionally exposed to bulls was available.

The heifers were 18-32 months old when first mustered for this study in April 1996.

Live weights, condition scores, pregnancy status and lactation status were recorded twice a year when these cattle were routinely mustered by station staff.

**Results:**

Bulls had continuous access to these heifers between January 1996 and July 1997. Pregnancy diagnosis data showed that:

- those heifers which became pregnant in January to March inclusive achieved an 86% remating conception rate six months after their estimated start of calving,
- Those heifers, which became pregnant in April to June inclusive only, achieved a 46% pregnancy rate six months after their estimated start of calving.

These values (86% vs 46%) are likely to appreciably overestimate the difference in remating conception rate, that would have resulted if the two time of mating groups had run in two separate paddocks with both groups formed by random allocation of available heifers to time-of-mating/calving treatment.

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**PROJECT: Supplement Strategies for the Barkly Tablelands**

**Project Officer Darryl Savage**

**Project Period 1997 - 2000**

**Project Location Alexandria Station**

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**Objective:**

***To measure and report on the kilograms of calf weaned per 100kg of cow mated, rangeland conditions and their relationship in four herds of Alexandria composite breed cows grazing Barkly Tableland pasture on Alexandria Station.***

**Background:**

This project is run in collaboration with The North Australian Pastoral Company, Meat and Livestock Australia and Ridley Agri-Products.

It is well documented that the native pastures of the Gulf, Katherine and Barkly regions are seasonally deficient in phosphorus and protein for the purposes of beef production. Supplements are given to livestock to rectify these nutrient deficiencies.

Research undertaken on Kidman Springs Station (VRD) has shown improvements in weaning rate of almost 20% with all year round supplementation, compared to no supplementation. Trials undertaken on Mt Bunday Station (Top End, NT) have shown a 17% increase in pregnancy rates with wet season protein supplementation compared to not providing protein supplement during the wet season.

The Barkly Tablelands pastures generally exhibit less severe nutrition deficiencies than those mentioned in the above trials. However, most Barkly stations have been supplementing during the dry season for many years, with 17 stations spending \$235,000 on supplements in 1980. Supplementation trials have been previously undertaken in the barkly region. However, the only results of previous trials were published in 1965. There is recognition by the industry that improvements in supplementation procedures are possible and that these improvements may result in increased profit margins.

This research officially commenced in July 1997 after extensive consultation with industry stakeholders and agency staff. The intended duration of the project is four years. An important aspect of this work is to ensure that Barkly district pastoralists remain informed of the progress. The information in this report is presented as a part of the effort to communicating the results.

This project at Alexandria Station involves collecting information on a wide selection of animal performance and rangeland production parameters in four paddocks. Each of these paddocks is subjected to one of three supplementation strategies, which are considered suitable for the Barkly Tableland beef breeding industry. The information resulting from this research will assist in developing more efficient breeding management systems and ultimately improve the potential long-term profitability of the breeding enterprise.



**Method:**

Three of the four herds will receive different supplementation regimes but it was not feasible to reallocate cows at random to paddocks or to rotate herds between paddocks to eliminate confounding of paddock and animal effects (differences) with the supplementary feeding regimes. One of these paddocks currently runs approximately 1800 breeders whilst the other three paddocks run approximately 300 breeders each. These paddocks were selected for the following reasons:

- Paddocks are relatively close to the station and to yards suitable for pregnancy testing and weighing.
- Breed composition of cows and bulls is similar across these paddocks.
- Ages of bulls and cows are similar in all treatments. However, breeders in paddocks #1 and #2 are one year older than those in paddocks #3 and #4.
- Paddocks are of similar pasture and soil composition. (Downs country)
- Stocking rate is similar in all three paddocks.
- All paddocks use approximately 4% bulls.

**Measurements:****Animal Measurements**

- Pregnancy status, lactation status and comments for breeders. (annually)
- Weight, body condition score (BCS) and comments for breeders. (annually)
- BCS, weight, scrotal circumference, testicular tone and comments on bulls.(annually)
- Branding percentage, weaning percentage and weaning weights.
- Blood samples to test for blood phosphorus levels. (annually)
- Sheath scrapes on selected bulls to test for vibriosis and trichomoniasis

**Lick Blocks**

Lick blocks are the only form of nutrient supplementation that the cattle will receive. Timing of initial lick block distribution is flexible according to seasonal conditions. For example, a prolonged wet season will delay the onset of supplementation. Assumed lick block daily intakes have been based on district experience, block hardness and block palatability. Average daily intakes are measured.

The control treatment (Paddock #1) is the standard supplementation practice that has been used on Alexandria Station in previous years and is thus the basis for comparison. Treatment paddock #2 and #4 are similar to the control treatment in terms of the timing of supplementation. The major difference between the two is that less crude protein and less phosphorus is provided over the first half of the dry season with treatments two and four, and thus cost per head is less. The third treatment (Paddock #3) involves wet and dry season supplementation.

**Pasture measurements:**

- Pasture-monitoring sites were established in each paddock to monitor plant species composition (Dry Weight Rank procedure) and yield (Comparative Yield procedure) to detect paddock and seasonal differences.
- Collect monthly pasture samples to test for phosphorus, nitrogen and digestibility and therefore estimate nutrient deficiency trends in the pasture.
- Record timing, duration and intensity of rainfall.
- Collect fresh faecal samples (monthly) from bores to determine the relationship between nitrogen and phosphorus levels in faeces and pasture.
- Determine rate and trend of supplement consumption in relation to season and pasture.
- Collect water samples from the drinking troughs and bore heads in each of the paddocks.
- Collect soil samples to record soil phosphorus and nitrogen levels.

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**PROJECT: Cograzing Cattle and Camels for Commercial Production**

**Project Officers:** A. Phillips, V. Shrubbs and G. Crawford

**Project Period:** July 1997 - June 2001

**Project Location:** Waite River Station, via Alice Springs

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**Objective:**

***This project is investigating the differences between grazing cattle only and cograzing cattle and camels in two paddocks.***

**Background:**

The Project is partially funded by the Rural Industries Research and Development Corporation (RIRDC).

The project has four components:

- 1) Tree and shrub impact monitoring
- 2) Pasture utilisation monitoring
- 3) Animal production measurements
- 4) Camel feeding and behavioural observations

**Summary of findings to date:**

- In 1997 camel browsing resulted in a 15% decrease in tree and shrub canopy cover in the cograzed paddock, whereas canopy cover increased by over 20% outside the paddock.
- In 1998 winter rains and herbage availability enabled the camels to graze more ground storey species during winter and spring. Canopy cover was stable inside and increased slightly outside the paddock.
- No clear trends have emerged from pasture monitoring sites, however camels have actively sought caltrop (*Tribulus terrestris*) and galvanised and goathead burr (*Scerolaena sp.*) all commonly regarded as weeds because they have little or no value to cattle.
- Steers cograzed with camels or grazed alone gained 140 kg from March 1998 to March 1999, with an average daily gain for the year of over 0.4 kg per day.
- All camel weights (except calves) fell from March to June 1998, coinciding with when the bull was in rut. This included all the pre-pubescent, weaner age males. To optimise growth rates of young male camels, it seems necessary to remove them from breeding herds.
- For the year March 1998 to March 1999, the cograzed paddock maintained 2.4 tonnes and produced 875 kilograms of livestock per square kilometre. The cattle only paddock maintained 1 tonne and produced 440 kilograms of livestock per square kilometre.

Cograzing steers with camels has not limited their performance to date, presumably because they have not been competing for feed resources or had any other detrimental interactions. Cattle and camels will compete for some tree species eg whitewood (*Atalaya hemiglauca*) and supplejack (*Ventilago viminalis*) and some forbs eg tarvines (*Boerharvia sp.*). Camels will compete with cattle sometimes for grasses, but normally only after rains break a dry spell, and only until herbage species respond.

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**PROJECT: Available Soil Phosphorus in the Alice Springs District**

**Project Officer:** V. Shrubb  
**Project Duration:** January 1998 to December 2002  
**Project Location:** Alice Springs District Stations

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**Objectives:**

1. *To sample the soil from DLPE land units under cattle grazing in the Alice Springs district's for available soil P levels, by June 30, 2001.*
2. *To categorise the DLPE land units sampled, in terms of the following available soil P categories by October 30, 2001.*

**Available soil phosphorus level.**

Adequate	Marginal	Deficient
> 8 ppm	7 - 8 ppm	< 6 ppm

3. *To summarise the land units sampled into a broader land classification titled "land types" based on their available soil phosphorous levels for pastoralist use, by April 30, 2002.*
4. *To develop a map of available soil phosphorous categories for the Alice Springs district, by June 30, 2002.*
5. *To promote the use of cost effective and efficient phosphorus supplementation in Central Australia by supplying information on available soil phosphorous levels during the length of the project ie till December 30, 2002.*
6. *To produce a booklet for producers titled "A guide to phosphorous supplementation in Central Australia" using the project results by December 30, 2002.*

**Summary of results to date:**

At the end of May 1999 nine land units on Narwietooma station that had variable results in the September 1998 study were retested. At each site a 5-bulked core sample, a 10-bulked core sample and a 20-bulked core sample were taken to compare sampling techniques. Fifty-four samples were taken. The samples were sent to the DPIF Chemistry section at Berrimah for analyses. The laboratory results are currently being analysed. A focus group will be run in the last quarter of 1999 to discuss improvement of sampling techniques and interpretation and extension of the laboratory results.

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**PROJECT: Breeder Herd Performance Recording**

**Project Officers:** V. Shrubb  
**Project Duration:** July 1998 - June 2002  
**Project Location:** Alice Springs District Stations

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**Objectives:**

1. *Develop a database of reproductive performance records from commercial breeders in the Alice Springs district by taking "snapshots" as opportunities arise until December 31, 2001.*
2. *Model the Alice Springs district herd on the best available information and produce an "average herd" that producers relate to by June 30, 2000 for use as a focal point in discussions on breeder performance.*
3. *In conjunction with Primelink staff, extend knowledge of management for improved reproductive performance to Alice Springs district producers emphasising the benefits of recording the performance of*

*individual breeders for the duration of the project.*

**4. In conjunction with other Meat and Livestock and Primelink projects, develop management recommendations for producers for improved breeder performance by June 30, 2002.**

**Background:**

This project has used records from the earlier project, other Animal Production and Primelink projects and records collected during the Primelink officer's activities of pregnancy testing and spaying. The information obtained is a 'snapshot' of breeders' performance on stations throughout the district. The information is entered into the Access database to organise it. The results from the database will provide average herd information from herd to a regional level.

**Summary of results to date:**

Currently there are 2736 entries in the database. Current database results are shown below.

Pregnancy percentage of wet and dry cows at different condition scores.

<i>Condition Score</i>	<i>Pregnant Dry Cows %</i>	<i>Pregnant Wet Cows %</i>
1	0	2
2	9	36
3	47	47
4	41	15
5	2	0
6	0	0

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**PROJECT: Mount Riddock Herd Health and Production**

**Project Officer: J. Coventry**

**Project Period: July 92 –Dec 99**

**Project Location: Mount Riddock Station**

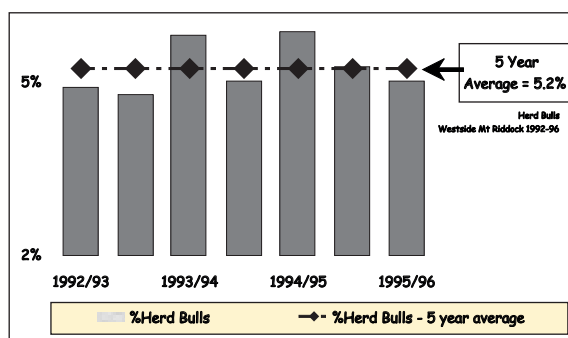
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**Background:**

During 1998/99 a number of written and audiovisual presentations were prepared from portions of the analysed project data. Major presentations were made for the Alice Springs Pastoral Industry Advisory Industry Committee (ASPIAC), Murdoch University Veterinary School, DPIF – Berrimah Staff and DPIF – AZRI Staff.

**Summary of results:**

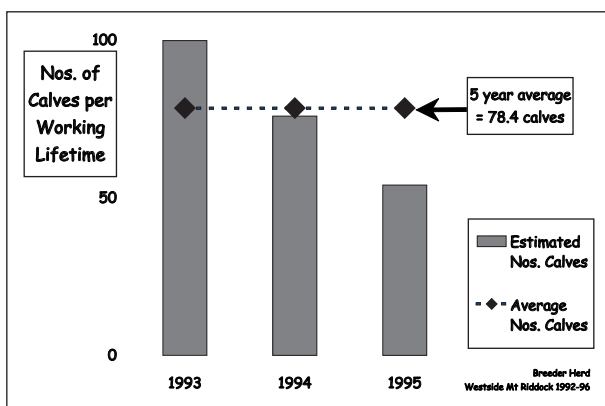
Below are four of the 10 "Priority bull performance benchmarks" presented to ASPIAC in June 1999.



**Figure 1. Annual bull percentage**

**Bull percentage**

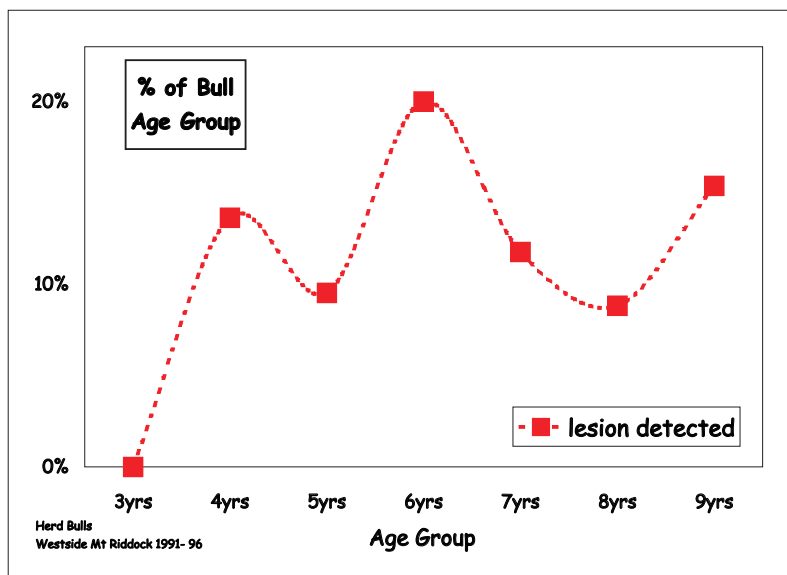
Figure 1 shows that during the 5-year study on Westside Mt. Riddock, the bull percentage averaged 5.2+/-0.2 % (range: 4.8 to 5.9%). This average is comparable with interstate recommendations for extensive northern cattle properties (4 - 5% bulls).



**Figure 2. Annual average number of calves per working lifetime**

Average Number of Calves per working lifetime. The 'average number of calves per working lifetime' is a management tool for comparing bull herd breeding efficiency.

Figure 2 shows that during 4 years of study on West side Mt. Riddock, the number of calves per (bull) working lifetime averaged 78.4+/- 5.8 calves (range: 54 to 100 calves). There was a seasonal fluctuation in the calculated average, with a fall at the end of 1994 as a result of reduced post drought branding percentage and a possible over estimation of active bull numbers.



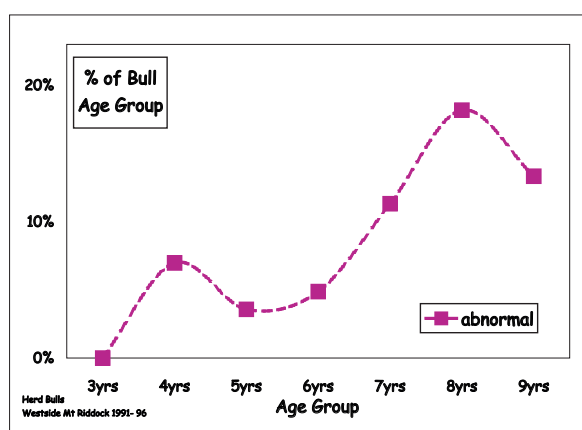
**Figure 3. Percentage of bulls by age with sheath lesions**

**Reproductive Tract Soundness**

The reproductive tract of each bull was examined at muster during the five-year study on Westside Mt. Riddock. The following observations were made:

- Testicular tone fluctuated seasonally. As bulls aged, they appeared to lose the capacity to recover 'good' testicular tone.

- The prevalence of sheath lesions increased with age (range 0% in 3-year-old bulls to 18% in 8-year-old bulls). The sheaths were visually inspected and palpated during sampling for 'trich' and 'vibrio'. It is possible that specific penile abnormalities were under reported. (see *Figure 3*)
- Seminal vesicle abnormalities developed in bulls when they commenced mating activity and these abnormalities were often maintained with age (range 0% in 3-year-old bulls to 8% in 9-year-old bulls). See *Figure 4*.
- Prevalence of reproductive tract lesions appeared to commence with mating activity and increase with age. Annual assessment of the bull herd removed many bulls with reproductive tract lesions and thus minimised the percentage of bulls with low breeding soundness.



**Figure 4. Percentage of bulls by age with seminal vesicle lesions**

#### Reasons for culling bulls:

The reasons for culling bulls during the five-year study on Westside Mt. Riddock were recorded at muster. The following observations were made:

- Twenty-seven out of 34 bulls culled (80%) were aged (8 years and older), at which time other reasons for culling were often recorded.
- Older bulls had more arthritis.
- Up to the age of 8 years, no bulls were culled for precursor or advanced 'cancer eye' lesions.
- Bulls less than 5 years old had a higher percentage of reproductive organ injuries.

No bulls were culled for temperament. See *Figure 5*.

- The average annual percentage cull (all age groups) was 11.4%. Comparison with reported interstate surveys suggests that up to 10% of bulls left in a herd under similar extensive cattle management practices, may have sub optimal breeding soundness.

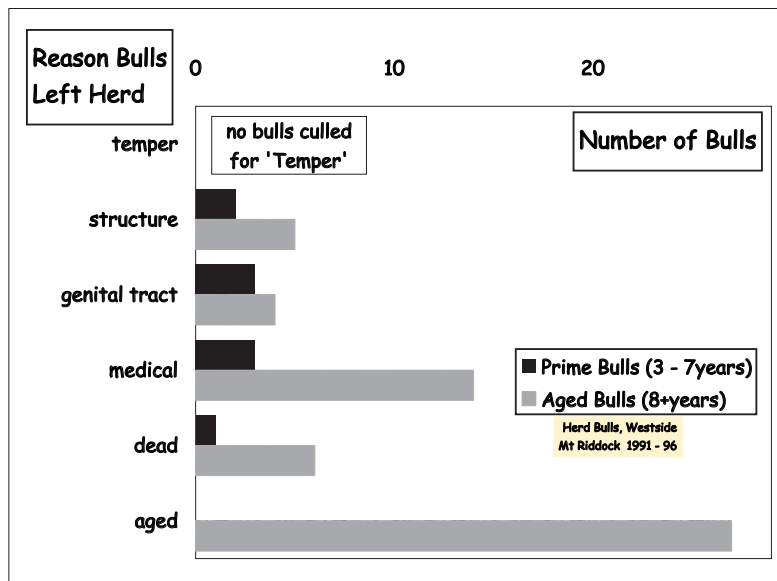


Figure 5. Reasons for culling bulls

The 5 year summary of reasons that bulls leave a breeding herd helped describe functional and genetic problems, environmental risk factors and the effective working life of the bull herd.

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**PROJECT: Nutrition Laboratory Service**

**Project Officer: D. Wilson**

**Project Period: Ongoing**

**Project Location: All NT districts**

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**Background:**

The Animal Nutrition Laboratory was originally part of the chemistry section based in Alice Springs. The laboratory remained in Alice Springs and became part of Animal Production when chemistry was transferred to Darwin in the early 1980's. For over 25 years the laboratory has been analysing pastures for nitrogen and phosphorus content, Dry Matter Digestibility and faeces for dry matter, nitrogen and phosphorus content. The purpose of these analyses is to provide information on nutritional status of cattle and pastures. The majority of samples are received from DPIF staff from Alice Springs, Tennant Creek and Katherine regions. Laboratory results are placed in the Australian Feeds Information Centre (AFIC) database. The Alice Springs AFIC database has been recently upgraded and now has the capacity to provide easily read and accessed summaries and reports on individual species of plants, pastoral properties and regions.

Table 1 shows the number of samples analysed in 1998/99.

**Table 1. Samples analysed in the Alice Springs nutrition laboratory in 1998/99.**

1998-1999 SAMPLES	% Pepsin / cellulase solubilities	% Crude Protein	% Nitrogen	% Phosphorus	% Dry Matter
Faecal			346	330	346
Pasture	309	735	735	466	
TOTAL	309	735	1081	796	346

## ANIMAL HEALTH

### Introduction

The Animal Health components of the Meat and Livestock Program deliver projects to protect and enhance the health and marketability of commercial livestock in the Northern Territory.

The sub-programs are:

- Livestock Market Access
- TB Freedom Assurance Program

Review of stock legislation and compliance is within the Division Management program.

A key function is providing health certification for consignments of livestock and livestock products produced in the Territory, so they comply with the requirements of other Australian states and importing countries.

In order to provide credible health certification, the program monitors the disease status of Northern Territory livestock by investigating disease incidents and through planned surveillance programs. Information is collected on the prevalence, incidence and distribution of bacterial and viral animal diseases, plant toxins and other toxic and deficiency states.

The Berrimah Veterinary Laboratories (BVL) play an important role in gathering objective information on disease status of Northern Territory livestock.

The TB Freedom Assurance Program (TFAP) has been funded for 5 years from 1998 to 2002. The TFAP follows the conclusion of the Brucellosis and Tuberculosis Eradication Campaign (BTEC) at the end of 1997, when Australia was declared a TB free area. The purpose of TFAP is to monitor for 5 years to confirm the absence of TB and to be able to respond with an eradication program if a TB case is found.

The Division maintains preparedness to deal with outbreaks of animal diseases not normally found in Australia, and carries out surveillance to detect these exotic diseases if and when they enter the country.

Programs are also in place to satisfy consumer demands for animal products that are free from disease and chemical residues, and help protect the community from zoonoses (diseases transmitted from animals to people).

The programs depend on a team of professional and dedicated Stock Inspectors, Veterinary Officers clerical support staff, and close collaboration with staff from Berrimah Veterinary Laboratories.

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### **SUBPROGRAM: Livestock Market Access**

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#### **PROJECT: Animal Health News from the Northern Territory**

**Project Officers:** AHNNT Editorial Committee

**Project Period:** Ongoing

**Project Location:** NT wide

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#### **Objective:**

***Production of a quarterly newsletter on animal health issues.***

#### **Activities:**

The quarterly publication of this newsletter by Animal Health staff started at the beginning of 1996. It is sent to all registered veterinarians in the NT (and bordering towns in WA and Queensland), stock inspectors and other interested people (both within and outside the department). The articles cover tropical animal disease events, animal health surveillance news, information from Berrimah Veterinary Laboratories and other items. Articles are received from laboratory and field staff in southern and northern regions.

About 180 copies were distributed each quarter. In 1999 the newsletter was also added to the DPIF intranet site.



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**PROJECT: Animal Welfare Monitoring and Policy****Project Officers: K. de Witte, Pastoral Division staff****Project period: Ongoing****Project location: NT wide**

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**Objective:*****Participate in the development and implementation of appropriate national welfare standards for animals.*****Progress Report:**

The Animal Welfare Committee (AWC) met for the third time since its inception. AWC has expanded its terms of reference from 'livestock industries' to 'agricultural industries' to allow welfare input into vertebrate pest management.

The Codes of Practice are a major tangible output from AWC. The Standing Committee on Agricultural Resource Management (SCARM) has agreed that the codes are to be recognised within Animal Welfare Acts and included within industry Quality Assurance Programs. Of particular relevance to the NT is the Land Transport of Cattle code, which has been revised and a draft NT Animal Welfare Act is under consideration.

Codes under revision or being drafted include Cattle, Livestock and Poultry at Slaughtering Establishments, Land Transport of Sheep, Land Transport of Goats, and Ostriches.

Comments have also been provided on the ANZECC draft Code of Practice for the Humane Treatment of Captive and Wild Australian Crocodiles.

AWC has also focussed on emerging strategic and priority research issues affecting livestock. Other specific issues of concern to AWC members have been the development of a national animal welfare strategy, live exports, animal stress caused by high production demands and funding for the Australian and New Zealand Council for the Care of Animals in Research and Teaching (ANZCCART).

The National Consultative Committee on Animal Welfare (NCCAW) to the Federal Minister for Primary Industries and Energy met for the 22<sup>nd</sup> and 23<sup>rd</sup> time in 1998/1999. The following are issues of notable relevance to the NT:

*Position statements.* These serve as policy guidelines. The following topics are under discussion: cattle spaying, dog health in traditional indigenous communities, tail docking of dogs, and rodeos. The Recreational Fishing statement was adopted.

*Livestock export.* Discussions have been ongoing with the Australian Quarantine and Inspection Service and Australian Livestock Exporters' Council (ALEC) to strengthen their Third Party Program and the Livestock Export Accreditation Program (LEAP), respectively. Concerns are particularly held about the adequacy of audit, the livestock selection process and the movement of livestock to the point of export. Proposals have also been made to the Australian Maritime Safety Authority (AMSA) to upgrade the Marine Orders Part 43. Various reviews are taking place, discussions are ongoing and progress is being made.

*ATSIC.* Ongoing consultations are being attempted on the issues of traditional hunting and a dog management strategy.

*Egg industry - animal care statements.* Egg producers are required to prepare one of these statements, which complements QA requirements. All NT egg producers have complied. The audit process is under review. Pressure is mounting to review the battery cage system of egg production.

*Other issues within the NT.* The NT Prevention of Cruelty to Animals Act is under review and will be replaced by the Animal Welfare Act at some time in the future. The Department of Local Government is managing this process, with advisory assistance from DPIF. Drafting instructions have been issued to parliamentary council.

In relation to the Code of Practice for the Care of Animals for Scientific Purposes, steps have been taken within the department to apply the animal welfare approval and reporting requirements of this code. The department continues to supply veterinarians to sit on the NT University Animal Ethics Committee (AEC) and will largely seek to gain approval as required through this AEC. An interdepartmental AEC also operates in Alice Springs. Most departmental activities are considered to conform to normal humane animal husbandry.

The widespread adoption of the Willis Dropped Ovary Technique has led to an improvement for cattle needing spaying. A lay spayer accreditation process is being considered.

All reported animal welfare incidents were investigated. Investigations were undertaken in respect of starving, injured and perishing stock.

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**PROJECT: Bluetongue Survey (1998)**

**Project Officers:** D. Pinch, L. Melville, RVOs and regional staff, BVL staff

**Project Period:** 1998

**Project Location:** NT wide

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**Objectives:**

**To identify regions within the NT where cattle do not exhibit antibodies to bluetongue viruses, and**

**To estimate seroprevalence in the regions where cattle are exposed to these viruses.**

**Background:**

The export of live cattle has developed into an important market for cattle producers of the NT over the past decade. Whilst the protocols of the NT's two main markets, Indonesia and the Philippines, do not have requirements relating to area of freedom from, or serological evidence of, bluetongue virus, other potential markets may. A potential market for which requirements for bluetongue virus do exist is the People's Republic of China. During the first half of 1998 negotiations were finalised on a revised protocol for the export of slaughter cattle from Australia to the People's Republic of China. A requirement of this protocol is that cattle are born and raised in bluetongue free zones, and that they have a negative test for bluetongue. To satisfy this condition, bluetongue free, buffer and infected zones were established on the basis of historical information.

However, since the bluetongue virus is vector-borne, it is somewhat artificial to create zones dividing cattle into groups that are exposed and those that are not exposed to it. The cattle-raising areas of the NT can be viewed as a continuum from north to south, with frequent exposure of cattle to the bluetongue virus in the north through to negligible risk of exposure in the south. The abundant *Culicoides spp.* insects responsible for transmitting the virus are affected by constantly changing geographic and environmental conditions.

**Method:**

The survey plan required sampling from over 80 randomly selected properties with almost 4000 blood samples to be collected. Blood samples were collected from station bred cattle over three years of age, in order to obtain information on bluetongue exposure over the past few years. Four proposed zones (bluetongue activity, free, buffer and extra buffer) were used to establish the sampling strata. The selected sample sizes in each stratum were calculated to detect disease at 1% prevalence (95% confidence level) in the bluetongue free zone, the extra buffer zone and the buffer zone; and to estimate prevalence in the bluetongue activity zone (at over 97% confidence, 4% acceptable error). It was necessary to modify the survey plan, as initial results became available - and intensive sample collection was carried out on a band of properties south of the buffer zone.

The samples were tested at Berrimah Veterinary Laboratories. Initially the serum samples were tested with a competitive enzyme-linked immunosorbent assay as the screening test. Positive reactors were then tested with serum neutralisation tests for the four most common bluetongue types in the NT, as confirmatory tests.

**Results:**

Seventy-two properties were visited and 3678 blood samples collected. The survey confirmed the bluetongue free area as the Alice Springs and southern Tennant Creek regions. However, antibodies to bluetongue virus were found further south than first expected - *ie* across the northern Barkly Tablelands.

The percent of cattle with antibodies for the bluetongue virus tended to increase the further north they were. Seventy-five to 90% of cattle on some properties in the Darwin, Katherine and gulf regions had antibodies. Pastoralists can use the information from this survey to gauge whether their cattle would be suitable for a bluetongue-free market.

Pastoralists who participated in the survey were sent a copy of their results, and summary articles were submitted to the four rural reviews. A paper is being prepared for submission to a veterinary journal.

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**PROJECT: Certification****Project Officers: Regional Stock Inspectors, Stock Inspectors, and Veterinary Officers****Project Period: Ongoing since 1946****Project Location: NT wide**

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**Objectives:*****Provide property and animal certification for export, interstate and intrastate movements,******Facilitate interstate movements from the Tick Infected and Tick Protected areas by providing a service to inspect and/or treat cattle and horses for cattle ticks and for weed seeds,******Prevent the spread of cattle tick from NT Cattle Tick Restricted Area to tick-free areas within the NT and interstate,******Prevent entry of cattle tick from interstate, particularly acaricide resistant strains from Queensland.*****Background:**

Governments in consultation with industry and consumers prescribe controls to prevent the spread of animal disease. This was a response to cattle disease plagues common in the 18<sup>th</sup> and 19<sup>th</sup> centuries. In recent years there has been some industry self-regulation. While market assurance and quality assurance programs have been developed and will continue, there is an industry and consumer attitude that governments have a responsibility to protect the community from health risk for consumers and spread of disease to animal populations. This applies within the NT (*eg* cattle ticks) and national and international markets (*eg* tuberculosis and other diseases).

A service is provided to NT producers to facilitate trade by the certification, inspection and treatment of stock, if required. Control programs (*eg* cattle tick) may also be implemented. Mobile spray plants and chemical are provided for spraying horses for movement.

There is continual review of stock movement controls and area declarations in consultation with state governments and industry associations.

**Method:**

Stock from the tick infected area require a clean treatment (clean inspection and treatment) to pass into or through the NT Tick Free area or into the Tick Free areas of other States. Treatment is by plunge dipping, except for led and tractable horses and show cattle, which may be sprayed in lieu of dipping

Cattle moving to Western Australia also require inspection for burrs.

Cattle moving to all states except South Australia require a Health Certificate. Other stock moving interstate may also require a Health Certificate.

Certifications are provided to AQIS regarding the disease status of properties and animals to satisfy export protocols. An associated project to improve the reporting and retrieval of disease data for this purpose is the Animal Health Information System. Planned active surveillance programs complement passive disease monitoring.

Some export protocols require treatment of animals prior to export. Departmental staff provide this service if authorised private veterinarians are not available.

**Progress Report:**

The number of cattle exported live to South East Asia decreased substantially during late 1997 due to the currency crisis. During 1998 cattle exports to Indonesia were much reduced. The total number of NT bred cattle exported in 1998 was about 170,000. It is expected that about 180,000 NT bred cattle will be exported in 1999. The number of NT bred cattle exported was similar to 1996 but lower than for 1997. The most significant effect was the dramatic reduction in the export of Queensland bred cattle through Darwin.

The NT continues to export live cattle to the Philippines and Malaysia. Fortunately there has been an increase in the number of cattle exported to North Africa for slaughter. This trade favours heavier *Bos taurus* type animals. This trade has only occurred due to the concerns with BSE in Europe, the traditional source of export slaughter cattle for that market.

Several properties in the southern parts of the Tennant Creek area and in the Alice Springs area have purchased Brahman bulls to produce cattle for the export feeder market. This is a marked change to the dominant Hereford breeding for the South Australian market and shows confidence in the long-term future of the export market to make such a major change to property management.

The Elliott clearing dip again has had very little use in 1998/99. There were about 6,000 head dipped in 1998 and about 2,000 head so far in 1999.

Two bull sales were held in Katherine, with 397 bulls sold.

Summary of activity 1998/99 by region:

Activity (number of head)	Darwin	Katherine	Tennant Creek	Alice Springs	Total
Cattle inspected and treated for cattle tick	283	6,240	39,252	0	45,775
Horses inspected and treated for cattle tick	416	516	1,780	45	2,757
Cattle inspected at saleyards	60	5,575	0	19,381	25,016
Cattle moved interstate from tick free areas	n/a	6,240	89,296	26,005	121,541

There was a reduction in the number of cattle inspected for movement to Queensland following the changes to the tick areas in the first half of 1998. However, certification is required for cattle moving from the tick free areas to Queensland and Western Australia and all cattle moving to Western Australia must be inspected for weeds.

There were 19,381 cattle inspected at the Bohning Yards (9,260 in 1997/98 and 8,477 in 1996/97). No cattle were moved through the Kulgera yards. Records show that 26,005 cattle were trucked to interstate destinations during 1998/99. The actual number would be higher as the records are based on waybills.

There were 45 horses trucked through Bohning Yards to the Peterborough abattoir in South Australia.

There were 2338 cattle trucked from Bohning Yards to southwest Western Australia and 520 for export through Broome.

There has been a significant increase in the number of horses that require inspection and treatment for cattle tick associated with horse movements to and from horse events in Darwin *eg* Darwin races, campdrafts and rodeos.

The spread of cattle tick was prevented. There were no outbreaks of cattle tick within tick free areas. Standard Definitions and Rules were developed for cattle tick and were approved by the Veterinary Committee.

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**PROJECT: Chemical Residues in Animal Products**

**Project Officers: A. Brown, B. Radunz, D. Russell, K. Lunn, G. Coleman, J. Purdie**

**Project Period: Ongoing**

**Project Location: NT wide**

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The NT animal industries do not have a chemical residue problem. However, there are ongoing programs to monitor the situation and demonstrate the absence of residues. There are no properties under quarantine.

**Objectives:**

***Present chemical residue-free animal product to the consumer and protect and maintain the NT meat and milk markets.***

***Provide an advisory service on chemical residue issues to industry, government and the public; and represent the NT on relevant national committees.***

***This program has four components:***

***(1) National Residue Survey (NRS)***

***(2) Beef organochlorines, organophosphates and synthetic pyrethroids residues***

***(3) Hormonal Growth Promotant (HGP)***

***(4) National Antibacterial Residues Minimisation Program (NARM)***

**Activities:**

*National Residue Survey*

The National Residue Survey (NRS) is a random sample survey to monitor residues in Australia's agricultural food commodities, and has been operating to some extent since the 1960's.

During 1998/99, 176 samples were collected from NT stock. There were 105 cattle and 9 buffalo samples analysed with no detection greater than the maximum residue limit (MRL)/MPC from an NT property. No antimicrobials, organochlorines, organophosphates or hormonal growth promotants (zeranol and trenbolone) were detected.

During 1998/99, 20 eggs and 60 poultry samples were analysed. No antimicrobials, organochlorines, organophosphates or traces of environmental metals were detected.

A violation of oxytetracycline antimicrobial was detected in meat from one of two samples from a piggery. This was investigated and found to be a result of medication of an enzootic pneumonia outbreak amongst the pigs. There was an error either in stopping medicated water supply over a long weekend, or there may have been a problem with residual oxytetracycline in a water medicator operated on water only. Management has changed procedures to ensure no further violations occur and treatment has ceased.

*Beef Organochlorines, Organophosphates and Synthetic Pyrethroids*

The main issue for the NT continues to be the interval between the last treatment with these chemicals for control of cattle tick and buffalo fly and time of slaughter, to satisfy the MRL in both domestic and export markets.

Advice was provided to all producers in the cattle tick and buffalo fly area on the residue risk and control of cattle tick and buffalo fly.

*Hormonal Growth Promotants (HGPs)*

Following an unsatisfactory voluntary vendor declaration system from 1989 to 1992, a revised enhanced national program was developed in 1993 which satisfied European Union reviewers, subject to ongoing review. Legislation was activated by all state governments with the *Control of Hormonal Growth Promotants (Stock Act)* becoming law from April 1993. Industry (exporters, cattle council and livestock agents) decided that it was important to maintain the market to the European Union.

From 1 April 1994, cattle producers must use a pink ear tag or tail tag instead of a Vendor Declaration Form to declare HGP free animals. Due to the problem of loss of tail tags in buffalo, the Vendor Declaration for that species was retained. There has since been extension activity via rural newsletters and direct contact with producers.

Of approximately 300 properties managing cattle in the NT, 58 routinely declare marketed stock as HGP free by the use of pink tail tags. There are 51 properties registered as users of HGPs. A register of HGP users and pink tag users is maintained in the NT as a requirement of the national HGP control system.

Six audits were conducted during the year, as required under the national HGPs audit program (2 users, 1 saleyard, 1 retailer and 2 non-users). An additional audit conducted by AQIS Compliance Officers in December on 6 properties declaring stock free of HGPs, found full compliance.

The European Union was to conduct its first detailed audit on the HGP control system in April 1999, which put this export market at risk. There was increased activity amongst all state departments to ensure they were fully compliant with the system. This audit has been deferred.

*National Antibacterial Residues Minimisation Program (NARM)*

NARM is a national program to monitor antibiotic and antibacterial contaminants. The national program is now targeted to high-risk areas, which excludes the Northern Territory.

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<b>PROJECT:</b>	<b>Crocodile Farming</b>
<b>Project Officers:</b>	<b>J. Millan, V. Simlesa and regional staff</b>
<b>Project Period:</b>	<b>Ongoing</b>
<b>Project Location:</b>	<b>NT (Darwin and Katherine regions)</b>

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**Objective:**

***To provide a regulatory service to crocodile farms in the Northern Territory.***

**Method:**

In order to carry out regulatory duties under the *Territory Parks and Wildlife Conservation Act*, on crocodile farms in the Northern Territory, two crocodile officers are appointed as Honorary Conservation Officers. In addition, the Veterinary Officer is an authorised officer under the Commonwealth *Export Control Act* to carry out other regulatory duties requiring a veterinary officer, such as inspection of export abattoirs and skin shipments.

**Regulatory duties include:**

- The inspection and certification of export shipments,
- Collation of monthly reports from all NT crocodile farms to the Australian Nature Conservation Agency (ANCA) through Parks and Wildlife Commission NT,
- Regular full audits and/or inventories of all stock on NT crocodile farms to conform to the requirements of the Convention on International Trade in Endangered Species (CITES),
- Issuing of movement permits involving farmed crocodile products produced in the NT,
- Regular inspection of NT crocodile abattoirs and the issuing of health certificates to accompany crocodile skins, as required by importing countries.

A disease investigation service is provided to all NT crocodile farms on request.

**Activities:**

The DPIF is responsible for all regulatory duties associated with the crocodile industry in the NT.

Posters and pamphlets were prepared for the World Aquaculture Conference in Sydney in April 1999. The DPIF Aquaculture and crocodile products display at the conference was extremely popular and one of the most attended. An NT crocodile farm provided a live crocodile, which made the round trip to the display without incident.

Promotional stands for the crocodile industry were set up by the Technical Officer (Crocodiles) for the Environment Day exhibition at the Darwin Wharf Precinct and at the NT EXPO.

The RIRDC funded project, in conjunction with James Cook University, on crocodile skin diseases is continuing.

A total of 147 NT movement permits were issued, 31 of which were for export. This is a 50% increase on the number issued last year.

At the end June 1999, there were over 36 000 salt-water crocodiles on the eight NT crocodile farms. During the year a total of 9,177 crocodiles were processed and 46 tonnes of meat produced. A total of 7,391 raw belly-skins were exported and the rest were sold domestically.

Externally funded research, in conjunction with other organisations, will continue and be supported by the industry.

The Veterinary Officer (Darwin) presented a paper on crocodile blood values at the Crocodilian Biology and Evolution Conference in Brisbane in August 1998. The Technical Officer (Crocodiles) presented a poster on NT crocodile production from 1994 - 1997 at the Crocodile Specialist Group Meeting in Singapore in July 1998.

A full audit of crocodile stock on all farms is to be held in late 1999, in accordance with the management program.

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**PROJECT: Exotic Disease Preparedness****Project Officers: J. Millan, A. Brown and Pastoral Division staff****Project Period: Ongoing****Project Location: NT wide**

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**Objectives:*****To participate in contingency planning and training for exotic disease preparedness.******To ensure that DPIF staff, relevant organisations and pastoralists have a continuing high level of awareness of the threat of exotic diseases.*****Activities:**

The NT continues to send veterinary officers to exotic disease courses at the Australian Animal Health Laboratory (AAHL), and virtually all field staff are now trained in practical exotic disease recognition. The AAHL course in May 1999 was directed at laboratory veterinarians, and was attended by the Senior Veterinary Virologist, who last completed the course almost 10 years ago.

An outbreak of virulent Newcastle Disease in NSW resulted in trace forward activity and surveillance on a Darwin property. The surveillance was completed and the property is no longer under any restrictions for movement of birds or products.

The Regional Veterinary Officer (Tennant Creek) attended a Foot and Mouth Disease Workshop in Canberra and was involved in meetings with the Australian Animal Health Council regarding the development of a coordinated approach to national emergency diseases training for departmental officers and industry.

The Regional Veterinary Officer (Darwin) was included in a survey by McGugh Marketing Adelaide, which was studying the effectiveness of Public Relations in the North Australian Quarantine Strategy program.

Protect Australian Livestock Week ran from 21-27<sup>th</sup> March nationally. It was fairly low-key in the NT with only a couple of general enquiries to the hotline number and one radio interview on 'Country Hour'.

The exotic disease component of the Wild Pig Harvesters Course was well received.

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**PROJECT: Honey Bee Industry Development****Project Officers: K. de Witte, Regional Veterinary Officers and Stock Inspectors****Project Period: Continuing****Project Location: NT wide**

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**Objective:*****Provide technical advice, disease investigation and regulatory services to the honey bee industry.*****Activities:**

Advice was provided to NAQS about the *Apis cerana* (Asian honey-bee) detection in Darwin and the subsequent eradication and monitoring program. Inspection and destruction of feral colonies is undertaken around Katherine and for the NAQS program. There is major concern about the potential introduction of exotic bees and parasitic mites, which must be prevented.

No disease surveys were conducted, but sporadic cases of chalk-brood have been confirmed in the top half of the NT. The epidemiology of the disease is not understood but the impact is minor.

Sample collection was coordinated for a RIRDC project on honey quality monitoring.

The apiary has been downsized due to a lack of time to effectively manage it. The apiary assists with pollination at Katherine Research Station.

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**PROJECT:       Livestock Identification**

**Project Officers:   N. Schofield and K. Small**

**Project Period:     Ongoing**

**Project Location:   NT wide**

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***Objectives:***

***Ensure compliance with NT Brands Act and Regulations, and Stock Diseases Act and Regulations.***

Consumer demands for food safety have highlighted the importance of being able to trace meat products back to the property of origin. The Australian cattle industry aims to stay ahead of its competitors with this important trade issue.

**Background:**

Prior to BTEC the disease trace-back system was based on waybills and brands. In the early 1980's tail tags were introduced to identify a property or part of a property. Each animal sent to saleyards or abattoirs was required to be tail tagged.

Since the achievement of Impending Free status for TB in 1992 the cattle industry lobbied for various exemptions from tail tagging to suit the disease risk of each herd and the low risk of mixing large lot sizes en route to slaughter. A hide retrieval scheme operates at the major NT abattoirs to identify brands on animals, which are found to have granulomas, which could be due to tuberculosis. Otherwise trace-back is based on the property tail tag number which is provided on the waybill.

The national cattle industry has identified the need for a consistent trace-back system across Australia, which utilises new technology in data collection. This is being achieved in the NT by the development of the National Livestock Identification Scheme (NLIS) which will identify all cattle herds by a Property Identifier Code.

In the NT a Government Industry Working Group has been established to maintain effective consultation with the NT Cattlemen's Association (NTCA) during the development of the NLIS. The success of the scheme will depend on continuing input from producers and processors to ensure that an effective and practical system of livestock identification is developed. Producers are encouraged to pass on any suggestions or comments to members of the Working Group.

**Brands:**

Brand registration is an ongoing project. The following were registered during the 1998/1999 period:

- 33 three letter brand registrations
- 18 earmarks
- 30 distinctive brands
- 21 brand transfers.

Brands applications will no longer offer the neck cheek position for new registrations.

A cabinet submission requesting permission to draft changes to the Brands Act and Stock Diseases Act was prepared. Changes to the Brands Act have been postponed to be included in the new Stock Bill.

***Property Identifier Codes:***

At the present time we are changing our Pastoral Property Database from a register of tail tag numbers to a register of Property Identification Codes. The existing tail tag number can be modified to become the property identification number. Excess numbers on properties will be removed and the use of stranger tail tag numbers and stranger tags will be discontinued. Updating the Pastoral Property Database is ongoing.

A centralised national database is proposed, in addition to each state having its own database containing information on property number, property owner and manager details.



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<b>PROJECT:</b>	<b>Meat Industries</b>
<b>Project Officers:</b>	<b>J. Purdie and S. Sell</b>
<b>Project Period:</b>	<b>Ongoing</b>
<b>Project Location:</b>	<b>NT</b>

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**Objective:**

***Ensure compliance with national standards for all sectors of the meat industry.***

**Progress Report:**

*Abattoirs*

One export abattoir was licensed, operating on a seasonal basis. Seven domestic abattoirs, one poultry abattoir and five crocodile abattoirs were licensed.

The following stock were slaughtered:

Cattle	53 964
Buffalo	534
Pigs	*
Camel	*
Deer	*
Crocodiles	15 519
Poultry	*

\* Figures not given due to confidentiality (*ie* one abattoir only involved in these species).

A total of 161 days of meat inspection was provided to three domestic abattoirs.

Two domestic abattoirs were granted exemptions under the *Export Control Act* to export meat to two different South East Asian countries.

*Pet Meat*

Twelve licences to slaughter and three licences to process were issued. The following stock were slaughtered (figures incomplete):

Horses	956
Donkeys	93
Cattle	126
Buffalo	20

Approximately 500 tonnes of pet meat was processed in the NT, which included kangaroo meat sourced from interstate.

*Game Meat*

Forty people attended a training course for the harvesting of wild pigs for game meat for human consumption.

Twenty-one licences to slaughter game animals were issued.

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**PROJECT: Monitoring Cattle Dip Strength**

**Project Officers:** B.Radunz and Regional Staff

**Project Period:** Ongoing since 1969

**Project Location:** NT cattle tick area

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**Objectives:**

***Ensure government and private dipping facilities are run at correct strength.***

***Provide an advisory service on correct dip chemical usage, plunge dip management and choice of acaricide. Provide a dip analysis service.***

**Method:**

Provision of dip sample bottles, dip sampling sticks and an analysis service for industry and government. Station staff, veterinary officers and stock inspectors collect samples. The samples are then sent to the BARC Chemistry Section. Results and appropriate advice is then given to senders.

**Activities:**

There is minimal use of acaricides except for movement treatments, due to the increasing proportion of Brahman content in the breeding herd in the tick endemic areas.

A total of 35 dip samples were analysed from NT properties. Ten samples were at correct strength, five samples were over-strength and 20 samples were under-strength. Corrective action was advised in each case.

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**PROJECT: Monitoring for Chemical Resistant Strains of Cattle Tick**

**Project Officers:** B. Radunz and Regional Staff

**Project Period:** Ongoing since 1969

**Project Location:** NT cattle tick area

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**Objectives:**

***Locate chemically resistant strains of cattle tick on NT properties and prevent their spread.***

***Advise industry on chemical control of any detected resistant cattle tick strains.***

**Background:**

Prior to April 1999, there were no known cattle tick strains resistant to synthetic pyrethroids or amitraz in the NT. Previously some resistant strains to organic phosphates were detected during the 1970s and 1980s. Organic phosphates were banned as an acaricide in 1987.

There are strains of cattle ticks resistant to one or more acaricides in Queensland. All cattle from the tick area of Queensland require a clean inspection followed by plunge dip to enter the NT. Despite this control, there is a low level of activity to monitor for resistant ticks as there may be illegal movements, or inspectors in Queensland may not detect ticks. Although there is very little tick control in the NT to improve cattle production, the entry of resistant ticks would have a significant effect on achieving tick free cattle for export overseas and interstate.

**Activities:**

Fully engorged female cattle ticks are collected in the field and sent to CSIRO Division of Tropical Animal Production, Indooroopilly or the Animal Research Institute, QDPI for processing and larval packet testing against a number of tickicides. Collectors and station owner/managers are given the results and appropriately advised. The program targets properties, which report poor tick kill and properties on which pour-on synthetic pyrethroids are used for cattle tick or buffalo fly control.

Parkhurst resistant ticks (resistant to synthetic pyrethroids *eg* cypermethrin and flumethrin as in Bayticol, Barricade 'S' and Blockade-S) were found on two properties in the Mary River area in April 1999. Resistance was detected following failure of pre-export treatments on steers. About 80% resistance was detected. The two properties had movement controls imposed so only tick free cattle may move from the two properties. It is suspected that resistant ticks were introduced from Queensland on export cattle in 1996. A survey of ticks on the neighbouring properties and on other export depots has not found more resistant ticks to date. Risk management procedures have been adopted on the neighbouring properties. There is consultation with industry to consider long-term options – movement controls and risk management or attempt eradication. A decision will be made by the end of 1999.

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**PROJECT: National Animal Health Information System (NAHIS)**

**Project Officers: D. Pinch, regional field staff and BVL staff**

**Project Period: Ongoing**

**Project Location: NT wide**

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**Objectives:**

***The objectives of this national program in which the NT participates include:***

Collection of relevant, existing summary data on animal health status from the Commonwealth, State/Territory and selected non-government agencies as required by Australian Animal Health Council (AAHC) Members.

Collation, management, analyses and reporting on data and collected information, to accurately reflect Australia's animal health status as well as its surveillance and disease control activities and capabilities.

**Activities:**

The NAHIS provides timely and accurate summary information on Australia's animal health status to support trade in animal commodities and meet Australia's international reporting obligations. It also provides information on Australia's capabilities and activities with regard to animal disease surveillance and control.

A quarterly report is provided to NAHIS on NT animal health status, specific testing carried out at Berrimah Veterinary Laboratories and significant animal disease events.

The AAHC collects and collates these reports from all the agriculture/primary industry departments, as well as information from AQIS, NAQS, the National Arbovirus Monitoring Program, the National Residue Survey, the Commonwealth Department of Family Services and Health, and various national reference laboratories.

A quarterly report, *Animal Health Surveillance Quarterly*, is produced and circulated to various NT addressees, including livestock industry groups. There is also an Internet site at: <http://www.brs.gov.au/aphb/aha>.

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**PROJECT: National Transmissible Spongiform Encephalopathy (TSE) Surveillance Program**

**Project Officers: D. Pinch and regional field staff**

**Project Period: Ongoing**

**Project Location: NT wide**

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**Objective:**

***NT participation in this national scheme of trade support for demonstrating that Australia is free of bovine spongiform encephalopathy (BSE) and scrapie (which are both TSEs).***

**Methods:**

Australia is presently free of bovine spongiform encephalopathy (BSE) and scrapie. However, among other things, the Office International des Epizooties (OIE) International Animal Health Code now requires that countries claiming to be free of TSEs have in place a surveillance system to detect BSE and scrapie, should they occur. It is important that Australia meets this requirement to assure continued access to export markets.

OIE guidelines have been used to determine the necessary surveillance levels. Surveillance involves examining a large range of specimens from cattle (over 2 years of age) or sheep with signs of nervous system disease. The number of cases that each State/Territory need to examine has been calculated according to their cattle or sheep population.

There should be 24 cattle cases examined from the NT annually (and no sheep).

**Results:**

The program operates on the calendar year. The NT achieved the target number of animals for examination in 1998.

In March 1999 a workshop was held at Berrimah Farm to demonstrate a novel method to veterinary officers and stock inspectors to collect brains for this purpose.

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**PROJECT: NT Animal Health Information System**

**Project Officers:** D. Pinch, R. Wilson, regional field staff and BVL staff

**Project Period:** Ongoing

**Project Location:** NT wide

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**Objective:**

*To maintain and use an accurate and reliable database for storing animal health information.*

**Activities:**

The NT Animal Health Information System ('ANDI') is a mainframe database. 'ANDI' is used by both laboratory and field animal health staff for storing investigation details and results. Quantitative data for the NT report to NAHIS is obtained from 'ANDI' and significant disease events are recorded in it.

It is used to record and report details and results on all other submissions to Berrimah Veterinary Laboratories from a wide variety of clients such as other DPIF staff in animal production, agriculture, and fisheries; private veterinary clinics and the public.

During 1998 'ANDI' underwent rigorous Y2K testing, in association with the Department of Corporate and Information Services (DCIS). Automated test scripts were run in a database aged forward to critical dates in 2000. Analysis of results showed no unexplained differences in output compared to current date output. A contingency plan has also been developed.

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**PROJECT: Passive Surveillance (Disease Investigation)**

**Project Officers:** Veterinary Officers, Stock Inspectors

**Project Period:** Ongoing

**Project Location:** NT wide

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**Objectives:**

*To investigate the occurrence of diseases in the NT livestock industries (passive surveillance);*

*To exclude exotic diseases from differential causes, and provide advice to the producer to resolve the problem;*

**To reduce loss of production by advice and education to treat and control significant endemic diseases.**

**Method:**

Investigation by field veterinary officers and stock inspectors of reported cases of disease in livestock achieves two objectives. It provides a diagnostic service for sick animals and assists producers to treat, prevent and control disease in their animals, thereby enhancing profitability. It also enables passive surveillance for both exotic and endemic livestock diseases. Information from passive surveillance can be used for market health assurances in trade. The accumulation of knowledge over time regarding endemic disease conditions in livestock also improves the advice and extension information that is provided to producers.

There is an active extension program on prevention of diseases such as botulism, tick fever and coccidiosis across the Northern Territory. Advice to property owners is provided on request or following a disease investigation.

Advice may be offered over the phone, or a property visit is made to investigate the nature of the problem and conduct clinical examinations of stock, perform post mortems and collect samples. Following assessment of the property visit, and the results of laboratory findings, the producer is advised of the outcome, and control measures are discussed. For the purpose of this project, NT livestock consist of cattle, buffalo, working horses (non-pleasure), camels, goats, crocodiles, pigs and poultry.

**Activities:**

*Endemic disease*

The table below shows the number of investigations, by region, for the period between July 1998 to June 1999, carried out by field veterinary officers and stock inspectors, usually by a visit to the property or advice over the phone.

	<b>Darwin</b>	<b>Katherine</b>	<b>Tennant Creek</b>	<b>Alice Springs</b>	<b>Total</b>
Banteng	1	-	-	-	1
Bat	-	3	-	-	3
Bee	-	1	-	-	1
Buffalo	3	-	-	-	3
Camel	-	-	-	6	6
<b>Cattle</b>	<b>12</b>	<b>18</b>	<b>24</b>	<b>14</b>	<b>68</b>
Crocodile	7	-	-	-	7
Dog	-	-	1	-	1
Horse	7	9	15	1	32
Insect	13	2	2	-	17
Pig	7	-	-	-	7
Poultry	2	2	2	-	6
Sheep	-	-	-	1	1
Turtle	1	-	-	-	1
<b>Total</b>	<b>53</b>	<b>35</b>	<b>44</b>	<b>22</b>	<b>154</b>

The 68 investigations on cattle were done on 45 properties, and include sampling for the National Transmissible Spongiform Encephalopathy Surveillance Program. The high number of 'insect' investigations in the Darwin area is due to sampling of cattle ticks for acaricide resistance testing. The total number of investigations has changed little compared to 1997/98, when there were 167. There are significantly more horse investigations this year.

*Exclusion of exotic disease*

There were eleven investigations to exclude exotic disease during 1998/99. The probable diseases excluded were screw worm fly, canine ehrlichiosis, bovine brucellosis and vesicular disease.

Bees from a feral nest collected in a Darwin suburb in mid-June 1998 were identified as *Apis cerana*, or Asian honey bees. These bees are exotic to the Australian mainland, and they are less suitable for honey production than *Apis mellifera*, the species of bee that is the basis of the Australian honey bee industry. Australia is also free of three major mite pests of bees: *Varroa jacobsoni*, *Tropilaelaps clareae* and *Acarapis woodi*. One of the major concerns following detection of the Asian honey- bee is the possible introduction of these species of mites. The continuing presence of *Apis cerana* on the Australian mainland may have jeopardised our mite free status. An Asian bee eradication program

coordinated by North Australian Quarantine Strategy Veterinary Officer, in association with the NT Chief Veterinary Officer, DPIF Entomology Section, and Pastoral Division, successfully concluded on 30/6/99. No further Asian honey bees and exotic mites were detected.

During the eradication program 7699 bee trachea were examined for the bee tracheal mite (*Acarapis woodi*) and 8471 worker bee pupae and larvae were examined for the *Varroa jacobsoni* and *Tropilaelaps clarae* mites. Also 10131 worker bees were washed in alcohol and the washings examined for the *Varroa jacobsoni* and *Tropilaelaps clarae* mites. 'Sticky boards' were inserted into 150 managed hives to trap any mites. No testing of feral nests or of managed *Apis mellifera* hives in the Darwin region during the course of the eradication program detected any exotic bee mites. The Regional Veterinary Office (Darwin) will continue coordination of passive surveillance for Asian honeybees and exotic bee mites during 1999/00, with examination of insects by staff in the Entomology Section.

### **Diagnostic highlights**

#### *Abortion Investigation*

One Tennant Creek region property reported frequent abortions and low calving rates amongst their herd of 1000 heifers imported from Queensland. Intensive sampling failed to identify a definitive cause, although vibriosis and some arboviruses are suspected to have contributed. The now exotic disease, bovine brucellosis was eliminated as a possible cause.

#### *Avian Leukosis*

A Barkly Tablelands station reported sporadic loss over a 12-month period of 12 chickens from one batch of 67 18-month old chickens. No other chickens purchased from other sources appeared affected. A necropsy of one sick chicken showed lymphoid leukosis as the cause of illness, probably initiated by the avian leukosis virus.

#### *Blackleg*

Two Tennant Creek region properties reported the loss of 30 out of 700 weaner steers two days after castration. Clostridial infections (blackleg, malignant oedema and tetanus) were suspected, and improved levels of hygiene during castration procedures eliminated further losses.

#### *Botulism*

Botulism was confirmed as causing mortality on three properties in the Tennant Creek region during the year. Losses ranged from sporadic deaths to 20 heifers out of a mob of 250 within a week. The disease is easily preventable, but the incidents, which occur each year, show how inadequate vaccination can result in losses.

Botulism type D was confirmed as a cause of sudden deaths in a small rural poultry flock.

#### *Colibacillosis in pigs*

Colibacillosis was suspected to have caused deaths of piglets at a piggery in the Darwin region. An enterotoxigenic *E.coli* was confirmed as the cause.

#### *Crocodile mortalities*

Increased mortalities in hatchlings were reported and investigated from two crocodile farms.

The diagnosis from one was confirmed as *Providencia rettgeri* septicaemia. After antibiotic sensitivities were determined the appropriate antibiotic effectively controlled the outbreak.

The other farm was probably losing hatchlings due to hypocalcaemia – based on clinical signs, and no laboratory evidence of a septicaemia. The farm management and dietary supplementation is satisfactory and the most likely explanation was the introduction of a fatty batch of meat. This would greatly decrease the digestibility of the diet and hence result in insufficient absorption of the dietary supplements, including calcium.

#### *Enzootic pneumonia in pigs*

Enzootic pneumonia has been introduced to piggeries in the Darwin region with the introduction of pigs from a South Australian piggery. Examinations of dead pigs, and lungs at abattoirs were carried out. Weaner pigs have shown extensive pleuritis, pericarditis, peritonitis and pneumonia, which is suggestive of *Actinobacillus pleuropneumonia*. Growers have less severe lung lesions but have suffered sudden deaths. *Streptococcus sp.* was isolated from the lung, pericardial fluid and cerebrospinal fluid, which were quite cloudy in appearance. The streptococcus was tetracycline resistant. Cull sows at slaughter have shown typical mycoplasma lesions with consolidation of the ventral portions of the cranial lung lobes. In-feed therapy with tylomycin has commenced and a recently released mycoplasma vaccine is now being used. Individual clinical cases are being treated with parenteral procaine penicillin.

Serum samples were collected at an abattoir and tested for serological evidence of *Mycoplasma hyopneumoniae*. Out of 25 samples, 21 were positive on an ELISA. Serum samples collected from the same piggery prior to 1998 were also submitted for testing and all were negative. This confirms that enzootic pneumonia was only introduced to the piggery in 1998.

#### *Equine Infectious Anaemia*

Two out of a consignment of imported horses became sick shortly after arrival on a Barkly Tablelands property, and prompted concern that they may be infected by EIA. The property of origin had an outbreak of EIA in 1990. Testing of all horses in the consignment gave negative results. There was concern again when after the sick horses died, another followed. The postmortem of the last revealed evidence consistent with EIA. Repeat testing of the herd was negative.

#### *Hydatids*

Hydatid cysts were detected in stock from a Darwin region property. They were probably imported stock.

#### *Ironwood poisoning*

Deaths occurred in young buffalo grazing a pangola paddock in the Darwin region. A sick buffalo with bloody diarrhoea was destroyed for post mortem examination and a number of other depressed buffalo were examined. The sick buffaloes had increased neutrophil counts, raised liver enzymes and increased serum creatinine and urea levels.

The post mortem showed extensive myocardial haemorrhage in both the right and left atrium. Ironwood leaves were detected in the rumen. The histological picture was suggestive of a septicaemia. A diagnosis of ironwood poisoning was made, with a septicaemia developing in the chronic cases.

There were no ironwood suckers in the paddock but small branches had been torn down by a storm. It was suggested that the buffalo were seeking some roughage in their diet.

#### *Kimberley Walkabout*

A northern Barkly Tablelands property lost three valuable stock horses and three more were very sick after grazing *Crotalaria montana* in a green watercourse during March. The sick horses recovered after removal from the apparent source of poisoning.

#### *Onchocerciasis*

A number of valuable stockhorses and performance horses in the Tennant Creek region this year developed subcutaneous nodules caused by *Onchocerca sp.* Biting flies spread this microscopic worm. Worm pastes alleviated the problem on some horses, but nodules had to be removed surgically from others.

#### *Phycomycoses*

*Basidiobolus haptosporus* was identified as the cause of a swamp cancer on a horse. The lesion, which was located on the brisket, had a large central crater but the kunkers which are characteristic of lesions caused by *Pithium* species were not present.

#### *Poultry Sentinel Flock*

Sentinel flocks of chickens are maintained at various locations throughout the NT and bled monthly for Newcastle disease, avian influenza and flavivirus seroconversions. The entire Tennant Creek flock seroconverted to Murray Valley encephalitis in February, prompting media releases and public health warnings by Territory Health Services.

#### *Sudden Death in Horses*

In early March the sudden deaths of two racehorses were reported to a local veterinarian in Alice Springs. Post mortems were carried out, with advice from the Australian Jockey Club (AJC) equine specialist regarding suitable samples for toxicology, and the DPIF was notified. The post mortems were unremarkable, except that the spleen of one horse was 2-3 times the normal size. On advice from the AJC, the Alice Springs Turf Club placed under quarantine the horses that had been in the same stables with those that died. DPIF through advice from the Australian Animal Health Laboratory and the Elizabeth MacArthur Institute laboratories provided assistance through visual examination of quarantined horses. Initial results ruled out anthrax, salmonella and Hendra virus, and histopathology indicated that the horses died from a severe, acute allergic reaction to an undetermined source.

#### *Trichomoniasis and Vibriosis*

Sampling of bulls for vibrio and trichomoniasis was undertaken on five properties in the Tennant Creek region

during the year. The primary reason for investigation was lower than expected branding rates. No vibrio (*Campylobacter foetus sub. venerealis*) was cultured from the bulls, but trichomoniasis was prevalent in two herds. It is suspected that culturing techniques for vibrio may be too insensitive to detect the bacterium if small numbers of bulls are sampled. The new IgA ELISA test was used on cows on one property, with results indicating vibrio is likely to be a problem in that breeding herd.

#### *Urea poisoning*

Sudden introduction to urea based supplements caused mortality in one mob of Barkly Tableland weaners. Fifteen out of 900 weaners died within three days.

A Darwin property lost a few cattle to urea poisoning. A dry season block was being used to trap stock.

#### Other diagnoses:

Bat	Australian bat lyssavirus excluded Hendra virus excluded
Camel	Liver condition Traumatic peritonitis
Cattle	Anaplasmosis Bloat Bovine ephemeral fever Coccidiosis Pneumonia Poison plant - zamia Tetanus Transport stress syndrome
Horse	Cancer Colic Encephalitis
Poultry	Cancer Colibacillosis Renal condition

## **SUBPROGRAM: TB Freedom Assurance Program (TFAP)**

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### **PROJECT: Tuberculosis (TB) Eradication**

**Project Officer:** B. Radunz, Regional Veterinary Officers and staff

**Project Period:** 1998 to 2002

**Project Location:** NT

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#### ***Objectives:***

***Monitor of slaughter cattle at abattoirs to maintain TB free area status.***

***Turn-off of cows previously exposed to TB infected animals to remove the remaining group of risk cattle.***

***Deal with TB case herds to the satisfaction of the owner and a national TFAP Property Program Group.***

#### **Background:**

The Tuberculosis Impending Free declaration in November 1992 was a culmination of years of work by many pastoralists and Departmental staff, with the expenditure of \$192m. The Northern Territory was declared a Free Area for TB at the end of 1997 and so achieved the goals of BTEC.

A 5-year monitoring program, known as the TB Freedom Assurance Program (TFAP), was agreed to and funded for 5 years from 1998 to 2002 by the states, the NT cattle industry and Commonwealth. It is expected that a small



number of TB cases will be found in cattle previously exposed to TB, despite having completed the testing programs. Of the 24 million cattle in Australia there are about 200,000 on 70 properties in the risk group of cattle.

**Activities:**

*Eradication*

Eradication activity continued on 5 properties where a TB case had been detected in 1996 or 1997. No further TB cases were found on those properties. All cattle exposed to the TB infected animal at the time of detection were destocked. Wherever possible, any cattle exposed to the TB case were also destocked.

It is often not possible to identify the progeny from the paddock of origin of the TB case separate from other weaners on the property. A program to maintain segregation with early turnoff of cattle in addition to a testing program is implemented.

*Breakdowns*

There was one new TB case herd in the NT from July 1998 to June 1999. TB was found in an old cow at slaughter. No further TB has been found following destocking of the exposed group and testing of the rest of the herd.

There was one new TB case herd found in the first 6 months of TFAP (January to June 1998) when an old cow was confirmed positive at slaughter. It was from a group of old cows previously exposed to TB. Destocking and testing during the second half of 1998 detected an old cow with TB at destock and one TB culture positive. No visible lesion was found in a test reactor yearling steer. This was the first TB case herd since 1996 where more than one TB positive case was found.

During 1998/99 5,566 cattle were destocked to an abattoir at a net compensation cost of about \$200 per head.

During 1999 there were three active eradication programs. Two are due for completion by the end of 1999. No TB cases were found to the end of June 19,99.

*Bush Destocking*

There was no bush destocking during the period.

*National Granuloma Submission Program (NGSP)*

The monitoring system includes a granuloma submission program at abattoirs, which is working satisfactorily. A pleasing aspect of the granuloma submission program is that the majority of lesions, which are detected through abattoir monitoring, are not tuberculosis. This increases confidence that meat inspectors are submitting granulomas, which will assist the early detection of TB outbreaks.

During the year there were 55,429 cattle and buffalo slaughtered at NT abattoirs. There were 71 granulomas detected with one confirmed as TB (excluding any destockers). The NT had the highest granuloma submission rate in the country (1.3/1000) This provides confidence in the detection of tuberculosis infected herds in the NT. The national target is 1/2000.

TB Testing July 1998 to June 1999

	Number Tested	Number Reactors	Number with TB
Cattle	119,142	187	1

Testing was done on 18 properties.

*Voluntary Monitor Programs*

Cattle previously exposed to TB infected animals remain a very low but possible risk of undetected TB cases despite completion of the eradication program (at CF2 or CF3 status). Of the estimated 24 million cattle in Australia there are about 200,000 on 70 properties in this risk category. The national cattle industry decided that the owners of these properties should adopt risk management strategies to minimise the risk and the chance of a possible future TB case.

Relevant owners are contacted with a proposed voluntary monitor program. The program comprises continued segregation of the cattle previously exposed to TB infected animals, early turn-off of the cattle and a TB test in 2001 if turn-off during 1999 or 2000 is not possible. The national cattle industry provided about \$4 million to accelerate the turn-off. This was in the form of a spay subsidy and a freight rebate. Owners who agree to implement a voluntary monitor program will be eligible for all available financial assistance in the event of an outbreak of TB. Owners who do not adopt a voluntary monitor program will only be eligible for compensation if destocking is done.

There were 50 properties in the NT which our records indicate may have stock remaining that were previously exposed to TB infected animals. Four properties have completed the voluntary monitor program. The owners of three properties have decided not to adopt the voluntary monitor program. Thirty properties have commenced a program. A program is still to be developed for 13 properties.

## BERRIMAH VETERINARY LABORATORIES

### **Provide an accurate, efficient and reliable veterinary laboratory service**

The Berrimah Veterinary Laboratories (BVL) provide an ongoing diagnostic service in the broad fields of veterinary pathology and veterinary virology. BVL also conducts research projects and participates in quality assurance programs to ensure that the quality of tests carried out at BVL meets national and international standards.

An internal review of services and charges of BVL recommended *inter alia* that: "All submissions and associated testing, at BVL, should attract a service fee unless the submission deals with a disease investigation of a production animal, involves an exotic or emerging disease or involves an approved government program".

As a consequence four lists of tests and charges were prepared and became effective from 2 August 1999, replacing the existing schedule of charges. The first list concerns companion and performance animals, aviary birds and wildlife testing. The second list details the tests and charges for live export testing and the third list covers testing performed at BVL for NAQS (North Australian Quarantine Strategy). The fourth list addresses *ad hoc* testing which is usually non-routine or one-off and project-specific.

The provision of the diagnostic service remains free of charge to the extensive (cattle and buffalo), intensive (pig, goat, poultry and dairy) and emerging (crocodile and camel) animal industries as well as to the fishing, aquaculture and pearl oyster industries. However, testing for disease monitoring or research purposes of the animals mentioned above does attract a service charge.

A total of 2,488 submissions were received and processed during the year at BVL. Each submission may consist of one or more specimens and each specimen may undergo one or more tests in one or more of the 12 sections of BVL. The 2,488 submissions generated some 69,604 individual tests in gross and microscopic pathology, bacteriology, clinical pathology, parasitology, serology and virology. The numbers of tests and investigation reasons were:

- 7,608 tests for diagnosis of disease in production animals
- 641 tests associated with monitoring for bovine tuberculosis
- 1,533 tests for export certification, a decrease of 82% compared with last year reflecting the virtual cessation of the export of breeding cattle to South East Asia
- 12,608 tests on a service charge basis for companion and performance animals, aviary birds and native fauna
- 26,255 tests for sentinel herd and flock monitoring
- 16,469 tests for research and surveillance programs
- 404 tests for quality assurance

BVL participates in 23 laboratory tests in the Australian National Quality Assurance Program (ANQAP) for veterinary serology and virology. All test results obtained at BVL fell within the respective acceptable variation ranges.

The new post-mortem room became ready for use in May and it has since passed an inspection for physical containment level 3 (PC3) status. The refurbished virology part of BVL has also attained PC3 status but still needs minor changes before occupancy can be resumed.

The appointment in May of a fourth veterinary pathologist, who is a specialist fish pathologist, has ensured an enhanced diagnostic veterinary laboratory service for the fisheries, aquaculture and pearl oyster industries.

The water microbiology laboratory, which is integrated into BVL's management structure but which has a unique (non-veterinary) client base, tested 4616 water samples from various sources. Most samples are subjected to three individual tests.

**Laboratory submissions by region and by species**

	<b>Darwin</b>	<b>Katherine</b>	<b>Tennant Creek</b>	<b>Alice Springs</b>	<b>Interstate</b>	<b>Total</b>
Banteng		9				9
Bat	9	6				15
Bee		3				3
Bird (cage&wild)	125	1				126
Buffalo		15				15
Camel	1			7		8
Cat	126	1			1	128
Cattle	249	226	114	131	14	734
Crab	1					1
Crayfish		2				2
Crocodile	18				1	19
Dog	719	14	3		3	739
Exotic species	5				1	6
Fish	34		1	2		37
Goat	19		2			21
Horse	98	17	10	1	1	127
Insect	75	22	17	11		125
Laboratory animal	16					16
Mussel	1					1
Native fauna	77			4		81
Pearl oyster	2					2
Pig	49		4			53
Poultry	73	11	9	10		103
Prawn	7					7
Rabbit	1			10		11
Sheep	11			1	2	14
Other	32	2			27	61
<b>Total</b>	<b>1774</b>	<b>303</b>	<b>160</b>	<b>177</b>	<b>50</b>	<b>2464*</b>

\* This figure is based on date collected

**Laboratory submissions per investigation reason**

Diagnostic	404
TFAP**	315
Export	20
Sentinel	279
Research	234
Survey	232
Fee for Service***	964
Quality Assurance	32
Other	8
<b>2488****</b>	

\*\* TFAP: tuberculosis freedom assurance program.

\*\*\* Companion and performance animals, aviary birds and native fauna only.

\*\*\*\* This figure is based on date received at BVL.

## **SUBPROGRAM: Diagnostic Pathology**

**Coordinator:** A. Janmaat

**Officers:** S. Aumann, S. Benedict, L. Chambers, C. Day, K. Fomiatti, J. Humphrey, A. Janmaat, N. Jolliffe, N. Elliott, L. Melville (25%), H. Parkes, L. Small and R. Wilson

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### **Objective:**

**Provide an accurate, efficient and reliable veterinary pathology service.**

**The sub-program is divided into the sections of gross pathology, histopathology, bacteriology, parasitology, serology, clinical chemistry, haematology, cytology and urinalysis - the last four sections fall under the heading of clinical pathology.**

### **GROSS PATHOLOGY**

*Submissions 145*

The activity of this section consists of post-mortem examinations of cadavers and gross examination of pieces of organs and tissues. The range of species is large. The most frequent submissions were poultry (16%), fish (14%), crocodiles (11%) and dogs (10%).

- A common finding in the crocodile submissions was septicaemia due to *Providentia rettgeri* infection. Calcium deficiency was observed in some submissions.
- Post-mortem examinations of pigs from two Darwin piggeries suggested enzootic pneumonia (*Mycoplasma* sp infection). This was confirmed histologically and serologically and was traced to the introduction of pigs from southern Australia.
- A five years-old male goat from the Darwin rural area showed weakness in the hindlegs. Post-mortem examination revealed a spinal abscess. There were also abscesses in the lungs and liver. *Burkholderia pseudomallei*, the bacterium which causes melioidosis, was isolated on bacteriological culture.
- An infrequent diagnosis was heartworm infestation as the cause of death in a seven-year old cat.

### **HISTOPATHOLOGY**

*Submissions 594*

Submissions included cattle (111) and buffalo (1) under TFAP either as lesions from reactors or as lesions collected at abattoirs under the National Granuloma Submission Program (NGSP). Lesions collected at slaughter from an aged cow from a station in the Katherine region were consistent with tuberculosis, once again illustrating the usefulness of the NGSP. There was another case of TB in destocked cattle from a property on which tuberculosis was previously diagnosed.

- An 11-months old Labrador showed muscular and nervous tissue lesions consistent with *Neospora caninum* (a protozoan parasite like toxoplasma) infection. The diagnosis was confirmed elsewhere. This is the first recorded case of *Neospora caninum* infection in the Northern Territory.
- Infectious bursal disease was diagnosed in broiler chickens. The diagnosis was confirmed at AAHL (Australian Animal Health Laboratory). Both BVL and AAHL are of the opinion that the lesions are associated with the endemic form of the virus. Confirmatory testing is continuing.

### **BACTERIOLOGY**

*Submissions 745*

Tuberculosis submissions remain the biggest group at 41% followed by diagnostic submissions at 23% and fee for service submissions at 33%. The bacteriology section re-established the microscopic agglutination test (MAT) for the three common serovars of *Leptospira interrogans* viz pomona, tarassovi and hardjo.

Interesting isolations included:

- *Burkholderia pseudomallei*, the causative agent of melioidosis, from two dogs (including from the placenta of an aborting bitch), a spider monkey and a goat.
- *Nocardia* sp from an inguinal abscess of a dog.
- An atypical *Mycobacterium* sp which caused pyogranulomatous panniculitis in the inguinal fat of a cat.
- *Actinomyces viscosus* instead of the expected *Actinomyces bovis* from three, histologically typical, actinomyces granulomas.

Botulism was confirmed as a cause of death in turkeys, chickens and guinea fowl.

The section participates in the IFM proficiency testing program for veterinary microbiology and the three Leptospira MATs are part of ANQAP proficiency testing.

## PARASITOLOGY

### Submissions 218

- The parasitology section introduced the CATT (Card Agglutination Test for Trypanosomiasis) for sera submitted by NAQS for Surra exclusion.
- Forty lesions, collected at slaughter, from destocked cattle from a Kimberley station showed hydatid cysts in 32 animals. About 25% were fertile cysts. All affected cattle had originated from Queensland.
- Hookworm infestation in dogs can have nasty consequences in the tropics as illustrated by the death (3) and severe disease (4), with bloody diarrhoea, in a litter of greyhound pups. Histological findings showed that death was due to changes associated with the severe anaemia.
- Faeces from a 3-months old dog with pasty diarrhoea had large numbers of *Giardia* sp cysts and trophozoites.

The section participates in a faecal egg count proficiency-testing program run by Agriculture WA.

## SEROLOGY

### Submissions 339

Sentinel submissions for bluetongue ELISA testing were the biggest group at 40% followed by diagnostic, bluetongue survey and NAQS survey submissions each at 12%.

A survey of the prevalence of CF (complement fixation) and IHA (indirect haemagglutination) antibodies to the causative agent of melioidosis in 45 dog sera collected during the wet season, showed that many dogs had been exposed to *Burkholderia pseudomallei*. One dog, which had *B. pseudomallei* isolated from a leg wound, had a CF titre >1024 and an IHA titre of 160.

Eight tests conducted in the section are part of ANQAP proficiency testing.

## CLINICAL PATHOLOGY

The clinical pathology sections illustrate how a service charge for non-production animals contributes towards the cost of maintaining sections, which are necessary, but under-utilised if used for production animals only.

## CLINICAL CHEMISTRY

### Submissions 409

Fee for service submissions comprised 70% of the total followed by diagnostic submissions at 24%.

The section participates in the BIORAD international quality assurance program for clinical chemistry.

## HAEMATOLOGY

### Submissions 500

Fee for service submissions comprised 74% of the total followed by diagnostic submissions at 20%.

The section participates in the RCPA (Royal College of Pathologists of Australia) haematology quality assurance program.

## CYTOLOGY

### *Submissions 112*

Submissions from private practitioners on a fee for service basis were 92% and submissions for diagnostic purposes from production animals were 8% of the total.

## URINALYSIS

### *Submissions 67*

Submissions from private practitioners on a fee for service basis were 85% and submissions for diagnostic purposes from production animals were 15% of the total.

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## **SUBPROGRAM: Virology**

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### **PROJECT: Diagnostic Virology**

**Project Officers:** L. Melville, N. Hunt, R. Weir M. Harmsen, S. Walsh,  
L. Simmington and N. Cox

**Project Period:** Ongoing

**Project Location:** A.L. Rose Virology Laboratory, Berrimah Farm.

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### ***Objective:***

***Provision of an accurate, efficient and reliable veterinary virology service to support diagnostic, regulatory and research programs in livestock health and production.***

### **Background:**

The diagnostic virology service comprises both virus isolation and identification and serology. A major survey for bluetongue was carried out across the NT during the year.

### **Results:**

During the year, 93 submissions were received for diagnostic virus isolation, electron microscopy or PCR. Bovine ephemeral fever (BEF) virus was isolated from cattle, and Wallal and Eubenangee from sick red kangaroos at the Territory Wildlife Park. Viruses identified by electron microscopy included equine herpesvirus and fowl pox. A total of 122 submissions were received for diagnostic serology, including 6 for export testing. A further 219 submissions were received from NAQS and other surveys with 41 submissions from research projects. As part of the NT bluetongue survey, 4061 cattle sera were tested for bluetongue.

Export testing consisted of 610 cattle sera and 4 buffalo sera for enzootic bovine leucosis (EBL) and 5 horse sera for equine infectious anaemia (EIA).

Quality assurance tests were provided by the Australian National Quality Assurance Program (ANQAP) for Agar Gel Immunodiffusion (AGID) tests for EBL, BVD, EIA, BEF, epizootic haemorrhagic disease (EHD), bluetongue, Aino and caprine arthritis encephalitis (CAE). Serum neutralisation tests (SNT) were performed for bluetongue, BEF, Akabane and Aino. Haemagglutination inhibition (HI) tests were performed for Newcastle Disease Virus (NDV).

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**PROJECT:        Assessment of External Chemical Treatments  
in Preventing Blue Tongue Virus Infection of  
Cattle**

**Project Officers:**    L. Melville, N. Hunt, M. Harmsen and L. Chambers

**Project Period:**     March 1998 - October 1998

**Project Location:**    Beatrice Hill Farm, Berrimah Veterinary Laboratory

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**Objective:**

*To compare the efficiency of four different external parasite chemicals in preventing attack of cattle by biting midges (Culicoides sp) which spread bluetongue virus.*

**Background:**

The current export protocols for live cattle shipments to China restrict export through bluetongue endemic areas. Australian Quarantine Inspection Service (AQIS) indicated that several markets are interested in chemical protection of cattle transiting arbovirus endemic areas.

**Method:**

One hundred head of cattle negative to bluetongue viruses were divided into five groups of equivalent weight and sex. Treatments diazinon ear tags ("Spike"), deltamethrin ("Coopafly"), flumethrin ("Bayticol Pour-on") and fenvalerate ("Sumifly") were applied to four groups with the fifth group an untreated control. Treatments, except for the ear tags, were applied at weekly intervals. Cattle were bled at two weekly intervals and tested for antibodies to bluetongue viruses and Akabane virus. Seroconversions in the treatment groups were compared to the controls in contingency tables.

**Results:**

When seroconversion to bluetongue virus was compared, only deltamethrin gave a significant reduction in infection rates. When seroconversion to Akabane virus was compared both deltamethrin and fenvalerate gave significant protection.

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**PROJECT:        National Arbovirus Monitoring Program  
(NAMP)**

**Project Officers:**    L. Melville, N. Hunt, M. Harmsen, R. Weir, S. Walsh,  
L. Simmington and G. Bellis

**Project Period:**     Ongoing

**Project Location:**    BHF, BARC, DDRF, KRS, VRRS, AZRI, Rockhampton Downs, Mt.  
Sanford, Riveren, McArthur River, Helen Springs

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**Objectives:**

*Trade support - by providing information to meet Australian Quarantine and Inspection Service (AQIS) requirements for export protocol negotiation and certification.*

*Bluetongue early warning - by the dynamic surveillance of the northern bluetongue endemic area to detect any new viruses or vectors entering Australia and monitoring any southern spread.*

*Control of important insect-borne endemic disease - by monitoring for endemic virus activity and the insect vectors which transmit these viruses.*

**Background:**

NAMP is an integrated national program jointly funded by industry and governments to monitor the spread of economically important insect borne viruses of livestock and their insect vectors.

**Method:**

Monitoring is achieved by using sentinel herds at various sites around the Northern Territory, which are bled at regular intervals and tested for antibodies to a number of viruses. At BHF, weekly blood collections are made and virus isolations performed. Monthly light trap collections of insects are also made at each site.

**Results:**

**(1) SENTINEL HERD SEROLOGY AND VIRUS ISOLATION**

***Beatrice Hill Farm***

A total of 176 viruses were isolated from the following groups:

Bluetongue	type 1	January - March	48
	type 20	April - May	8
	untyped		20
EHD		March	2
Ungrouped			98

Monthly serology also indicated Akabane activity from July to November and March to April. BEF activity was recorded from August to December and Palyam from January -February.

***BARC***

Monthly serology indicated the following activity:

Bluetongue	type 1 and 20	March - April
Akabane		August - September, April
BEF		October, April
EHD		April
Palyam		April

***DDRF***

Monthly serology indicated the following activity:

Bluetongue	type 1 and 20	March - April
Akabane		August - November
BEF		September - October, February
EHD		April
Palyam		January - February

***KRS***

Monthly serology indicated the following activity:

Akabane		July - October
BEF		January - April
Bluetongue	type 1	March - April
EHD		April
Palyam		April

***VRRS***

Monthly serology indicated the following activity:

Akabane		July, February - March
Bluetongue	type 1	July - October, April
BEF		July - September
EHD		June
Palyam		May - June



**Mt.Sanford**

The only arbovirus activity detected was Akabane in October - November and March - April.

**Riveren**

The only arbovirus activity detected was Palyam in July and Akabane in July - August

**McArthur River**

Bluetongue, Akabane and Palyam activity was detected.

**Rockhampton Downs**

No arbovirus activity was detected.

**AZRI**

The only arbovirus activity detected was BEF in April.

**(2) ENTOMOLOGY**

Insect numbers were high at all sites following the higher rainfall during the wet season. The most widespread vector, *C. brevitarsis*, was identified at all sites except AZRI, Rockhampton Downs, Riveren and Mt. Sanford. *C. fulvus*, the most efficient vector, was only found at BHF, BARC and DDRF. *C. wadai* was found only at CPRS. *C. actoni* was found at BHF, BARC, DDRF and KRS.

**(3) GENOTYPIC ANALYSIS OF BLUETONGUE ISOLATES**

Sequence analysis of BLU 1 viruses isolated from BHF in 1999 confirmed the reassortant virus first identified in 1995 has continued to circulate in the environment.

**PROJECT: Monitoring for Murray Valley Encephalitis (MVE) and Kunjin Viruses for Territory Health Services**

**Project Officers:** L. Melville, N. Hunt and N.Cox

**Project Period:** 1998 - 1999

**Project Locations:** Darwin, Katherine, Tennant Creek, Alice Springs, Gove

**Objective:**

***To detect flavivirus (MVE and Kunjin) activity through poultry sentinel flocks which are bled monthly and tested for antibodies to these viruses.***

**Background:**

Sentinel chickens are used to monitor flavivirus activity in Australia. Currently twenty six flocks are maintained in the north of Western Australia, seven in the Northern Territory, nine in New South Wales and ten in Victoria. The aim is to provide early warning for the potentially fatal disease in humans, Australian Encephalitis, caused by the viruses MVE and Kunjin.

**Results:**

Sentinel flocks were located at Leanyer, Howard Springs, Beatrice Hill Farm, Katherine, Tennant Creek, Alice Springs and Gove. Seroconversions to MVE were widespread, occurring at Tennant Creek in February and April, at Gove in April, at Howard Springs in May, at Beatrice Hill in March, May and June, at Katherine in February and March and at Leanyer in June. Seroconversions to Kunjin occurred at Howard Springs in May, Katherine in February, Leanyer in May, Tennant Creek in February and Gove in February.

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**PROJECT: Wildlife and Exotic Disease Preparedness Program (WEDPP) Development of Flaviviral Monitoring Strategies in Northern Animal Ecosystems - Japanese Encephalitis Preparedness**

**Project Officers:** L. Melville, S. Walsh, N. Hunt and N. Cox

**Project Period:** 1997 - 1998

**Project Location:** Darwin, Northern Region and Research Farms

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**Objective:**

***To investigate sampling strategies and develop a laboratory testing capability in northern Australian to allow monitoring of flaviviral infections of animals as preparedness for a possible incursion of Japanese Encephalitis.***

**Background:**

In 1995, clinical and serological evidence was obtained of the presence of Japanese Encephalitis (JE) in the Torres Strait Islands. JE is exotic to Australia but the vector *Culex annulirostris* is widely distributed. It is currently unknown if the virus would establish in Australia and how far and fast it would spread.

**Results:**

Feral pig sera were obtained from feral game meat hunters, NAQS surveys and departmental officers. Cattle sera were collected under the NAMP and other sera were obtained from NAQS surveys and Parks and Wildlife officers.

Sera were screened in a flavivirus ELISA and positive sera tested for JE, MVE and Kunjin specific antibodies by neutralisation. A total of 3922 sera were tested comprising 1086 porcine, 90 avian, 2413 sentinel cattle, 104 native animals and 224 other animals. 478 of the pig sera were flavivirus positive. Sentinel pig herds were established at BHF and BARC. All pigs at BHF seroconverted to the flavivirus group with titres to both MVE and Kunjin being detected. No seroconversions occurred at BARC. 273 positive pig sera were tested for specific antibodies and 73 were Kunjin positive and 72 MVE positive.

Testing of sentinel cattle sera yielded 745 positive in the ELISA. More than half of these positives have been titrated for MVE and Kunjin, with 192 positive for Kunjin and 108 positive for MVE. Cattle sentinel herds are proving to be a sensitive indicator of flavivirus activity.

Antibodies have also been detected in buffaloes, camels, bantengs, equines, rats, goats and reptiles.

Preliminary work has commenced on testing the vector competence of the mosquito *Culex annulirostris* for JE. Completion of this work, and also JE specific serology, is awaiting renovations to the Virology Laboratory.

# HORTICULTURE

## PROGRAM: FRUITS

### SUBPROGRAM: Mango

#### PROJECT: Mango Cultivar Trials

Project Officers: V. Kulkarni and D. Hamilton

#### Objective:

- (1) Kensington Pride (KP) has been our only commercial cultivar in the domestic market. This cultivar has some limitations such as susceptibility to sap burn and lack of consistency in external blush development. Of more concern is its unsuitability to tropical conditions where excessive vegetative growth and erratic flowering diminish its productivity. Performance of some new cultivars such as R2 E2, Nam Dok Mai, Keitt and Palmer shows that there is scope for new outstanding cultivars.**
- (2) A survey of potential export markets shows that there is preference for some cultivars of Asian and Florida origin. In view of our timing advantage, we can capture these markets if we can supply what the markets want. It is proposed to identify these cultivars and trial them in Australia. As a part of a national effort, it is proposed to obtain all the promising cultivars to establish a national repository. Some of these introductions may play an important role in future breeding programs.**
- (3) Introductions of *Mangifera* species and specific cultivars with special attributes allow us to use them in our breeding and rootstock projects.**
- (4) The project also addresses the need to identify promising seedling selections of monoembryonic cultivars as well as clonal selections of KP.**

#### Method:

At introduction, new cultivars and species are propagated and planted at CPHRF or BARC. After establishment, promising cultivars are ready for multi-location testing. It is proposed that this evaluation will be done at properties of volunteer growers under a special agreement. If new promising cultivars are found, they will be patented with the Plant Breeders' Rights (PBR).

#### Results:

Two cultivars, Baneshan and Kesar were introduced from India. Baneshan is a later-maturing cultivar being exported to Malaysia and Singapore and is expected to be better suited to the Katherine region. Kesar is a very good quality fruit with a slight external red blush. After initial establishment in Darwin, both cultivars will also be planted in Katherine. Of the four species of *Mangifera* introduced earlier, *M. torquenda* flowered and has set fruit. It is proposed to introduce other species as and when possible in collaboration with QDPI to exploit their potential as rootstocks and in breeding.

The new mango cultivar 'Celebration' has been registered with PBR and is now available to the industry. Kulkarni in 1994 identified it in a private orchard (Australian Tropical Produce Ltd) for its very attractive appearance, regular bearing and quality attributes. The cultivar is late maturing compared to KP. There is a considerable demand for it in Katherine and Queensland where growers wish to extend the season. Fruit quality is expected to be superior in the Katherine region. There is also considerable overseas interest in the cultivar from Brazil and South Africa.

Cultivars introduced earlier from India and Thailand were affected by termites and were restabilised at CPHRF in 1996 and are likely to produce a sizeable quantity in 2000. A few cultivars are particularly suitable for processing and will be worth evaluating in conjunction with an external collaborator. One cultivar has potential as a dwarfing clonal rootstock and is being used for trials aiming at tree vigour control.

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**PROJECT: The National Mango Breeding Program**

**Project Officers: V. Kulkarni and D. Hamilton**

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The Australian National Mango Breeding Program is a joint project between the Queensland Department of Primary Industries, CSIRO, DPIF and Agriculture WA. The program which, was initiated in 1994, aims to develop commercially acceptable mango hybrids for the Australian industry that are suitable for the various growing regions and have characteristics required by present and future markets.

The project has four phases: crossing to generate the progenies and planting them, evaluation, field-testing and release. This year marks the completion of phase one. Using hand pollination techniques, the partners in the project developed 1851 crossed progenies between 1994 and 1997. These have been propagated and planted at South Edge Research Station in Mareeba district in Queensland and at CPHRF. Grafts are used in Queensland while original seedlings are being planted at CPHRF. Initial screening of the hybrids will be done at both sites. After selection, the best trees will be planted in field trials in each agro-climatic mango-growing region for detailed evaluation of their plant and fruit characteristics and commercial suitability.

Of the 1851 hybrids produced to date, 33 parental combinations have been used. Nineteen of the parental combinations have produced 50 or more hybrids and another four have produced more than 40. Phase one (hybrid production) of the project has been mostly completed with a few more hybrids from 1997 to be planted. The evaluation phase will start in the 1999 season. Protocol for evaluation of various vegetative, floral and fruit characteristics has been standardised.

It is proposed to attract industry and external funding for the future phases of the project. Field days are planned for the 1999 season at fruiting time at CPHRF and at South Edge Mareeba.

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**PROJECT: Propagation and Rootstock Trials for Control of Tree Vigour**

**Project Officers: V. Kulkarni and D. Hamilton**

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***Background and Objectives:***

***The warm tropical climate of Darwin favours vegetative growth. The excessive vigour is counter-productive and is a major factor limiting yield and quality of fruit. It is hypothesised that strategies aiming at tree vigour control would therefore considerably improve productivity. Development of dwarfing rootstocks and high density planting systems and its positive impact on the temperate fruit industry is a good example of such gains. Vigour control will also have a considerable impact on recurring costs of harvesting and pest management. Four major strategies towards vigour control are breeding, management practices such as pruning, chemicals such as paclobutrazol and use of rootstocks and interstocks. In the national breeding project for improvement of Kensington Pride, we have included dwarf parents such as Willard and Julie. Our research on development of combination approach with paclobutrazol and pruning has shown considerable promise and is being adopted by the industry. As a non-chemical strategy, rootstock research has been a relatively unexplored area in mango and provides exciting opportunities. Use of clonal rootstock in particular offers unique advantages. Although mango is considered to be difficult to root species, some dwarf cultivars have been shown to be easy to root and have imparted significant vigour control to the scion. This project aims to explore the potential of such clonal rootstocks and also to develop a simple and commercially feasible system of propagating such rootstocks. It also aims to test a few polyembryonic rootstocks, which have shown promise elsewhere.***

**Method:**

The trials will be conducted on private properties. Two types of materials are going to be used.

- (1) Seedlings of polyembryonic cultivars Vellaikolamban, 13-1, Sabre and Kensington Pride.
- (2) Clonally propagated marcots of dwarf cv Mahmuda (introduced from India) as rootstocks.

*Preparation of grafts on seedling rootstocks for planting.* Grafts of Kensington pride on seedling rootstocks Vellaikolamban and 13-1 and Sabre were planted at a site in Katherine.

*Standardisation of clonal propagation technique using marcots of dwarf cultivars as rootstock:*

The conventional technique of marcotting using polyethylene film was found to be cumbersome and did not provide proper root space for the marcot. An improved technique was developed using the polystyrene containers (the common stubby holders). A hole was drilled at the bottom of the stubby holder to fit in the shoot to be marcotted. A vertical slit was made across the stubby holder to join the bottom hole to slide in the shoot to be marcotted. A convenient position was decided to ring bark the shoot. A two to three cm ring of bark was removed with a sharp knife. Care was taken not to leave any strands of phloem (bark) on the ring. Passing the stem into the container through the vertical slit, the container was aligned so that the ring was just below the top of the container. Rooting hormone IBA 5000 ppm or commercial formulation of the hormone was applied above the ring. The container was fitted in with the desired alignment and filled in with wetted rooting medium containing peat and fine sand, mixed in the ratio of 3:1 v/v. The top of the container was then sealed with plastic foam rims, which had a hole in the middle and a fine slit across the radius so as to snugly fit on the top of the container. In some cases, a clothesline peg was inserted at the base to provide additional strength to the marcot. Almost 100 % success and profuse rooting were obtained with this technique. Satisfactory rooting was achieved within 40 to 60 days of marcotting. The Wet season was ideal for quality of rooting and survival. Potting mortality is usually a common limitation with marcots in mango but this was not an issue because the marcots had adequate root system and weather conditions were ideal. The warm and humid conditions prevailing in November-February seem to be ideal for marcotting in the Darwin region. This technique has been successfully adopted for other species and is a distinct improvement over the existing technique.

One observational trial is being planted at a site in Darwin with Kensington Pride grafted on the marcots of Mahmuda. . More numbers will be propagated in the wet season of 1999 for planting at two more sites. Two approaches are being considered to raise grafts of Kensington Pride on rooted marcots. The rootstock can be marcotted on the mother tree, potted up after rooting and then grafted with the scion (Kensington Pride). Second alternative is to graft the scion on the mature stem of terminal shoots of the proposed rootstock and then to marcot stock shoots after establishment of the graft union.

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## **PROJECT:           Improvement of Mango Productivity Through Manipulation of Flowering**

**Project Officers:   V. Kulkarni and D. Hamilton**

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**Objective:**

***Kensington Pride mango may not be suited to the tropical conditions of Darwin where it generally tends to flower sparsely and flush more frequently. Here, depending upon its timing, intermittent and pre-flower flushing can delay, stagger and even prevent flowering, affecting fruiting in a similar way. This has a direct impact on productivity of the industry, which relies heavily on high productivity and the early domestic market. Three to four vegetative flushes are produced from harvest to flowering; the last one is usually through the flowering cycle. As a result, trees are vigorous. While efforts are in progress through breeding to improve Kensington Pride, it is imperative that our immediate priority should be to develop management strategies to improve its productivity because it is the most preferred variety in the domestic market. Moreover development of management practices aiming at vigour control and flower promotion will also be useful in other cultivars in future.***

**Our research objectives in this area aim:**

- (1) To manipulate flowering and vegetative growth (tree vigour) to improve mango productivity through research on physiology of flowering, growth and growth regulators,***
- (2) To induce regular and early flowering to ensure high yields and early harvests,***
- (3) To reduce and minimise adverse effect of untimely and excessive vegetative growth which adversely affects productivity,***
- (4) To develop a cost-effective high density planting system and a management strategy on a scientific basis.***

## Results:

### 1. Trials on the use of paclobutrazol (PBZ) and pruning for manipulation of flowering:

One potent tool to regulate flowering and fruiting in tropics is the growth retardant paclobutrazol (PBZ). Trials over last six years have shown that PBZ may have a major role in manipulation of flowering in a tropical environment. Soil application of a small quantity after harvest can control tree vigour and induce early and profuse flowering. Most growers in the Darwin region have adopted this tool and have benefited from our research in this area.

One factor adversely affecting efficacy of PBZ is delayed flushing at flowering time. A combination approaches including PBZ application after harvest and pruning before flowering was very effective and is being adopted by a number of growers. On account of precision required for the pre flower pruning, the operation has to be done manually. Observational trials with mechanical shoot pruning were not successful. Mechanical pruning is however very effective after harvest, which aims at vigour control and renewal of growth. Current strategy therefore aims at limb and canopy pruning after harvest before application of PBZ and selective pruning of immature flush before flowering. This approach is very practical. Two growers have successfully adopted this in higher density planting areas.

A higher density planting block was established at CPHRF in 1995 with spacings of 7 X 5m (PBZ and pruning) and 7 X 7m (PBZ and pruning) with untreated 10 X 10 m as control. With 1/3<sup>rd</sup> h /treatment, the densities are 285/h, 240/h and 100/h respectively. The treatments were applied in 1998. The 1999 season will be the first harvest for the trial. As expected, very early flowering was observed in the first week of June 1999 in the 7 X 5 and 7 X 7 treatments where PBZ was applied. In the untreated 10 X 10 area, flowering was significantly less and was also delayed. Yield record will be taken in the 1999 season. The trial has been affected by *mastotermes* damage in the 10 X 10m treatment. The 7 X 5m and 7 X 7m treatments however look well established.

One more aspect of use of paclobutrazol is standardisation of dosage rates for the tropical climate of the Top End. With a view to develop an optimum canopy-based strategy, one trial was undertaken at a private property in the Darwin region with application rates of 0.75, 1.0, 1.25 and 1.5 g a.i/ m mean linear canopy (mean of height and canopy spread). Observations on flowering, yield and fruit maturity will be made during the 1999 season.

### 2. Mango Flowering Project

This is a joint project with CSIRO and is being funded by the industry and HRDC. It is based on two treatments developed to manipulate flowering in Kensington Pride. The first is derived from research conducted by CSIRO. It has demonstrated that flowering and fruit production of mango can be considerably enhanced by cutting a cincture around the tree trunk and applying a plant growth retardant called morphactin. The treatment, which has evolved from this experimental work, is called the Mango Flowering Treatment (MFT) or the Morphactin-Twine Treatment.

The second approach is use of paclobutrazol (PBZ) as a soil drench. Paclobutrazol is being widely used in several mango-growing countries including Australia for improvement of flowering and yield, for tree vigour control and in higher density planting. Research by DPIF discussed in the previous section has shown that significant gains can be obtained with this treatment if it is done in combination with pruning unwanted growth to limit the adverse effects of vegetative vigour.

A field day was organised in the 1998 fruiting season at two Darwin sites, one showing results of the twine treatment and the other showing PBZ results. From the response received from growers, 12 sites were selected for the trial. The three treatments at each site are: PBZ (1.25g a.i/ m linear canopy of tree, twine treatment and untreated control. PBZ was applied as a collar drench in early January. Twine treatment involved cincturing the bark to the depth of the phloem in early January with a small specially designed chain saw and tying bailing twine pre-soaked in morphactin. Fifty trees were allocated per treatment at each site.

Observations are being recorded on flowering and later on at harvest on fruit maturity, yield and quality. Effect of the treatments on tree nutrition is also being investigated.

The year 1999 has been a very strong 'on' year for mango. Flowering has been generally good in all treatments. The twine and PBZ treatments however flowered significantly early. Flowering was more synchronous in the twine treatment. In water logged situations, twine treatment was found to be detrimental to tree health and caused a decline growth and in some cases death of trees. Effect of the treatments on tree nutrition, health and long term performance is being monitored.

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**PROJECT: Calcium and Mango Fruit Quality**
**Project Officers: V. Kulkarni and D. Hamilton**


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**Background and Objectives:**

*There is considerable interest in pre harvest nutrition effects on mango productivity, especially of calcium on fruit quality. High calcium status in fruits generally results in better fruit quality and fewer problems with post harvest fruit rot. As compared to the Katherine region, calcium content of soil and leaf samples from the Darwin region is generally low. This could be attributed to a low soil pH, high rainfall and humidity and excessive tree vigour in the Darwin region. Fruit from Katherine is generally considered to be of better quality. To further investigate this, we looked at location effects on fruit quality in relation to calcium levels in leaves as well as fruits.*

**Method:**

In an earlier experiment, leaf and soil samples collected after fruit set, and fruit samples at harvest, showed significantly high levels of calcium in Katherine as compared to Darwin.

For the 1998 season, the mango productivity project sites in the two regions were used for this purpose. Leaf and soil samples were collected before flowering and after harvest, and fruit samples at fruit maturity, from six sites in Darwin and Katherine, and were analysed for nutrient levels. Fruit, flesh and peel analyses were looked at separately.

**Results:**

As in the previous experiment, significant differences were observed in respect of calcium levels. Leaf, soil and fruit samples from Katherine showed higher calcium content than the Darwin samples. In fruit samples, although similar trends were noticed in flesh and peel samples, differences were more significant in the calcium content of the peel as compared to flesh. Fruit from Katherine was more firm, had better quality attributes and no internal disorders. Internal disorders were noticeable in late-maturing fruit from Darwin.

These results have shown that high calcium levels may play an important role in fruit quality in mango. As in temperate fruits, further work is warranted on standards for fruit nutrient content for fruit quality.

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**PROJECT: Mango Productivity Survey in the NT**
**Project Officers: V. Kulkarni, G. Owens and D. Hamilton**


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**Background and objectives**

*Average yields of mature Kensington Pride trees in the NT are approximately 8 t/h. That is less than half of what is being achieved in some other mango growing countries. This has been attributed to Kensington's genetic make up, which is poorly suited to tropical climates. Improvement of the genetic make up of Kensington has already been addressed with the implementation of the Australian National Mango Breeding Program in 1994. Breeding a suitable Kensington hybrid is expected to be a fairly lengthy process. In the short term, however, we are still confronted with the day to day problems of production. It therefore essential that we focus on identifying the key factors which are important to mango productivity in the Top End.*

*The Mango productivity survey commenced in 1997. The project aims, over a three year period, to look at variations in productivity of different mango producing areas in varying environments and monitoring different management practises so as to establish ideal indicators. At the tree level the project aims at identifying critical events, which dictate productivity (time and extent of flowering, fruitset, fruit drop) so that management practises are primarily aimed at managing these events. In the first year, 62 growers participated in the project, covering orchards at Acacia Hills, Bees Creek, Berry Springs, Elizabeth Valley, Humpty Doo, Howard Springs, Lambell's Lagoon and Virginia. In the second year only 38 of the original 62 growers participated in the project.*

**Method:**

At the start of the project three trees at every orchard were chosen for sampling of soil and leaves for nutrient analysis, yield recordings and other pertinent observations. These trees were selected for the term of the project.

Samples were collected twice a year pre flowering (May/June) and after harvest (November). In six of the orchards, samples have been collected monthly, and recordings taken of fruit set and fruit drop.

Leaf nutrient analysis assesses the concentration of nutrient on a dry matter basis. Leaf and soil analysis results are compared with a set of standards depicting optimum levels. Assessment of yield for all of the trees has been rated subjectively by visual observation on a scale of 0-10 (very poor to very high). Growers were required to supply information about their inputs in the form of an orchard diary.

**Results:**

- Nutrition in relation to yield – no definite trend was found between soil or leaf nutrient levels and yield.
- Paclobutrazol (plant growth regulator) in relation to yield – an assessment of orchards in Berry Springs generally showed significantly higher yields from trees treated with Paclobutrazol. There was also a tendency for increased nutrient (especially calcium) levels in the leaves of trees treated with Paclobutrazol.
- Soil pH – optimum level 6.5. Top End soils are generally acidic. To improve the availability of nutrients we expect growers to achieve a pH of at least 6.0. Over the last two years on average 39.5% of orchards achieved a pH > 6.0 and 60.5% of orchards achieved pH <6.0. The stability of soil pH is also important to ensure uniform availability of nutrients throughout the season. We defined stability as a change in pH of no greater than a five-fold increase or decrease. Throughout the project to date, 45 % of orchards recorded stable pH levels, while 55 % of orchards have recorded unstable levels. Nevertheless, we have seen a general increase in soil pH, as a result of increased liming.
- Soil pH in relation to yield – no definite trend was found between yield and soil pH. High and low yields were recorded in orchards with similar pH levels.
- Yield Assessment in relation to dry season minimum temperatures – in 1997, 21 orchards averaged a yield rating of greater than 5.0. In 1998, only four orchards achieved a yield rating of greater than 5.0. Those four orchards performed well in 1997. In 1998 temperature data for the months of June, July and August showed that temperatures for most part of the flowering time were above 20C. Flower initiation in mango and requires a base temperature below 18C. Warm conditions at flowering time seem to have played a very important negative role resulting in low productivity in 1998.
- Micronutrient levels (zinc and boron) – both zinc and boron are important for growth, fruit set and fruit formation. These particular nutrients tend to be in very short supply in soils with low fertiliser inputs. In 1997, pre harvest, approximately 37% of orchards had zinc leaf levels below the minimum level. In 1998, approximately 24% of orchards recorded minimum levels. Boron levels were generally quite low for most of the orchards. The stability of boron leaf levels was a concern, as boron is an immobile nutrient in the plant and is very easily leached out of the soil. Approximately 45% of the orchards recorded unstable boron leaf levels throughout the season. There appeared to be a strong relationship with seasonal rainfall and irrigation.

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**PROJECT: Fruitset in Mango as Affected by Copper and Non-Copper Fungicides at Flowering**

**Project Officers: V. Kulkarni, B. Conde and D. Hamilton**

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We investigated the response to copper fungicides in terms of fruit set and retention in Kensington Pride for the following reasons. The confirmation of mango scab in the Darwin region, the efficacy of copper fungicides in combating diseases, especially scab and bacterial black spot, and the mixed opinions about the adverse effect of copper fungicides on fruit set and retention. In 1997-98, copper fungicides, copper oxychloride and copper hydroxide, were compared with Mancozeb. Panicles were sprayed at fortnightly intervals from anthesis and observed for fruitset. Fruit counts after fruit set showed no significant differences in any of the treatments. Large-scale sprays on commercial orchards with copper oxychloride confirmed these observations. In view of this evidence, this project was terminated.

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**PROJECT: Leaf Nutrient Deficiency or Anthracnose**

**Project Officers: D. Hamilton and V. Kulkarni**

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Mango leaf dieback is a commonly occurring problem in Darwin mango orchards. Generally these symptoms are diagnosed as anthracnose caused by the fungus *Colletotrichum*, and consequently growers are advised to



spray fungicides. Nevertheless, it is questionable whether disease is always the cause of these symptoms because of the following reasons:

- (1) Throughout the year, but particularly during the dry season with low soil moisture levels, the symptoms exhibit a regular pattern along the leaf margin. Disease symptoms in most cases exhibit irregular patterns of dieback.
- (2) Fresh symptoms always appear on the most recent developed leaves, and not on leaves of the previous flush at the same time on the same shoot.

It appears that the most recent developed leaves are more susceptible to dieback because of a deficiency of one or more immobile nutrients in those leaves. These particular nutrients rely heavily on adequate soil levels and good transpiration flow for maintaining optimum levels in the tree. This theory was tested on a sample exhibiting these symptoms in September of 1996. The results of the nutrient analysis showed that the levels of calcium (0.18%), zinc (15 ppm), manganese (16ppm), iron (28ppm) and boron (16ppm) were all below their respective optimum levels for mango. All of these nutrients, except in the case of zinc, which is considered partially mobile, are considered to be immobile within plants. We then set out to determine which of the nutrients were most likely to be responsible for the symptoms. Generally deficient levels of zinc, manganese, or iron are not known to cause leaf dieback in plants. Deficient levels of either boron or calcium, particularly the latter, do exhibit symptoms of marginal dieback.

Another set of samples was taken in July 1998 during the pre-flowering non-irrigated stage. The leaves of these samples were light green in colour, with marginal dieback, and some leaf drop was evident. A healthy leaf sample was also collected from the same tree for comparison. Analysis for calcium, boron and nitrogen was conducted. Unlike calcium and boron, nitrogen is very mobile within the plant. The results showed that there were no significant differences between the nitrogen levels in the unhealthy leaves (1.33%) and healthy leaves (1.31%). The calcium levels, however, in the unhealthy leaves (0.21%) were significantly lower than the levels in the healthy leaves (0.89%). The same trend applied to the boron levels in the unhealthy leaves (14.5ppm) compared with the healthy leaves (41ppm). This finding further substantiates our theory that either a lack of calcium or boron can be a cause of marginal dieback in mango leaves.

We need to test the above findings through controlled experiments so that we can be sure of whether or not we are dealing with a disease or nutrient deficiency. This information could have considerable implications for tree health and fruit quality.

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## **PROJECT: Mango Research in Central Australia - Cultivar Evaluation**

**Project Officers: G. Kenna, D. Salter and A Nesbitt**

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### **Objective:**

***The objective of this project is to evaluate the commercial production of mangoes in the southern region of the Northern Territory for the lucrative late season domestic market.***

### **Method:**

In 1990 twelve cultivars were planted in a single row running northwest, at a spacing of 3 metres between trees. For nine of the cultivars, there were two trees of each, planted adjacent to each other. For the other three cultivars (Davis Haden, Keitt and Manzanillo nunez) there was only one tree of each. All the trees were on Kensington rootstock except for Manzanillo nunez, which was on Adelaide River common rootstock. Bagging of fruit was carried out on various varieties by securing plastic bags over individual fruit or where possible over up to 4 mangoes at a time. The aim was to achieve a more uniform colour of ripening fruit while reducing sunburn and fruit piercing moth damage. Fruit was harvested and recorded as it matured. From this information it is possible to compare the cultivars for differences in harvest patterns, fruit number, size and total yield (kg fruit/tree).

### **Results:**

Fruit was harvested from 2 January 1999 to 10 April 1999. The cultivars in general began maturing from the first week in January. The harvest period varied significantly. Kent, Keitt, Palmer and Springfels had a long harvest period but tended to produce the best quality fruit. The cultivars that produced the best average fruit weight were Springfels (490g), Keitt (480g), Davis Haden (350g) and Palmer (320g).

The cultivars with the highest average yield were Kent and Keitt, which averaged 28 kg/tree each. Although the variety R2E2 performed badly this season, in previous years it cropped consistently having the best average fruit weight and yield per tree.

**Discussion:**

Covering the fruit with bags tended to cook it and make it go too soft and soggy. Leaves crumbled and fell off. Fruit piercing moths still managed to find their way into the bags, which had more than one mango, through small openings around the stem. Even in bags with single mangoes, moths managed to attack the fruit through the bag. Where coloured bags were used, it was very difficult to judge the ripeness of the fruit without squeezing every mango through the bag on a daily basis. The use of bags over fruit was of little or no advantage and in some cases, more of a hindrance to harvest management.

Due to heavy rains around Christmas and the New Year and again in early February, fruit piercing moths were a major problem in the later fruiting varieties such as Kent and Keitt, attacking up to 90% of the fruit. Once attacked, the fruit collapsed and spoiled and was of no value whatsoever. The only way to prevent this happening was to pick the fruit semi-ripe and let it fully ripen in storage.

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**PROJECT: Monoembryonic Seedling Selection**

**Project Officers: J. Bright, S. McAlister and R. Renfree**

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**Objective:**

***Although Kensington Pride enjoys a strong preference in the Australian market, it exhibits some poor attributes that could be improved through breeding and selection. Hand pollination in mango is time consuming and therefore expensive. An alternative approach is to collect and propagate seed from a tree growing in close proximity to the desired pollen parent. This approach enables the rapid establishment of large progeny populations, and has been employed with some success elsewhere.***

**Method:**

A population of 550 seedlings of the cultivar Glenn were field planted in May 1994 from seed collected in December 1993, from different orchards in the Katherine area. Seeds were collected from Glenn trees growing at 6 different pollination distances from Kensington Pride trees. Since the trees started flowering in 1996, they have been rated for flowering intensity, and those that carried fruit were assessed for a range of characteristics once the first fruit on each tree ripened.

**Results:**

The 1998-9 season had poor flowering and fruiting. Of the 30 % trees that required assessing, only a small proportion flowered and not enough fruit was produced to justify detailed assessments. As a result the trial has been extended for another year and the results will be available in late 2000. The trees identified for further assessment will be propagated and planted in a replicated trial for further evaluation.

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**PROJECT: Rootstock Effects on Mango Productivity**

**Project Officers: J. Bright, S. McAlister and R. Renfree**

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**Objective:**

***In response to the promising results obtained over past seasons with just a few rootstocks, it was decided to evaluate a greater range of polyembryonic genotypes that may prove useful as rootstocks for Kensington Pride. The influence of soil type on rootstock performance was also evaluated.***

**Method:**

In mid 1996, 64 different rootstocks were planted on a Tippera clay loam, and 104 were planted in late November/early December 1997 on a Blain sandy loam. These rootstocks consisted of polyembryonic genotypes from DPIF arboreta, trees identified by local nurserymen, polyembryonic types bred at KRS, seed supplied by overseas mango

workers and a limited range of other *Mangifera* species. In both groups each treatment is replicated five times with individual tree plots. Nearest-neighbour designs have been employed in an attempt to account for spacial variation.

**Results:**

The Tippera clay loam trees will be harvested late 1999 and results will be available in early 2000. The Blain sandy loam trees should flower in the next 2 years.

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**PROJECT:      Mango Rootstocks for Saline Soil Conditions**

**Project Officers:    J. Bright and S. McAlister**

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**Objective:**

***Rootstocks offer one solution to overcome the production constraints imposed by saline soil conditions. This experiment aims to assess the performance of Kensington on a small number of different rootstocks, at sites spread across northern Australia.***

***Rootstocks were included primarily on the basis of their performance in past experiments in Central Australia in which the uptake of Na and Cl and the development of leaf symptoms were used to screen polyembryonic cultivars. It was considered necessary to evaluate the effectiveness of this screening procedure by examining how selected cultivars performed as rootstocks for Kensington under a range of "stressful" soil conditions.***

**Method:**

The following rootstocks were used in the trial:

Treatment 15	KRS water tank
Treatment 16	Kensington Pride
Treatment 18	Sg. Siput
Treatment 35	Banana Callo
Treatment 52	? 13-1? (selected in Israel good tolerance)

Kensington pride was used as the scion on all rootstocks at all sites.

At each site, treatments were replicated 5 times in single tree plots.

Plants will initially be assessed for physical damage. Symptoms may include scorching of the leaf tips and margins. In extreme cases the plant may show smaller and yellowish leaves, shorter internodes and defoliation (Kadman *et al.* 1975). Leaf samples may be collected to assess Cl and Na uptake and to compare these levels with results obtained in previous pot screening work.

Results will become available over the next few years.

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**PROJECT:      Pre-Flowering Irrigation of Mango**

**Project Officers:    C. Wicks, Y. Diczbalis, S. Marte and A. Hosking**

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**Objective:**

***In the Northern Territory irrigation is traditionally withheld from the end of the wet season until flowering. This period of stress is imposed to improve the flowering response. The objective of this trial is to answer questions raised by growers and researchers as to whether this stress had a negative effect on fruit set.***

**Method:**

In 1995 a trial was initiated with 96 trees on a commercial property to determine whether irrigation through the dry period prior to flowering influenced flowering, fruit set and hence yield. The work was carried out on untreated and Cultarâ treated trees.

Each year the trees were lightly pruned after harvest. After this, half the trees (the same half each year) had Cultarâ applied at conventional rates. An irrigation system was installed which allowed four pre-flowering irrigation treatments (50, 25, 13 and 0 mm/week) from the end of the wet season until flowering. Following flowering, trees were fully irrigated through to harvest.

#### **Results:**

In 1995, the Cultarâ treated trees flowered approximately a week earlier, in mid July. Pre-flowering irrigation treatments decreased flowering in the untreated trees and increased flowering in the Cultarâ treated trees.

Similar yields of 38 kg/tree were recorded in the non-irrigated untreated trees and the Cultarâ treated trees irrigated at 25 mm/week. Cultarâ increased the number of flowering panicles per tree but there was no evidence of a similar increase in yield as fruit set was reduced.

In 1996 flowering was extremely poor. There was little fruit on the trees in the trial block. However, as in 1995, the best yields were obtained in the untreated, unirrigated trees and in the Cultarâ plus the 13mm/wk irrigation trees.

In 1997, the Cultarâ treated trees flowered approximately two weeks earlier, in mid August. Pre-flowering irrigation treatments generally decreased flowering in the untreated trees and increased flowering in the Cultarâ treated trees.

The highest yield (44 kg/tree) was from the non-irrigated untreated trees. The highest yield in the Cultarâ treated trees was from those irrigated at 13 mm/week (37 kg/tree). Cultarâ increased the number of flowering panicles per tree but there was no evidence of a similar increase in yield as fruit set was reduced.

In 1998 flowering was generally very poor. There was little fruit on the trees in the trial block. The best yield, 17 kg/tree, was obtained in the Cultarâ plus 13-mm/wk irrigation treatment. The non-Cultarâ trees produced very little fruit.

The trial was concluded at the end of the 1998 season. A full report will be written during 1999. Initial analysis of results indicates that:

- If using Cultarâ, small amounts of water pre-flowering may be beneficial to production.
- In trees not treated with growth regulators, pre-flowering irrigation reduces yield by reducing the flowering response.

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## **PROJECT: Drip Irrigation of Mango**

**Project Officers: C. Wicks, A. Hosking, S. Marte and Y. Diczbalis**

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#### **Objective:**

*Over the last few years growers have been asking the Division for advice on the use of drip irrigation on mangoes. While there has been some work overseas, there is little clear information on the benefits of drip irrigation in mango.*

*In the NT there are a number of growers who have used drip irrigation with apparent success. However most of the data is anecdotal and the irrigation systems involved have had problems not apparent in a cursory investigation. It appears that most growers who use drip irrigation believe that they do not need as much water as with a sprinkler system.*

*This is not entirely true. The water requirements of a fully mature tree do not change because the method of application has changed. However, drip irrigation can direct the water more accurately - especially when the trees are young and the root zone small.*

*With an ever-increasing number of mangoes trees being planted, the demand on water resources is climbing rapidly. This may mean that in a few short years mango growers may be operating in an environment of water shortages. Using drip irrigation is one way growers can reduce water inputs in the early years. The objective of this trial is to compare tree performance under two irrigation systems, the sprinkler and the drip.*

#### **Method:**

In 1997 the Irrigation section started a small trial on a grower's property. In that trial we are comparing the growth, yield and water usage of trees grown on drip with trees grown on sprinkler irrigation. The trial commenced on the day of planting and will continue for at least five years.

**Results:**

The data collected to date shows no significant differences in tree growth, even though the sprinkler-irrigated trees received approximately 20% more water than the drip-irrigated trees.

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**PROJECT: Variation in Mango Productivity - Katherine**

**Project Officers: J. Mansfield, T. Maddern, G. Kyle and V. Kawaljenko**

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There are large variations in yield and fruit quality between two mango farms in the same year, between trees on the same farm in the same year, and on the same tree in two consecutive years. To try to understand this variation, a previous study in the Katherine Region investigated 12 groups of three trees in orchards on three different soil types over three years. Those orchards varied in management practices and in the age of the trees. Information was collected on the nutrient status of the leaves at flowering and after harvest, fruit yield and fruit quality. However few relationships between yield and the concentration of nutrients were observed. This was possibly due to soil type, climate, microclimate, and rootstock and management practices than individual nutrient levels. The objective of this trial was to further study a greater number of factors.

**Method:**

In a joint study between staff in the Darwin and Katherine regions, six sites in both regions were selected for evaluation. At the Katherine sites tree performance, climatic and management parameters are being measured. The performance of trees is being assessed by their growth patterns by recording at what time of the year they are producing new leaves, flowers or fruit, yield and fruit quality. Climate is being studied by recording temperature and relative humidity and using data loggers. The nutritional status of trees is being assessed by monitoring soil nutrients, leaf nutritional status, and irrigation. In addition growers are recording when and how much fertiliser they are applying and when they are carrying out other management operations. From this information, the relations between tree performance and climatic and management factors will be assessed. The trial started in July 1998 and the sites are visited on a weekly basis to record readings and take samples.

**Results:**

This project has completed one year and will continue for at least another two. Therefore, it is too early to draw any conclusions.

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**PROJECT: Foliar Nitrogen Nutrition of Mango**

**Project Officers: J. Bright, S. McAlister and R. Renfree**

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**Objectives:**

***The nitrogen nutrition of mango remains an area of much debate and confusion. Over the last decade in the NT there have been major swings in the quantity of nitrogen recommended for commercial orchards. Current rates range from zero up to 300 g N per tree per year. Foliar application of nitrogen has received limited attention. The aim of this project is to determine any effects of foliar nitrogen application on the yield and quality of mangoes.***

**Method:**

The experiment was established in January 1996, with four different rates of nitrogen (80, 40, 20 and 0 g/tree) applied at four different phenological stages (post-harvest flush, pre-flowering, fruit at golf-ball size, and all three of these stages). These treatments were arranged in a factorial design with 5 replicates and individual tree plots. Additionally, potassium nitrate was applied pre-flowering and window pruning was done in August.

**Results:**

Results for 1998/9 showed no significant differences between different foliar nitrogen treatments with respect to yield and quality. However, the 1998 season can be characterised as a year of poor flowering and production. However the 1999 season looks to be a reasonable year for flowering and results for yield and quality data will be available in early 2000.

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**PROJECT: The Katherine Mango Industry**

**Project Officer: J. Bright**

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**Objective:**

*A quick and easy way of assessing the nature and extent of mango orchards in Katherine was sought with little success. Several techniques were employed over the years including questionnaires, aerial photography and satellite images. The lack of response for the questionnaires made this method unacceptable. Aerial photography, although expensive and time consuming, proved to be more successful. The problem with this method was the absence of up-to-date photographs. The problem with satellite imagery was the lack of resolution. This might be rectified with the release of high-resolution satellite imagery in the future.*

**Method:**

Due to changes in interstate quarantine requirements, producing farms now need an identifying number (IP number) so that their produce can be identified in the market place. This information will assist in documenting the extent of mango orchards. The limitation with this method is that it would not identify non-producing plantations ie. those less than 3 years may not be recorded. However, these growers with non-producing trees may be documented through their attendance at various training workshops.

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**PROJECT: Evaluation of Mango Selections and Lines in The Katherine Region**

**Project Officers: J. Bright, S. McAlister and R. Renfree**

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**Objective:**

*Although Kensington Pride (KP) is the preferred mango by most Australians that have had mangoes, it exhibits a number of attributes that might be improved through breeding and selection.*

**Method:**

In January 1998, a number of mango trees were planted at Katherine Research Station as part of a number of sub-projects. These projects were looking at:

- 1) Crossing KP with other mango cultivars including Irwin and Julie and evaluating the performance of the seedlings. Measurements are being taken to identify trees that produce fruit that has KP flavour but with less fibre, good size, colour and shape.
- 2) Determining the optimum tree density for evaluating breeding trials by examining how close mango seedlings can be planted without affecting seedling performance and assessment.
- 3) Examining whether cultivars that are quick to come into bearing as grafted trees pass on this characteristic to their progeny.

An explanation of each of these sub-projects was presented in the Horticulture Division Technical Annual Report 1997/98 under the titles:

- Use of the bouquet-method in mango breeding
- High density planting for mango seedling evaluation
- Use of Kensington Pride as a seed parent in mango breeding
- Variation in the length of the juvenile period for mangoes derived from different seed parents

In 1998/9 several of the rootstock trees in the variation in the length of the juvenile period trial were grafted. Replants were carried out where plants had died. These will be treated as missing sites. It is expected some of the early flowering varieties in this trial eg Willard will flower this season.

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**PROJECT: Postharvest Application of Waxes to Mango Fruit****Project Officers: M. Gosbee and A. Hosking**

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**Objective:**

***Mango waxes are known to increase lustre or fruit shine, decrease water loss and occasionally increase shelf life of fruit. This experiment was conducted to determine whether the application of waxes to mature green mango fruit would increase their shelf life while maintaining colour, firmness and eating quality.***

**Method:**

Two waxes were selected after discussion with the chemical company E.E. Muir & Sons. *Apple Lustr 231* is a carnauba based wax, while *PNP Lustr 251* (Peach Nectarine Pear) is mineral based. Dilution rates (eg. 1 part wax: 2 parts water) were recommended by E.E. Muir & Sons. Fruit were obtained after dipping in prochloraz and dimethoate at the recommended rates. No other oils or dips were used. Fruit were immersed in the wax solution for 30 seconds the day after harvest and allowed to dry. They were then stored at 22°C and 70% RH and allowed to ripen. Twenty fruit were used for each treatment, and were assessed every two to three days for weight loss, colour and firmness changes. Ten of the fruit were sampled for eating quality when they had reached eating soft, the other ten were held until over ripe to discern if any disorders developed in the fruit. Dry matter was assessed on ten fruit.

**Results:**

The waxed fruit showed an increased shine after the application at all concentrations. Wax 251 felt a little greasy.

*Weight Loss*

Weight loss was greatest in the non-waxed control fruit, as expected. These fruit lost 1.0% of their initial fresh weight each day. The waxed fruit lost much less water, with fruit coated with a higher concentration of wax losing less water than those coated with the lower concentration.

*Fruit Softening and Days to Eating Soft*

No significant difference was detected in fruit softening. Non-waxed fruit were marginally firmer than waxed fruit. This is because of the reduced water loss in the waxed fruit. Analysis of the number of days that the mangoes took to reach eating soft did not detect any significant differences. Average difference was in the order of 2 days, however variability between fruit in a single treatment was high.

*Skin Colour*

Mangoes treated with Wax 231 had significantly slower colouring than the non-waxed mangoes. Fruit dipped in Wax 251 were intermediate. At the higher concentration of Wax 231, colour development was quite retarded. At day 13 after the wax was applied, fruit should be at a score of 5 or higher, which corresponds to greater than 60% of the fruit surface area covered. The skin colour at eating soft was greatest in the non-waxed fruit and at the lowest dilution of the wax. Mangoes coated with Wax 231 retained greener colour on the skin.

*Eating Quality*

Eating quality was generally poor. This is due to the low dry matter content of the fruit (12.4%) at harvest. Eating quality is based on a score from 1 (poor) to 9 (fantastic). The average eating quality score for these mangoes was less than 5, which means that the flavour was only mediocre. No significant differences in eating quality were detected between treatments. Off flavours were not detected.

*Skin Blemishes*

Low levels of disease and sapburn were recorded in fruit from all treatments. Lenticel spotting was however significantly enhanced in fruit treated with Wax 251. While all these fruit still were within the grade, this may be an indication that there may be difficulties with this wax if fruit are subject to more extreme temperatures.

**Conclusion**

The application of wax is intended to retard ripening and place a shine on the fruit. The ripening rate of mangoes is greatly affected by temperature. These mangoes were ripened at a uniform 22°C and 70% RH. Controlling temperature has a greater effect on storage life of mangoes at these temperatures than the wax. Wax

231 is of little use, as no extension of shelf life was observed while colour development was delayed. Wax 251 showed acceptable retention of near normal flavour and colour, but little storage life extension. The increase in storage life of 1.5 days from non-waxed mangoes is unlikely to be economical or reliable to be of use.

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**SUBPROGRAM: Grapes**

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**PROJECT: Table Grape Cultivar Evaluation in a Tropical Climate**

**Project Officer: S. McAlister**

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**Objective:**

***The aim of this trial is to screen various table grape cultivars to determine which are suitable for the tropical environment of the Katherine region and to identify suitable management strategies.***

**Method:**

Various table grape cultivars, such as Ruby Seedless, Flame Seedless, Shtur Angur, Kali Sahebi, Muscat Hamburg, Perlette, Cardinal, Ribier, Queen, Carolina Black Rose, Sultana H5, and Hussiene were planted on their own roots at KRS in July and August 1994. Other varieties such as Centennial Seedless, Menindee Seedless, and Maroo Seedless were planted in 1995, on Schwarzman rootstock, Teleki 5A rootstock and own roots, respectively. The vines in this trial were removed in 1998. The data is being analysed and the experiment will be written up as a technical bulletin.

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**PROJECT: Identifying Grapevine Nutrition Issues in the Ti Tree/Pine Hill Areas**

**Project Officers: S. Nagarajah, G. Kenna, C. Ellis and D. Salter**

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**Objective:**

***A study was carried out to determine the nutrient deficiencies in vines at Ti Tree. Soil nitrogen, phosphorus and potassium were also measured. The study is the first stage of a research program, which has the goal of establishing petiole and soil nutrient standards for different vine varieties grown at Ti Tree.***

***At Ti Tree there is a possibility for phosphorus, potassium, magnesium, iron, zinc copper and manganese deficiencies to occur. Also, high vine nitrogen levels can occur because of the high nitrate levels in the bore water. Although the soils at Ti Tree are likely to contain adequate supplies of potassium and magnesium, deficiencies can occur because of inadequate irrigation. In addition, salt toxicity and a heavy crop load can induce potassium deficiency. Heavy cropping induces potassium deficiency because the berries require large amounts of potassium for maturation, sugar accumulation and colour development. Soils at Ti Tree may contain adequate supplies of iron, zinc copper and manganese, but deficiencies may occur because the soil is alkaline.***

**Method:**

*Petiole analysis*

The vine varieties used in the study were Sultana, Flame, Menindee, Red Globe/Ramsey and Menindee/Sultana. The vines were grown in three vineyards. Petiole analysis was used to determine the nutrient problems in the vines. In all the varieties except Menindee/Sultana petiole samples were collected from two vine rows. In Menindee/Sultana petioles from only one vine row was collected. From each row 100 petioles were collected on 15/10/98, 19/11/98, 13/1/99 and 24/3/99.

The petiole analysis results were compared with two sets of grapevine standards. They were the Sultana standards at flowering and tentative nitrogen, phosphorus and potassium standards established for the whole season for Sultana vines (Nagarajah, unpublished results). The limitation of this comparison is that Sultana standards may



not be strictly valid for the table grape varieties grown at Ti Tree. Therefore, firm conclusions cannot be drawn on the basis of this comparison. Nevertheless, the comparison would give some idea of the nutrient problem in vines at Ti Tree.

### Soil analysis

Soil samples were collected from the rows from which petioles were collected on 21/1/99. The samples were from 0-20 and 20-40cm depths. The nitrogen, phosphorus and potassium levels were measured in these samples. Soil nutrient standards for drip irrigated vineyards are not available to compare the soil results.

The Chemistry Section of DPIF at Darwin carried out the petiole and soil analysis.

### Results:

Nitrogen was high in Red Globe/Ramsey, was slightly high in the own rooted vines and slightly low in Menindee/Sultana.

Phosphorus was at the higher end of the adequate range in Red Globe/Ramsey and in own rooted vines. Menindee/Sultana was deficient in phosphorus all through the season.

Potassium was high in Red Globe/Ramsey and slightly high in own rooted vines and in Menindee/Sultana.

Manganese, copper and zinc were not deficient in the vines. Iron was slightly less than the adequate level. However, the vines did not show any iron deficiency symptoms.

### Soil analysis

Nitrogen, phosphorus and potassium were present at a higher concentration at 0-20cm relative to 20-40cm. The difference was most marked in the case of phosphorus.

### Discussion

The only significant nutrient problem was phosphorus deficiency in Menindee/Sultana vines. The soil phosphorus data indicates that low soil phosphorus was not responsible for the deficiency. The soil phosphorus level in Menindee vines was 29 mg/kg. Other vines with only slightly higher levels of soil phosphorus were not deficient in phosphorus. More studies are needed to determine whether phosphorus nutrition is a problem with Menindee/Sultana.

The slightly high levels of nitrogen, phosphorus and potassium observed at Ti Tree can be attributed to a number of factors. These include varietal differences, climatic differences, and irrigation and fertiliser management practices. It was not surprising that Red Globe/Ramsey had higher levels of nutrients than the other vine varieties. This is to be expected because Ramsey rootstock vines are likely to have a bigger and deeper root system than the other varieties.

The high nitrate levels in the bore water did not cause very high petiole nitrogen levels. It appears that other factors at Ti Tree were inhibiting nitrate assimilation and keeping the vine nitrogen level under control eg high temperature, water stress and high salt levels in the vines. Care must be exercised in managing the nitrogen nutrition of vines. Unwanted nitrogen fertiliser would have a number of harmful effects eg, excessive cane growth, reduced fruit bud development in the canes, increased berry splitting during rain and the delayed maturation of the berries.

Petiole phosphorus and soil phosphorus data indicate that high rates of phosphorus fertiliser were being applied in some vineyards. High soil phosphorus can induce zinc deficiency and this could reduce fruit set.

It was likely that deficiencies in Zn, Mn and Cu were not observed because some fungicides contain these nutrients.

### Summary:

- Petiole and soil analysis was carried out to identify nutrient problems;
- Only Menindee/Sultana was deficient in phosphorus;
- No other nutrient deficiencies were noted;
- The vines did not contain an unusually high levels of nitrogen;
- Some vineyards are using high levels of phosphorus fertiliser.

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## **PROJECT: Improving Irrigation Efficiency and Reducing Salt Toxicity in Grapevines at Ti Tree**

**Project Officers: S. Nagarajah, G. Kenna, C. Kinnaird and D. Salter**

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### **Introduction**

Great care must be exercised in managing irrigation at Ti Tree because the climate is arid, the root system is restricted in drip irrigated vines and the irrigation water quality is low. Inadequate irrigation induces vine water stress, salt toxicity and potassium and magnesium deficiencies. Excess irrigation leads to a waste of water and contributes to salt toxicity.

Using scheduling aids, such as tensiometers and weather data should prevent mistakes in irrigation management. Salt toxicity symptoms were observed in Ti Tree vineyards during the last season. The symptoms in the leaf blade appeared as a rim of black tissue followed by the scorching of the margin. Even rootstock vines showed salt toxicity symptoms.

Data on the following subjects are presented in relation to the salt toxicity problem at Ti Tree:

- composition of the bore water,
- exchangeable sodium percentage and electrical conductivity values of the soil,
- sodium and chloride levels in the petiole.

For comparative purposes, the composition of the Murray River water at Loxton and the sodium and chloride levels in petiole samples collected in Mildura are also presented.

### **Scheduling aids:**

#### *A cheap tensiometer*

A cheap tensiometer is now available to monitor soil moisture levels and schedule irrigations. These tensiometers can be made locally and cost about \$10 per unit. An electronic vacuum meter is required to read the tensiometers. Details on how to make these tensiometers and the address from which the electronic meter can be purchased can be obtained from one of the authors.

### **Tensiometer readings**

At present information on the tensiometer readings at which irrigations should be scheduled is not available for Ti Tree vineyards.

### **Evaporation data and crop factors**

Evaporation data and crop factors can be used to calculate the water requirements of vines. The formula used for the calculation is:

$$\text{Evaporation} \times \text{crop factor} - \text{rainfall} = \text{water required by the vines (mm)}$$

Rainfall less than 10mm is not taken into account in the calculation. The accuracy of the method is dependent on whether correct crop factors have been used in the calculation. A whole range of factors influence the crop factor eg method of irrigation, density of planting, the vine variety and the soil type. The annual water required by the vines is 847 mm ie 8.47 MI/ha.

#### *Salt toxicity*

Composition of the bore water.

The composition of bore water at Ti Tree and Murray River water at Loxton was investigated.

The sodium absorption ratio (SAR) is a measure of the active sodium concentration in the water. The SAR and electrical conductivity (EC) values of the bore water are not high. However, the high bicarbonate in the bore water has the potential of increasing the SAR. This would increase the sodium concentrations in the soil and the vine. The high chloride levels in the bore water would also contribute to salt toxicity.

*Soil chemical characteristics*

Exchangeable sodium percentage (ESP) and EC values of soil samples collected from two soil depths were also recorded. The samples were collected from four Ti Tree vineyards on 19/11/98 and 21/1/99.

ESP data indicates that soil collected below 20 cm was sodic, with some samples having high ESP values. The sodic soil would cause sodium toxicity. The EC value was not high.

**Gypsum**

Gypsum can be used to displace sodium from the soil. Dr. P.Rengasamy, of the University of Adelaide, determined the gypsum requirement for soils at Ti Tree. He is an expert on sodic soils and has developed a special soil gypsum test. Sodic soils at Ti Tree require between 2-5 tons/ha of gypsum. High quality gypsum containing low salt should be used.

**Petiole sodium and chloride levels**

Petiole sodium and chloride levels during the season in own rooted and rootstock vines were recorded. The Ti Tree data is from own roots - Sultana, Flame and Menindee

**Rootstocks and Redglobe/Ramsey**

Data from Mildura vineyards was used for comparative purposes. The Mildura samples were from own rooted and Ramsey rootstock Sultana vines, which did not show salt toxicity symptoms. The vines in Mildura were irrigated by either furrow or over-head irrigation systems.

During the season sodium and chloride levels increased more at Ti Tree than in Mildura in both own rooted and rootstock vines. At Ti Tree the increase in sodium level in own rooted and rootstock vines was not markedly different indicating that rootstock vines did not exclude sodium any better than own rooted vines. However, at Ti Tree the chloride level in rootstock vines was lower than in own rooted vines.

At Mildura the toxic levels of sodium and chloride at flowering were 0.5 and 1–1.5% respectively. At Ti Tree sodium and chloride were below these values at flowering but increased significantly after flowering. It is not known whether this increase affected the health of the vines because salt toxicity standards are not available for later stages of vine growth. Until such standards are established the sodium and chloride levels should be kept as low as possible.

*Leaves showing salt toxicity symptoms*

Data on the sodium, chloride and potassium concentrations in healthy and leaves showing salt toxicity symptoms was recorded. The data is mean value from leaves collected from Sultana, Flame and Menindee vines in January 1999.

Leaves showing salt toxicity symptoms had a higher sodium concentration than healthy leaves. The similarity of the chloride concentrations in both sets of leaves suggests that only sodium was responsible for the toxic symptoms. Salt toxicity reduced the potassium concentration by about 70%.

**Control measures**

Adequate leaching irrigations should be applied at periodic intervals during the season to leach salt from the root zone. Gypsum should be used to displace sodium from the soil only after carrying out a soil test.

**Summary**

- Great care should be exercised in managing irrigation at Ti Tree.
- Tensiometers and crop factors should be used for this purpose.
- Tentative tensiometer readings and crop factors have been mentioned.
- Soil and petiole data draw attention to the problem of salt toxicity in vines at Ti Tree.
- Salt levels in the soil and vines should be regularly monitored.
- Adequate leaching irrigations must be applied to minimise salt damage to the soil and vines.
- Gypsum should be used after carrying out a soil test.

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**PROJECT:      Root Distribution Patterns in Drip Irrigated Red Globe, Flame and Menindee Grapevines**

**Project Officers:    S. Nagarajah, C. Kinnaird, D. Salter, D. McDonald, A. Nesbitt and G. Kenna**

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**Objective:**

*At present information on the rooting patterns of vines at Ti Tree is not available. Therefore, a study was carried out to obtain this information including:*

- *vine root growth along the vine row and into the tractor row,*
- *effect of depth on root growth,*
- *soil characteristics in the root zone.*

*Rootstock vines are known to have a bigger and deeper root system than own rooted vines. At Ti Tree the vines are drip irrigated and it is known from the literature that in drip irrigated vineyards the roots are confined to a narrow strip along the vine row. The extent of soil compaction is measured using a penetrometer. It is also known that root growth is inhibited when the penetrometer resistance value of the soil exceeds 2 Mpa and that in saline soil the majority of roots in rootstock vines are confined to the top 60 cm of the soil. In the latter study the electrical conductivity of the saturation extract (EEC) and exchangeable sodium percentage (ESP) below 60cm depth were 6.35 dS/m and 31.3% respectively.*

**Method:**

The study was carried out using 4-year-old Red Globe on Ramsey rootstock, Flame and Menindee grapevines. The vines were growing at a spacing of 3.3 m between rows and 2.4 m within rows. The soil texture was medium and the clay content increased with depth. The vines were drip irrigated and the spacing between the drippers was 0.75m.

Five grapevines from each variety were selected at random along a row for the study. The root system was studied by taking soil cores using an auger (diameter 72mm) at different distances from the vine butt and at increasing soil depths. These soil cores were collected both into the tractor row and along the vine row and the two sides will be referred to as sides 1 and 2, respectively. In both directions, soil cores were collected at 17.5, 35 and 60 cm from the vine butt. In addition, soil cores were collected along the vine row at 90 cm from the vine butt. At each of these positions soil cores were collected at 15cm depth increments until a depth of 150cm. The soil cores were placed in plastic bags and brought to the laboratory to measure the root length. The soil was washed away from the roots in a sieve with 1mm mesh and the root length in each soil core was measured using a graph paper. The root length data was used to calculate the root length density (mm/ cm<sup>3</sup>) in each soil core. The latter value was obtained by dividing the total length of roots (mm) in each soil core by the volume of the soil core, which was 611 cm<sup>3</sup>. The study was carried out between February and April 1999.

Penetrometer resistance of the soil at 15cm depth increments was measured until a depth of 90cm on 6<sup>th</sup> May 1999. These measurements were made at five positions next to each of the vines used in the above study. Because soil moisture level affects the readings, irrigation was applied a day prior to taking the penetrometer readings.

**Results:**

*Total root length*

An estimate of the relative sizes of the root systems in the three varieties was obtained by comparing the total length of roots collected in the seven soil cores.

According to the root length data Red Globe/Ramsey had the biggest root system and Menindee smallest root system.

*Root distribution*

Root distribution - into the tractor row vs along the vine row

Results showed that:

- Root growth along the vine row was more than root growth into the tractor row,
- Root growth along the vine row did not decline with increase in distance from the vine butt.

- Root growth into the tractor row declined with increase in distance from the vine butt.

The percentage reduction in root length into the tractor row at 35 and 60 cm relative to 17.5 cm was recorded.

### **Root distribution - effect of depth**

#### *Side 1 - into the tractor row*

The effect of depth on the root length density in Side 1 showed that the root length density decreased with depth. The root length density at 17.5 cm was generally higher than at 35 and 60 cm in all three varieties. However, the root length density at 35 cm was higher than at 60 cm only in Red Globe/Ramsey and not in Flame or Menindee. At 17.5 cm the decline in root length density with depth started at a depth of about 75cm in Red Globe/Ramsey. While the decline in root length density with depth in Flame and Menindee began at a depth of 30cm. In all three varieties there was a marked reduction in root growth below 90 cm and a few roots were found even at 150 cm.

#### *Side 2 - along the vine row*

The effect of depth root length density along the vine row at 17.5, 35, 60 and 90 cm showed that the root length density data for each variety at the four positions were generally similar.

In all the varieties about 80% of the roots in Side 2 were present in the top 60 cm of the soil.

Results showed that:

- The highest and lowest root length densities were in Red Globe/Ramsey and Menindee respectively,
- The reduction in root length densities with increase in depth started at 30 cm Red Globe/Ramsey and Flame and in Menindee it started at 15 cm,
- The soil depth at which the three varieties started to have very low root length densities ( $<5 \text{ mm/cm}^3$ ) was different. For Red Globe/Ramsey, Flame and Menindee it was 100, 75 and 45 cm respectively,
- A few roots were found even at 150 cm.

#### *Penetrometer resistance*

The penetrometer resistance increased from about 1 to 1.5 Mpa to about 3.4 to 3.9 Mpa with increase in soil depth.

### **Discussion**

The rooting pattern of the three varieties was different. Red Globe/Ramsey had the biggest and deepest root system while Menindee had the smallest and shallowest root system. The size of the root system alone does not determine vine vigour and yield. Two hormones synthesised at the tip of the roots also determine it. These hormones are gibberellin (GA) and cytokinin.

The restriction of root growth to a narrow strip along the vine row is similar to other results in drip irrigated vineyards. The absence of any difference in root growth along the row indicates uniform wetting of the soil with a dripper spacing of 0.75m. This refers to a medium textured soil in which the clay content increased with depth.

The penetrometer data indicates that soil compaction was one factor responsible for the decline in root growth with increase in depth. The increase in soil compaction may have been caused by increases both in silt plus clay and sodium contents of the soil. The increase in silt plus clay content is responsible for the change in soil texture from a light to a heavy soil. Sodium hardens the soil by cementing the clay particles. Studies should be carried out to determine whether deep ripping prior to planting vines and incorporation of gypsum in the soil would promote root growth deeper in the soil. Any increase in the size of the root system will be beneficial because drip irrigated vines have a small confined root system.

Grapevines with a confined root system in drip irrigated vineyards will more quickly deplete water and nutrients from the roots zone than vines with unrestricted root growth.

Thus special care must be taken in the irrigation and nutrition management of drip irrigated vines. Therefore, scheduling aids should be used to manage irrigation in drip irrigated vineyards. If tensiometers are used they should be placed at depths of 30, 60 and 90 cm for Red Globe and Flame and at depths of 20, 40 and 60 cm for Menindee. The readings on the shallow tensiometer should be used to decide when to schedule irrigations. The two deeper tensiometers should be used to find out whether sufficient water is supplied at each irrigation to wet the full root zone.

## Summary

- The root system four-year-old drip irrigated Red Globe/Ramsey, Flame and Menindee was studied in a Ti Tree vineyard. The intention was to use the root data and improve irrigation management.
- The study was carried out by collecting soil cores using an auger at 15-cm depth intervals until a depth of 150 cm. The soil cores were collected at different distances from the vine butt into the tractor row and along the vine row. The soil cores were washed to collect the roots and their length measured. The root length data was used to calculate the root length density (mm/cm<sup>3</sup>) in each soil core.
- Root growth was mainly confined to a narrow strip along the vine row and only limited root growth took place into the tractor row.
- Red Globe/Ramsey had the biggest root and deepest root system and Menindee the smallest and shallowest root system.
- About 80% of the roots were present in the top 60 cm of the soil.
- Penetrometer resistance data indicated that soil compaction increased with depth.
- When tensiometers are used to schedule irrigations they should be placed at depths of 30, 60 and 90 cm for Red Globe/Ramsey and Flame and at 20, 40 and 60 cm for Menindee.
- The shallow tensiometer should be used to schedule irrigations while the two deeper tensiometers should be used to find out whether sufficient water is supplied at each irrigation to wet the whole root zone.

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## **PROJECT: Survey of Irrigation Practices in Tablegrapes in the Ti Tree Area**

**Project Officers: G. Kenna, S. Nagarajah and D. Salter**

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## Introduction

There are a number of issues regarding crop water use in vines in the Alice Springs region, which need to be addressed in order to improve crop productivity. Crop water use, the efficient application of water, irrigation scheduling, the sustainable use of water and the effects of irrigation water on soil structure and plant health have all been identified as being factors which are critical for the ongoing profitability of the industry.

### **Objective:**

***As part of the ongoing research attempting to address these issues the Ti Tree Water Advisory Committee requested DPIF to initiate a survey of current irrigation practices within the water control district. The main objective of this project is to gain information, which could be used to assist in determining what effects current practices are having on these issues.***

## Survey Method

Table grape growers willing to cooperate in the survey were asked to record the number of hours each irrigation shift was watered for each month. If tensiometers were installed in the planting the tensiometer readings were also recorded.

The number of vines in each irrigation shift, vine age, row spacings, emitter spacings and emitter output data was also collected. In addition the volume of water pumped each month was also recorded from the meter at the bore.

## Survey Trends

The survey started in December 1998. It is planned to continue the project for as long as possible with the cooperation of growers. It would also be beneficial to expand the project to involve all table grape growers. The information gathered will become even more valuable as research work into crop water use and irrigation scheduling proceeds.

Although the survey only began in December there are a number of trends evident in the data which has been collected so far, regarding irrigation scheduling and crop water/leaching requirements:

- Irrigation scheduling at the 3 properties surveyed varied considerably. Periods between the application of water varied from intervals of 2 days up to 7 days.

- Plantings irrigated at intervals of 7 days had a large variation in moisture levels in the vine root zone over that period of time as indicated by the 30cm and 60cm tensiometers.
- Crop water requirements applied to vines on 2 properties were adequate during the post-harvest period after December, however moisture levels in vines at the other property varied significantly in the vine root zone.
- The general trend for 90cm tensiometer readings on all properties has been between 15 centibars (cb) and 23 cb from December to March with readings increasing to between 20 cb and 60 cb on one property in April.

### **Discussion**

The high tensiometer readings indicate that the moisture available to the vine was severely limited. Tensiometer readings of greater than 15cb at 30cm would certainly stress vines based upon recommendations from South African research.

Not supplying adequate amounts of water after harvest can also have a detrimental effect on vines the following season. The plants begin a flush of new root growth after harvest. They also take up and store nutrients for the following season and mature canes. Moisture stress or the accumulation of high levels of sodium in the plants at this time inhibits the ability of vines to perform these functions.

The leaching factor, ie surplus water to the requirements of the plants, applied to leach accumulated salts down past the vines root zone, is not applied in sufficient volume in the majority of, if not in all, irrigations. This is evident by the tensiometer readings at 90cm, which do not indicate that any significant volume of water is infiltrating the soil profile to that depth.

### **Summary**

- Efficient crop water use is an important issue for the horticulture industry in Central Australia.
- Water quality available for horticulture in the region requires good management for long term viability of crops.
- The scheduling of irrigations in table grapes has implications for crop yields, quality, vine health and long term management of soils.
- Better irrigation management is an important issue for the horticultural industry in this region, which needs to be addressed by ongoing research.

Acknowledgment: The cooperation of the participating growers in the recording and collection of this data is very much appreciated.

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## **PROJECT: Management Techniques for Red Globe Grapes in a Tropical Environment**

**Project Officer: S. McAlister**

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### **Objective:**

***Red Globe table grapes remain one of the most popular grape cultivars for both the domestic and Asian market. Although seeded, consumers are attracted to its very large size and good eating qualities.***

***This project aimed to determine if Red Globe grapes could be produced successfully as well as the optimum pruning method for this cultivar, in a tropical environment. Red Globe vines were grafted to Ramsey rootstocks and planted in the field in 1992. Six pruning methods were applied to 6 single vine replications in a randomised complete block design. The vines in this trial were removed in 1998. The data is being analysed and the experiment will be written up as a technical bulletin.***

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## **PROJECT: Nematode Survey in Tablegrape Plantings and the Use of Rootstocks**

**Project Officers: G. Kenna, C. Ellis and D. Salter**

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### **Introduction**

The table grape industry in Central Australia is a relatively new primary industry in the Northern Territory. Although the first commercial planting of table grapes was made in the early seventies the industry has only experienced rapid expansion in the past twelve years.

The majority of plantings that have been made in the area have been own rooted vines. Standard practice until recently has been to plant the late maturing variety Red Globe on Ramsey rootstock with the varieties Flame Seedless, Menindee Seedless and Thompson Seedless being grown on their own roots.

There have been instances in the past few years where vine vigour has been reduced dramatically with a subsequent loss in yield and in some instances death of vines. Investigation of the cause of this loss of vigour in a part of a planting and the subsequent death of some of these vines has revealed root knot nematodes as the cause. The implications for the future expansion of plantings of table grapes and the management of own rooted vine plantings is an issue that must be addressed by industry in this region.

The light sandy soils and climate in the Alice Springs region are ideal for the spread of root knot nematode once it has been introduced into susceptible plantings. High soil temperatures during the long, hot summers are ideal for the rapid increase in nematode populations, including an increase in the number of generations during a season compared with the more temperate vine growing areas of southern Australia.

### **Objective:**

***It was decided to survey the table grape plantings in the Ti Tree/Pine Hill areas to assess the extent of nematode populations in established vine plantings. Areas being prepared for vine plantings in 1999 were also sampled.***

### **Survey method:**

All commercial growers in the Ti Tree/Pine Hill areas were asked to participate in the survey that included covering the cost of the soil analysis. The number of samples taken from each property was dependent upon the size of the planted areas and the number of irrigation shifts. Sampling based upon irrigation shifts was important for ease of management if there was a requirement to use Nematicurâ through drip lines.

Soil samples were taken to a depth of 30cm over all areas. Up to 10 samples were taken for each irrigation shift. The number of samples taken depending upon the size of the area. Care was taken to sterilise sampling tools with bleach to ensure that nematodes were not spread during the sampling process. Each soil sample was then mixed mechanically and a sub-sample taken for analysis.

Prepared samples were then sent to the Department of Primary Industries and Resources at Renmark, South Australia for nematode identification and counts.

### **Results:**

A total of 6 properties were surveyed. Another property that was not surveyed at this time had been sampled earlier and results were recorded for comparison.

Lance nematode, (*Hoplolaimus spp*) has not been identified as a parasite of commercial horticultural crops and is indigenous to the soils in the area.

Survey results did indicate that root knot nematode is present in a number of plantings in the area. A count of more than 80 root knot nematodes per 200gm of soil is considered to be the threshold for economic damage to vines. This nematode is already a major threat to the long-term viability of a number of vine plantings in the area, for the following reasons:

- Soils best suited to root knot nematode are sands, sandy loams and sands. All vine plantings are grown on these soil types.
- A wide variety of host plants and weeds are susceptible to nematode attack including tomato weed which can be difficult to control in vine plantings in the area.



- A female nematode may lay from 500 to 1000 eggs every 6 weeks under ideal conditions

Root knot nematode numbers vary throughout a vine planting. Populations will be at their highest where a vine root-ling which is infested with this nematode is planted into clean ground or when a clean vine root-ling is planted into soil which has been previously infested with root knot nematode.

If a small percentage of vines planted into virgin soil are infested with root knot nematode populations will tend to be confined to the vine originally infested and perhaps a cluster of vines in the vicinity.

It is estimated that root knot nematode may spread down a row of vines at the rate of 1 metre/year in grapevine plantings where no cultivation occurs.

### **Management of root knot nematode**

Root knot nematode can be managed in a number of ways:

#### *Source clean plant material*

When sourcing vine material from nurseries ask what precautions they take to ensure that plant material is not infested with nematode. Before vine material can enter the Northern Territory a quarantine requirement is that it must be "hot water treated at 51.5°C – 54.5°C for 3 to 5 minutes or fumigated with Methyl Bromide". This helps to ensure that the plant material is free of nematode. However it is not a guarantee.

#### *The use of Nemacur® in established plantings*

Nemacur® (Fenamiphos) can be applied to grapevines through the dripper system to reduce nematode populations. It should be applied when nematode populations are high and vines are making new root growth. Regular treatment will be necessary throughout the life of plants.

The cost to treat one hectare of grapevines is approximately \$400. There is no withholding period when the chemical is applied to this crop.

#### *Nematode resistant rootstocks*

The use of these rootstocks must be seriously considered if the long term production of table grapes is to be viable in soils which are infested with or have the potential to be infested with any plant parasitic nematode.

The nitrate content of some bore water used for irrigation has in the past been considered to be a major impediment to the use of rootstocks. Past research in other countries indicates that this may not necessarily be the case. Nitrate is reduced to nitrogenous compounds in the plant's leaf blade. An enzyme is required for this conversion to occur. Water stress or high salt levels in the plant can inhibit the enzyme reaction. Both of these factors can occur at Ti Tree and may affect plant vigour.

### **Summary**

- Nematodes are becoming an increasing threat to the viability of table grape plantings grown in their own roots in the Alice Springs region.
- The climate and soils in this region are ideal for the rapid increase in nematode numbers in susceptible crops.
- Treatment of infested plantings is costly and can have poor results.
- Sourcing clean nursery stock is an important issue that may limit introduction of the pest.
- The suitability of nematode resistant rootstocks needs to be evaluated under Central Australian conditions.
- The use of rootstocks may have other advantages in terms of irrigation management and water quality.

**SUBPROGRAM: Banana**

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**PROJECT: Banana Cultivar Evaluation**

**Project Officer: J. Bright**

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**Objective:**

*The aim of this experiment was to develop a database on the performance of different banana cultivars and identify cultivars suited to the climatic conditions of the Katherine region. A trial was field planted in February 1995. Observations were made on flowering and fruiting times, as well as bunch weights and fruit quality. The plants in this trial were removed in 1998. The data is being analysed and the experiment will be written up as a technical bulletin.*

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**PROJECT: Banana Nutrient Monitoring**

**Project Officers: K. Blackburn and M. Traynor**

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**Objectives:**

*This project commenced five years ago. Industry and DPIF initiated it after the formation of the Banana Working Group in late 1993. The project consists of bi-monthly soil and leaf analyses to be correlated with grower fertiliser practice to optimise banana nutrition. Initially, the project set out to establish what the 1994 situation was in respect to the nutritional status of plants and the frequency, amount, and type of fertiliser applied. Since then the project has generated sufficient data to enable growers to dramatically improve their plant nutrient status and to understand some of the nutritional problems they face under local conditions.*

**Results and Discussion:**

Results over the first four years of the project have shown some interesting trends. Starting with one grower with under tree sprinkler irrigation in 1994, now all farms are using the system with frequent fertiliser injection as a part of the system. It was quickly recognised that high soil and leaf levels of magnesium, which originated from the dolomitic bore water, had seriously altered the cation balance within the plant and restricted the uptake of calcium and potassium. As well, nitrogen, zinc and boron were less than optimal on all farms in the early project period. It was found that both ground and foliar applications of zinc were necessary to raise leaf zinc levels above the critical level. Small frequent applications of potassium fertilisers increased the leaf potassium levels but leaf calcium levels were still low although magnesium leaf levels could be reduced by this technique.

Currently, all growers are very much more aware and concerned with the leaf and soil nutrient levels in their crops and use the regular analyses as the basis for their crop fertiliser programs. Unfortunately, none of the growers are using soil moisture instruments such as tensiometers to precisely schedule irrigation, which is considered essential on sandy soils, to gain optimum response from improved fertiliser programs. The calcium story is still not fully understood although the addition of large quantities of gypsum or lime is required to build up calcium levels over a long period to restore cation balance. In tropical climates, calcium, nitrate and potassium levels are generally low in the plant due to high growth rates. There is now recognition of low Ca to Mg ratios in other crops such as mango and rambutans and high Ca applications are being used to increase the ratio. It is now thought that a soil Ca level of around 1000 ppm may be a more realistic goal to aim for.

On-farm trials are assessing the injection of micro-fine gypsum into the irrigation water as a water treatment to adjust the Ca/Mg ratio. At this stage it is too early to evaluate the results of this work. In the past year one interstate and one local fertiliser spreading company have set up in the Top End. The interstate company is using gypsum sourced from Alice Springs and lime from Mataranka. With these new services the use of calcium compounds will increase as growers understand the cation imbalance problems with local soils. However, improved crop yields and fruit quality may not be the major outcome of the improved nutritional status.

One of the main objectives of this project was to correlate grower fertiliser practice with soil and leaf levels of nutrients. The interaction of some selected fertilisers with leaf and soil analysis for one leading grower was investigated. This farm injects nutrients through the under tree irrigation system, with the exception of lime and superphosphate, on a weekly basis. The small frequent applications of potassium (K) have overcome the cation imbalance caused by

excess magnesium (Mg) and have raised leaf K to an acceptable level. It should be noted that frequent injection of nutrients into the soil does not lead to a general build-up of nutrients in the soil particularly with K and phosphorus (P). The P soil levels were high when D.A.P. dry fertiliser was used at high rates in February 1996 and April 1997 but dropped when small amounts of M.K.P. were injected at weekly intervals.

The highly mobile elements nitrogen (N) and boron (B) have been kept in the sufficiency range by regular applications which, in the case of Boron was not achieved until after April 1997 when regular applications were applied. The calcium story is not so clear. The farm management injected weekly amounts of calcium nitrate over 12 weeks from March to June 1997. The soil Ca levels have risen after Ca application but still remain at levels below the 0.6 – 0.9% sufficiency range. The soil Ca levels are gradually rising over time and that would most likely be due to the influence of Ca contained in the irrigation water. Further work is being carried out on the long-term effects of micro-fine gypsum injection onto commercial banana plantings on the same farm.

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**PROJECT: Banana Nurse Sucker Selection Experiment**

**Project Officer: J. Bright**

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Although Katherine has quite an extreme environment, it is possible to produce exceptional quality bananas with little problems of pests and diseases. A commonly held view among certain sections of producers was that conditions were too cold to produce fruit through the dry season and therefore consistent supply to the market was not possible. The aim of the project is to implement nursery management as a tool to influence bunch production and to attempt to produce bunches (of good quality) through the dry season months and thus have a continuous supply through the year. The plants in this trial were removed in 1998. The data is being analysed and the experiment will be written up as a technical bulletin. Some results were presented in the Horticulture Division Technical Annual Report 1997/98.

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**SUBPROGRAM: Tropical Exotics**

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**PROJECT: Durian Introduction and Cultivar Trial**

**Project Officers: L. Luders, T.K Lim, S. Marte, Y. Diczbalis and M. Hoult**

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**Objective:**

***Durian varieties and Durio species have previously been introduced from Thailand, Malaysia, Sarawak and Queensland. The trees were established at Berrimah Agricultural Research Farm (BARC) or Coastal Plains Horticultural Research Farm (CPHRF) as seedling trees, or as grafted trees. These collections resulted from efforts to find high-yielding and more adaptable species for the Darwin environment.***

**Method:**

During November 1998, Yan Diczbalis and Mark Hoult visited Sabah and collected several plant species and clones, including *Durio kimabatuensis* and *Durio sp.*, possibly *D. zibethinus*. The species were brought back to Darwin as seed and germinated successfully. The trees will be established at BARC or CPHRF when they are a suitable size.

Grafted and seedling plants from previous collecting trips were planted into the remaining rows of the durian variety block at CPHRF from 1996 until November 1998. Many trees were severely stressed or died from the subsequent flooding of the block during the wet season. The larger, established trees showed only minor water stress, but all small trees were severely affected by the water.

A paper, entitled 'Seasonal Changes in Durian Leaf and Soil Mineral Nutrient Element Content', was published in the *Journal of Plant Nutrition*. The paper reports the results and recommendations for the Darwin area from the durian leaf and soil monitoring study conducted over several years.

**Durian Multiplication using cuttings**

Demand for durian fruit is increasing in Australia and available seed is limited. Seed from South East Asia can be difficult and expensive to source. A rapid method for multiplication of material for rootstocks is required to

overcome the shortage of seed.

Cuttings are quite easy to establish in many ornamental and temperate fruit species, but have a low success rate for tropical, woody fruit-tree species. A trial using young material from lower branches, various rooting hormones and rates, misting and bottom heat, leaves and no leaves, different branch thicknesses, and different media, was started in the wet season and continued into the dry season.

A literature search revealed many techniques to produce rooted cuttings. Only one PhD paper (Hasan, B. M. 1983) referred to durian cuttings. In the paper, only seedling trees were used to obtain rooted cuttings. The trees were less than two years of age in a controlled environment glasshouse. Cuttings were treated with an alcohol dip with or without IBA, and some were wounded at the base.

Other papers mentioned tree pruning to encourage new growth, pre-treatment of the branches prior to removal, length of cuttings and thickness, bleach and fungicide dips, and IBA and NAA dips. Most papers recommended perlite or vermiculite media, and storage in a misting unit with bottom heat. For the various species mentioned in the papers, time to form roots was from two weeks to twelve months.

The trial commenced in February, using new growth from the lower branches of the trees at BARC, and continued until April, where the branches were defoliated several weeks prior to removal. No cuttings were collected after this due to the dry season conditions. The cuttings received various treatment methods and were stored in a bottom heated misting unit at CPHRF. The final trial was relocated to an enclosed fish tank in a shade house at BARC due to the low success rate at CPHRF

Leaves or new shoots were retained on cuttings prepared during the wet season, and also cuttings in the final trial, which were kept in an enclosed fish tank. The cuttings and the media in the misting unit became very damp and fungal growth was noted on the cuttings. Bottom heat induced callous tissue rapidly when plastic covered metal trays were used rather than open plastic seedling trays, but the plastic bags used to enclose these trays did not retain enough moisture to sustain the cuttings. The vermiculite in the fish tank was damp before sealing, and this enabled the cuttings to receive a constant high humidity. The cuttings were sprayed once with fungicide inside the fish tank, but fungal growth still occurred in the high humidity.

Using a very low concentration of bleach or the alcohol dip did not damage the cuttings. The hormone treatment using a powder, liquid, or powder dissolved in alcohol, did not show any differences at this stage. Wounding the base of the cutting before the hormone treatment does appear to induce a faster callous formation. Thicker cuttings are surviving better in the misting unit as the thin cuttings dehydrate rapidly. Thin cuttings in the enclosed fish tank did not dehydrate as quickly.

Defoliation prior to removal did encourage new buds to swell on the branches. Two leaves retained at the top of other cuttings remained attached while the humidity level was above 95%. Seedling trees also appear to have faster callous formation than grafted trees.

Although the results do not look promising at this stage, the success may be better once the dry, cold conditions have gone. While the cuttings are not actively growing, the bark on the lower half of the cuttings is still green and hydrated. Further assessment in the wet season may reveal a successful treatment for obtaining rooted durian cuttings.

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## **PROJECT: Avacado Cultivar Evaluation**

**Project Officers: S. McAlister and R. Renfree**

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### **Objective:**

***A low land tropical environment, such as Katherine, presents considerable problems in terms of avocado production. Most importantly, many cultivars recognised by the market and consumers simply fail to flower under the warm conditions. It is only cultivars from the West Indian avocado race, or hybrids derived from them, that are considered to possess the ability to fruit under conditions at Katherine. Although the market opportunities for this crop are considered limited, these trees will be monitored until they commence fruiting. It is hoped that it will be possible to at least identify a cultivar suitable for small-scale commercial production.***

### **Method:**

Trees of the cultivars. Semil 34, Hall, Choquette, Peterson, Pollock, Waldin, Tower 2, Vitoria, Booth 8, Dr Dupius 2, Kimberly and T6 were propagated at KRS onto Zutano seedling rootstocks and planted in the field in October 1995.

**Results:**

No results have yet been collected in this trial. The trees are just starting to reach flowering age. Over the next few years the trees will be monitored for fruit yields and fruit quality.

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**PROJECT: Lychee Cultivar and Flower Induction Assessment**

**Project Officers: S. McAlister and R. Renfree**

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**Objective:**

*Lychee trees have been growing in the Katherine region for many years but, with few exceptions, they seldom fruit. It is felt that this is a consequence of the high nighttime temperatures generally experienced throughout the year. Opportunities for crop phenology manipulation, and the identification of cultivars better suited to the environment are two areas where some research is justified.*

**Method:**

Marcotts of Tai-so and Kwai may-pink were planted at KRS in June 1994 and February 1995, respectively.

**Results:**

No results have yet been collected in this trial. The trees are just starting to reach flowering age. Over the next few years the trees will be monitored for fruit yields and fruit quality.

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**PROJECT: Cupuacu Research**

**Project Officers: C. Wicks, A. Hosking, S. Marte and Y. Diczbalis**

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Cupuacu (*Theobroma grandiflorum*) is a relative of cocoa and is commonly used in Brazil for the production of juice, nectar and jams from the considerable mass of pulp found around the seeds. The fruits, commonly called pods, are generally larger than those of cocoa and rounder in shape. A number of publications from Brazil suggest that the seeds can be used to make a chocolate-like product called "cupulate". The cupulate product is low in caffeine and theobromine, two stimulants that are found in chocolate, and hence may be useful for creating a "health food" product. Cupuacu also lends itself to mechanical harvesting as the pods drop to the ground when ripe, unlike cocoa, which needs to be harvested by hand. The combination of novel product possibility and applicability of mechanical harvesting suggests that Cupuacu may have potential as a new crop for the tropical north of Australia.

The performance of Cupuacu trees is difficult to compare with other plantings, as there is no published data available on growth and yield of Cupuacu in its native or any other environment. The dry bean yield of four-year-old trees was 430 kg/ha. The yield evaluation carried out in the last season suggests dry bean yield may be capable of reaching 1000 kg/ha/year with pod yields in the vicinity of 9,000 kg/ha/year.

In 1998 a large testing (over 150 samples) of Cupuacu pulp product was made. In this testing both ice cream and juice products made by Territory Gold (a commercial fruit processing plant) were tested. The results were quite favourable, with 86% and 94% of the samplers liking the ice cream and juice respectively. To the question of purchasing the products, 72% and 86% indicated affirmatively for the ice cream and juice respectively.

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**PROJECT: Miscellaneous Exotic Fruits Research**

**Project Officers: L. Luders, T.K. Lim, S. Marte, Y. Diczbalis and M. Hoult**

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**Fruiting cactus species**

Pitaya varieties were the main focus for work on miscellaneous fruit for this year. New cultivars of the red skinned, white fleshed variety (*Hylocereus undatus*) were collected from Vietnam, and the red skinned, red fleshed variety

(*Hylocereus polyrhizus*) was sourced from a local grower. New growers have become interested in pitaya growing over the last year, promoting the publication of a pitaya Agnote. Fruit were harvested from the red skinned, white fleshed pitaya, and also the yellow pitaya (*Selenicereus megalanthus*), from November to March. Flowers did not set fruit once the wet season finished, except on the apple cactus (*Cereus peruvianus*), a columnar species which has a longer fruiting season than the climbing cactus species.

New and existing plants were pruned for cuttings, which were distributed to growers, or potted for a new trial. A new method of growing the cuttings on concrete posts will be looked at, since the metal trellis system has not allowed the branches to hang down for flowering and fruiting. The new area is being established on a higher site at CPHRF, as the original site was prone to flooding in the wet season.

### **New introductions**

N. Dasari introduced new exotic fruits from Sydney, TK Lim and N. Dasari from Vietnam, Y. Diczbalis and M. Hoult from Sabah and by V. Kulkarni from Brazil. Most were brought in as seeds and others as cuttings or bare rooted plants. All seeds germinated except the mango seeds from Vietnam. A cocoa species (*Theobroma bicolor*) from Sabah, which drops the ripe pods, died from fungal diseases after germination. Others plants were potted on after germination, and are to be planted at BARC or CPHRF, or are available for growers to purchase.

Some deaths or leaf drop occurred in the BARC old and new areas in the previous introductions, either due to the dry season, waterlogging in the wet season, or termite damage. Flowers were recorded from: *Lepisanthes sp.*, *Artocarpus rigidus*, *Garcinia livingstonei*, *Blighia sapinda* (Akee), *Nephelium kebau*, *Antidesma bunius* (Bignay), *Carissa grandiflora*, *Averrhoa bilimbi* (Bilimbi), *Garcinia dulcis*, *Sandoricum bomeese* (Kelanpu), *Mangifera torquenda* (Lamantan) and *Pouteria sapota* (Mamey Sapote). Fruitset did not follow flowering in some species. Some deaths and damage were also recorded in the black netted area at CPHRF.

A review of both orchards at BARC and CPHRF was conducted and the recommendations on tree removal will be followed through next year. Planting of the new trees in the nursery will occur when they are of a suitable size.

### **Imbe fruit assessment**

Seeds of *Garcinia livingstonei* (Imbe) were introduced from Florida in 1992. Trees were planted at BARC and CPHRS, with a combination of male and female trees flowering by two years of age. Fruit from both orchards were harvested in August 1998, for a comparison between the growing areas. Fruit were harvested at the full orange colour, and were assessed within one day after harvest.

The CPHRF orchard receives more water and fertiliser than the arboretum at BARC, and is more protected. The lack of windbreaks around the BARC orchard resulted in two of the three trees being blown over to a 45° angle. The trees were pruned and staked back during the wet season, which did not hinder flowering and fruiting during the dry season.

Fruit from CPHRF were larger than from BARC but had a lower Brix reading and less flesh recovery. While latex was only present in the flesh of one assessed fruit, the seeds contained latex. Fruit contained one large and one very small seed, or two large seeds. Flesh colour was noted to be in two bands, with a darker orange flesh near the skin, and a yellow to orange band around the seed. The shape of fruit was mostly rounded, though a flattened shape was also recorded. While total harvest weights and numbers are not available at present, the trees do carry a high number of fruit along the main trunk and branches.

### **Abiu phenology**

Three varieties of abiu (*Pouteria caimito*) are growing at CPHRF - a Queensland selection and two local selections made from over seventy seedlings grown previously at CPHRF. Four trees were randomly selected in April 1998 and twenty branches were marked and tagged per tree. Measurements were taken on a regular basis for branch length from the mark and phenology activity. Measurements ceased close to final harvest due to the trees being pruned along with other trees in the orchard. Measurements and phenological data are summarised below. Unfortunately, in the random selection of trees, only two of the three varieties were assessed.

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## **PROJECT: Carambola Fruit Deformity - Nutritional and Pollination Problems**

**Project Officers: L. Luders, T.K. Lim, S. Marte, M. Poffley and G. Owens**

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### **Fruit deformity and pollination problems**

No further carambola pollination studies were conducted during 1998-99.

### **Nutrition**

Leaf and soil samples have been collected from the carambola (*Averrhoa carambola*) trees at CPHRF since March 1993. Trees in the trellis and single trees were initially compared but due to tree death, new trees of different varieties were added in 1997. The results are to be used to calculate m-DRIS indices for carambolas to determine the fertiliser requirements of the trees throughout the year. A second property was added to the sampling run in 1997 and two more properties added in 1999, to reach a sample size of approximately 300 by the end of 1999. The different properties also have different soils and management practices. High producing trees and different varieties are also present on the new properties. Except for CPHRF, growers are following a similar pruning program but have different fertiliser programs.

Leaf and soil samples are collected every two months from the properties. The sixth pair of mature leaves from the terminal end is collected randomly from branches around the tree for a total of twenty or more leaves, depending on their size. Four 10cm soil cores are collected from each tree and combined. The leaves are washed, rinsed, dried and milled before sending to the Chemistry section for analysis. Soil samples are air dried and sieved before sending to Chemistry.

At the end of May 1999, 232 samples had been collected over 38 sampling months. Using these results to calculate preliminary m-DRIS indices for leaf samples, the limiting factors are those elements that are less than the dry matter (DM) index. The present indices are only calculated for nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). The data, in terms of months, years and properties, show that most of the calculated elements are limiting throughout the year. This would be expected as carambola trees can fruit for most of the year with a regular pruning program.

Both leaf and soil results show a drop in nutrient levels during the wet season. This is when the main crop is harvested and also fertiliser applications can be reduced due to the rain. The second property also had higher levels of zinc (Zn), copper (Cu) and manganese (Mn) in the leaves due to the spray program used. Different soils and fertiliser applications are evident with the extra properties as the pH and conductivity levels have changed. There has also been an increase in the levels of certain elements with higher and/or more frequent fertiliser applications.

Samples will continue to be collected until the end of 1999, bringing the total sample number to 292. Final m-DRIS indices can then be calculated for the Darwin rural area.

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## **PROJECT: Durian Precocity Trial**

**Project Officers: L. Luders, T.K. Lim and S. Marte**

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The durian precocity trial is continuing at CPHRF. New plantings were added in November 1998 to complete the four replications, but could be included due to the age difference and death of trees during the prolonged flooding of the block during the wet season.

The two established rows have missing trees in some treatments and will now be considered only as an observation block for the influence of single and double rootstocks, and a comparison of the clones D24 and Gumpun with seedling trees. No flowers have been recorded on the trees at this stage for any treatment. The trees are growing well but showed signs of stress due to waterlogging. Smaller replant trees are severely stressed, while some of the larger trees have had a high defoliation rate.

Differences in the tree shape are visible between the two clones, as expected. D 24 has a rounder shape, while Gumpun is conical. The seedling trees have various shapes. D 24 trees also show rolling of the leaves throughout the year, which is typical for this variety. The height growth data for the two replicates does show a slightly more growth in height for the double rootstocks. While D 24 is growing faster in height at this stage than Gumpun, eventually it is expected to be a shorter tree. Differences in the mean trunk diameter growth show that D 24 has more growth than the seedling and Gumpun trees at this stage.

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## **PROJECT: Mangosteen Precocity and Phenology**

**Project Officers: L. Luders and T.K. Lim**

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The mangosteen, *Garcinia mangostana*, is a slow growing rainforest tree from South East Asia. Most trees are female and are able to set fruit and seed without pollination. Shading is required and fruit is produced after 8-10 years. The trees have a long taproot and some lateral roots, but few root hairs, which are needed for the uptake of water and nutrients.

In this trial the following seedling treatments were compared: double rootstocked seedling prepared by inarching and cleft grafting with scion wood from a bearing tree, double rootstocked seedling non-grafted at the top, single rootstocked seedling cleft-grafted as above, and seedling with a single rootstock and non-grafted. Inarching began in 1992 and grafting was done over the 1992-93 wet season.

**Method:**

Six rows of mangosteens were planted at CPHRF in April 1993, in three twin rows, and 50% shade cloth covers were placed over the trees. Trees were planted 5m apart within rows, 6m apart within the twin row, and 8m between the twin rows. The first and sixth rows were used as guards and rows two to five were used for the precocity trial. *Gliricidia* shade trees were planted near each mangosteen. Inga bean (*Inga edulis*) shade trees were planted between the twin rows a year later. The trees were maintained until 1995 but then several problems were experienced which prevented the trial from performing as expected.

**Results:**

Growth was slow in the dry season but improved during the wet season. The double rootstocked, non-grafted plants had the best mean height growth in the first year, followed by non-grafted seedlings. Trees were growing well until the *Gliricidia* formed a canopy cover over the trial. Rootstock regrowth was removed from the grafted plants to encourage the scion to grow. This resulted in more suckering from the rootstock. The shade cloth covers were removed to maintain adequate light levels to the mangosteens. Poor growth was evident soon after. The *Gliricidia* shade trees were very competitive with the poorly developed mangosteen roots. Lack of nutrients and water, too much shade and insects and fungi problems were attributed to the shade trees and these were cut down and the trunks painted with Garlon and diesel.

The mangosteens were assessed and double rootstocks were regrafted where required. These were not successful as mounds were placed around the trees soon after grafting. The scions of the grafted plants were sprayed with urea and/or GA<sub>3</sub>. Scion deaths were recorded after these sprays. The shade cloth covers were placed over the trees again to prevent leaf burning.

The trial was discontinued in January 1999. The trees remained unthrifty after the *Gliricidia* trees were removed. Problems in tree growth and deaths could be due to the initial root competition, too much and too little shading, herbicide damage to the trunks, fungal damage causing dieback on trunks and branches, insect damage to new leaves, the grafting process, and rootstock suckering.

After five years, no plant had flowered. Plant deaths occurred and trees showed low vigour. Most grafts had either died or did not grow, with only one growing to 50cm. Grafted trees did increase in overall height due to growth in the suckers from the rootstocks. Double rootstocks grew successfully on a few trees, while others died or were no longer visible due to the mounding around the trees that occurred after the trial was established. Single ungrafted trees had more height growth than double rootstocked ungrafted trees.

From the results after five years, it can be concluded that a well-managed seedling tree may grow well provided there is adequate shade, fertiliser and water. Rapid sucker growth with grafting may have prevented scion growth in the grafted trees and further investigations into the fungal growth on the trunks and branches are required. It is recommended that residual herbicides should not be sprayed around the root area and on trunks of mangosteens.

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**PROJECT: Trellised Versus Single Tree Carambola**

**Project Officers: L. Luders, T.K. Lim and S. Marte**

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Single trees and trellised tree numbers were reduced due to tree death during the wet season; hence the harvest data collected was not compared for the two treatments.



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## **PROJECT: Rambutan Pruning**

**Project Officers: C. Wicks, Y. Diczbalis, S. Marte and A. Hosking**

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In 1995, the Horticulture Division was invited to collaborate in a national project on Sapindaceae tree size control. Rambutan is a member of the Sapindaceae family along with Lychee and Longan. QDPI, CSIRO and DPIF are conducting the three-year trial, which is funded by RIRDC. In the NT, the DPIF is carrying out work on rambutan with the assistance of Erindale Tropical Produce (Kerry and Diane Dysart).

### **Method:**

In 1995, we examined the effects of three pruning treatments on two varieties (Jitlee and R167). Tree age at the time was 6-7 years depending on site and variety.

The pruning treatments were:

P0 - Minimal tip pruning at harvest (December 1994)

P1 - Removal of two to three flushes (February 1995)

P2 - Removal of two to three flushes (April 1995)

In 1996-98, the treatments included some structural pruning, which was necessary due to the constraints of the fixed netting and were as follows:

P0 - Minimal tip pruning at harvest

P1 - Structural pruning in February followed by a tip prune (15-20 cm) in early June

P2 - Structural pruning in February

### **Results:**

#### *1995*

Measurement of flush number and length indicated that pruning treatments did affect growth and that the response was variety dependent. Flowering was also affected by pruning treatment and variety. The pruning appeared to greatly reduce the flowering potential of the tree. In the P1 treatment there was a clear variety difference in response with Jitlee and R167 producing an average of 3.5 and 1.5 flowering panicles, respectively.

#### *1996 to 1998*

For the 1996-98 seasons, flush numbers and lengths, flowering times and whole tree yields were recorded.

### **Flush number and length**

The data suggested that flush number and length were unaffected by pruning treatments. The data shows that regardless of pruning strategies, there are approximately three vegetative flushes prior to flowering and the average flush length is approximately 100 mm.

### **Commencement of flowering and harvest synchrony**

Pruning delayed the onset of harvest but tended to concentrate or synchronise the harvest period. In 1996 the pruning treatment which resulted in the most synchronous harvest was the structural prune in February followed by a tip prune in June (P1). The first harvest of the year came from the P0 trees followed by the P2 and then the P1 trees.

In 1997 both pruning treatments delayed the start of harvest and synchronised the picking period. The most intensive picking occurred in the structural pruning treatment (P2). All treatments continued to produce fruit well into February until a strip pick was carried out.

In 1998, there was a general repeat of the previous year. However the warmer Dry season delayed flowering, thus the P1 and P2 trees had mature fruit only 1-2 weeks after the P0 trees. A cyclone, which caused a significant level of fruit drop and a sharp increase in the rate of fruit maturation then, interrupted the 1998 harvest.

### **Yields**

In 1996 and 1997, tree yields differed with both pruning and variety treatments. In 1996, the P0 treatment resulted in the highest yields for both varieties. In 1997, the P2 pruning treatments yielded at a similar level to the P0 treatment with the P1 treatments yielding less. In both years cv R167 was the better producer of the two varieties.

In 1998, a cyclone in early January caused a significant level of fruit drop. This caused some anomalous data such as the P0 treatment had the highest yield for R167 but not for Jitlee. However, the mean yield for the P0 treatment was still the highest of the pruning treatments. The variety R167 was again the higher yielding.

### **Conclusion**

Pruning can reduce the subsequent seasons yield potential, however, the response appears to be dependent on season and longer term studies are required to determine the full effects of pruning strategies. The variability of results between varieties is a concern as it suggests that pruning practices may have to be examined for the major commercial varieties.

It appears that well managed pruning can be used to alter the onset of fruit set and the intensity of harvest, thereby spreading the workload. Since regular structural pruning will be a required practice in netted orchards, the frequency and timing of the pruning will be an important feature of management.

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## **PROJECT: Management Techniques for Annonaceae Species**

**Project Officers: S. McAlister and R. Renfree**

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Custard apple types are recognised as a crop with considerable market opportunities, and for which the Katherine region may prove a suitable production area. However it is also recognised that much research effort will be required if this opportunity is to be captured in the medium to long term. Cultivar introduction, screening, and possibly development, together with the development of management techniques, are seen as the four critical areas for research attention.

### **Method:**

Pinks mammoth, Gefner, African pride and bradly trees (on atemoya seedling rootstock) were field planted at KRS in October 1995. Two seedlings of *Annona reticulata* and one of *A. muricata* were also planted at the same time.

### **Results:**

No results have yet been collected in this trial. Some trees have produced some fruit but this has not been recorded. Over the next few years the trees will be monitored for fruit yields and fruit quality. In addition, work will be conducted on hand pollination as well as investigation of management techniques to induce cropping such as defoliation and pruning.

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## **PROJECT: Rambutan Rootstock/Scion Interactions and Crop Water Use**

**Project Officers: L. Luders, T.K. Lim and S. Marte**

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### **Objective:**

***The objective of this trial was downgraded due to inadequate tree numbers after grafting. The trial was further downgraded to an observation area after trees died due to flooding. Trees that were not severely stressed in the wet season are showing strong growth. Flowering occurred on some trees this year, but yield data could not be recorded. Trees will need to be individually netted, or the fruit bagged, to obtain data from the trees.***

Data was collected and mean growth differences in tree heights, scion heights, rootstock diameters and scion diameters over an eighteen-month period since planting were calculated. Most rootstock varieties have three replicates surviving. Rapih rootstock with R134 scion had only two trees left. Rongrien and Gula Batu with Jitlee, each had five replicates, due to the spare trees being planted into the empty spaces.

The study showed that most trees were similar in height. Jitlee on R156, and Jitlee and R134 on Jitlee, had the least amount of growth, while Jitlee and R134 on Rongrien had the most growth. Total scion height growth

does not show the same results as total height growth. R134 on Gula Batu, Rongrien, and Jitlee, and Jitlee on Rongrien and Jitlee had the least growth. R134 on Rapih showed the most growth.

Slight differences between the rootstock and scion diameter growth were calculated. A trend for a particular rootstock or scion was not obvious at this stage, although the Rongrien and Jitlee rootstock trees showed less growth, as was the scion height growth.

A comparison next year may show a clearer dwarfing effect, which is a requirement under nets. Fruit may also be harvested next year if the area is netted in some way.

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**PROJECT:       Effect of Temperature on the Storage Life of  
Rambutans**

**Project Officers:   M. Gosbee and A. Hosking**

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**Objective:**

*Rambutans were harvested from CPHRF and stored at 10, 17 and 24°C. The objective was to determine the effects of the mid range temperature (17°C) compared to lower temperatures. Fruit colour, fruit and spintern browning, eating quality, disease, Brix and weight loss were measured twice weekly.*

**Results:**

Rambutans stored at 24°C showed increased skin browning and disease 8 days after harvest and also lower eating quality. Those stored at 17 and 10°C were still of an acceptable eating quality after 15 days, which is ample storage life for the current marketing system. However skin browning and disease were beginning to affect the appearance of the fruit stored at 17°C by this stage. Clearly a low temperature of 10°C is still the best for storage of rambutans.

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**SUBPROGRAM:    Dates**

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**PROJECT:       Date Production in Central Australia**

**Project Officers:   G. Kenna, N. Isgro, C. Kinnaird, D. McDonald and A. Nesbitt**

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**Introduction**

There are several thousand known cultivars of dates around the world, out of which the commercially important number around one hundred. Dates are grown throughout the world where an arid environment with high summer temperatures, lack of summer rainfall and adequate supplies of water ensure the production of quality fruit. Western countries have a preference for date fruit that is large in size, sweet with medium moisture content.

**Objective:**

*The aim of this project is to establish a collection of the world's best cultivars and to evaluate their potential for the production of high quality dessert fruit under Central Australian conditions.*

**Method:**

The date research farm at the Arid Zone Research Institute near Alice Springs consists of 248 mature date palms, both male and female selections. The collection is made up of 3 male and 18 female cultivars, all imported from overseas. The plant material has been imported as offshoots and as tissue culture.

**Results:**

Thirty-two female palms were selected for pollination in the 1998/1999 season. These were varieties that are yet to be assessed for fruit quality characteristics and yield potential. Immature palms have a tendency to crop erratically.

A percentage of fruit was lost due to bird damage, vermin including mice and insect attack. Some palms were also carrying a number of offshoots, which may have reduced their capacity in yield and fruit quality. Offshoots compete with fruit on the tree for water and nutrients and cause management problems. They have dangerous

thorns that make access to fruit bunches difficult sometimes. The 1999 season showed generally higher average yields than the previous year. The occurrence of rain during the 1998 harvesting period did affect total yields during this season.

**SUBPROGRAM: Citrus**

**PROJECT: National Red-Flesh Grapefruit Cultivar Trial**

**Project Officers: J. Mansfield, T. Maddern, S. Marte and R. Renfree**

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**Objective:**

*Red-fleshed grapefruit are expected to be popular in Australia because they are visually more appealing and some cultivars are tastier than the traditional white-fleshed cultivars. This trial is part of a national HRDC project that aims to assess red-fleshed grapefruit cultivars in a wide range of growing conditions around Australia.*

**Method:**

Eight cultivars of grapefruit were budded to 2 different rootstocks and planted in randomised, single tree plots in 1995. Originally, there were four replicates of each cultivar/rootstock combination. The eight cultivars are Marsh, Oroblanco, BCP3-Ruby type grapefruit, Henderson, Ray Ruby, Rio Red, Star Ruby and Flame (established 8 months later). The rootstocks used were Swingle Citrumelo and Carrizo Citrange. However, because there was a number of existing red grapefruit trials and plantings in the Katherine region, and due to limited staff, it was decided to reduce the size of the trial by removing some trees in January 1999. This then left two replicates of each combination except for Flame on Swingle where there was one replicate and Oroblanco on Swingle where there were three replicates.

On a regular basis, mature fruit were picked from the trees and counted and weighed. In addition, the weight of fruit that had dropped or was damaged was estimated by counting the number of fruit and using the average fruit weight of the picked fruit to calculate the weight of the loss. Estimated yield is the weight of picked fruit plus the weight of the damaged fruit.

Fruit quality for each cultivar/rootstock combination was assessed where possible at 3 times, early February (between 3 February and 9 February 1999), late March (29 March to 30 March 1999) and late May (24 May 1999). However, for the Star Ruby on Carrizo combination, only one sampling was conducted and this was on the 21 January 1999. For some combinations no fruit was available for sampling at all or for some of the sampling times. For the February sampling, where possible, 10 fruits from each tree were used for assessment but this was later reduced to 5 due to limited numbers of ripe fruit on the trees.

**Results:**

The trees are still yet to come into full production. Some trees failed to produce fruit while the maximum estimated yield of 38.1 kg was from the Marsh on Carrizo rootstock. The largest average fruit size (1203g) was from the Oroblanco on Carrizo combination and this was at least double the size of all other combinations.

The juice percentage varied between sampling times and combinations. However most combinations had above 33% juice (the minimum market standard for grapefruit in NSW). The exception to this was Marsh on either rootstock at most sampling dates, Rio Red on Carrizo at all sampling dates and Oroblanco on Carrizo at the early February and late March sampling. The Oroblanco levels were extremely low (17% and 9%). However, it should be borne in mind that these are still relatively young trees that have not settled into a production pattern and that due to limited sampling numbers, it is possible that some of the fruit sampled was not fully mature.

The brix: acid ratio was below six for some cultivar/rootstock combinations at the early February sampling but was above six for combinations in the late March and late May samples. Oroblanco had extremely high ratios (15.7 and 20.6) for the two sampling periods it was tested (early February and late March). This was due to its extremely low acid content (0.59% and 0.46%) rather than its high brix.

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## **PROJECT: National Red-Flesh Grapefruit Cultivar Trial in the Southern Regions of the Northern Territory**

**Project Officers: G. Kenna, N. Isgro, C. Ellis, C. Kinnaird, D. McDonald and A. Nesbitt**

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### **Objective:**

*The national red fleshed grapefruit cultivar trial has been established to evaluate a range of grapefruit selections suitable for commercial production in various locations throughout Australia. The trial also includes two white fleshed selections, Oroblanco that has a sweet low acid flesh and Marsh Seedless, the main variety used in commercial grapefruit production. The Rural Industry Research and Development Corporation (RIRDC) assisted with funding the trial.*

*Commercial selections of red fleshed varieties were introduced into Australia in 1986. Participation in a national trial has enabled these selections to be made available for commercial assessment in Central Australia. The South Australian Research and Development Institute is coordinating this project. The objectives for the grapefruit trial are to:*

- *Evaluate the potential of new grapefruit cultivars to growing conditions in Central Australia by measuring tree growth performance and cropping characteristics.*
- *Assess fruit quality and yields by recording fruit maturity and quality characteristics to determine which cultivars have commercial potential for production in Central Australia.*

### **Method:**

#### *Arid Zone Research Institute*

Seven clones consisting of Marsh, Oroblanco, Ruby Pink, Henderson, Ray Ruby, Rio Red and Star Ruby on two rootstock's, Carrizo Citrange and Swingle were planted. The trees are arranged in single plots with four replicates of each in a random block design. Windbreaks consisting of sorghum were established parallel to the tree rows to protect the young plants during the hot summer months.

#### *Ti-Tree Research Farm and Murray Downs Station*

Demonstration plants of one of each cultivar on Carrizo citrange and Swingle rootstocks were established at the Ti-Tree Research Farm (TTRF) and Murray Downs station.

Four-year trees initially cropped in the 1997-98 season. Data collected included fruit maturity, number, weight, size, and rind thicknesses, skin and flesh colour.

### **Results:**

Ruby Pink and Rio Red had similar yields when grown on Swingle compared to the Carrizo Citrange rootstock. Yields were lower for Ruby Pink on Carrizo, and were notably lower for the selection of Rio Red when grown on the same rootstock. In contrast, Henderson had similar yields when grown on Carrizo or Swingle rootstocks. Yields for Ray Ruby were higher when grown on Swingle. Marsh and Oroblanco had low yields when grown on either rootstock.

At this stage Swingle is performing better than Carrizo Citrange in the AZRI planting. The trees however are still to reach maturity and these results may not be an accurate indication of the performance of these cultivars on these rootstocks.

Data collected from the red fleshed grapefruit trees at TTRF suggest that fruit maturity will occur at around the same time as the Katherine harvest season is completed, early to mid March. The trend continues with Alice Springs fruit maturity following on from Ti-Tree.

One particular variety, Star Ruby, is extremely sensitive to our climatic conditions. The trees are showing signs of chlorotic foliage and are sensitive to trace element deficiencies evident in our soils.

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**PROJECT: Citrus Rootstock/Cultivar Evaluation  
(Katherine) - Grapefruit**

**Project Officers: J. Mansfield, T. Maddern, S. Marte and R. Renfree**

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**Objective:**

***Hot conditions during fruit maturation make the Katherine region ideal for quality grapefruit production. This trial aimed to rapidly screen several new red cultivars for their production performance in the Katherine region.***

**Method:**

Five super red cultivars, Star Ruby, Rio Red, Flame, Ray Ruby and Henderson were planted on a range of rootstocks at KRS during 1992-1995. These rootstocks were C35 citrange, Swingle and Trifoliata. However, not all scions were grafted onto each rootstock. There is one tree each of the following combinations:

Flame on Swingle (planted 14/7/92 and budded October 1995),

Ray Ruby on C35 (planted 14/7/92 and budded 15/12/92),

Rio Red on C35 (planted 14/7/92 and budded 11/8/94),

Rio Red on Swingle (planted 14/7/92 and budded 11/8/94),

Star Ruby on C35 (planted 14/7/92 and budded 11/8/94), and

Star Ruby on Swingle (planted 14/7/92 and budded 15/12/92),

There are two trees of Henderson on Trifoliata (planting date unknown),

Ray Ruby on Trifoliata (planted 14/7/92 and budded 15/12/92),

Three trees of Henderson on Swingle (planted 14/7/92 and budded 15/12/92),

Ray Ruby on Swingle (planted 14/7/92 and budded 15/12/92).

There are no trees of Flame on either C35 or Trifoliata, Henderson on C35, Rio Red on Trifoliata or Star Ruby on Trifoliata

Fruit quality for fruiting trees of each cultivar/rootstock combination was assessed where possible at 3 times: February (between 9 February and 25 February 1999), late March (26 March to 29 March 1999) and late May (between 18 and 24 May 1999). For some combinations no fruit was available for sampling at some of the sampling times. For the February sampling, where possible 10 fruits from each tree were used for assessment but this was then reduced for later assessments to 5 due to limited numbers of ripe fruit on the trees.

On a regular basis, mature fruit were picked from the trees and counted and weighed. In addition, the weight of fruit that had dropped or was damaged was estimated by counting the number of fruit and using the average fruit weight of the picked fruit to calculate the weight of the loss. Estimated yield is the weight of picked fruit plus the weight of the damaged fruit.

**Results:**

It should be stressed that the results are based on only one or several trees of each cultivar and any interpretation must be treated with caution. The yields presented are total yields and not marketable yields.

Due to an error in the processing of the data, the information presented for the 1998 season in the Horticulture Division Technical Annual Report 1997/98 was incorrect.

In the 1999 season the trees varied in production from an estimated yield of 0.3kg (Flame on Swingle) to 128 kg (Henderson on Swingle). However, it should be noted that the trees are not the same age being budded over a three-year period. The average fruit size ranged from 240g (Star Ruby on C35) to 520g (Ray Ruby on C35). However the Star Ruby on C35 tree was under stress due to termite damage and later died. The average fruit weight for the Star Ruby on Swingle tree was 468g and this is possibly a more accurate indication of Star Ruby fruit size.

The juice percentage in the 1999 season varied between sampling times and combinations. However all combinations had above 33% juice at all sampling times (the minimum market standard for grapefruit in NSW). The highest juice content was Flame on Swingle at 50% but this was only based on a one fruit sample.

The brix: acid ratio was above six for all combinations at all sampling times except for Star Ruby on Swingle when sampled in February. The highest brix to acid ratio was 9.2 for Henderson on Trifoliata when sampled in February.

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**PROJECT: Citrus Rootstock/Cultivar Evaluation  
(Katherine) - Lemon**

**Project Officers: J. Mansfield, T. Maddern, S. Marte and R. Renfree**

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**Objective:**

***With some manipulation of phenology, Top End lemons mature at a time when prices on the domestic market are at their highest (January - March).***

***This trial aimed to look at the production performance of various lemon cultivars in the Katherine region with particular emphasis on summer lemon production.***

**Method:**

Four cultivars, Meyer, "Taylor" Eureka, "Prior" Lisbon and Villa Franca, were budded on 15/12/92 to Benton rootstock planted on 14/7/92. Fino and Verna were budded on 15/4/93 to Benton rootstock planted on 14/7/92. For each cultivar, except Meyer, there are two trees of each. For Meyer there is only one tree.

Fruit quality for fruiting trees of each cultivar/rootstock combination was assessed where possible 5 times, late January (28 January), mid February (between 16 and 17 February 1999), March (between 9 and 26 March 1999), late April (27 April 1999) and mid May (14 May 1999). For the January and February assessment, where possible, 10 fruits from each tree were used, but this was then reduced in later assessments to 5 due to limited numbers of ripe fruit on the trees.

On a regular basis, mature fruit was picked from the trees and counted and weighed. In addition, the weight of fruit that had dropped or was damaged was estimated by counting the number of fruit and using the average fruit weight of the picked fruit to calculate the weight of the loss. Estimated yield is the weight of picked fruit plus the weight of the damaged fruit.

**Results:**

It should be stressed that the results are based on only one or several trees of each cultivar and any interpretation must be treated with caution. It should also be noted that yield included total and not just marketable produce.

In the 1999 season the trees varied in production from an estimated yield of 68kg (Verna) to 159 kg (Meyer). However, it should be noted that the trees are not of the same age, having been budded over a period of 4 months. The average fruit size ranged from 190g (Meyer) to 248g (Eureka). However it should be noted that these average weights would be heavily influenced by the fact that a majority of the fruit was picked in May and if the trees would have been strip picked earlier these average fruit weights would have been lower.

The juice percentage in the 1999 season varied between sampling times and combinations. However all combinations had above 30%. The juice percentage was generally at it highest during the Mid February sampling and then reduced to its lowest during the Mid May sampling.

The acid content was above 6% for all combinations at all sampling times except for Verna at the Mid February sampling and Meyer, which did not get above 6% until the Mid May. All cultivars had lower acid in mid February than in late January and March.

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**PROJECT: Citrus Rootstock/Cultivar Evaluation  
(Katherine) - Mandarin**

**Project Officer: J. Bright**

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**Objective:**

*Early cultivar assessments of Mandarin production in Katherine were not encouraging due to poor flowering, and low and erratic yields. A new trial is presently being planned to re-evaluate mandarins in the region. This trial will probably include cultivars such as Topaz, Fallglo, Daisy and some West Indian, Vietnamese and satsuma types. In addition it may contain selections from the CSIRO and the QDPI mandarin breeding programs.*

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**PROJECT: Citrus Rootstock/Cultivar Evaluation  
(Katherine) – Pummelo**

**Project Officers: J. Mansfield, T. Maddern, S. Marte and R. Renfree**

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The pummelo is considered to be the best suited of the citrus species to tropical conditions. However, the greatest impediment to the development of large-scale pummelo production in Australia is the lack of thin skinned, high quality cultivars. The introduction of known overseas cultivars has been severely retarded by quarantine restrictions. Citrus canker, citrus dieback and greening, navel orange worm, citrus mal secco, orange stem pitting (OSP) strain of tristeza and citrus fruit borer are all potential quarantine risks that could be introduced via overseas propagating material. Therefore it is very difficult and expensive to import cultivars. However, seeds from some overseas cultivars have been introduced. The material currently grown in Australia has been selected from these seeds, as well as from local promising seedlings. Pummelo, unlike most other citrus, produces seedlings that are genetically different from the parent.

This is unfortunate in that seeds cannot be used as a reliable means of importing known cultivars from overseas. However, it is advantageous as a way of selecting superior cultivars within Australia since a wide range of plants with different characteristics are available – though most are inferior.

**Method:**

Seedlings of six pummelo lines introduced from overseas by CSIRO Merbein, Victoria, were planted at Ti Tree farm on 11 June 1987. The seedlings of CS43 Blood red pummelo showed the most potential with five seedlings (CS43-4, CS43-5, CS43-6, CS43-8 and CS43-9) producing fruit with some potential. The number “CS43” given to this selection is the CSIRO Division of Horticultural Research identification number. It was originally an introduction from the Horticultural Research Laboratory, USDA, Orlando.

Bud wood from these five seedlings was used to propagate up more trees for further evaluation at Katherine Research Station. Each selection was grafted onto Trifoliata and Swingle rootstocks and one replicate of each combination was planted in June 1994. The tree of CS43-5 on trifoliata died due to termite damage.

Fruit quality for fruiting trees of each cultivar/rootstock combination was assessed twice, where possible: mid February (between 18 and 22 February 1999) and mid May (between 17 and 18 May 1999).

On a regular basis, mature fruit were picked from the trees and counted and weighed. In addition, the weight of fruit that had dropped or was damaged was estimated by counting the number of fruit and using the average fruit weight of the picked fruit to calculate the weight of the loss. Estimated yield is the weight of picked fruit plus the weight of the damaged fruit.

**Results and Discussion:**

It should be noted that the results are based on only one of each cultivar and their interpretation must be treated with caution. Yields indicate total and not just marketable produce.

In the 1999 season the trees varied in production from an estimated yield of 8kg (CS43-6 on Swingle) to 51kg (CS43-8 on Trifoliata). The average fruit size ranged from 389g (CS43-4 on Trifoliata) to 650g (CS43-6 on Swingle).



The juice content in the 1999 season varied between sampling times and combinations. However all combinations had less than 27% juice with the lowest having 13.6% for C43-4 on Trifoliata at the mid May sampling.

The Brix: acid ratio was above six for all combinations at all sampling times. The highest brix is to acid ratio was 12.3 for CS43-4 on Swingle when sampled in mid February. The ratio was higher in the mid-February sampling than in the mid-May sampling for all combinations.

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**PROJECT: Breeding/Selection of Citrus Cultivars**

**Project Officer: J. Bright**

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Research work to date has demonstrated that much of the citrus germplasm currently in Australia is of limited commercial value under the hot dry conditions of the Katherine region. Consequently, efforts have been made to identify alternative sources of suitable material, and to investigate the possibility of breeding new material.

Seed of a red-fleshed pummelo type from Israel was sown at KRS in September 1996, and transferred to the field in July 1997. A total of 46 trees from this material have been established (on their own roots). Seed from a low acid pummelo type (Leeman pomello) from Darwin were also sown at KRS and from these 24 trees were field planted in May 1997 (again on their own roots). These seedlings are yet to fruit.

Controlled crosses were made between Marisol clementine and Fremont mandarin at KRS in the 1995 season. Several of these crosses were field planted so that they can be used to provide material for a replicated mandarin trial, which is currently being planned. Seedlings of Fairchild mandarin (USA), Quit Duong mandarin (Vietnam), Cam Sanh (Vietnam), an easy-peel selection from Indonesia, Ugli, also spelt Hoogly, (West Indies) and Ortanique (West Indies) have also been propagated. These have been either field planted or given to a citrus nursery to multiply up so that they can be used in this planned mandarin evaluation trial.

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**PROJECT: Evaluation of Navel and Lemon Cultivars in the Alice Springs Region**

**Project Officers: G. Kenna, N. Isgro, C. Kinnaird, A. Nesbitt and D. McDonald**

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**Introduction:**

At present, the supply of navel oranges and lemons to domestic markets is very limited between the months of March to June for navels, and from December to April for lemons. The Queensland citrus industry is the first to supply early navel oranges for domestic consumption and replace imported Californian navels. Demands for lemons are also strong with supplies limited and market prices at a premium from December to April. Limited evaluation work on these fruits in the Alice Springs region indicate that it may be possible to produce high quality, early maturing navel oranges. Additional work is also required to evaluate the potential for the production of high quality lemons.

**Objective:**

***The objective of this trial is to evaluate the adaptability of navel and lemon cultivars to growing conditions in Central Australia.***

***Some of this work is being done on the existing navel cultivars along the driveway into Arid Zone Research Institute (AZRI), such as maturity times and quality. With the new plantings, assessments will be made on fruit quality and yields to determine which cultivars have commercial potential for production in Central Australia. Also, assessment will be made on fruit maturity to determine harvest times to supply domestic markets when supplies are limited.***

**Method:**

A trial plot of navel oranges and lemon was planted in 1997. The planting is still too young to produce enough yield information for the different cultivars. Orange cultivars consist of Leng navel on Swingle, Washington navel on Citrange, Barnfeild summer navel on Trifoliata. Lemon varieties consist of Fino lemon, Verna lemon, and Lisbon lemon, all grown on Citrange rootstock. The planting consists of 10 trees of each cultivar on the nominated rootstock per row.

An old planting of navel and Valencia oranges also occurs at AZRI along the front driveway. These trees are roughly 25 years old and include Thompson navel and valencias on unknown rootstocks. This planting provides us with useful yield data and maturity information.

**Results:**

Maturity results for the navel samples, which were analysed on the 29th of April, indicate maturity was well above the Australian standards for sugar-acid ratios (Brix/Acid ratio of 10.0:1)

Lemon varieties growing as guard rows around the red fleshed grapefruit planting in their fourth year produced their first crop. Harvest commenced on the 22nd of February, and later on 6 April. The first variety to be analysed was Eureka on Citrange, followed by Lisbon on Citrange, and then Lisbon on Troyer Citrange.

Unlike other varieties of citrus, lemons are assessed by juice content and not by sugar-acid ratios. The Australian standard for juice content starts at a minimum of 33 %, which is exceeded by all our varieties.

**Discussion:**

Data collected so far from the mature navel trees along the drive into AZRI shows early maturity and without having to de-green the outside of the fruit due to our colder nights. This is a major advantage for a high quality product. Lemons on the other hand, especially the early maturing varieties such as Eureka do need the assistance of de-greening to be marketable.

The trees planted in spring 1997 at the Horticulture block at AZRI suffered from the harsh summer period. As young trees, it was difficult for them to establish their root systems for water uptake during the hottest part of the day and during hot dry winds. The Barnfield Summer Navel on the rootstock Trifoliata cultivar of orange did not survive the summer. In a previous trial at Ti-Tree farm, it was found that the rootstock Trifoliata, did not perform well in Central Australia.

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**PROJECT:      Lemon Rootstock Trial (Katherine)**

**Project Officers:    J. Mansfield and T. Maddern**

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The rootstock can influence the performance of a tree in a number of ways:

- Tree shape and size
- Yield
- Maturity time
- Size and colour of the fruit
- Adaptability to certain soils and climates
- Resistance to diseases.

**Objective:**

***The trial was initiated to identify the most appropriate rootstock for commercial lemon in some of the major soil types in the region. One of the main aims is to determine which rootstocks are best suited to the alkaline soils of the area caused by the use of irrigation water high in calcium carbonates.***

**Method:**

Four cultivars of lemons were budded, in the nursery at KRS, to seven different rootstocks, resulting in 21 cultivar/stock combinations. Cultivar/stock combinations were originally replicated 4 to 6 times depending on the site. Field layouts have been designed with cultivar/stock combinations randomly assigned to single tree plots. The four scion cultivars are Eureka, Lisbon, Fino and Verna. The seven rootstocks are Benton Citrange, Cox Mandarin, Lockyer Rough Lemon, Rangpur, Nelspruit hybrid 639, Volkameriana (Volker) Lemon and Swingle Citrumelo. The trial was to be carried on 3 different soil types namely Tippera, Blain and River levee. The Tippera site was established in mid-1996 and the Blain site was planted in November 1997. However the river levee site was planted in October 1997 but was severely damaged by the Australia Day 1998 flood and was not replanted.

Originally, the Tippera site comprised six replicates but because the collaborator wished to pursue other crops, the size of the experiment was reduced. Where possible, three replicates of each combination were left. To

make up the replicates from two to three in some combinations, some trees were transplanted in January 1999. Since then, most trees have recovered well and it is now difficult to distinguish between transplanted and original trees. However, the transplanted trees have been marked for statistical analysis.

**Results:**

Following the flood in January 1998, the leaves on the trees at the Tippera site started yellowing and dropping and the trees lost vigour. This may have been caused by damage to roots and death resulting from waterlogging for several days during the flood and possible damage by mites. The trees were sprayed with foliar phosphorous acid but when they were still slow to recover it was decided to prune them hard, in some cases back to several major branches. While some trees produced fruit, no fruit was collected in the 1999 season due to the pruning.

At the Tippera site, the Rangpur and Rough Lemon rootstocks appear to be particularly prone to suckering from below the ground. This problem may have been exaggerated by loss of vigour. To overcome this problem, the suckers are being removed using a wood chisel and it is hoped that when the upper tree becomes more vigorous, this will suppress the rootstock suckering.

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**PROJECT: Red Grapefruit Rootstock Trial (Katherine)****Project Officers: J. Mansfield and T. Maddern**

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The rootstock can influence the performance of a budded tree in a number of ways including:

- Tree shape and size
- Yield
- Maturity time
- Size and colour of the fruit
- Adaptability of the tree to certain soils and climates
- Resistance against diseases.

**Objective:**

***This trial was initiated to identify the most appropriate rootstock for commercial grapefruit in some of the major soil types in the region. One of the main aims is to determine which rootstocks are most suitable for the alkaline soils, which occur in the area due to the use of irrigation water high in calcium carbonates.***

**Method:**

Three cultivars of grapefruit were budded to seven different rootstocks, resulting in 19 cultivar/stock combinations. Cultivar/ stock combinations were originally replicated four or six times depending on the site. Field layouts were designed with cultivar/ stock combinations randomly assigned to single tree plots. The three scion cultivars were Rio Red, Flame and Star Ruby. The seven rootstocks were Benton Citrange, Cox Mandarin, Cleopatra Mandarin, Carrizo Citrange, Trifoliolate Orange (*Poncirus trifoliata*), Nelspruit hybrid 639, and Swingle Citrumelo. The trees were planted on two different soil types, Tippera and Blain. The Tippera site was planted in mid-1996 and the Blain site in November 1997.

Originally, the Tippera site comprised six replicates but because the property owner wished to pursue other crops, the size of the experiment was reduced. Where possible, three replicates of each combination were left. To make up the replicates from two to three in some combinations, some trees were transplanted in January 1999. Since then, most trees have recovered well and it is now difficult to distinguish between transplanted and original trees. However, the transplanted trees have been marked for statistical analysis.

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**PROJECT: Extension Services to the Citrus Industry - Katherine and Darwin**

**Project Officer: J. Mansfield**

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The citrus industry in the Top End is a rapidly expanding. In the Katherine region there are around 30,000 trees. These are mainly red-fleshed grapefruit and lemons. The majority of these trees are planted on one property with a significant proportion of the remainder planted on another property. In the Darwin region there are approximately 27, 000 trees. The majority of these are grown on properties with less than 1,000 trees. These are mainly red and pink-fleshed grapefruit, Tahitian lime, Kaffir lime with some mandarins.

In February 1999 a Field Day was held by DPIF in conjunction with the Northern Territory Citrus Growers Association (NTCGA), to visit citrus properties in the Katherine region and to sample fruit of cultivars of grapefruit and lemons. Growers from Darwin, Adelaide River, Katherine, Mataranka and Kununurra attended.

At the request of the NTCGA and with the cooperation of NSW Agriculture, the Department arranged for Greg Moulds (District Citrus and Grape Horticulturist – Dareton) to visit in May/June 1999 to run pruning workshops at Katherine, Darwin and Kununurra. This workshop was part of the training packages from Murrumbidgee Agriculture College. The pruning workshop in Kununurra was a result of the agreement made between growers from Katherine, Darwin and Kununurra to work together. Workshops on soil assessment, irrigation and nutrition have been requested by industry.

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**SUBPROGRAM: Subtropical Fruits**

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**PROJECT: Stone Fruit Evaluation in the Alice Springs Region**

**Project Officers: G. Kenna, N. Isgro, C. Ellis, D. McDonald, A. Nesbitt and C. Kinnaird**

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**Introduction**

At present there are no commercial orchards of stone fruit in the Alice Springs region. There are indications that a potential market exists in the Northern Territory as well as interstate for Central Australian stone fruit.

Stone fruit trees have been grown for research purposes at Arid Zone Research Institute in the past. Although these trees initially grew well and produced satisfactory crops, they eventually became unthrifty and had a short life span. The rootstock used for these earlier trees was NemaGuard. This rootstock was not able to adapt to the high pH levels of our soils, or the high soil temperatures we experience through the summer period.

**Objective:**

***Establish a trial to determine the performance of a number of stone fruit trees in Central Australia and assess their varying chill requirements using a number of rootstocks.***

**Method:**

New trees of peaches, nectarines, apricots and plums were grown at AZRI in 1996, 1997 and 1998. Now there are 4 varieties of apricots, 5 of plums, 10 of peaches, and 17 of nectarines.

A number of trees were also established at Ti Tree Research Farm in 1998. They included 8 varieties of peaches, 5 of nectarines and 2 of apricots.

The main rootstock used on a number of low chill selections of peaches and nectarines is Bright's Hybrid. This rootstock has nematode resistance and a tolerance to high soil temperatures and pH. Plum and apricot varieties were grown on plum rootstock

**Results:**

In 1997, in their second year, low chill peaches and nectarines produced their first crop. Flowering began at the end of August and harvest commenced in mid November. Fruit number, weight and diameter were recorded. In 1998 the same trees produced their second crop and were assessed as for 1997, including brix measurements.

For the 1997 harvest, Flordaglo peach had the highest average yield per tree, followed by Flordagold and Desert Red. Overall, yields increased markedly for the 1998 harvest with Flordaglo, again having the highest yield per tree, followed by Flordagold and Desert Red.

For the 1997 nectarine harvest, Sundowner (6/3) had the highest average yield per tree, followed by Sunraycer (84/16). In 1998 harvest yields also increased markedly, with Sundowner (6/3) having the highest average yield per tree followed by Sunraycer (84/16).

The apricot trees yielded their first crop in 1998. However, the yield was very low with the variety Trevatt being the only producer.

**Plant nutrition:**

Nutrient analyses were conducted in January each year after harvest. Results have indicated low to deficient levels of zinc throughout the orchard. Copper and calcium levels were marginal.

Root and soil samples results showed that there were "high to extremely high numbers of root knot nematodes in a section of the orchard at AZRI".

Assessment of fruit was difficult due to bird damage. Regular maintenance includes, summer and winter pruning, monitoring for pests and disease, weed control, water usage, plant nutrition and fruit thinning.

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## **PROJECT:       Evaluating the Potential for Pome Fruit Production in Central Australia**

**Project Officers:   G. Kenna, C. Kinnaird, D. Salter, N. Isgro, D. McDonald  
and A. Nesbitt**

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**Introduction:**

Apple varieties suitable for commercial production in the arid Central Australian environment must be able to endure long, hot summers and a relatively short but cold winter. These varieties must be vigorous with good foliage cover to protect developing fruit, and not prone to biennial bearing.

**Method:**

In 1997, 22 apple trees were planted at the AZRI horticultural block. They consisted of 15 Pink Lady and 7 Granny Smith scions grafted on to Malling-Merton (MM106) rootstocks. Seven of each of Sundowner, Pink Lady and Granny Smith were planted in 1998. The Granny Smith variety was planted as a pollinator. The trees are planted in 2 rows, with a pollinator for every other 2 trees.

In 1998 a planting of apples was established at the Ti Tree Research Farm. This planting consisted of 11 Pink Lady and 5 Granny Smith trees. The trees were planted in the same pattern as those at AZRI. To record chill hour exposure, data loggers have been located in the vicinity of the trees at both locations.

**Results:**

Apples bear fruit on two-year spurs and generally begin fruiting after four years. It is likely that spurs will form this growing season and that fruit will set in 2001. The trees are presently growing vigorously but little data has been collected to date.

Dormancy in this region may be a problem. Last winter was relatively mild with only a small number of frosts. Leaf fall did not occur and the trees did not go into dormancy. Leaves were stripped by hand from the oldest trees at AZRI to induce dormancy. Three trees in this group were left with leaves intact to compare growth patterns. No difference in budburst time was observed.

The Pink Lady trees have a very upright habit. Date fruit spreaders were used to promote a more spreading habit and the trees have been pruned for shape during the growth period and in winter. Trellising has been considered however sunburn on exposed fruit by using this method may be a problem.

Termites (*Mastotermes darwiniensis*) have killed one tree and caused damage to another at TTRF.

**Timing:**

Sundowner apples flowered between 1-29 October in Manjimup and from 25 September to 22 October in Stoneville There is no data for this variety in the region

**Summary**

At this stage there is little information about the potential for pome fruit in Central Australia. The trees continue to grow well and more information will be recorded as the trees mature.

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**SUBPROGRAM: Cashew**

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**PROJECT: Cashew Selection and Evaluation**

**Project Officer: J. Bright**

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In 1992, over 800 trees of about 450 different cashew hybrids were planted at King Producers' Venn block, 20km south of Katherine. These trees were part of an NTDFIF, QDPI and CSIRO hybrid evaluation program to identify superior hybrids. Unfortunately, only one of these hybrids (6/1) showed potential as being suitable for commercial production and this selection has been propagated for further evaluation. The trees were removed in late 1997. However, this project did highlight the problems that would be encountered in the production of cashews on a commercial basis in the Katherine region and in the process a new management system was developed which would overcome most of these problems. This management system has been described in previous Horticulture Technical Annual Reports.

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**PROJECT: Management Techniques for Cashew**

**Project Officers: S. McAlister and R. Renfree**

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Two cashew selections, one from the collection of hybrids at King Producers' Venn block and one from the CPHRS Brazilian seedlings were outstanding. In previous experiments, these selections were grown in single tree plots. Competition from neighbouring trees and the lack of competition from neighbouring trees (where trees were missing) made fair assessment of 'per hectare' yields unrealistic. The new planting at KRS will assess these two selections in multiple tree plots while further developing management systems.

Originally, an observation block was planted at KRS in December 1997 as a demonstration of new genotypes and technology development. The planting consisted of 5 rows of 16 trees with 8 metres between rows and 5 metres between trees within rows. The middle three rows contained 21 trees (3 rows x 7 trees) each of the Hybrid 6/1 from King producers and of the seedling 5/9 from CPHRS. The two outside rows and the end trees on the three middle rows were buffers of various scion rootstock combinations and included some promising cultivars from Kununurra. However, grasshoppers devastated the trial. Not only was the foliage affected but many of the young trees were effectively 'ring-barked' as the grasshoppers stripped the bark, in some cases, to ground level. The trial has been terminated. Some trees of the 6/1 hybrid and the 5/9 hybrid have been kept as a source of propagating material.

# PROGRAM: Vegetables and Ornamentals

## SUBPROGRAM: Vegetables

### PROJECT: Farm Production Efficiency Improvement - Petiole Sap Monitoring of Cucurbit Crops

Project Officers: K. Blackburn and M. Traynor

#### Background:

During the early to mid 1980's extensive plant nutrition research was carried out on cucurbit crops to develop nutrient injection systems, particularly with rockmelons, that were suitable to Top End conditions. Also, the Irrigation Section carried out detailed crop water requirement research the early 1990's to refine irrigation scheduling of cucurbit crops. These two areas must be fully integrated and together are the key to successful vegetable production. It was considered necessary that relatively recent growers in the vegetable industry be made aware of this work and about petiole sap analysis monitoring by extension projects that demonstrate the potential of the improved growing system.

#### Objective:

- *Technology transfer to provide the opportunity to upgrade some aspects of plant nutrition*
- *To improve on-farm crop production efficiency by linking precise irrigation management with accurate nutrient injection*
- *To assist a new Lebanese cucumber grower with nutrient scheduling particularly with trace element levels in the leaf and soil.*

#### Results:

- The development of nutrient level trends over several crop cycles were refined and extended. Precise irrigation scheduling must be integrated with improved plant nutrition for optimum plant performance.
- Lebanese cucumber production was high under the improved growing systems and the grower was generally happy with the results.
- Soil application of trace elements, as well as foliar sprays, is required to overcome deficiencies and raise levels in the soil and in the leaf.
- The importance of nitrogen in early plant growth and both calcium and potassium in later growth must be clearly understood by growers.
- Boron toxicity symptoms developed on young leaves at a boron rate of 6-8 kg/ha in the first crop. Over-irrigation and a reduction in boron rates corrected crop growth.
- A comparison of plant nutrient levels in the main growing area under 50% shade and an unshaded area showed that there were no significant differences between the plants.
- A varietal selection trial of 15 cultivars was planted within the commercial crop. The grower kept yield records. DPIF staff carried out assessments on fruit appearance and quality. The best performance in terms of yield, uniformity of fruit use and the ideal shape was Hybrid Montana followed by Luna, Hanna, Stella. Stella was the main variety grown in the commercial unit and performed very well under the conditions of the trial.
- The 1998 growing season was particularly hot with only 4 nights below 18°C. The Lebanese cucumbers performed satisfactorily but yields were medium to low under the hot conditions. The use of 50% shade to enclose the growing area prevented pollination of the parthenocarpic varieties used and produced fruit of good colour and free of wind rub and blemish.
- At the end of the crop cycle a precise fertiliser program had been developed for the crop under the growing conditions and under the management regime of the crop.
- The nitrogen values started at 5000 ppm in early growth and gradually levelled out at about 2500 ppm, which is ideal for continued production and growth. Cucurbits require high nitrogen in early growth to grow a large plant and so produce an abundance of flowers.

- It is important to maintain fairly high potassium levels throughout the crop.
- Calcium ensures the fruit are firm with a good post harvest life.
- Zinc should be at a good stable level indicating good irrigation management.

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**PROJECT: Cultivar Evaluation of a Host of Annual Crops - Katherine**

**Project Officer: S. McAlister**

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There were no crops planted as part of this project in 1999 because the vegetable research plots at the Katherine Research Station were planted with a green manure crop which was then ploughed in and the land left fallow.

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**PROJECT: Bamboo Research**

**Project Officers: K. Blackburn and M. Traynor**

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The Bamboo research project is partially funded by RIRDC and is an Australia-wide research investigation involving Central Queensland University, Bamboo Australia, Queensland DPI and NT DPIF. The objectives of the project are:

**Objectives**

- **To identify suitable species for bamboo shoot production,**
- **To develop cultural methods to optimise shoot production,**
- **To assess the market potential of trial quantities of shoots,**
- **To collate and extend information.**

**Method:**

The trial started on February 24, 1995 comprising 162 plants of *Bambusa oldhamii* and covering an area of nearly one-hectare. It was unfortunate that at the time, the two most preferred species *Dendrocalamus asper* and *D. latiflorus*, were far too expensive to be used in the trial and although *B. oldhamii* was selected on price we were assured that it was a tropical type and would perform well in Darwin.

The trial is a 3x3x3 factorial arrangement with a split plot design comprising the following treatments.

3 irrigation levels - 30, 60 and 90% evaporation replacement.

3 fertiliser levels - (i) 125N – 31P – 93K  
(ii) 250N – 63P – 189K  
(iii) 375N – 94P – 282K

3 replications

**Results:**

The initial growth rate of this species was very encouraging with few problems encountered. The major pest problems have been a leaf-rolling caterpillar and a hard scale on the culms. Clump thinning has been a major labour-intensive operation carried out in April each year to leave 10-12 culms per clump which include 3-4 mature and 6-8 new culms for growing on. As well, the clumps of this species require regular trimming, which is a poor characteristic, to allow access for harvesting.

The first trial harvest in 1997 was conducted from October 15 to November 24 until shoot numbers and size decreased markedly. An average of 18-20 shoots was harvested per plant as an average weight of 167gm over the 5-week harvest period. The fertiliser treatments were imposed on the trial after the completion of harvest in February 1998 and the irrigation treatments were applied, after some delay, in July 1998.



The irrigation treatment (I) 30% evaporation replacement was changed to nil irrigation from the onset to determine the effect on the dormant growth period and due to the lateness of imposing the treatments.

The 1998 harvest commenced in early November and was terminated in late January 1999.

There was little yield difference between treatments and grades of shoots although there was a trend to higher yields of the larger shoot grades in the 90% evaporation irrigation treatment (W3). The data will be analysed at a later date but significant differences between treatments are not expected. The results of the trial suggest what has been known for some time, that *B. oldhamii* is not adapted to local climatic conditions and has been under considerable stress. As a result, the future of this large trial based on this species is under serious review.

The two preferred tropical clumping species *D. asper* and *D. latiflorus*, with 5 and 7 plants, respectively, in the varietal collection, were also harvested and compared to *B. oldhamii*. A comparison with *D. latiflorus* shows very large differences in species performance at 4 years of age. Although the average shoot weight of *B. oldhamii* was only 120gm, 78% of the shoots had a size grading of less than 110gm and were considered unmarketable. Because every shoot had to be harvested, the cost of harvesting this species was very high compared to the species with larger shoots.

Clump 1 in *D. latiflorus* was a very high yielder compared to the other clumps and was the first clump in the row. Although the plants were given sufficient irrigation water from one month before harvest, the occurrence of rain was still closely related to shoot production, suggesting that excess water may be required to achieve optimum production. The withholding of irrigation water during the dry season may be a method of manipulating the plants and promoting early shoot production. The nil water treatment (W1) on the trial did not have the desired effect on *B. oldhamii* in 1998 and any effect on the time of harvest may differ widely between cultivars.

Future issues:

- (i) The two preferred species, *D. asper* and *D. latiflorus*, may differ in terms of maturity and period of harvest and should be investigated further,
- (ii) These two tropical clumping types have large shoots (1-3 kg) which could cause post harvest problems and marketing difficulties,
- (iii) Packaging, presentation, marketing and post harvest research present major challenges,
- (iv) With such an intensive hand labour component, the economics of the crop will depend very much on obtaining a good market price.

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**PROJECT:            Plant Nutrition Studies on a Host of Annual  
                          Crops - Farm Production Efficiency  
                          Improvement - Petiole Sap Monitoring of  
                          Annual Crops**

**Project Officers:    J. Bright and S. McAlister**

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In early 1999 a Katherine vegetable growers meeting was held to discuss issues that members would most like to see addressed. From this meeting it was identified that growers would like to understand what effects their current fertiliser programs were having ie whether they were applying too much fertiliser or too little. It was decided that a leaf and sap nutrient monitoring program be conducted, at that stage only on selected properties and with a few crops, so as to refine the method before expanding the service next season.

Although sap testing has been used in Katherine in the past, this is the first time in several years that it has been used in conjunction with growers. Previous work by K. Blackburn and M. Traynor has set general trends for cucurbit crop nutrient levels at certain stages of production and these were used as a reference to for Katherine. From this extension work growers are gaining a better understanding of plant nutrition and in particular the importance of nitrogen in early plant life and calcium and potassium throughout the life of plants. Growers are also realising the importance of irrigation management to maximise the beneficial effects of applied fertilisers.

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**PROJECT: Legume Green Manure Development - Katherine**

**Project Officer: S. McAlister**

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No plants were grown as part of this project in 1999 as the vegetable research plots at the Katherine Research Station were planted with a green manure crop which was then ploughed in and the land left fallow.

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**PROJECT: Quality and Yield Variability Investigations in Watermelon**

**Project Officer: S. McAlister**

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No crop was grown as part of this project in 1999 as the vegetable research plots at the Katherine Research Station were planted with a green manure crop, which was then ploughed in, and the land left fallow.

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**PROJECT: Bamboo Postharvest**

**Project Officer: M. Gosbee**

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Two experiments on bamboo shoots were conducted this season.

**1. Effect of a 0 to 200ppm chlorine dip on *B. oldhamii* shoots**

**Method:**

This experiment was performed to determine whether fungal growth and discolouration of the cut end of the shoot could be reduced by a chlorine dip. Dip strengths of 0 (tap water), 50, 100 and 200 ppm were tested. Ten shoots were used for each treatment. Shoots were dipped for 1 minute in the solution, allowed to drip dry and placed in plastic bags for storage. Storage temperatures were 10°C and 20°C.

No effect of the chlorine dip at any concentration was detected on the shoots. When shoots were stored at 10°C, browning was not observed on chlorine or water dipped shoots after 5 days. However, when shoots were removed to 20°C, browning developed on both chlorine and water dipped shoots.

This indicates that temperature is a much more effective tool for controlling browning and fungal growth at the stem end of the shoots than chlorine dipping.

**2. Storage life of bamboo shoots at several temperatures**

Previous work indicated that shoots kept much longer at 2°C than 20°C, but no studies had been undertaken on intermediate temperatures.

**Method:**

18 *D. latiflorus* and 9 *D. asper* shoots were used in the experiment. Shoots were stored in sealed plastic bags and stored at 2 to 4, 5 to 8, 10 to 12 and 20 to 22°C. Shoots were assessed for weight loss and internal quality at 9 days after packaging. As such, this experiment did not assess the maximum storage life, but the internal quality of shoots after 9 days.

As storage temperatures increased, weight loss increased, browning and fungal growth increased and the whiteness of the cut shoot decreased. Dryness of the cut end depended on the amount of condensation and water loss. Dry matter accumulation was also lower at higher temperatures.

Shoots stored at temperatures lower than 10°C are of better quality than shoots stored at higher temperatures. My instinct was that shoots stored in the 5 to 8°C range were slightly better than those stored at 2 to 4°C. This temperature range is commonly used in refrigerated trucking to southern markets, and a storage period of 9 days is adequate to reach southern markets.

This work still needs refining, particularly in the assessment of eating quality of the shoots after storage. This will hopefully be conducted next season.

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**PROJECT: Postharvest Handling of Asian Vegetables -  
Vegetable Cool Chain****Project Officer: M. Gosbee**

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The Vegetable Cool Chain project, funded by HRDC also involves SARDI and Agriculture Victoria, includes temperature and microbial monitoring as part of the work. Temperature logging of Asian vegetables was mainly from Darwin to Melbourne, and found that inadequate pre-cooling prior to packing was the most common cause of problems later in the handling chain. Ms Janine Jaeger, of Agriculture Victoria, visited in September 1998 and baseline data of naturally occurring microbial populations of snake beans and bitter melon were evaluated. Data suggested a high level of variability in separate samples but within the normal ranges for vegetables.

Changes in microbial populations due to temperature are being studied in conjunction with temperature logging this year. Several information kits about cool room use, post harvest handling and transport of vegetables have been produced as part of this project. Many thanks to Territory Produce Freight Management and growers who have been involved in this project.

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**PROJECT: Postharvest Handling of Asian Vegetables -  
Effect of Temperature and Packing on the Shelf  
Life of Bitter Melon and Okra****Project Officer: M. Gosbee and S. Marte**

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These experiments were performed to examine the effects of four types of packaging on the shelf life of bitter melon and okra when they were stored at different temperatures. This continues previous work on other Asian vegetables. The vegetables were packed in boxes with either plastic bags, perforated plastic bags, peak-fresh bags or just with newspaper lining, and stored at 5, 10, 15 and 20°C and 95% RH. Weight loss and quality scores were recorded twice weekly to determine shelf life. Other parameters also noted included chilling damage, rots, ripening and colour changes.

Bitter melon had the best storage life of 23 days when stored at 5°C. however, it developed chilling injury at this temperature. Okra also had the best storage life at 10°C.

The rate of water loss was strongly affected by packaging, as expected. Produce packed in newspaper lost the most water, and this method would not be recommended particularly in low humidity cool rooms. Plastic bags, while they reduce water loss also keep in heat. Perforated bags are the best option. No advantage was gained from the peak-fresh bags. Thanks to Territory Produce Freight Management and Amcor for supporting this work.

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**PROJECT: Bitter Melon Harvest Maturity****Project Officer: M. Gosbee and S. Marte**

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**Objective:**

*To develop harvest maturity stages that optimise post-harvest storage life, minimise ripening in transit and maximise final eating quality to the consumer.*

**Method:**

Eight to 10 bitter melon were harvested three time periods after flowering, 15-16 days, 18 - 19 days and 22-23 days. Each melon was assessed for a series of parameters to determine if any of these characters could be used as a harvest index. Additional melons were also harvested to determine the effect of harvest time on shelf life. These melons were wrapped in perforated bags and stored at 5, 10 and 15 °C.

**Results:**

*Quality*

No one measure satisfactorily distinguished between the categories. Starch, acid and brix were all similar ( $P>0.05$ ), which is what would be expected, as the fruit are all harvested before ripening changes take place. Firmness, bump height or width and diameter could be distinguished between some but not others. Weight was the only parameter, which was significantly ( $P<0.05$ ) different. However this would be affected by nutrition, irrigation, temperature and other factors and would not be a suitable maturity index.

Development of the seeds seems to offer the best prospects for distinguishing between mature and immature melon. This however is still destructive, and affected by environmental conditions.

*Storage*

Both storage temperature and the maturity of the melons affected storage life. The longest storage life is achieved when melons are picked immature or on maturity rather than over-mature, and stored at 5°C. However bitter melon stored at 5°C can develop chilling injury. If fruit is picked over-mature, the benefit of low temperature storage is reduced. If fruit is stored too hot, the benefit of picking it smaller is also reduced. Considering that bitter melon is commonly stored at 10°C, the stage of picking has only a small difference of four days on shelf life. But if the produce heats up, the shelf life rapidly reduces to 11 days, which is marginal.

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**PROJECT: Asparagus Cultivar Evaluation**

**Project Officer: J. Bright**

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Currently UC157 F<sub>1</sub> is the standard asparagus cultivar grown in Northern Australia. The commencement of the 2nd International Asparagus Cultivar Trial provided an opportunity to obtain a wide selection of genetic material for comparison with UC 157 F<sub>1</sub> at Katherine.

**Method:**

Seed of 18 cultivars were sown and transplanted to the field in March 1998.

**Results:**

Due to delay in field planting results will be available in late 1999. The seed provided had a very low germination rate and as a result, a number of lines are only represented by a few plants and some lines are not represented at all. Currently the plants have been slashed and the spears will be harvested.

The disease anthracnose is a problem with asparagus in the Katherine region. In 1999, the cultivars will be inoculated with this disease in early September to screen the cultivars for resistance. The irrigation system in the block will be changed from drip tap to overhead sprinkler to encourage the disease.

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**PROJECT: Asparagus Response to Droughting**

**Project Officer: J. Bright**

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A limitation to growing asparagus in Northern Australia is that growers need to induce dormancy prior to cutting back the fern to allow build up of the plant reserves necessary for spear production. Normally dormancy is induced by cold weather but in Northern Australia, due to the mild winters, some other means of inducing dormancy is necessary. A recently completed trial examined the potential of using droughting to induce dormancy in asparagus under tropical conditions. Some of the results of this trial were discussed in the Horticulture Division Technical Annual Report 1997/98. The results of this research are being written for publication.

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**PROJECT: Asparagus Post - Harvest Field Herbicides****Project Officer: J. Bright**

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Total weed control in asparagus is essential in management of the crop and will assist the crop to grow strong and disease free. To achieve this several weeds will need particular attention. These weeds include Daisy and Native vigna. Trials were carried out on a grower's property in August 1998, to assess several post harvest herbicides on these weeds. The best control method was a glyphosate spray using a shielded applicator.

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**PROJECT: Asparagus Colletotrichum Control****Project Officers: J. Bright and B. Condé**

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In both research and commercial situations, the disease anthracnose (*Colletotrichum gleosporioides f.sp.*) infested asparagus crops in the Katherine region. The disease can be identified as dark circular spots that appear on the fern usually where the fern is branching. The lesions will produce pinkish spores when the conditions are favourable. Once the lesions are present on the fern more will develop if the disease is not controlled. Eventually the fungus will dominate the fern with numerous concentric rings running up the length of the fern causing the fronds to die. The spores are transported by wind, water splash or direct contact such as when emerging fronds touch infested fronds.

The disease affects the yield and quality of the spears probably due to a reduction in the amount of photosynthetic area that the plant has available. This would lead to a reduction in carbohydrates produced and subsequently stored in the crown resulting in a reduction in stored reserves the plant has to put into spear production. It appears that the disease was present in the region on native asparagus and subsequently spread to the cultivated asparagus. Plants that are under stress are more prone to the disease.

Strategies of control for the disease have been investigated. These strategies examined various chemical control methods as well as crop management techniques that would minimise inoculum levels. The disease is more prevalent in the wet season when the humidity and moisture are both high. In fact the disease is most severe where there is high moisture and temperatures are between 20 – 30°C. (October to March) and, if controlled during the wet, is rarely found in the dry season, as conditions are not optimum. However, after the wet season, it was found that the plants that have been affected must be cut back and debris raked and burned. If this is not done, the disease will continue to infest the new emerging plants as they contact the dead diseased stems of the infested plants. In addition a regular alternating spray program of benomyl, mancozeb and copper fungicides throughout the wet season months is recommended as prevention for *Colletotrichum gleosporioides f.sp.* As the fern at this stage is quite tall and dense it would be difficult getting full coverage of the spray that is required. The sprays need to be applied with full coverage getting down to the base of the infested plants. Therefore, the management strategy developed for control of *Colletotrichum gleosporioides f.sp.* in the region is that the fern needs to be slashed early in the wet season (around December), then the trash should be raked and burnt as even dead material may harbour the fungus. Once slashed the plants should be sprayed regularly, every seven to 10 days, with different fungicides. This will give the plant time to renew (fern out) and develop to a stage when it is again capable of carbohydrate accumulation and storage prior to dormancy initiation in May.

This management strategy is to be implemented in a commercial situation in 1999/2000. The property is intending to change from over head sprinklers to drip tape in late 1999. It is suggested that drip tape will allow the bulk of fern to remain dry in the humid build up months. This will help in holding back the disease until the early wet season. Prior to the wet season the fern will be slashed and a regular spray program put in place through the wet season. The fern will again be slashed in the late wet season and allowed to grow for 5 months until it is harvested. All trash that has been slashed will be raked into rows and burned to get rid of potential inoculum. Fern will be slashed with "root cutters" that cleanly cut the fern off just below the surface.

**SUBPROGRAM:                   Ornamentals**

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**PROJECT:           Improving Heliconia Productivity**

**Project Officers:   M. Hoult and D. Marcsik**

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Yield and leaf nutrient was monitored for important commercial *Heliconia psittacorum* cultivars. Yields between four commercial farms over a six-month study period varied dramatically for cultivar "Golden Torch", with some sites yielding double the number of harvested stems. A similar trend was observed for Petra. Correlations between leaf-nutrient data and yield indicated an increase in yield with increasing leaf calcium to magnesium ratios and leaf iron for both Golden Torch and Petra. Increasing leaf nitrogen to potassium ratios improved yield for Golden Torch. Also increasing leaf manganese and sulphur for cultivar Petra increased yield.

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**PROJECT:           Heliconia Cultivar Improvement**

**Project Officers:   D. Marcsik and M. Hoult**

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Because of a complete embargo on the importation of heliconia vegetative material (including *in vitro*) into Australia, new cultivar development is limited to open-pollinated seedling selection and induction of mutants from existing cultivars. Several new accessions from Queensland were introduced and are presently being evaluated. In addition, 130 open pollinated seedlings from *Heliconia psittacorum*, *chartacea* and *rostrata* species have been propagated and will be field evaluated for their suitability for commercial production.

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**PROJECT:           Tissue Culture of Tropical Ornamentals**

**Project Officer:    D. Marcsik**

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Tissue culture is important in the ornamental crops program for rapid multiplication and production of disease-free plants. Priority is currently given to *Heliconia* to ensure industry has access to clean planting material of commercial cultivars in the future. For *Zingiberaceae* species, the technique is central to the ginger-breeding project and the development of new commercial types. Other plants of priority to be tissue cultured are accessions introduced as part of the nursery product and cut flower product diversity projects. Presently, *Aglaonema*, *Curcuma*, *Calathea* and *Alpinia* plant species are being cultured.

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**PROJECT:           Ornamental Ginger Breeding**

**Project Officers:   D. Marcsik and M. Hoult**

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Preliminary pollination studies were conducted on selected *Zingiber* and *Etlingera* parents to better understand their pollination dynamics and to complement the ginger-breeding project. The *in vitro* fluorochromatic test shows promise for determining germination for both ginger species.

The 1998 hybrid crosses trial for *Zingiber* resulted in 24 successful crosses out of a total of 49 different combinations from 11 parents. Data was recorded for all crosses for time of pollination, stage of flower development, number of flowers pollinated, and condition of pollen (ie. fresh or stored) when applied to the female flower. Approximately 800 *Zingiber* seedling hybrids have been generated from this third round of hybridising. The first round of *Etlingera* hybridising resulted in only one successful cross from 10 different combinations using 4 parents. The pollination dynamics for *Etlingera* needs further study so as to maximise the hybridising effort.

The first field planted *Zingiber* hybrids were evaluated one year after field planting. Three families derived from combinations between 3 parents were evaluated. All except one family did not survive the first year due mainly to a high water table from a record wet season. Out of the surviving family, seven tentative selections were made using

established selection criteria. Yield for these selections varied from 80 to 220 stems per plant for the first harvest year. None of the selections were considered suitable for commercial use although several will be incorporated in further hybridising programs. Open pollinated seedlings of 5 *Etilingera* species were also evaluated and 10 preliminary selections were made. As for Zingibers, selections were made for use as potential parents in future hybridisation.

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**PROJECT: Cut-Flower Product Diversity**

**Project Officers: M. Hoult and D. Marcsik**

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Several new genera of potential cut-flower species along with new cultivars and species of current cut-flower types were introduced. Fifteen *Curcuma* accessions, 12 *Curcuma australasica* accessions and 6 *Globba* accessions have been established or are being bulked up for evaluation. In cooperation with the Darwin Botanic Gardens, several Papuan New Guinea Zingerberaceae species were introduced with 2 *Reidellia*, 3 *Tapeinochilos* and 3 *Alpinia* accessions recently released from Quarantine. These will be evaluated for their suitability to commercial cut flower production.

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**PROJECT: Nursery Product Diversity**

**Project Officers: M. Hoult and D. Marcsik**

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Approximately 130 nursery accessions were introduced during the reported period. This material was sourced from Singapore, Thailand and Hawaii. The majority has been released from quarantine and distributed to industry or is being bulked up for distribution. A number of nursery crops have been identified for future development work, notably dwarf Frangipani, Cordyline, Madagascar and Papuan New Guinea palms, Top End native species and North Queensland rainforest species.

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**PROJECT: Development of Alternative Growing Media Ingredients**

**Project Officers: M. Hoult, H Ngo and D. Marcsik**

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A survey of local tree felling contractors revealed that around 20,000 cubic metres of green woodchip is produced annually in the Darwin region. Of this approximately 40 % is African mahogany, 35 % Black wattle and 25 % mango and other species. 60 % of this total volume is produced during October through to March. Price for woodchip ranges from \$10 to \$30 per m<sup>3</sup> depending on how much cleaning is necessary for pure woodchip. The estimated total volume of organic components of growing media used by the local nursery industry is around 4000 to 5000 m<sup>3</sup>. Issues currently addressed include the severe nitrogen draw down and potential toxicities from phenolics in wood-based growing media components. Another potential source is the by-product from the Cypress pine oil extraction process that is occurring locally.

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**PROJECT: Effect of Vase Solution Additives on the Vase Life of Tropical Cut Flowers**

**Project Officer: M. Gosbee**

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**Benzyl adenine (BA) on *Heliconia psittacorum***

BA has been reported in previous DPIF work as increasing the vase life of *H. psittacorum*. However, the effect of vase solutions on tropical cut flowers has been reported to be very seasonal, with increases at some times of the year and not at others. *H. psittacorum* varieties 'Golden Torch' and 'Petra' were placed in 200 ppm solutions of BA or water and observed every 2 days for signs of aging.

The use of BA did not increase the vase life of *H. psittacorum*; it actually decreased it. This is in contrast to previous work, and will be followed up in the future.

**Hydroxyquinoline sulphate (HQS) on *Alpinia purpurata***

Likewise, HQS has been reported to increase the vase life of *A. purpurata*. Flowers were placed in solutions of HQS for 48 hours then tap water, HQS continuously, or tap water continuously. No significant difference was detected in the vase life of flowers in either solution, with average vase life of 11 days for flowers kept in water, and 15 days for flowers kept in the HQS solution for 48 hours, and 12 days for flowers kept in HQS solution continuously. Large variability in the results was also noted.

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**PROJECT: Nursery and Flower Industry Promotion**

**Project Officer: M. Hoult**

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Assistance is being provided to NIAANT for the forth coming Nursery Industry Association of Australia National conference to be held in Darwin in April 2000. It is anticipated that over 400 delegates will attend this national event. DPIF will assist with workshops and seminars during the conference.

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**PROJECT: The Federation Flower**

**Project Officer: M. Hoult**

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After several meetings with the local cut flower growers group and the Federation Flower Committee, cultivars of *Alpinia purpurata* "Darwin Collection" were chosen as the NT locally developed flower for the "Celebration of Federation" events. As earlier financial commitments given by representatives of the National Federation Flower committee could not be met by the local Federation Flower Committee, this project had a greatly diminished role. The local cut flower growers group has predicted that with strong demand for *Alpinia* flowers from southern markets, production from increased plantings should be readily sold.

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**PROJECT: Implementation of NIASA - Nursery Industry Accreditation Scheme Australia**

**Project Officers: M. Hoult, S. Belgard and M. Connelly**

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Two wholesale nurseries maintained full accreditation under NIASA. These are the first two businesses to be accredited in the NT. In addition, six others applied for preliminary inspections. Of these, five are still in the process of developing their businesses to a standard that will ensure accreditation. Funding for NIASA implementation was successfully sought from HRDC to hold two workshops on growing media management and "waterworks", the national learning module for irrigation management of nurseries.



# RESOURCE MANAGEMENT

## PROGRAM: Weeds Management

### SUBPROGRAM: Chemical and Physical Control of Weeds

#### PROJECT: Eradication of Class A Noxious Weeds in the Darwin Region

**Project Officers:** J. Pitt, O. Sutter, H. Stapleton, M. Ashley, F. Maurer, A. Gracie, G. Flanagan, J. Ross, B. Hitchins, N. Ostermeyer and B. Lukitsch

**Project Period:** Ongoing

**Project Location:** Darwin Region

#### **Objective:**

*To eradicate infestations of all Class A weeds in the region.*

#### **Method:**

Class A noxious weeds are controlled and eradicated through cooperative efforts by the Weeds Branch and landholders, using chemicals, fire, mechanical or other physical means, combined with surveys to monitor regrowth.

#### **Results:**

Darwin City Council provided regulatory assistance under their By-laws to compel two residents growing the herbaceous weed, *Barleria prionitis*, to undertake control of the species. *Barleria* continues to be detected in urban areas and it is essential that a community education program be initiated to outline the potential of the weed to seriously affect the environment, so that eradication can eventually be achieved.

The Territory's first field infestation of the aquatic weed, cabomba (*Cabomba caroliniana*), at Marlow Lagoon, Palmerston, is the subject of an eradication program. Less cabomba was recovered in 1999 than 1998. A weed management plan was prepared and draining commenced in May 1999 and was completed in August. This will allow the lagoon floor to bake until the wet season. As the lagoon refills, the herbicide diuron will be applied to those sites from where cabomba was removed in 1999. Palmerston Town Council funds control, with technical advice from DPIF. Inspections will need to continue for 10 years before eradication can be claimed.

After its discovery, the Territory's first infestations of alligator weed (*Alternanthera philoxeroides*) continue to be inspected for re-shooting from rhizomes. Six plants were found and manually removed at one site in the last year. Alligator weed was declared a Class A noxious weed (to be eradicated) as well as Class C noxious weed (not to be introduced). The alligator weed Agnote was updated.

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**PROJECT: Eradication of Class A Noxious Weeds in the Katherine Region**

**Project Officers:** S. Wingrave, M. Fuller, R. Maloney, L. Johns and B. Whitworth

**Project Period:** Ongoing

**Project Location:** Katherine Region

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**Objective:**

***To eradicate infestations of Devil's Claw, Mimosa pigra, chinee apple and parthenium weed from the Katherine Region.***

**Method:**

Strategically important infestations of Class A noxious weeds are controlled using chemical and mechanical methods, with the aim of eventual eradication.

**Results:**

Control of strategically important infestations of Devil's claw continued on Willeroo Station, Camfield Station and Victoria River Downs as well as provision of assistance to Gregory National Park. These infestations are important as they all lie at the top of large catchments with potential to affect large areas of land.

Survey and control of infestations of *Mimosa pigra* on Scott Creek and Jindare continued in conjunction with landholders. Minimal numbers of mature seed producing plants were found, however survey and control will continue in the future because of the extended viability of the seed.

Ground survey continued for parthenium infestations at Elsey Creek and Katherine Town. No plants were found.

Strategic control of chinee apple continued in the Katherine Town area, in conjunction with Lands Planning and Environment. Control of seed producing plants was not completed and therefore will be continued in the future.

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**PROJECT: Eradication of Class A Noxious Weeds in the Barkly Region**

**Project Officers:** J. McMahon and C. Robertson

**Project Period:** Ongoing

**Project Location:** Barkly Region

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**Objective:**

***Improve weed management and awareness of prickly acacia (Acacia nilotica) in the Barkly Region.***

**Background:**

Prickly acacia is a major weed in north Queensland, but only isolated infestations occur in the NT. It is a Class A noxious weed – to be eradicated. On the Barkly tablelands, infestations are confined to two properties, but there is potential for the weed to spread across the entire region.

**Method:**

The management of prickly acacia involves the removal of mature plants and the continued control of seedlings.

**Results:**

Ongoing programs have reduced the number of seedlings emerging at both locations and reduced its potential damage to the cattle industry.

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**PROJECT: Survey and Control of Class B Noxious Weeds in the Darwin Region**

**Project Officers:** J. Pitt, O. Sutter, H. Stapleton, M. Ashley, F. Maurer, and A. Gracie, G. Flanagan, J. Ross and B. Hitchins

**Project Period:** Ongoing

**Project Location:** Darwin Region

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**Objective:**

*To protect NT primary industries and the environment from the effects of Class B noxious weeds.*

**Method:**

Extension services and limited physical assistance is provided to landholders in the region for control of Class B weeds. The Minister also continues to provide additional assistance through the Weeds Management Assistance Scheme (WMAS) and the Herbicide Subsidy Scheme. These schemes are designed to provide financial incentive to landholders to integrate a range of control options to control mimosa and other noxious weeds.

**Results:**

Control of key infestations of mimosa along the lower Mary River continued on Melaleuca, Opium Creek and Marrakai stations. Strategic control of mimosa in the lower Mary River catchment is essential to prevent rapid expansion of the current mimosa problem.

A control program integrating biological and chemical control methods targeting salvinia (*Salvinia molesta*) commenced at Mission Hole, a billabong on Elizabeth Downs Station. The bud and stem-boring weevil *Cyrtobagous salviniae* was released in 1997 and has provided excellent control. Its action has reduced the area of salvinia by over 95 % and in conjunction with wet season floods, cleared part of the lagoon that had been blocked for several years. To date there has been no need for herbicide applications.

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**PROJECT: Survey of Class B Noxious Weeds in the Alice Springs Region**

**Project Officers:** S. Wingrave, F. Shiel and B. O'Hanlon

**Project period:** Ongoing

**Project Location:** Alice Springs Region

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**Objective:**

*To protect NT primary industries and the environment from the effects of Class B Noxious Weeds.*

**Background:**

This program involves the effective management of strategically important Class B weeds.

**Method:**

Class B noxious weeds in the Alice Springs Region are controlled through cooperative efforts by the Weeds Branch and landholders, using the most appropriate techniques for the particular weed.

**Results:**

The management of Mexican Poppy continued in key areas identified in the "Mexican Poppy Management Plan". This program involved Government agencies, a range of community stakeholders and private industry.

The Finke River Athel Pine project continued in conjunction with the Titjikala CDEP program and the Federal

Government NHT program. To date, all mature Athel Pine has been removed from approximately 380km of the Finke River bed and banks.

Management of other species such as Noogoora Burr, Bathurst Burr, saffron thistle, parkinsonia and mesquite continued in the region. Management of these species involved a combination of survey, mapping and extension processes with the private and public sectors.

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**PROJECT: Survey and Control of Class C Noxious Weeds**

**Project Officers:** J. McMahon, in collaboration with Queensland Department of Natural Resources

**Project Period:** Ongoing

**Project Location:** 100 kilometre Buffer Zone east of the Northern Territory and Queensland border

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**Objective:**

***To stop the introduction of noxious weeds into the Northern Territory.***

**Background:**

This project was developed when noxious weeds in Queensland were rapidly approaching towards the Northern Territory border.

**Method:**

Yearly aerial surveys involving Queensland and Northern Territory officers continue to map the movement of rubber vine (*Cryptostegia grandiflora*) towards the Northern Territory border. The management of prickly acacia, (*Acacia nilotica*), mesquite (*Prosopis pallida*) and parkinsonia (*Parkinsonia aculeata*) continues in a buffer zone 100 km east of the NT border.

**Results:**

Control programs are being developed to eradicate rubber vine infestations within the buffer zone.

Personnel from the Northern Territory and Queensland Governments have reduced plant numbers in the buffer zone.

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**PROJECT: Survey and Control of Mimosa on Aboriginal Land**

**Project Officers:** J. Pitt, O. Sutter, H. Stapleton, M. Ashley, F. Maurer, A. Gracie, S. Wingrave, R. Maloney and B. Whitworth

**Project Period:** Ongoing

**Project location:** Arnhem Land Aboriginal Land Trust, Daly River Port Keats Aboriginal Land Trust, Delissaville / Wagait / Larrakia Aboriginal Land Trust

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**Objective:**

***Management of mimosa (Mimosa pigra) on Aboriginal land***

**Background:**

Following a joint project between the Commonwealth, the Gunbalunya Community, Environment Australia

and DPIF to manage mimosa on the Oenpelli floodplain, a further funding agreement has been negotiated with the Indigenous Land Corporation, Northern Land Council, and the White Eagle Aboriginal Corporation. This has enabled expansion of mimosa control on Aboriginal lands in the Top End.

**Method:**

As a result of the ILC/NLC/DPIF/WEAC agreement, further survey and control activities have occurred throughout known infestations of mimosa in Arnhem Land, the Southern Daly River/Port Keats region, the Wagait area, Ngukurr area, and in areas within the lower Daly River district.

The ILC/ NLC/DPIF/WEAC agreement aims to prevent the further spread of mimosa, eradicate isolated satellite mimosa infestations, and provide mimosa management training to Aboriginal land managers. Training of community members in each of the areas has enabled the establishment of on-ground control crews that treat isolated pockets of mimosa following aerial control, or in areas where aerial application is inappropriate.

**Results:**

A strategically important infestation of *Mimosa pigra* was discovered on the Phelp River in 1997. Survey and control of this infestation continued in 1998/99 when conditions permitted. The affected area was reduced however mature plants were still present. Operations in this area will continue with plans in place for a more extensive aerial survey in the future.

A strategically important mimosa infestation was detected in the Cadell River floodplain in northern Arnhem Land following commencement of work under the agreement. The infestation was located by Djelk community rangers from Maningrida, and illustrates the importance of local surveillance and control on the extremity of the existing mimosa population.

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**PROJECT:            Survey and Control of Noxious Weeds in the Katherine Region**

**Project Officers:    S. Wingrave, M. Fuller, R. Maloney, L. Johns, and B. Whitworth**

**Project Period:     Ongoing**

**Project Location:   Katherine Region**

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**Objective:**

***To protect NT primary industries and the environment from the effects of Class B noxious weeds. This program aims to effectively manage strategically important infestations of Class B Noxious Weeds throughout the region. Strategic infestations are identified as those, which are isolated in their current range but have the potential to affect entire catchments.***

**Method:**

The management of all Class B Noxious Weeds involved aerial and ground based surveys, mapping and monitoring of infestations, extensive liaison with land managers and further release and monitoring of biological control agents.

**Results:**

The management of parkinsonia continued in the Roper River catchment in association with the Roper River Landcare group.

Lion's tail control continued in the Timber Creek district in high use areas and on Humbert River Station, Yarralin and Victoria River Downs.

Chemical efficacy trials commenced at Willeroo Station on Bellyache Bush with the aim of developing economic and effective control options for this species.

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**PROJECT: Survey and Control of Class B Noxious Weeds in the Barkly Region**

**Project Officers:** J. McMahon, C. Robertson and J. Peart

**Project Period:** Ongoing

**Project Location:** Barkly Region

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**Objective:**

***Improved weed management in the Barkly Region.***

**Background:**

This program involves the effective management of strategic Class B noxious weed infestations.

**Method:**

The management of Class B noxious weeds involved ground based surveys, mapping and monitoring of infestations and liaison with land managers.

**Results:**

The management of parkinsonia (*Parkinsonia aculeata*) continued at strategic locations across the Barkly Region.

Aerial and ground management of Noogoora burr (*Xanthium occidentale*) continued on Helen Springs, Alexandria, Epenarra and Rocklands Stations.

Ongoing containment and control of rubber bush (*Calotropis procera*) occurred at various locations throughout the western Barkly Region.

Mesquite (*Prosopis limensis*) control on Brunette Downs, Austral Downs and Lake Nash has reduced the number of plants significantly.

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**SUBPROGRAM Biological Control of Weeds**

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**PROJECT: Biological Control of Mimosa**

**Project Officers:** G. Flanagan, B. Hennecke, M. Paskins, L. Burrell, J. Ross, B. Hitchins, B. Lukitsch and N. Ostermeyer

**Project Period:** Ongoing

**Project Location:** Darwin Region

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**Objective:**

***To protect NT industries and the environment from the effects of Mimosa pigra.***

**Background:**

*Mimosa pigra* is one of Australia's most significant environmental weeds, and is a major hindrance to pastoral activities, tourism and public amenity in the monsoonal regions of the Northern Territory. It has the potential to invade and devastate wetlands in coastal regions across all of Australia's tropics and sub-tropics. This joint program with CSIRO Entomology commenced in 1979.

**Method:**

Natural enemies of mimosa are imported from tropical America, tested for host-specificity in quarantine in Brisbane and released onto mimosa in the NT. During 1980-81 the search for natural enemies of mimosa was centred on Brazil, with brief sorties to Mexico, southern USA and Venezuela. Since 1984, the search has

concentrated on Mexico, with visits to Costa Rica, Honduras, Venezuela and Brazil.

#### Results:

A total of nine insect species and two fungal pathogens have been released. Seven of the insect species and a fungal pathogen have established on river systems across the Top End.

*Carmenta mimosa*, a stem-boring moth, has doubled its area of distribution in the Finnis and Adelaide River catchments in the last 12 months. The release program has extended to the lower Mary, Reynolds and Daly River catchments.

A bud-feeding weevil, *Coelocephalopion pigrae*, has continued to spread through the entire lower Finnis and Adelaide River catchments. It spread unaided to the Daly River catchment and is spreading through that area.

Two species of seed feeding weevils continue to be released on the Finnis and Adelaide Rivers. The first field recovery of *Chalcodermus serripes* occurred this year and adults have been laboratory reared for the first time.

The wet season fungal pathogen *Phloeospora* release program has been suspended pending investigation into six new isolates. Preliminary results of molecular analysis indicate a differentiation of the isolates. This will enable the selection of the most suitable isolate, for further field releases.

Two field inoculations of the dry season rust fungus, *Diabole*, were carried out. The rust has reappeared at release sites after the 1998/99 wet season indicating establishment has been achieved. An efficient culturing and harvesting technique is under evaluation in Darwin.

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## PROJECT: Biological Control of Sida Spp

**Project Officers:** G. Flanagan, B. Hennecke, L. Burrell, J. Ross and B. Lukitsch

**Project Period:** Ongoing

**Project Location:** Darwin Region

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#### Objective:

**To protect NT industries and the environment from the effects of Sida spp.**

#### Background:

Spinyhead sida (*Sida acuta*) is a perennial weed of improved pastures, disturbed areas and roadsides in the Northern Territory. It is a small, erect shrub with a woody, fibrous stem and a deep taproot. It can dominate areas that are heavily grazed, leading to a loss of pastures and a reduction in biodiversity. Flannel weed (*Sida cordifolia*), spiny sida (*Sida spinosa*) and Paddy's lucerne (*Sida rhombifolia*) are other related weeds that can cause similar problems to landholders and the environment.

All these sida species are native to tropical America and have been in Australia for at least 100 years. They are widespread in the monsoonal regions of the Northern Territory.

#### Method:

In 1984, a biological control program for weedy sida species was commenced with the establishment of an exploratory station in Mexico funded jointly by DPIF and CSIRO, Division of Entomology. The aim was to search the Americas for damaging natural enemies of the sidas and to introduce into Australia those that passed stringent host-specificity tests.

#### Results:

Three insects have been released for the biological control of *Sida acuta*: the leaf feeding beetle, *Calligrapha pantherina*, in 1989, the stem-boring weevil *Eutinobothrus* sp in 1994 and another stem boring weevil *E. pilosellus* in 1997. *Calligrapha* established rapidly in the coastal Top End. By the 1996/97 wet season, it had established as far inland as Katherine.

By 1999 a landowner survey showed that *Calligrapha* was providing complete or substantial control in 79% of sida infested areas and reduced other control costs by up to \$3000 pa in over 50% of infested areas in the coastal regions. The highest recorded populations were in the Katherine and Douglas Daly regions and substantially

defoliated sida.

Over 6400 stem-boring weevils, *Eutinobothrus pilosellus*, and *Eutinobothrus* sp were released at eight sites on properties in the Katherine, Darwin and Arnhem Regions. The weevils were recovered at three release sites after the wet season. A rearing colony for the two species was set up at DPIF Darwin, taking over work previously performed by CSIRO Brisbane. Over 1000 weevils were reared to date.

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**PROJECT: Biological Control of Parkinsonia**

**Project Officers: G. Flanagan, B. Hennecke and B. Lukitsch**

**Project Period: Ongoing**

**Project Location: Katherine and Barkly Regions**

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**Objective:**

***To protect NT industries and the environment from the effects of Parkinsonia aculeata.***

**Method:**

In 1982 the DPIF, WA Department of Agriculture and the Queensland Department of Natural Resources (formerly Department of Lands) entered into a joint biological control program for parkinsonia. In 1989 a tiny sap-sucking bug (*Rhinacloa callicrates*) was released in the Northern Territory, but has probably failed to establish.

Two species of seed-feeding beetles (*Mimosestes ulkei* and *Penthobruchus germani*) were subsequently processed through quarantine in Brisbane and cleared for release in Australia. Insects were subsequently released along the Roper River, on the Barkly Tablelands and in the Victoria River district.

**Results:**

Two species of pod-feeding beetles have established on *Parkinsonia aculeata* in the Roper River catchment, the Barkly Region and the Victoria River District. Surveys show these agents are spreading up to 99km from release sites and destroying up to 87% of seeds.

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**PROJECT: The Integration of Biological Control of Mimosa with Other Control Options**

**Project Officers: G. Flanagan, B. Hennecke, M. Paskins, L. Burrell, J. Ross, B. Lukitsch and N. Ostermeyer**

**Project Period: Ongoing**

**Project Location: Darwin Region**

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**Objective:**

***To determine the most cost-effective method of integrating biological control, herbicides, mechanical control, fire and re-vegetation into a mimosa management program***

**Method:**

A 64 ha site has been selected. Combinations of herbicide and mechanical control treatments have been applied. Initial plant population measurements are complete, and native floodplain grass seed has been harvested. Due to the record 1997/98 wet season and the early 1998/99 wet season, it was not possible to apply the burning treatments. Biological control agent numbers are monitored monthly. Results are not yet available.



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<b>PROJECT:</b>	<b>Biological Control of Mexican Poppy, Bellyache Bush and Mesquite</b>
<b>Project Officers:</b>	<b>G. Flanagan, B. Lukitsch, N. Ostermeyer, J. McMahon and J. Peart.</b>
<b>Project Period:</b>	<b>Ongoing</b>
<b>Project Location:</b>	<b>Katherine, Alice and Barkly Regions</b>

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**Objective:**

**To protect NT industries and the environment from the effects of Mexican poppy, bellyache bush and mesquite**

**Method:**

The potential biological control agents against *Jatropha gossypifolia*. (bellyache bush), cerambycids, from the Dominican Republic, are undergoing testing in the CSIRO Quarantine Laboratories in Brisbane. Monthly surveys for phytophagous insects on infestations in Darwin, on Tipperary and Willeroo Stations continued. The bellyache bush Agnote was updated. Exploration for Biocontrol agents for both Mexican poppy and bellyache bush continue in Central America and the Caribbean.

**Results:**

The biological control agent, *Evippe* sp. No. 1, continues to be released at locations across the Barkly Tablelands to combat mesquite. Over 1750 *Evippe* sp were released at Alroy Downs, Austral Downs and Lake Nash on the Barkly Tableland. An inspection of the sites in May showed the *Evippe* sp insects have established at the three locations with the best results at Alroy Downs with plant damage approximately 80% at release sites.

Approximately 3900 psyllids have been released at the three sites but because of the late release and the longer life cycles there is at this stage no evidence the insects have established.

A leaf and stem feeder is undergoing host testing in the CSIRO Quarantine Laboratories, Brisbane.

## **PROGRAM: Sustainable Rangeland Management**

### **SUBPROGRAM: Rangeland Pasture Production**

#### **Barkly Region**

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#### **PROJECT: Nutritional Value of Native Pasture**

**Project Officer:** C. Materne

**Project Period:** 1997-2000

**Project Location:** Alexandria Station, Barkly District

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#### **Objective:**

***From laboratory and field data estimate the levels of nitrogen, phosphorus and metabolisable energy supplied to grazing animals by native pasture at the beginning and end of the dry season.***

***Investigate the effect of nutrient supplementation on native pasture dynamics.***

#### **Background:**

It is well documented that the native Mitchell (*Astrebla spp.*) and Flinders (*Iseilema spp.*) grasslands of the Barkly region are seasonally deficient in phosphorus and protein for the purpose of beef production (Norman and Stewart 1964, Eggington et al 1990, McCosker and Winks 1994, Fordyce 1992). Supplements are given to livestock to rectify these deficiencies (Ffoulkes and Wesley-Smith 1992).

Station managers in the Barkly region have sought advice from the Tennant Creek Pastoral staff regarding the nutritional value of native pastures and the improvement in breeder performance through supplementation.

This project will streamline the process for estimating the nutritional quality of highly variable native pastures, which previous projects have defined.

Seasonal variation of the semi-arid weather is believed to be a factor influencing the change in the composition of pasture species on the Barkly rangeland. Automatic rain gauges have been installed across the trial area to monitor rainfall patterns. This will increase our understanding of how seasonal variation effects pasture dynamics.

#### **Results:**

Nutritional value data of the various species and the overall paddock nitrogen and phosphorus summary is being collated.

The seasonal productivity and pasture composition data has been collected twice yearly over the past three years and is in the process of being collated and summarised. The results will be analysed to determine the effect varying rain patterns and seasonal changes have on the pasture yields and species composition.

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#### **PROJECT: Water Ponding on Red Country**

**Project Officer:** C. Materne

**Project Period:** 1996-1999

**Project Location:** Murray Downs, Barkly District

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#### **Objective:**

***To demonstrate native and introduced pasture species suited for pasture establishment behind ponding banks.***

***To promote spelling as an effective management tool whilst allowing pasture regeneration behind ponding banks.***

**Background:**

On the red soils of the Barkly region, stock rely heavily upon the native pastures in “flood-out” areas - areas where intermittent creeks spill out and flood the low-lying surrounds. The thin, sandy A-horizon of the red soils in these flood-outs may be removed by water or wind erosion. On Murray Downs Station, this scalding process has affected large areas between flood-outs with various reclamation methods having limited success. The principle behind using ponding banks as a reclamation technique is to slow the flow of water across the scalds, which will allow a greater volume of water to infiltrate. As a result of the increased infiltration, it is expected that pasture productivity will increase whilst alleviating the scalding problem.

**Method:**

Four grass species, three legume species and a control plot were randomly sown in strips behind eight ponding banks. An electric fence was erected to exclude stock.

**Results:**

All the four grass species germinated and established well behind the ponding banks with dry conditions. Sabi grass (*Urochloa mosambicensis*) had the highest germination rate (Table 1) and yield (Table 2). USA Buffel Grass (*Cenchrus ciliaris* cv USA) also established and yielded well (Table2).

Verano Stylo (*Stylosanthes humata*) was the most successful legume, germinated well in all replications and appeared to be able to tolerate a wider range of moisture conditions. It was extremely successful in establishing behind five of the eight banks, producing relatively high yields and good ground cover (Table 2). Wynn Cassia (*Chamaecrista rotundifolia* cv Wynn) and Cavalcade were unsuccessful in establishing behind any of the ponding banks.

Annual grasses such as *Sporobolus australiensis* and forbs such as *Ipomea muelleri* dominated the control plot, providing moderate protection to the soil but limited stock feed.

**Table 1: Densities of the individual species**

Species	Densities (average no.plants/m <sup>2</sup> )		
	Apr-97	Jul-98	Mar-99
Control	7.0	6.8	8.7
Sabi Grass	6.6	3.1	2.1
Birdwood Grass	4.4	3.3	2.5
USA Buffel Grass	3.5	2.6	1.3
Native Millet	4.7	1.9	2.5
Wynn Cassia	4.1	0.2	0.1
Verano Stylo	9.8	4.9	5.3
Cavalcade	3.7	1.5	0.8

**Table 2: Yields for each individual species**

Species	Yield (Tonnes/Ha)		
	Apr-97	Jul-98	Mar-99
Control	-	0.83	1.65
Sabi Grass	-	0.73	2.80
Birdwood Grass	-	0.44	0.76
USA Buffel Grass	-	0.75	1.38
Native Millet	-	0.13	0.45
Wynn Cassia	-	0.06	0.11
Verano Stylo	-	2.13	2.34
Cavalcade	-	0.01	0.11

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**PROJECT: Establishment and Persistence of Sown Native Grasses after Mechanical Control of Rubberbush**

**Project Officer: C. Materne**

**Project Period: 1996-1999**

**Project Location: Powell Creek Station, Barkly District**

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**Objective:**

**To determine the effect of grazing and mechanically disturbed soil on the establishment of sown *Astrelba pectinata* (barley Mitchell grass); and the impact of grazing and soil disturbance on the rehabilitation of a degraded black soil area. To increase producer awareness of spelling and reseeding through the collation and distribution of a 'demonstration' package**

**Background:**

This project commenced in association with the local Weeds Officers to determine if grasses could provide competition for weed seedlings that emerge after mechanical control, and to assess the establishment of sown Mitchell grass in an area where there was grazing, no grazing, soil disturbance and no soil disturbance.

**Method:**

An area infested with Rubberbush and Parkinsonia near a bore on a cattle station in the Barkly region was mechanically disturbed to a depth of 30cm using a bulldozer pulling a cutterbar. A fence was erected to exclude cattle from grazing the area that contained disturbed and undisturbed land. *A. pectinata* was sown in four treatments, with another four treatments remaining unsown.

**Results:**

Barley Mitchell grass (*Astrelba pectinata*) established most successfully under the disturbed-ungrazed seeded treatment (Table 1). *A. pectinata* densities decreased dramatically between May 1997 to April 1999 in all treatment areas. Grazing and competition with the native forbs and grasses already present in the area may have influenced this decline.

**Table 1. The establishment and persistence of sown barley Mitchell grass (*Astrelba pectinata*) (Plants per m<sup>2</sup>)**

Treatment	<i>Astrelba pectinata</i> per ha		
	May-97	Jul-98	Apr-99
1. disturbed-grazed-sown (DGS)	6,000	0	0
2. disturbed-ungrazed-sown (DUGS)	22,700	5,300	0
5. undisturbed-grazed-sown (UDGS)	9,300	0	0
6. undisturbed-ungrazed-sown (UDUGS)	5,300	0	0

Rubberbush (*Calotropis procera*) densities in the disturbed treatment plots increased sharply between May 1997 and July 1998 (Table 2). During this period, the largest increase in Rubberbush densities occurred in the disturbed-ungrazed plots, suggesting that grazing stock kept Rubberbush densities down. By April 1999, densities in the disturbed-ungrazed plots had declined slightly while the densities in the disturbed-grazed treatment plots had increased (Table 2). If this trend continues long term, areas containing high densities of Rubberbush may be reduced to manageable levels by excluding stock.

**Table 2. Rubberbush (*Calotropis procera*) density**

Treatment	<i>Calotropis procera</i> per ha		
	May-97	Jul-98	Apr-99
1. disturbed-grazed-sown (DGS)	1,300	2,400	6,700
2. disturbed-ungrazed-sown (DUGS)	0	17,300	11,300
3. disturbed-grazed-unsown (DGUS)	0	10,700	14,700
4. disturbed-ungrazed-unsown (DUGUS)	2,000	26,700	1,300
5. undisturbed-grazed-sown (UDGS)	0	0	0
6. undisturbed-ungrazed-sown (UDUGS)	0	0	700
7. undisturbed-grazed-unsown (UDGUS)	0	700	1,300
8. undisturbed-ungrazed-unsown (UDUGUS)	700	0	700

Initial results indicate that mechanical weed control of Rubberbush using a cutterbar appears to have an adverse effect on the population and in fact may enhance the problem.

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## **PROJECT: Irrigation Fodder Production Evaluation on Helen Springs Station**

**Project Officer:** C. Materne, T. Price and D. Parker

**Project Period:** 1999-2001

**Project Location:** Helen Springs, Barkly District

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### **Objective:**

To evaluate fodder species and fertiliser requirements for growing forage crops at Helen Springs Station.

### **Background:**

Helen Springs Station management is considering the possible benefits of growing forage under irrigation in order to be self-sufficient for feeding cattle prior to or during trucking to live export.

The trial will be a randomised block design with three fertiliser applications replicated three times. There will be eleven main plots, which will contain 11 species for evaluation.

Species to be evaluated are:

- Silk Sorghum (*Sorghum* spp.)
- Nutrifeed (*Pennisetum glaucum*)
- Sugargraze (*Sorghum* spp. – Hybrid *Sugargraze*)
- Graze & Sile
- Jumbo (*Sorghum* spp. – Hybrid *Jumbo*)
- Jarra Grass / Finger Grass (*Digitaria milanjiana* cv Jarra and Strickland)
- Cavalcade (*Centrosema pascuorum* cv Cavalcade)
- Milgarra Blue Pea (*Clitoria ternatea*)
- Lucerne (*Medicago sativa*)
- Ooloo (*Centrosema brasilianum*)
- Red Flinders Grass (*Iseilema vaginiflorum*)

### **Results:**

Plant samples will be taken for full analysis at 28 days after sowing and at normal harvest time. Yield measurements will be taken at normal harvest times.

## Alice Springs Region

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**PROJECT: Range Condition Assessment (RCA)**

**Project Officer:** R. Dance

**Project Period:** 1976 - 2000

**Project Location:** Alice Springs District

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**Objectives:**

*Record, interpret and provide timely feedback to producers about changes in grazed rangeland which are attributable to seasonal and management factors. In particular to:*

- *Monitor rangeland responses to season, management practices and other appropriate phenomena.*
- *Derive relationships between management practices, season and the value of rangeland as a grazing resource.*
- *Provide advice to pastoralists and government agencies on the productive utilisation of the area's resources.*

**Background:**

Formal data collection and reporting for this project ceased in about 1990. RCA activities had focused on fixed, 10-hectare recording sites, but also related the site-specific details to the wider area. These recording sites were established on high productivity land systems or those areas likely to be sensitive to seasonal and management influences. The sites were reassessed at intervals of one to ten years using procedures outlined by Bastin(1989). Principally, sites were photographed and detailed information collected on soils, herbage, shrubs and trees. Site inspections and discussions with landholders provided information on rainfall, fire and grazing histories. This project was conducted on a lease by lease basis.

**Results:**

Transfer of the data to a secure Year 2000 compliant form was completed. In the process a large number of anomalies in the data were corrected. Other data omissions were identified but have not been corrected. The data is contained in approximately 24 tables, some with tens of thousands of records. An application, which provides limited viewing capacity, is available. Ad-hoc data analysis is possible. Completion of a fully functioning database with data entry and editing capability is currently in the hands of another agency.

It is intended that eventually the data will be summarised and released, but no firm timetable is currently available.

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**PROJECT: Economics of Tree and Shrub Control**

**Project Officer:** R. Dance

**Project Period:** 1987 - 2000

**Project Location:** Alice Springs District

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**Objective:**

*Continue to evaluate and report on the costs and returns from the use of herbicides and mechanical methods for the control of excess woody vegetation in the Alice Springs area.*

**Background:**

Increase in unpalatable native woody vegetation is a continuing issue within some sections of the pastoral community, particularly to the north of Alice Springs. The dense vegetation competes with native pasture for moisture and nutrients rendering the affected areas less productive. Mechanical methods of control such as

chaining and blade ploughing are recommended as is the use of fire, however limited data has been available in the past on the costs and benefits of these control methods. Granular herbicides have been advocated as another option to the mechanical methods. Although an expensive control method, the use of herbicide has the advantage of being very fast to apply and of achieving a high level of control. This method does not require expensive application equipment, nor is there any need to preclude grazing for extended periods to accumulate fuel for burning.

Trials using the herbicide Graslan® commenced at Alcoota station during 1987 on target species mulga (*Acacia aneura*) and ironwood (*A. estrophiolata*) and on Stirling station in 1989 on ironwood and witchetty bush (*A. kempeana*.) The results achieved on the juvenile ironwood were very encouraging and it became apparent that the control of ironwoods could be achieved at low rates (below 5kg/ha). Additional plots were thus established on Alcoota and Stirling stations to determine the lowest and most economical rate of Graslan® necessary to achieve satisfactory control of the juvenile ironwood.

The mechanical treatments being considered are those that pastoralists have already applied in an attempt to maintain grassland productivity. These include chaining and blade ploughing. They have been applied to various plant communities dominated by

1. Gidyea ( *Acacia georginae* and *A. cambagei*)
2. Witchetty bush
3. Ironwood
4. Mulga
5. Turkey bush (*Eremophila gilesii*)

**Results:**

No further data was collected in 1999 due to dry conditions, and diminishing staff resources. Documentation is to be completed as soon as is possible.

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**PROJECT: Needlebush Rabbit Control**

**Project Officer: G. Bohning**

**Project Period: 1991 - 2000**

**Project Location: Alice Springs**

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**Objective:**

***To undertake an evaluation of the effect of rabbit eradication on vegetation in the CLMA Needlebush Rabbit Eradication Project.***

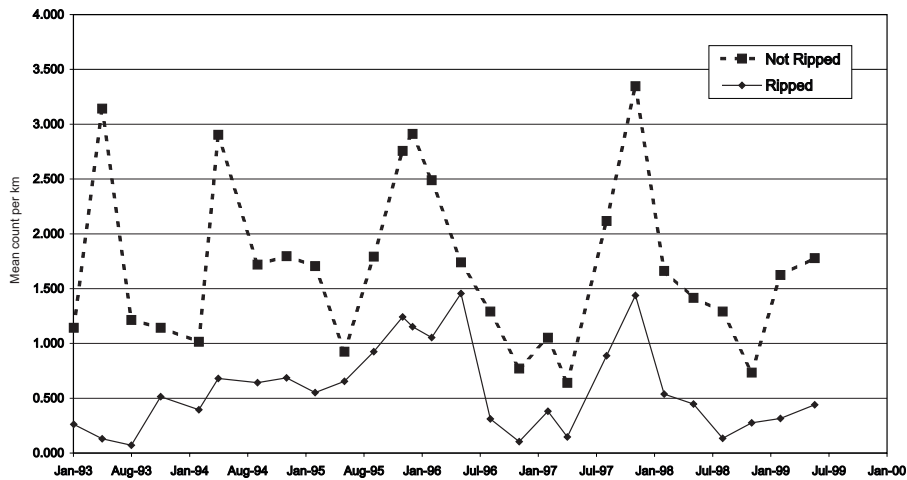
**Background:**

The Centralian Land Management Association (CLMA) has established a 300-km<sup>2</sup> rabbit eradication area on Erldunda, Lyndavale and Mt Ebenezer stations. The overall objective of the CLMA program is to show by establishing a demonstration at the extensive scale, the ecological and economic benefits of combined rabbit eradication and associated grass planting in an area of low and unpredictable rainfall. The role the Department is to measure the vegetation responses over the project period following the removal of the rabbits and to calculate the costs and benefits of the control operation.

**Results:**

Rabbit numbers continued to be low in both the "eradication area" and the untreated areas surrounding, due to infection by rabbit calicivirus, and because of dry seasonal conditions, which continue to prevail. Vegetation measurement sites continue to be maintained, but data collection is not occurring. It will be desirable to complete the project after one or two years of good seasons when the rabbit population and vegetation are able to demonstrate their potential.

### NeedleBush Rabbit Counts



**PROJECT: Camel Co-grazing Trial Pasture Monitoring**

**Project Officer: G. O'Reilly**

**Project Period: 1997-2001**

**Project Location: Waite River**

**Objective:**

*To compare the effects of co-grazing by cattle and camels on rangeland pasture with the effect of grazing by cattle alone, within similar land-types in adjacent paddocks.*

**Background:**

A small camel industry exists in Central Australia. There is potential for its expansion on pastoral leases. There is evidence that there is minimal overlap between the diets of camels and of cattle. In 1997 the project, *Co-grazing of camels and cattle for commercial production* was initiated by the Animal Production Section DPIF, Alice Springs. Its objectives are to collect production data and improve knowledge of the impact of camels on native vegetation, including rangeland pastures, grazed by cattle. As part of that project, the Rangeland Management Section is undertaking pasture monitoring.

**Results:**

Seasonal conditions at the time of the April 1999 pasture assessment were very poor and there was little or no effective rainfall over the previous summer period.



Figure 1. Typical pasture yields, Waite River



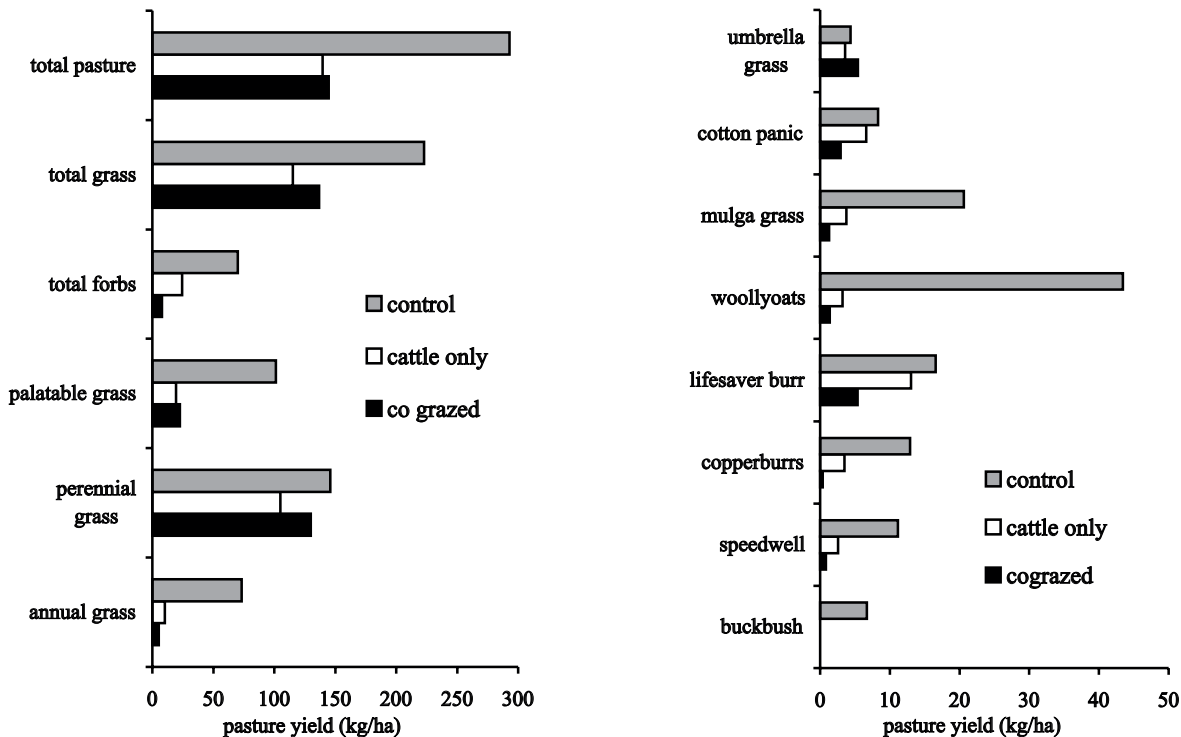


Figure 2. Botanical composition of treatments, cograzing

The poor seasonal conditions have resulted in significant quantities of pasture being grazed. Every one of the 1m<sup>2</sup> quadrats in the grazed paddocks showed signs of having been grazed by herbivores. All pasture species in the treatment paddocks have been grazed regardless of palatability.

The results show that palatable annual grasses such as woollyoats (*Enneapogon polyphyllus*) and mulga grass (*Aristida contorta*) have been heavily grazed as have semi-palatable forbs like speedwell (*Evolvulus alsinoides*). Copperburrs (*Sclerolaena* spp.) have also been well grazed, particularly in the cograzed paddock.

The results show that overall, half of all available pasture has been utilised. Most palatable pasture has been eaten out. With little prospect of rain for the next six months, the cattle will be forced to graze less palatable pasture and browse more topfeeds.

No clear trends have yet emerged from the pasture assessments thus far, indicating that running camels as extra livestock does not appear to impact on grass and herbage pasture.

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**PROJECT: The Effect of Cattle Grazing on Sandy Open Woodland in Central Australia**

**Project Officer: G. O'Reilly**

**Project Period: 1998 - 1999**

**Project Location: Mt Riddock Station**

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**Objectives:**

**To identify changes to vegetation and soils attributable to 30 years of cattle grazing on sandy open woodland adjacent to a bore, 140km NE of Alice Springs.**

**Background:**

After the 1960s drought several long-term cattle exclosures were established around the N.T. to document range condition and trend over time. Very few remain but one that is intact is the Spinifex bore exclosure (now 128 ha) constructed in 1968 on Mt. Riddock station. The vegetation changes in the first 11 years of the life of this exclosure (1968-1979) were published in 1982 (Foran *et. al.*, 1982). Limited measurements taken by DPIF in the 1993 to 1997 period indicated that differences between the grazed and ungrazed areas now existed, and justified closer scrutiny.

**Results:**

Pasture yield and composition, and tree and shrub canopy cover were measured in June 1998, after good cool season rainfalls. Cattle grazing has maintained cover of palatable trees, and has kept excessive shrub increases under control. Grazing has significantly increased the quantity of a perennial grass, but nutritional quality and co-dominancy of important pasture species has declined. Overall pasture species diversity has not been affected. Kangaroos have dissociated from cattle.

Table (1) Mean yields in kg/ha dry matter and level of differences between treatments, of some pasture species from Spinifex bore exclosure, June 1998.

Species	<i>Aristida holathera</i>	<i>Bonamia media</i>	<i>Enneapogon polyphyllus</i>	<i>Eragrostis eriopoda</i>	<i>Melhania oblongifolia</i>	<i>Sauropsis trachys-permus</i>	<i>Sida cunning-hamii</i>	<i>Tribulus terrestris</i>
Grazed	14.0	4.0	0.3	326.6	2.0	0.4	1.3	2.0
Exclosed	56.2	25.0	41.5	120.6	6.0	1.1	0.8	19
LSD	0.33	1.35	1.242	0.3711	0.805	0.987	1.190	1.554
p-value	0.156	0.017	<0.001	0.005	0.158	0.295	0.520	0.019

Table (2) Percentage of 'sites' where species were absent or present. Species shown had significant differences (Fisher's exact test). Spinifex bore exclosure, June 1998

Species	Exclosed		Grazed		P value
	Absent	Present	Absent	present	
<i>Enneapogon polyphyllus</i>	15	85	90	10	<0.001
<i>Bonamia media</i>	10	90	40	60	<0.05
<i>Tribulus terrestris</i>	65	35	20	80	<0.01
<i>Aristida contorta</i>	40	60	95	5	<0.001
<i>Evolvulus alsinioides</i>	60	40	90	10	<0.05
<i>Panicum decompositum</i>	65	35	95	5	<0.05
<i>Sida rhombifolia</i>	75	25	30	70	<0.01

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**PROJECT: Fire for Pastoral Management**

**Project Officer: G. O'Reilly (from 1998)**

**Project Period: 1997 - 2002**

**Project Location: Alice Springs District**

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**Objectives:**

***To quantify the short term (1-3 years) and medium term (3 to 5 years) effects of controlled fire and management practices on recorded pasture species and designated tree and shrub species. To recommend the potential use of fire and its likely outcomes.***

**Background:**

The northern Alice Springs district has had large increases in native woody species since the 1970s, which can now hinder station operations and compete with more useful pasture species. Many stations recognise that the reduced frequency of fire when woody plants are still small is an important reason why this woodland increase has occurred. DPIF has been advocating the general use of fire as a pasture management tool but this has been based on limited factual information for specific land types in central Australia and minimal direct experience within the Department. The encouragement to try using fire cannot be more specific until more factual information can be gathered.

**Results:***Mt Riddock (woodland thickening)*

575 trees/shrubs have been tagged at 16 pasture sampling sites in Windarra and Mallee paddocks. Conditions have remained unsuitable for burning to date.

*Delmore Downs (woodland thickening)*

400 trees have been tagged at a proposed burn in a dense mulga and woodland drainage. There is not enough fuel to carry a fire so it has been suggested that a criss-cross pattern of lines be bulldozed through the scrub. This would create a series of 'squares', which could be treated experimentally while still grazing the area.

*Ambalindum (Acacia farnesiana) increase*

This shrub-kill-burn was carried out at Canteen Creek on 22<sup>nd</sup> and 23<sup>rd</sup> March 1999. Pre-burn measurements were taken at a series of relocatable sampling plots. Photo-points were established and data was collected on pasture composition, yield and density, and age/class structure of the target shrub. Good canopy scorching of dense *Acacia farnesiana* was achieved. Small grassy creeks nearby with numerous 1m seedlings were also burnt. Conditions have remained dry since the fire but basal regrowth of all age/size classes has begun to occur.

*Undoolya "Todd flood-out" (saffron thistle/ creek land type)*

This burn was carried out on 19-20<sup>th</sup> April and is a cooperative project between the Rangelands and Weeds sections of Resource Management. The NT Bushfires Council is an active participant. Pre-burn measurements were taken at a series of relocatable sampling plots a few days before the fire. Photo-points were established and data was collected on pasture composition and yield, density of the noxious saffron thistle and mexican poppy, as well as tree and shrub canopy cover. Samples of grass were taken for 'before and after' nutritional analysis. Photo-point and general photographs, and unburnt control sites were established the day after the fire. The fire scar was mapped using DGPS data. It is still early to have any clear results.

*Narwietooma (grass increase in spinifex)*

In 1995, Narwietooma station, northwest of Alice Springs, burnt 20 km<sup>2</sup> in two sections of hard spinifex (*Triodia basedowii*) country. The following year, was dry, and the topsoil began to blow away, but good summer rains fell early in 1997 producing abundant germination and growth of perennial grasses (mostly *Eragrostis eriopoda*). Pasture measurements, combined with GPS mapping, indicates that 800 tonnes of extra grass has grown over the burnt area. This abundant coarse grass provides bulk feed and compliments water medication in use on this hard country.

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**PROJECT: Water Ponding for Pastoral Production****Project Officer:** n/a**Project Period:** 1997-2000**Project Location:** Alice Springs District

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**Background:**

Water ponding has been promoted as a means of land rehabilitation in central Australia. While there is anecdotal evidence of the benefits, there is little data on the value of these benefits compared to the cost of building the ponding banks. With the current financial squeeze that some central Australian stations find themselves in, it is important to have a clear idea of the costs and likely returns before committing time and money.

**Objective:**

***To record the potential productivity benefits and associated costs of water ponding for increased pastoral production in central Australia.***

**Progress:**

This work is currently in abeyance, pending recruitment.

## KATHERINE REGION

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**PROJECT: A Booklet for Better Land Management of Native Pasture Communities in the VRD**

**Project Officer: M. Cobiac**

**Project Period: 1997-2001**

**Project Location: Katherine/VRD**

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**Objectives:**

***To produce a booklet that ensures the majority of pastoral land managers gain an increased understanding and knowledge of local pasture communities and basic grazing ecology and management.***

**Background:**

The aim of this sub-project is to utilise research information gained throughout the first phase of NTA 022, to produce a booklet directed at graziers throughout the VRD, Katherine and Sturt Plateau areas. This booklet will provide a description of the basic characteristics of the major pasture communities and outline the likely impact of land management practices in a state and transition model framework.

**Results:**

In cooperation with (QDPI), the booklet *Managing grazing in northern Australia* was published. This booklet has been compiled by Ian Partridge of QDPI from input from several agencies throughout northern Australia and drew on results gained from research conducted in the VRD.

A more detailed document containing data specifically relevant to the VRD is planned. Data analysis for the Master's thesis of Michael Cobiac is nearing completion and will be included in the publication.

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**PROJECT: Economic Assessment of Grazing Management Options**

**Project Officer: R. Dyer**

**Project Period: 1997-2001**

**Project Location: Katherine/VRD/Sturt Plateau**

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**Objectives:**

***To ensure that 50% of pastoral managers have investigated the economic viability of a range of sustainable grazing management options using a range of Decision Support Systems (DSS) in a whole-property framework***

**Background:**

The economic analysis of development, management and marketing options is essential to assess the potential financial risk and impact of management decisions. It is also necessary to promote the increased adoption of sustainable grazing management options.

In cooperation with individual pastoralists, the economic impact of various climatic and management scenarios is being investigated throughout the Sturt Plateau and VRD. On-property case studies will utilise Herd Econ, GRASP, Breedcow Dynama and RAINMAN decision support systems. Input data for each enterprise will be provided from producer records and knowledge, and available production and economic data.

**Results:**

As previously reported, Rosemary Buxton, CSIRO Division of Wildlife and Ecology, Alice Springs in conjunction with Rodd Dyer gathered information and carried out economic case studies throughout the VRD and Sturt Plateau. A report was produced as part of the Land Use Change in Northern Australia (LUCNA) project titled *Regional Report: Sturt Plateau and Victoria River District*. The report contains a brief description of the region, outline of management practices, factors causing variations in cash flow and several general case studies. These included:

- Methods of herd build up
- The cost of improving the placement of watering points
- The benefits of increasing the proportion of steers reaching saleable weights as yearlings
- The costs of pasture improvement
- Sensitivity of cash flow to branding rates, breeder mortality and prices

No further analyses have been carried out due to difficulty of getting access to economic specialists.

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**PROJECT:            Assessment of Stocking Rates and Carrying Capacity for Pastoral Properties**

**Project Officer:     R. Dyer**

**Project Period:     1996-2001**

**Project Location:   Katherine/VRD/Sturt Plateau**

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**Objectives:**

***To ensure 60% of pastoral properties have documented current paddock and property stocking rates and developed individual estimates of sustainable livestock carrying capacity.***

**Background:**

There are few objective estimates of safe stocking rates for pasture communities throughout the VRD and Sturt Plateau. Current recommendations are based on subjective estimates over the years. Disagreement regarding "safe" stocking rates exists between different government agencies and pastoralists.

This project will gather current stocking rate information and utilise grazing research results, pasture growth models, producer knowledge and GIS to estimate safe levels of stocking on a pasture community (land unit), paddock and property basis. The methods outlined by Scanlan et al. (1994) and Johnston et al. (1996) will be utilised.

**Results:**

Paddock stock numbers have been collected from 14 pastoral properties throughout the VRD.

A pilot prototype of an integrated database (Access) and GIS (Arc View) package is almost complete. This package will undertake semi-automated calculation of paddock, land unit areas, stocking rates and estimated carrying capacity for pastoral properties. These calculations will be based on a variety of input data and display outputs in tabulated report or property map formats.

Once complete, analysis of property stocking rates will be undertaken.

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**PROJECT: Practical Burning Guidelines to Manage Pasture Communities and Woody Plant Populations**

**Project Officer:** R. Dyer and L. Cafe

**Project Period:** 1997-2001

**Project Location:** VRD

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**Objectives:**

*That 70% of producers will be aware of the principles and best practice of controlled burning by providing a relevant and practical fire management manual and presenting information at on-property workshops, field days and shows.*

**Background:**

Fire management is of particular importance for the sustainable use of pastoral lands in northern Australia. There is considerable uncertainty and difference of opinion regarding the potential benefits and cost associated with the prescribed use of fire.

The aim of this sub-project is to further develop burning guidelines and provide land managers with a booklet that details the expected benefits and impacts of using fire. The booklet will be directed at land managers and provide answers to frequently asked questions such as the reasons for burning, when, where, how often, what types of country and how much to burn for a range of climatic zones and pasture communities. It will also outline practical operational procedures involved in sustainable use of fire. Information will be collated from available fire ecology research undertaken in the VRD and across northern Australia and involve input from experienced pastoralists, other researchers and other agencies such as the NT Bushfire Council and Bureau of Meteorology.

**Results:**

To date the impact of fire frequency and season on shrubs and pastures has been investigated for six years. Pasture sampling is continuing during the early and late dry season each year. Change in shrub canopy cover was measured in May 1999 using aerial videography to detect changes between burning treatments. After burning in 1999, the biennial treatments have now been burned 4 years out of six. Significant reductions in canopy cover are evident in burnt treatments with differences increasing with fire frequency and intensity. Although black soil pastures are stable under most burning regimes, significant reductions in perennial grasses at the expense of annual species occurs following burning in red soil pastures.

A poster paper summarising fire impacts on pastures was presented in July at the IRC in Townsville. A review paper on *Fire in the Management of Pastoral Lands* was presented at an ACIAR workshop in Darwin in April 1999.

Plans are underway for the production of a Fire Management Booklet for Land Managers that draws together work from a variety of agencies.

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**PROJECT: The Impact of Woody Vegetation**

**Project Officer:** R. Dyer and L. Cafe

**Project Period:** 1997-2001

**Project Location:** Katherine and Victoria River District

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**Objective:**

*To ensure that the majority of land managers and administrators are aware of the increase, cause, impact and potential cost of unchecked woody plants.*

**Background:**

Anecdotal and scientific evidence shows that the size and density of native tree and shrub species are increasing throughout the VRD. The influence of the tree and shrub layer on pastures in northern Australia is poorly understood. Four experimental sites have been established in Katherine and the VRD to determine the relationship between the overstorey and understorey in densely treed and cleared areas. The aim of this trial is to:

1. Quantify the effects of tree density on soil moisture and pasture production at two locations with distinctly different rainfall,
2. Provide sufficient data to calibrate and validate the tree effects within the GRASP pasture growth model, and
3. To utilise GRASP to extrapolate tree effects across a range of climate, soil and vegetation systems, and to use these results to determine the economic advantage of preventing woody plant thickening.

**Results:**

Three to four growing seasons of data for each site has now been collected. In seasons with both good and poor rainfall, pasture production has been significantly greater in plots without tree competition. The trees are competing with the pasture for both soil water and nutrients. The magnitude of the increase in pasture production with tree clearing has not declined over time, and measurements will continue to ensure this result is maintained in the longer term.

This data has been used to calibrate and validate the tree effects in GRASP, and the model accounted for a high amount of the variation in soil moisture and pasture production. In the next twelve months GRASP will be used to determine the impact of varying densities of woody plants on pasture production, and therefore the economic impact of not controlling woody plants.

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## **PROJECT: Sustainable Grazing Practices Producer Demonstration Sites**

**Project Officer:** R. Dyer

**Project Period:** 1997-2001

**Project Location:** Katherine/VRD/Sturt Plateau

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**Objectives:**

***To ensure that 50% of pastoral leases have developed or implemented strategic grazing management plans as a result of active participation in whole paddock demonstrations of sustainable grazing management options.***

**Background:**

The impact of implemented grazing and land management practices across the paddock will be monitored twice yearly throughout the project. Of particular interest is the interaction between the imposed grazing management practices (eg stocking rates, burning and spelling) and influences such as seasonal variation, pasture community, pasture condition, distance to water, the effect of previous grazing on land condition and grazing pressure in a spatial context. A measure of animal performance (eg. weaning rates, growth rates etc) will be undertaken where possible.

**Results:**

Pasture growth in Wedgetail and Budgie paddock at Mount Sanford was excellent following another favourable and extended 1998/99 wet season. A total of 120 weaner steers averaging 219kg were stocked in Wedgetail paddock to achieve 25% pasture utilisation over the year. No burning was carried out during 1998 because of extensive burning the previous year by wildfire. Mean weight gain for the year was 131kg with a loss of 10 kg during an extended dry season and a gain of 140 kg in the wet. Total mean weight gain was between 10 and 30 kg lower than steer weight gains for other stocking rate treatments. This could be due to several factors.

Flexible stocking rates can be used to safely take advantage of increased pasture production during favourable season without affecting pasture condition. This can result in significant increases in LWG/km<sup>2</sup> compared to conservative set stocked regimes. To avoid pasture degradation during a less favourable season, stocking pressure must be adjusted.

Burning can be used to manage grazing distribution. Analysis of spatial grazing distribution standing yield and

cover in Wedgetail paddock indicated that burning (ie 1997wildfire) resulted in more even grazing throughout the paddock. This was compared to Budgie paddock that is run at a similar but fixed stocking rate, and with no burning. Even though the size of Budgie paddock is small, grazing pressure is uneven throughout the paddock with grazing concentrated on specific pasture and soil types. Spatial analysis revealed preferably grazed areas as having lower cover and yield levels and high grazing score.

Rotational burning strategies have been implemented in paddocks on 4 pastoral properties within the Katherine region. Most involve late dry season burns. Aerial digital video is being utilised to monitor impacts of grazing pressure and distribution at a landscape scale. Image capture is proceeding for the early dry season data.

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**PROJECT:        Spatial Validation of Grass Pasture Production Models and NOAA Fire Scar Images in the NT and Kimberley, WA**

**Project Officer:**    R. Dyer

**Project Period:**    1997-2000

**Project Location:**   Katherine/VRD/Sturt Plateau

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**Objectives:**

- 1. Complete calibration and validation of NT GRASP models from SWIFTSYND sites throughout the Victoria River and Katherine regions.**
- 2. Collect an independent spatial validation data set for associated pasture communities throughout the Top End of the NT and the Kimberley, WA.**
- 3. Coordinate with QDNR to carry out validation of spatial models of NT GRASP sites throughout the northern NT and the Kimberley.**

**Background:**

This is a sub-project of the Aussie Grass (Australian Grassland and Rangeland Assessment by Spatial Simulation) project. Aussie Grass is a National Climate Variability Program funded project administered by the Land and Water Resource Research and Development Corporation (LWRRDC). The project involves both research and extension, of organisation in New South Wales, South Australia, Western Australia, Queensland and the Northern Territory.

The Aussie Grass project aims to:

- Compare the ability of various regional models to simulate biomass and, where appropriate incorporation of these into the model
- Improve inputs to the model both spatially and temporally
- Collect field data to calibrate and validate the spatial model
- Develop extension products that meet the requirements of the project stakeholders.

**Results:**

Maps showing total and relative rainfall, pasture growth and total standing dry matter can be downloaded from the Aussie Grass web page. Local model calibrations have been included for the NT maps.

Spatial field observations of TSDM were collected for the VRD in May and October 1998. The May observations ensured measurement of peak pasture yield, while the October observations showed the impact of significant levels of grazing on pasture TSDM. This data has been used to calibrate the models for the VRD, and the information now available to land managers on the Aussie Grass web-site is calibrated.

The area sampled was enlarged in 1999 to cover the entire NT and Kimberley with the aim of recording observations on all pasture communities in these areas. The 1999 data is currently being prepared to send to the Queensland Centre for Climate Applications (QCCA) to allow further calibration of the models for the NT and Kimberley.



During 1998 a benchmarking survey was carried out in the Katherine and VRD areas to determine pastoral producer attitudes to seasonal climate information and decision making. Results showed that the majority of respondents (87%) regarded their judgement of future climatic conditions to be important in their planning and decision making, however only 4% of respondents currently use long term climatic records to assist them. As many as 71% of respondents regarded probability based climatic information as a useful management tool. A Territory and national report is being prepared.

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**PROJECT: MT Sanford Stocking Rate Demonstration****Project Location: Mount Sanford station****Project period: 1993-2001****Project Officer: N. MacDonald**

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**Objective:*****To investigate the medium and long term effects of different stocking rates in terms of ecology and economics.*****Background:**

This project has been running on a 65 sq km area of land leased from Mt Sanford Station since 1993 and sponsored by the NHT. For the last seven years the site has been blessed with a remarkable run of good wet seasons, the best spell since rainfall recording began in that area 71 years ago.

Cattle performance on the trial has been excellent, averaging 84% weaning and 149 kg/year steer growth. With an average grass growth of about 2.2 t/ha, the heaviest stocking rate (15 cows/sq km) has worked out to a utilisation rate of 23%, which is about right. The main conclusions from the trial to date are that great cattle performance, sustainable pastures and high stocking rates are all achievable if cattle are able to graze the whole paddock evenly. This means fewer cattle per water point. For stable perennial grasses, a utilisation rate of 25% of the year's pasture growth is a good target, but pastures in poorer condition dominated by annuals will need a lighter utilisation rate if the perennial grasses are to regenerate. This is advisable despite the fact that the annual pastures will deliver better animal performance in good years.

**Developments in 1998-99:**

The 1998 dry season was started early and was exceptionally hot and windy. As a result pasture quality dropped off early and the condition of the cattle became worse than any other time in the last six years. For the first time in this trial, steers lost weight over the dry season as a whole. Luckily there was an early break to the wet season in September and it was an excellent season, raining steadily until April, a total of 843 mm.

Steers in the breeder paddocks gained an average of 148 kg. Some bigger steers in Wedgetail paddock (with variable stocking rates and fire) put on 131 kg and those in Quail and Finch (previously under-grazed pastures) put on 118 kg. The overall weaning rate in 1998 was down to 78%, and that of 1999 is expected to be only about 75%. This is poorer than recent years, mainly because of extra culling for age.

Changes to the composition of the pastures are becoming very obvious. In the highly stocked paddocks, there is only half the amount of highly palatable grasses by October compared to that in the lighter stocked paddocks (8% compared to 15%). The amount of non-palatable grasses is about the same at about 30%.

This year we started monitoring animal performance and pasture trends in a large commercial paddock on Mt Sanford station (Poison Creek 135 sq km). This will allow us to extrapolate the results of the stocking rate trial to full commercial scale.

A paper on the relationship between pasture condition and animal performance (based on some of the Mt Sanford results) was prepared for the International Rangeland Congress in Townsville in July 1999.

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**PROJECT: Sustainable Fire Management in the Victoria River District and Sturt Plateau**

**Project Officer: A. Johnson**

**Project Period: 1998 - 2001**

**Project Location: VRD and Sturt Plateau**

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**Objectives:**

***To develop a sustainable fire management plan for the VRD and Sturt Plateau regions. The role of DPIF in the project will involve the assessment of fuel curing and accumulation rates, for different fuel types across the study area using satellite imagery.***

**Background:**

An understanding of fuel curing is important for the development of fire management plans as it enables the identification of areas of fuel flammable enough to carry fire.

Using methodology developed for North Australian grasslands, this project will calibrate NOAA-AVHRR satellite imagery and develop a better understanding of fuel curing and fuel accumulation processes in the Top End.

Using these calibrated greenness images, this project aims to recognise and identify areas of fire risk as well as areas ready to burn for strategic burning practices. The development of this fire management plan will be created with the co-operation of land managers, CRC, Bush Fires Council and DPIF

**Results:**

Field data has been collected at 24 permanent sites representing the major vegetation types of the study region. Each site has been visited monthly from February through to August. Photographs of the site have been taken at each visit, as well as measurements of standing dry matter, fuel greenness and fuel moisture content. Data has been entered into an Access database and summarised, and the next stage is to correlate this with satellite imagery data to review the methodology and site placement for next year's field program.

There have been significant differences in the fuel curing rates between different vegetation types. The most notable differences occurred between different areas of red and black soil. This is largely due to species composition and soil moisture; though it is likely that the differences in tree and shrub cover are also having an effect on this change in curing status. This year's data has shown that fuel greenness is strongly related to fuel moisture content.

# RESOURCE PROTECTION

## SUBPROGRAM: Plant Pathology

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**PROJECT: Maintenance of PMV-Free Peanut Crops Through Inspection and Indexing**

**Project Officers:** B. Condé M. Connelly, L. Ulyatt and R. Pitkethley

**Project Period:** Ongoing

**Project Location:** Darwin-Katherine

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Routine monitoring of peanut crops for peanut mottle virus (PMV) has been discontinued and monitoring is only done as the need arises. In response to a request Rex Pitkethley and Barry Condé visited a peanut crop at Douglas Daly on 17 February 1999 for general disease assessment. No signs of PMV were seen.

Indexing of *Arachis* spp. is done on request. In October 1998 six lines of forage *Arachis* spp. were tested for PMV by indexing onto navy bean cv. Spearfelt. Results indicated that the lines were negative for PMV. Difficulties were encountered due to poor germination of the seed.

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**PROJECT: Assessments and Pathogen Testing for Nursery Industry Accreditation Scheme**

**Project Officers:** M. Connelly, S. Bellgard and Andrew Daly (with M. Houlst)

**Project Period:** Ongoing

**Project Location:** Darwin-Katherine

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Two local nurseries were surveyed in October 1998 as part of the annual accreditation review. Fungal recoveries from the baiting program were interpreted with *Pythium* sp. being the only potential pathogen.

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**PROJECT: Survey for Banana Sigatoka and Fusarium Wilt (Panama Disease)**

**Project Officers:** R. Pitkethley, B. Condé, S. Bellgard, A. Daly, M. Connelly and L. Ulyatt

**Project Period:** Ongoing

**Project Location:** Darwin

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**Sigatoka:**

Full scale monitoring of bananas for Sigatoka diseases has been temporarily suspended pending the filling of a vacant position of a plant pathologist position. When resumed, the monitoring will be part of a national program for the detection of black Sigatoka, run under the auspices of the Cooperative Research Centre for Tropical Plant Protection. One sample of banana leaves was forwarded to QDPI Mareeba in June 1999 and only yellow Sigatoka was detected.

### **Panama Disease:**

The 6-monthly surveys of commercial banana plantations were continued following the 1997 outbreak of tropical race 4 of *Fusarium oxysporum* f.sp. *cubense* at Berry Springs. Plantations at Lambells Lagoon were surveyed on 3 September, at Middle Point on 10 and 24 September and at Tortilla on 30 September. No signs of Fusarium wilt or any other significant disease were seen. All Plant Pathology staff participated in the surveys.

In response to a call on 7 October 1998 from a banana plantation at Lambells Lagoon about suspected symptoms of Fusarium wilt in 3 plants in one block, Plant Pathology officers visited the site and collected samples. Subsequently Fusarium was confirmed by DNA analysis (Dr Suzy Bentley of CRCTPP) and vegetative compatibility group (VCG) analysis (Dr Natalie Moore, QDPI). It was identical to the tropical race 4 involved in the 1997 Berry Springs outbreak.

Following the detection of Fusarium wilt at Lambells Lagoon, an intensive survey was done of the affected property on 13-14 October. Follow-up surveys of the actual affected bay and the adjacent bay were initially done weekly, then monthly from February 1999.

A meeting of the NT Exotic Disease and Pest Outbreaks Working Group met on 16 October and agreed on a general approach. A SCARM Consultative Committee was convened by telephone on 22 October and agreed to a set of proposals put forward by the plantation owners with DPIF support. In accordance with the agreed strategy, an area containing the affected bananas and at least 12-m around it was destroyed, an earth bund constructed to contain drainage water and the area was fenced.

A complete and intensive inspection of all the property and an adjacent property was done between 7 and 16 December.

Between 1 and 14 March, 1999 a further regular biannual survey of all commercial banana plantations was done. No Fusarium wilt was found.

Batches of suspect bananas from the Lambells Lagoon plantation were sent to Plant Pathology on 13 March and 9 April. The first batch proved to be negative for Fusarium wilt. The second one was diagnosed as bacterial corm rot.

Following reports of detection of symptoms of Fusarium wilt at a plantation at Middle Point, Departmental Officers visited the property on 25 May 1999. Bananas apparently affected with Fusarium wilt were observed. The plants showed the typical plant, leaf and internal symptoms of the disease. Isolations were made from three samples; *Fusarium* sp. was obtained in culture from each sample. QDPI (Dr Natalie Moore) and CRCTPP (Dr Suzy Bentley) subsequently confirmed these isolates to be tropical race 4, identical to the previous infections.

A comprehensive survey of the plantation was done on 31 May and 1 June 1999 to ascertain the pattern of distribution and the severity of the disease. The distribution pattern of infected plants was determined and recorded on diagrams of the banana blocks. A follow-up survey to detect the disease was done on 28-30 June and repeated at monthly intervals since and will continue for the life of the plantation.

Another plantation at Middle Point was surveyed in detail for Fusarium wilt on 4,7 and 8 June. No signs of disease were seen. Vigilance will be maintained on this property because of its proximity to the infected plantation.

### **Other surveys**

#### **Sugarcane smut:**

Sugarcane smut (*Ustilago scitaminea*) was discovered in the Ord River Irrigation area on 20 July 1998. As part of a national survey to detect any other occurrences of the disease, attempts were made to track down any plantings of sugarcane in the NT. One small planting was inspected at Berry Springs in August, another at Pangola Road, Humpty Doo in early September and a third near Adelaide River at the end of September. There were no signs of sugarcane smut on any of the sites.

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**PROJECT: Disease Diagnostic Service****Project Officers:** B. Condé, R. Pitkethley, J. Duff, L. Ulyatt and M. Connelly**Project Period:** Ongoing**Project Location:** Darwin

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**Objective:**

*The plant disease diagnostic service is the core function of the Plant Pathology Branch. A total of 747 diagnostic cases were handled in 1998-99.*

**Method:**

Sorghum ergot (*Claviceps sp.*) was identified by Barry Condé on 6 May from the honeydew stage (conidia) of a specimen of Jumbo forage sorghum on a horticultural farm on the Venn block, Katherine. At an Industry meeting held on 7 May, it was agreed that sorghum crops be surveyed for the disease prior to deciding what action could be taken. Subsequent surveys have confirmed that the disease is widespread in Katherine and Douglas Daly areas (Stan Bellgard).

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**PROJECT: Plant Disease Reference Collection****Project Officers:** R. Pitkethley, L. Ulyatt, B. Condé and S. Bellgard**Project Period:** Ongoing**Project Location:** Darwin

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The reference database was converted from the DOS based Q&A program to the Microsoft Windows Access program. The conversion was precipitated by the need for Year 2000 compliance. The data only displays in table format at present pending the setting up of form view format. Entry of data has been suspended in the meantime.

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**PROJECT: Management System for Heliconia Wilt****Project Officers:** S. Bellgard, M. Connelly and A. Daly**Project Period:** Ongoing**Project Location:** Darwin

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**Method:**

Through contact with heliconia growers the disease situation for this crop was assessed and where appropriate recommendations were adapted. In July 1998 a root knot nematode (*Meloidogyne sp.*) problem was reported in a planting of *Heliconia stricta*. The grower was advised to use a management strategy involving the use of large quantities of mulch, incorporated around the plants and replenished as it breaks down. The efficacy of this approach is to be monitored. Root-knot nematode (RKN) bioassays set-up in September were interpreted. Okra seedlings were sown into a local grower's soil in an attempt to quantify local populations of RKN (Stan Bellgard and Megan Connelly). This confirmed the presence of RKN.

A pilot trial to test the efficacy of hot water treatment of heliconia rhizomes for control of Fusarium wilt was started in August 1998. Earlier attempts had been unsuccessful due to rhizome tissue damage. The strategy was adapted to look at matching temperature and treatment duration to rhizome thickness. Heliconia varieties included: Lillian psittacorum, Richmond Red, Sexy Pink, and Extra Sexy Pink. The trial also included *Alpinia purpurata*.

**Result:**

Treatment at 48°C for 20 minutes resulted in good rhizome survival. This temperature seemed to activate the resting spores (chlamyospores) of the *Fusarium* rather than killing the fungus. The treatment as it stands looks like a useful tool for nematode disinfestation and it actually promotes growth rate in heliconia. Several growers have taken up the technique, and it has been shown to give good nematode control as well as control of root pathogens other than *Fusarium*.

The next trial in this series will be a thermo-tolerance trial, consisting of 3 temperatures and 2 durations of treatment.

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**PROJECT:           A Management System for Mango Scab and Anthracnose**

**Project Officers:   B. Condé and R. Pitkethley**

**Project Period:    Review 1998**

**Project Location:  Darwin-Katherine**

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**Background:**

Liaison with growers continued to build up data for further development of a management strategy for mango diseases. Previous observations had shown a dramatic reduction in fruit losses to mango scab in the 1997-98 season compared with the previous season. The improvement was attributed to the use of a copper spraying program involving Kocide (copper hydroxide) at three weekly intervals, replaced with mancozeb at flowering.

The distribution of mango anthracnose is of interest. It appears that Kununurra WA, in common with Katherine, had never had a record of anthracnose disease although the anthracnose fungus has been recorded from Katherine for the first time by Plant Pathology. Knowledge of the distribution is of interest although the reason for its absence from certain areas is not fully understood at this stage. It is aimed to determine if mango anthracnose can persist in Katherine when introduced on planting material from anthracnose areas.

**Method:**

In the 1998 season fruit were studied to determine the nature, diversity and distribution of pre- and post-harvest disease symptoms. Overall the season saw a lower mango fruit retention due to some physiological factors in the trees. There has also been a generally low incidence of pre-harvest or field symptoms of anthracnose throughout the greater Darwin area. However in some orchards there have been higher incidences of pre-harvest anthracnose with over 90% of fruit from at least one orchard being rejected at the markets. It appears that some factors involved in influencing the degree of severity of pre-harvest anthracnose are age, nutrition and watering status of trees. Also depth of soil, coffee rock near the soil surface, lenticel damage and associated water exudation, frequency of heavy dews or fogs, nearness to swamps, and calcium nutrition of trees. Further work is planned to study these factors.

In November 1998 a warning was issued to mango growers through the Litchfield Times reminding them to apply copper sprays to protect fruit from anthracnose. Feedback indicated that this was helpful. This warning system is seen as part of the disease management strategy. Pre-harvest or "field" anthracnose was severe on one property, possibly because spray residue coverage on fruit was unsatisfactory.

Visits to mango orchards yield information, which adds to the knowledge base of mango diseases and disorders. In one orchard near Darwin 13 mango trees were affected by dieback and two of the trees had died. It was concluded that these mango trees were affected by "indirect" lightning travelling through the ground and then vertically upwards at each affected mango tree.

A disorder of mango trees at Katherine was investigated where progressively more trees were apparently being affected by a "slow form of dieback", some months after others. Observations revealed that the affected trees were on a ridge of decaying limestone. Mango trees are stronger and appear to have healthier fruit when grown in soil with adequate levels of calcium. However, in this case at Katherine the extremely high pH caused other elements to be unavailable to the mango trees, causing indirect deficiencies and leading to a slow decline. Generally larger trees were slower to be affected because they had larger reserves of the micronutrients in question.

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**PROJECT: A Management System for Asparagus Anthracnose**

**Project Officers:** B. Condé, S. Bellgard, M. Connelly and R. Pitkethley

**Project Period:** Review 1998

**Project Location:** Darwin-Katherine

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The new commercial asparagus crop in Katherine was devastated by anthracnose (*Colletotrichum gloeosporioides*) early in the 1997/98 wet season. It was surprising that the disease onset occurred so early in the life of the crop, which was less than a year old. It had taken two or three wet seasons for anthracnose to devastate the previous two commercial crops in Katherine. It had been estimated that it would take the usual two-three seasons for anthracnose to be blown in from native asparagus and to gradually build up in the commercial planting to the level where it would be a serious disease in this new planting.

It is believed that an old stand of edible asparagus that had not been ploughed in, was the source of anthracnose inoculum, which was blown in by windy wet season rains for the new crop.

Asparagus anthracnose was serious again late in the wet season in 1999 after unusually heavy late 1998/99 wet season rains prevented the regular fungicide-spraying program from being implemented. This second outbreak seriously depleted the food reserves in the asparagus crowns, and put a question mark over the asparagus venture.

Management procedures were discussed with the farm manager to control the potentially serious disease. These included removal of large sources of inoculum in old crops and the efficient application of copper fungicides towards the base of the plants. Another innovation is "root cutting" (or slashing below ground level above the crowns) and removing debris at appropriate times of the year in order to reduce the inoculum to levels that are manageable with fungicides. This "root pruning" technique should also ensure that new emerging fronds emerge through soil which has less anthracnose spores than usual, and that they have a good chance of developing into strong healthy plants with little or no disease. The success of these strategies is crucial for the viability of asparagus in the Katherine region.

The concept and need for an asparagus disease nursery was initiated by Barry Condé. As a joint venture involving Plant Pathology Branch (Darwin and Katherine) and Horticulture Division (Katherine) the disease nursery will be developed to study the asparagus disease, effects of fungicides, and to investigate differences in varietal susceptibility that could be useful in incorporating into the agronomic management package. As well, the disease cycle will continue to be studied in Darwin to gain further knowledge that can be applied in the management of the disease.

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**PROJECT: A Management System for Major Diseases of Asian Vegetables**

**Project Officers:** B. Condé, R. Pitkethley and M. Connelly

**Project Period:** Review 1998

**Project Location:** Darwin

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Contact with growers of Asian vegetables has been maintained to monitor disease incidence and the efficacy of current disease control methods, in order to develop more effective, overall disease management programs.

A severe root knot nematode (*Meloidogyne* sp.) problem was seen in bitter melon crops at three localities in Humpty Doo. Growers were advised to grow a dense green manure crop of sorghum over the Christmas break and to plough it into the soil to control the root knot nematode in the crops to be planted next year.

## **SUBPROGRAM: Entomology**

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### **PROJECT: Arthropod Identification and Control Service**

**Project Period:** 1970 - Ongoing

**Project Officers:** D. Chin, E. S. C. Smith, H. H. Brown, G. R. Young and G R Brown

**Project Location:** Territory Wide

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#### **Objective:**

*To provide accurate advice on the identification and control of agricultural, horticultural and domestic arthropods to primary producers, government personnel, pest control operators and the general public.*

#### **Background:**

The Branch has provided an advisory service on entomology issues pertaining to agricultural, horticultural or domestic situations for many years. Over the past few years, the demand for this service has increased dramatically. This is because the number of horticultural producers has increased and fruit trees in suburban gardens continue to mature.

#### **Results:**

The nature of the enquiry and the recommendations provided are recorded and entered into a database. The information recorded may be used for future planning and allocation of research.

During the 1998-1999 period, the Branch received 1314 inquiries. The proportion of the various client group categories (and the % difference compared to 1997-1998) are summarised below:

Government:	34.9 %	(-0.3 %)
Primary producers:	29.5 %	(+5.5 %)
Householders:	22.3 %	(+1.5 %)
Pest control operators:	1.4 %	(+0.7 %)
Others:	11.6 %	(-0.1 %)

Most of the extension inquiries were associated with services provided on insect identifications and pest control to primary producers and other officers of the Department. A large majority of the inquiries were on identification and control of pests in mangoes (commercial and backyard). There has been an increase in the number of inquiries from primary producers, householders and pest control operators.

The Integrated Pest Management systems encouraged and promoted through trials on fruit and vegetable growing properties prompted many follow-up inquiries, both from co-operating growers and others that interacted with these primary producers.

Diagnostic identifications were provided to all outstations of the Department and extension visits were carried out to Coastal Plains, Katherine and Douglas Daly Research Stations to respond to inquiries on fruit, vegetables and crops.



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<b>PROJECT:</b>	<b>Arthropod Reference Collection</b>
<b>Project Period:</b>	<b>1970 - Ongoing</b>
<b>Project Officers:</b>	<b>H. H. Brown, D Chin, E. S. C. Smith and G. R. Brown</b>
<b>Project Location:</b>	<b>BARC</b>

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**Objective:**

**To develop, curate and maintain a reference collection of economically important arthropods of the various NT agricultural and horticultural industries and to develop and maintain a suitable, retrievable database of all specimens held in the collection.**

**Background:**

The insect reference collection was initiated in 1970 and rapidly became the main insect reference collection in the NT. Over the years, the collection expanded to include economically important arthropods from agricultural, horticultural and domestic situations as well as general collections. In 1992, the majority of the non-economic insect specimens were donated to the NT Museum.

**Method:**

During 1998/99 the Branch forwarded 109 specimens for species confirmation or identification. Most specimens were of economic significance.

Computerisation of the museum specimens onto the network (ACCESS Database) is continuing. At this stage over 22,000 specimens have been recorded on the database, which is about 85% of the entire collection.

**New Records and Specimens of Interest:***Thysanoptera:*

- *Selenothrips rubrocinctus* (Giard) (Thripidae) was recorded on *Khaya senegalensis* (African mahogany), *Nephelium mutabile* (Pulasan), *Dinocarpus* sp. (longan type) and *Syzygium jambos* (Roseapple) for the first time in the NT.
- *Chaetanaphothrips signipennis* Bagnall (Thripidae) ex. *Antherium* sp.
- *Scirtothrips* sp. n. (Thripidae) ex. *Mangifera indica*.
- First detection in Australia of *Copidothrips formosus* Hood (Thripidae) damaging leaves of *Agleomena* hybrid.

*Acarina:*

- *Tuckerella* sp. (Tuckerellidae) was recorded ex. distorted *Mangifera indica* leaf buds for the first time in Australia.
- *Schizotetranychus* sp. (Tetranychidae) was recorded ex. a grass *Bothriochloa pertusa* for the first time in the NT.
- *Caloglyphus berlesii* (Michael) (Acaridae) was recorded ex. peanut seedlings for the first time in the NT.
- Citrus rust mite, *Phyllocoptura oleivora* (Ashmead) (Eriophyidae) was recorded for the first time in the NT ex. skin of *Citrus paradisi* fruit.
- Oriental citrus mite, *Eutetranychus orientalis* was recorded for the first time in NT ex. Citrus.

*Lepidoptera:*

- *Acyphas* sp. (Lymantriidae) ex. *Durio zibethinus*.
- *Olene* sp. (Lymantriidae) ex. hardened flush of *Mangifera indica*.
- *Mataeomera* sp. (Noctuidae: Acontiinae) was reared from larva feeding on *Ceroplastes rubens* (Maskell) (Coccidae), (Pink wax scale).
- A shoot miner of *Mangifera indica* has been tentatively identified as? *Spulerina isonoma* Meyrick (Gracillariidae).

*Hemiptera:*

- First detection of *Furacaspis biformis* (Cockerell) (Diaspididae) in the NT ex. *Cattleya* orchid.
- First detection of *Genaparlatoria pseudaspidotus* (Lindinger) (Diaspididae) in the NT ex. *Vanda* orchid.

- First detection of *Nipaecoccus viridis* (Newstead) (Pseudococcidae) in the NT on a potted lemon tree.
- *Metacanthus pertenerus vittatus* (Berytidae) feeding on *Cymbopogon citratus* (lemon grass)
- *Dieuches oceanicus* (Distant) (Lygaeidae) was recorded ex. peanut trash and sorghum seed for the first time in the NT.
- A scale in the family Asterolecaniidae on Bamboo leaves.

*Coleoptera:*

- *Corrhenes* sp. (Cerambycidae) was recorded for the first time on papaya in the NT.
- *Mesomorphus darwini* Blackburn was aggregating on trunks of *Mangifera indica* trees in large numbers. This beetle is not known to be a pest.
- First detection in the NT of *Tyrtaeosus?* sp. n. (Curculionidae) feeding on *Mangifera indica* leaves.
- New host record for the NT, longicorn larva (Cerambycidae) ex. Balsa tree.

*Diptera*

- *Dacus newmani* (Perkins) (Tephritidae) was reared for the first time from a host, *Marsdenia australis*.

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**PROJECT: IPM in Tropical Tree Crops**

**Project Period: 1997-Ongoing**

**Project Officers: D. Chin, H. Wallace, H. Brown and E. S. C. Smith**

**Project Location: Top End commercial fruit growing properties**

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**Objective:**

***To demonstrate and encourage the practice of Integrated Pest Management (IPM) on commercial properties.***

**Method:**

Through a series of extension exercises, commercial growers were supplied with information to enhance control of arthropod pests in tree crops, particularly mango, citrus, rambutan, and fig orchards. Recommendations emphasised an integrated approach using a combination of cultural and biological methods or, when necessary, the application of non-disruptive pesticides. The main pests targeted were fruit flies, redbanded thrips, caterpillars, swarming beetles, fluted scales, mealybugs, mites and sucking bugs.

**Results:**

The Branch has continued to work towards reduced use of insecticides and further grower acceptance of IPM principles in mango and tropical fruit orchards. Six properties have so far been introduced to the use of IPM principles and practices. These properties have been monitored on a regular basis to study the trends of potential pests and beneficial arthropods in each crop over a period of time. Monitoring methods have been demonstrated to the participating growers enabling them to better identify pest problems, type of damage and to determine the best method of control. The use of commercially bred predators and parasites to control pests has been encouraged. This has resulted in reduced use of insecticides and a greater understanding of the interaction between pest and beneficial insects in the orchard. The Mango IPM poster produced in 1997 has been very useful in showing growers how to identify and monitor pests and beneficial insects along with the use of a photo album and a display of preserved insects.

Common arthropod pests were recorded from selected commercial fruit trees (from July 1998 to June 1999). Pests are listed in the order of importance based on the most frequent inquiries to the Entomology Branch:

<b>Fruit Tree</b>	<b>Common Pests</b>	<b>Fruit tree</b>	<b>Common Pests</b>
Mango	fruit flies	Carambola	mites
	redbanded thrips		fruit flies
	mango leafhopper		flatids
	mites (tuckerellids, eriophyids)		aphids
	giant termite ( <i>Mastotermes</i> )		Guava
	Gracillariid shoot miner	sucking bug ( <i>Helopeltis</i> )	
	mango scale	<i>Myllocer</i> beetles	
	caterpillars (leaf and fruit)	flea beetles	
	mango flower caterpillars	Citrus	
	longicorns		white louse scale
	flatids		ants
	swarming beetles ( <i>Monolepta</i> , <i>Agetinus</i> and <i>Ryparida</i> )		cicadas
	mango flower thrips		citrus leaf miner
	beetles (various)		mealybugs
	mango seed weevil		<i>Mastotermes</i>
	hemipteran bugs (various)		fruit flies
	<i>Graptostethus</i> sp.		green vegetable bug
	mango tip borer		fluted scales
	sucking bugs ( <i>Helopeltis</i> , <i>Amblypelta</i> )	plant hoppers	
	bostrichids	scales	
grasshoppers	Mangosteen	caterpillars	
scales (soft green, pink wax scale)		redbanded thrips	
green ants		Durian	mites
hoverfly			
Rambutan			caterpillars
	redbanded thrips		
	sucking bug ( <i>Amblypelta</i> )		
	mealybugs		
	fluted scales		
	mites		
	flower caterpillars		
	soft green scale		
coccid scale			

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**PROJECT: Industry Adoption of Hot Water Disinfestation Treatments for Mangoes**

**Project Period:** 1996 - 1999

**Project Officers:** E. S. C. Smith and H. Wallace

**Project Location:** Top End growers' properties

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**Objective:**

***To encourage the adoption by NT mango producers of demonstrated on-farm hot water treatments effective against fruit flies and post-harvest rots.***

**Method:**

A Hot Water Dipping (HWD) system for mangoes has been developed over the past 8-9 years. The treatment will

- Satisfy quarantine security for fruit flies;
- Significantly reduce the incidence of post-harvest rots;
- Eliminate the use of post-harvest chemicals;
- Accelerate ripening;
- Give other advantages over the currently accepted methods of marketing mangoes for interstate trade.

The main reason for some reluctance to adopt the technique by NT growers has been the possibility of fruit heat scald. In the past, this damage has been severe enough to prevent marketing of the fruit. Previous work had shown that scald damage was strongly associated with pre-harvest rainfall and that the damaging effects could be ameliorated by field irrigation practices. Post-harvest conditioning by holding for 24 hours (or longer if harvested after rain) or heating the fruit will also decrease the risk of scalding. Work during the 1996 season showed that overnight preconditioning of fruit prior to HWD treatment prevented scald or development of rot and was a practical method of carrying out the technique on the farm or at the packing shed.

Fruit sourced within the 1998 Exotic Fruit Fly Quarantine Zone necessitated additional security and the heating treatments were required to raise the flesh temperature at the seed surface to 46.5°C and maintain it at that temperature for 20 minutes for acceptance as a disinfestation treatment by interstate quarantine authorities. Katherine fruit would be accepted when the fruit pulp temperature reached 46.0°C and was maintained at or above that temperature for 10 minutes.

**Results:**

Two commercial sheds in the Darwin rural area were visited pre-season and managers were informed of the previous research results and the suggested method of using pre-conditioning of fruit to prevent scald damage. Both growers constructed pre-conditioning rooms with thermostats which could heat the fruit to >39°C before immersion in 47°C water. Working closely with quarantine officials who were required to supervise all HWD treatments, data loggers were placed to measure both fruit and air temperatures in the pre-conditioning room and to continuously monitor and record fruit and water temperatures during the HWD process. With suitable preconditioning overnight at temperatures >39°C, treatment times for batches of 120-200 kg of Kensington Pride mangoes took between 30-40 minutes and no scald was observed on any fruit.

The system was also demonstrated using the sterilising water bath to four separate batches of fruit at Katherine where pre-conditioning could be provided in insulated rooms. Under the less stringent regime for non-Exotic Fruit Fly HWD treatments, no scalded fruit were detected, despite the less than optimum pre-conditioning.

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**PROJECT: Arthropod Problems on Mangoes****Project Period:** 1995-ongoing**Project Officers:** E. S .C. Smith, D. Chin, H. Brown and H. Wallace**Project Location:** Top End properties

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**Objective:****Identify potential arthropod problems in mangoes.****Background:**

Mangoes are the most important horticultural crop in the NT and receive a proportionate amount of the Entomology Branch's resources. New problems appear each year as this relatively new crop continues to expand in area and value, and new growers enter the production phase. Horticultural officers, commercial mango growers and urban backyard producers frequently refer previously unobserved or assumed pest situations to the Branch for advice or comment and these inquiries may help detect a new or potentially damaging pest problem.

**Results:**

During the year, two arthropod species were identified as new or potentially damaging to mango trees in the Top End.

A species of *Scirtothrips* (Thysanoptera : Thripidae) thought to be new was collected from fully expanded flush leaves causing feeding damage. However, the damage was very limited in extent and even with no treatment, the species disappeared within two weeks. It appears to be different to the *S. dorsalis* Hood previously collected in Darwin from *Mangifera indica*.

*Tuckerella* sp. (Acarina : Tuckerellidae) was recorded from distorted leaf buds suspected to have been damaged by mango bud mite. It is not certain whether this species, which is generally found on hardened bark some 100 - 120 mm from the growing tips causes any damage to mangoes and whether there is any significant association between it and the eriophyids known to cause bud distortion in mangoes.

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**PROJECT: Detection and Eradication of Arthropod Pests of Quarantine Importance in the NT****Project Period:** 1997 - ongoing**Project Officers:** All Branch Officers**Project Location:** Territory wide

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**Objective:****To detect, identify and assess the feasibility of eradicating or controlling arthropod species of quarantine significance, which are new to the NT.****Background:**

When species previously unrecorded in the NT have penetrated the Quarantine barrier, one of the responsibilities of the Entomology Branch is to detect, identify and assess the feasibility of eradicating or controlling the species. Over the 12-month period, two ongoing major eradication programs of arthropod pests of quarantine significance continued to receive a very substantial proportion of Branch resources.

**Results:**

A single specimen of the exotic fruit fly *Bactrocera philippinensis* Drew and Hancock (Diptera: Tephritidae) was trapped in a permanent Methyl eugenol trap at Berrimah on 19 November 1997. Another two flies were caught the following day necessitating the declaration of an outbreak. All States and the Commonwealth were advised

on 21 November. A successful eradication programme was mounted against this pest. Monitoring to prove area freedom and quarantine restrictions in the form of produce treatment and road and airport checkpoints against this exotic fruit fly continued until December 1998. Area freedom for interstate trade was declared in December 1998 and international area freedom declared by AQIS in May 1999.

A nest of the Asian honeybee *Apis cerana* Fabricius (Hymenoptera: Apidae) was identified in a Darwin suburb on 14 June 1998 and all States and the Commonwealth were advised on 15 June. The Ausvet plan for the Asian honeybee and the several parasites associated with the species (notifiable bee diseases) was immediately implemented. An eradication programme was mounted against this pest. The major components of this programme were:

- Quarantine restrictions on the movement of bees, hives, and bee products or equipment (in place by 18 June);
- Establishment of surveillance teams to detect Asian honeybees in managed hives and feral European honeybees;
- An intensive publicity campaign to alert the public about the pest and the damage it could cause;
- Sampling and testing of managed hives and feral European honeybees for three species of mites (*Varroa*, *Tropilaelaps* and tracheal);
- Intensive cooperation between commercial beekeepers both in the NT and in southern States.

During the eradication program, running from June 1998 to June 1999, 89 samples were tested for the presence of the three pest mites and 132 samples submitted for identification. No further Asian honeybees or mites were detected on any of the *Apis cerana* or *A. mellifera* Linnaeus bees examined. Area freedom will be declared in due course.

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**PROJECT:       Dissemination of Information**

**Project Period:   Ongoing**

**Project Officers:  All Branch Officers**

**Project Location:  Territory wide**

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**Objective:**

***Provide relevant agricultural entomology information to a range of clients.***

**Background:**

The Branch is the main provider of agricultural entomology information relevant to the Northern Territory. All primary producers and the general public may request information on a wide range of insect pest problems. This information is normally provided by telephone discussions, on-farm visits, examination of submitted specimens, original or annotated Departmental Agnotes, extracts from published works or illustrated talks and lectures.

In addition, the Branch provides data on arthropod occurrence and distribution to national and international organisations, which is frequently used for pest management or trade purposes. In conjunction with the NT Parks and Wildlife Commission the Branch as part of an Australia wide assessment, reviews all applications for the introduction into, or release from, quarantine of biological control agents used against agricultural pests, diseases and weeds.

**Results:**

In providing a pest and disease identification and advisory service to primary producers, government departments and the public, the Entomology Branch processed over 1300 inquiries and Branch officers delivered 17 presentations, organised six field days or demonstrations and two technical workshops during the year. In addition, radio interviews were conducted and articles were written on entomological matters for local newspapers. Talks were also presented to several visiting groups of primary and high school students and project information made available to universities in the NT and interstate. Insect display materials were provided for field days, local show days and various student groups. Contributions were made to many conferences, workshops and seminars attended by staff during the year.

During the year, separate reports were provided to the Australian Quarantine and Inspection Service on host and distribution data of both quarantine and non-quarantine organisms in the Northern Territory. These included NT records of arthropods on papaya, which will assist in negotiations with potential export markets.

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**PROJECT: Produce Inspection and Certification Service****Project Period: 1994-ongoing****Project Officer: E. L. Crowson****Project Location: Top End annual vegetables, cut flower and nursery producers**

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**Objective:**

***To provide an inspection and certification service to growers of annual vegetables, cut flowers and ornamental plants to enable them to market produce interstate.***

**Background:**

In 1991, NT producers and exporters of annual vegetables, cut flowers and ornamental plants suffered very considerably from Melon Thrips (*Thrips palmi* Karny (Thysanoptera: Thripidae) found on Top End properties. All interstate markets severely restricted imports of NT produce until negotiations were held with interstate quarantine authorities who eventually removed the restrictions under the declared area or property freedom status. Over the next few years, the situation eased with other interstate growing areas infested by the pest and the development of disinfestation techniques acceptable for quarantine security. The current situation is that producers exporting to WA, SA and Tasmania require certification of *T. palmi* freedom for each shipment of produce. This entails visual inspection following physical disinfestation on produce grown in infested areas or maintenance of a trapping program for declaration of a free area.

In addition, the Entomology Branch maintains a trapping grid for declaration of freedom from Poinsettia Whitefly (*Bemisia tabaci* (Gennadius) Homoptera: Aleyrodidae biotype B) and surveillance for Western Flower Thrips (*Frankliniella occidentalis* Pergande Thysanoptera : Thripidae).

**Results:**

From early December 1997 to 30<sup>th</sup> November 1998 this position was seconded to the Exotic Fruit Fly Eradication Program. During this period an Interstate Certification Assurance (ICA) system was introduced into the Northern Territory. This allows growers/exporters the ability to perform their own disinfestation treatments and reduce the need for direct Quarantine Supervision. The ICA system is still in effect for all states requiring treatments/certification for Queensland Fruit Fly host produce and has greatly reduced the number of certificates issued by departmental officers.

Due to detection of melon thrips on a number of occasions in produce received from the NT, Western Australian quarantine authorities have revised their restrictions to the point that fumigation is required for all but a very few host products. The bulk of certificates issued now for exports to WA are for nursery ornamentals and cut flowers and an average of 65 certificates per month are issued for freedom from melon thrips, poinsettia and spiralling white fly. Property and area freedom is still available provided they meet the protocol criteria. Restrictions on melon thrips hosts into South Australia and Tasmania remain unchanged.

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**PROJECT: Survey of Cotton Insects****Project Period: 1999-****Project Officer: G.R. Brown****Project Location: Katherine Research Station**

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**Objective:**

***To identify insects found in cotton.***

**Background:**

The Australian cotton industry is well established in Southeastern Queensland and Northern New South Wales; it is developing in the Kununurra area of Western Australia. Much is known about the insect pests in these areas, although differences in geography and climate result in differences in insect assemblages between these locations.

Cotton is currently being grown experimentally at Katherine Research Station to investigate its potential as a commercial crop in the Northern Territory. This year approximately 20 ha of cotton were grown. Most of this was genetically engineered with a single *Bacillus thuringiensis* gene.

Although cotton has been grown in the Northern Territory previously, it has not been grown commercially. Little is known about local pest species or the effects that parasites, predators and environmental conditions have on their population dynamics.

**Results:**

The crop at Katherine Research Station was surveyed for insects at fortnightly intervals since emergence in late April.

To date the crop has been very clean with very few insects present. The most frequently collected pest species were green mirid *Creontiades dilutus* (Stål) (Hemiptera: Miridae) and the immature stages of heliothis caterpillars *Helicoverpa* sp (p). (Lepidoptera: Noctuidae), but neither was observed in economic numbers. Most larvae were either parasitised or diseased.

Most insects found on the crop had been there by accident or were taking refuge in the crop, but not otherwise associated with it.

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**PROJECT: Identification and Bionomics of Wireworm Species**

**Project Period: 1999-**

**Project Officer: G.R. Brown**

**Project Location: Katherine and Douglas Daly Regions**

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**Objective:**

***To identify potential pest species and to determine their life history and pest status.***

**Background:**

Wireworms are the larvae of beetles (Coleoptera) belonging to the families Elateridae (true wireworms) and Tenebrionidae (false wireworms). The larvae of many of these are soil dwelling and feed on dead or live organic matter. Some species feed on the roots of commercial crops and become pests when in sufficient numbers to cause economic damage.

Wireworms are considered to be one of the most serious soil dwelling pests in the Katherine and Douglas Daly regions. Nothing is known of the species involved in these areas, although there are a few records of unidentified false wireworms (Coleoptera: Tenebrionidae) of the genera *Caedius* and *Gonocephalus* occurring in peanut and cucurbit crops in these areas. Nothing is known about the biology or pest status of any Northern Territory species.

**Results:**

A surveying programme was commenced in February in the Katherine and Douglas Daly regions. Sampling was undertaken at fortnightly intervals and was by hand, although some preliminary work was also undertaken using baits and light traps to attract larvae and adults, respectively.

Three tenebrionid species were collected commonly and in sufficient numbers to be considered as potential pests. They were *Caedius sphaeroides* Hope, *Gonocephalum carpentariae* Blackburn and *Pterohelaeus costatus* Macleay. The adults of all three were present and common throughout the monitoring period although the latter was common on only one property on the Venn Block, Katherine. All three species were also brought into culture so that immature stages could be studied in the laboratory and these cultures are being maintained.

A small number of other species were also collected as adults, but their relative rarity may suggest that they are not a pest species. These were:

- Tenebrionidae: *Adelium* sp. *Boreosaragus* sp
- Elateridae: *Conoderus* sp.



A number of larvae that belong to both families were also collected by hand digging in the soil, particularly around the base of plants that were stunted or dying, or at sites where there were large but isolated pockets of plant stubble. However, larvae are known to be highly mobile in the soil and extremely difficult to locate. Preliminary experiments with handfuls of presoaked cucurbit seed, as baits have been unsuccessful so far in attracting wireworms. Because larvae do not resemble their respective adults, the two cannot be correlated without rearing larval specimens or culturing adults. To date only the larvae of *Pteroheaeus costatus* is known.

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**PROJECT: Survey of Insects in Field Crops**

**Project Period: 1999-**

**Project Officer: G.R. Brown**

**Project Location: Katherine and Douglas Daly Regions**

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**Objective:**

***To regularly survey field crops for insects and their parasites to determine economic thresholds.***

**Background:**

A number of field crops were grown this year including sorghum, maize, mungbeans, soybeans, peanuts, cavalcade and sesame.

Although there are insect records for these crops, including the more serious pests, there is no comprehensive data available listing all pest species and their respective parasites or their seasonal occurrence and economic thresholds.

**Method:**

All types of field crop listed above were surveyed by hand, and a monitoring system using vacuum sampling was tested. Most crops were also visually inspected at fortnightly intervals at least at Katherine Research Station whilst growing, except Cavalcade which was only occasionally examined as time permitted. Visual sampling was used to determine what species were present in larger numbers.

**Results:**

The results were as follows:

*Cavalcade*

The main pests were redbanded shield bug *Piezodorus hybneri* (Gmelin) (Hemiptera: Pentatomidae) and green mirid *Creontiades dilutus* (Stål) (Hemiptera: Miridae). Ants of the genus *Meranoplus* and/or termites of the genus *Amitermes* may be implicated in causing scald patches within this crop, and will need to be investigated further next season.

*Maize*

The main pests were northern armyworm *Mythymna separata* (Walker), and heliothis *Helicoverpa* spp. caterpillars (Lepidoptera: Noctuidae), and green vegetable bug *Nezara viridula* (Linnaeus) (Hemiptera: Pentatomidae) although redbanded shield bug *Piezodorus hybneri* (Gmelin) (Hemiptera: Pentatomidae) and a variety of leafhoppers and plant hoppers were also common on occasions. Caterpillars and bugs were often abundant with several caterpillars or more than 10 bugs per plant. Leaf and plant hoppers were usually seen at less than one insect per plant, but were not noticed to cause damage.

*Mung beans*

This crop attracted a wide variety of insects. The main pests were caterpillars, which either fed on the leaves (*Helicoverpa* spp, *Chrysodeixis* spp.) (Lepidoptera: Noctuidae) or attacked the flowers (*Maruca vitrata Fabricius*) (Lepidoptera: Pyralidae), or bugs such as green vegetable bug *Nezara viridula* (Linnaeus) (Hemiptera: Pentatomidae), podsucking bug *Riptortus serripes* (Fabricius) (Hemiptera: Alydidae) and green mirid *Creontiades dilutus* (Stål) (Hemiptera: Miridae). A number of other insects such as grasshoppers and katydids were also present as well as predators such as spiders and ladybeetles. Wasp and fly parasites were present later, in May to June.

### *Peanuts*

This was one of the most closely monitored crops. The main pests were heliothis larvae *Helicoverpa* sp(p). (Lepidoptera: Noctuidae), cowpea aphid *Aphis craccivora* Koch (Hemiptera: Aphididae) and to a lesser extent cluster caterpillar *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae). Also present were adult wireworms *Gonocephalum carpentariae* Blackburn and *Caedius sphaeroides* (Coleoptera: Tenebrionidae) and leafhoppers, particularly *Austroasca* nr *viridigrisea* (Paoli) (Hemiptera: Cicadellidae). The only observed aphid outbreak was at 'Early Storms' and it was controlled naturally by ladybeetle adults and larvae (Coleoptera: Coccinellidae) and hoverfly larvae (Diptera: Syrphidae). The caterpillars were heavily diseased and/or parasitised with a variety of wasp (Hymenoptera: Braconidae) or fly (Diptera: Tachinidae) parasites.

Wireworm larvae were not found in large numbers, and economic damage was not observed. Similarly, leafhoppers were not observed causing damage.

### *Sorghum*

Very few insects were observed on sorghum. Problems were only observed in May with sorghum midge *Contarinia sorghicola* (Coquillett) (Diptera: Cecidomyiidae), heliothis larvae *Helicoverpa* sp(p). (Lepidoptera: Noctuidae), green vegetable bug *Nezara viridula* (Linnaeus) and redbanded shield bug *Piezodorus hybneri* (Gmelin) (Hemiptera: Pentatomidae).

### *Soybeans*

Only one crop of soybeans was examined. This crop was consistently infested with a wide range of insects. The most conspicuous pests were green vegetable bug *Nezara viridula* (Linnaeus) (Hemiptera: Pentatomidae) and podsucking bug *Riptortus serripes* (Fabricius) (Hemiptera: Alydidae). Leafhoppers were also present in large numbers.

### *Sesame*

This crop was grown experimentally at KRS and DDRS. The main pest was green vegetable bug *Nezara viridula* (Linnaeus) (Hemiptera: Pentatomidae).

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## **PROJECT: Management and Control of *Mastotermes* in Northern Australia**

**Project Period:** 1998 - 2001

**Project Officers:** G. R. Young, M. J. Neal and M. J. Geyer

**Project Location:** Darwin, Gunn Point, Wildman River area, CPHRS and selected growers' properties

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### **Objective:**

**To develop effective and environmentally sustainable control methods in horticultural crops, which can be applied against *Mastotermes darwiniensis* by growers or other persons with no expertise in termite biology and control. Studies of the biology of the species are being carried out in conjunction with development and testing of control methods so that their effectiveness can be fully assessed.**

### **Background:**

*Mastotermes darwiniensis* Froggatt (Isoptera : Mastotermitidae) is the most destructive species of termite in tropical Australia. In Northern Australia this species accounts for about one million dollars in annual production losses within horticultural tree crops and also is responsible for losses in vegetable and agricultural crops. *Mastotermes* can cause major damage to buildings, wooden structures, electrical cables and a variety of other materials. The main chemical registered for use in horticulture against this pest is an organochlorine, mirex. Mirex is the active ingredient of the product Mirant<sup>®</sup>. With organochlorines being phased out, it is necessary that alternative pesticides be trialled against *Mastotermes*.

### **Methods:**

A successful management strategy for the giant termite was developed from research and experimentation

conducted during a joint project for the control of *Mastotermes* and reported previously (TAR 1996, 1997 and 1998). The method involves aggregating the termites in 20 litre drums and applying Mirant<sup>®</sup> to cardboard in the drum. Termites chewing through the cardboard liner either ingest or have some of the gel adhering to their bodies (DPIF Agnote No. 734).

Field testing of several promising insecticides to replace mirex has commenced at Coastal Plains Research Station. Chemicals are trialled using aggregation drums, the object being to aggregate *Mastotermes* in soft pine billets before applying the pesticide. The drums have been placed on soil beside infested trees, over the cut stumps of dead trees and attached to the trunks of infested trees. New pesticides are tested by placing a bait containing the toxicant on top of the infested billets or by removing the infested billets from the drums, placing two layers of cardboard coated with the new compound in the drum and then replacing the infested billets on top of the cardboard. The method is consistent with that currently used with Mirant<sup>®</sup>.

An insecticide identified by CSRIO as active against *Mastotermes*, was trialed at CPHRS, between December 98 and March 99. The results are very promising and the trial will be repeated during the 1999 dry season.

Secrecy agreements will be signed with a number of chemical companies in order to test products, which might be adapted to the DPIF standard method of control with aggregation drums.

An epizootic of *Mastotermes* has been detected at CPHRS. The termite populations crashed in eight aggregation drums. The population crash started in February and continued into the dry season. Dissections and microscopic examinations have failed to detect any obvious pathogen.

Work will continue on the development of bait palatable to *Mastotermes*, into which any new compound might be incorporated. In addition, research on gels, which can be coated onto cardboard liners, will also continue.

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**PROJECT:        Intergrated Pest Management of Vegetables  
with Particular Reference to Bean Flies  
Attacking Snake Beans (*Vigna Unguiculata*)**

**Project Period:    1998 - 2001**

**Project Officers:   G. Young and L. Zhang**

**Project Location:   Darwin area**

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**Objective:**

***To control the two spotted mite and other bean pests by means of natural enemies and lower toxicity pesticides.***

**Background:**

The two spotted mite (TSM), *Tetranychus urticae* Koch (Acarina: Tetranychidae) is the most serious pest of snake beans in the Darwin area, usually limiting the productive life of the crop to less than 4 weeks. The two-spotted mite is resistant to nearly all of the available miticides. New miticide may be effective in the short term but eventually TSM populations become resistant.

A non-chemical method of controlling the two-spotted mite is by the use of the Chilean predatory mite, *Phytoseiulus persimilis*, Athias-Henriot (Acarina: Phytoseiidae). The predatory mite is reared commercially in NSW and Queensland. When TSM appears on the crop predatory mites are released and the population of predators brings the TSM population under control.

Leaf feeders can be adequately controlled with either carbaryl, to which *P. persimilis* is resistant, or *Bacillus thuringiensis*.

The cowpea aphid can be controlled with pirimicarb, which is only active against aphids.

During the 1998 dry season it was found that the bean fly *Ophiomyia phaseoli* (Tryon) (Diptera : Agromyzidae) had become resistant to dimethoate. In previous seasons the bean fly was controlled with two sprays of dimethoate, in the ten days after seed germination. As a result of the fly's resistance to dimethoate, populations increased rapidly and could only be controlled with weekly applications of methomyl. The use of methomyl up to flowering made it impossible to use the predatory mite, since the predator is highly susceptible to methomyl. Trials with relatively soft chemicals such as spinosad and confidor were planned for the 1999 dry season. However, because of a shortage

of trial sites and low bean fly populations, the trials have been deferred until the 2000 dry season. Work on the native plant hosts and parasitoids of bean fly continued throughout the year.

**Results:**

The only known native host in which bean fly can complete its life history is *Vigna radiata*, although female flies will sting the leaves of *Vigna marina* and *V. vexillata*. The introduced pasture legumes *Lablab purpureus* and *Macroptilium lathyroides* are also hosts.

There are eight to ten species of parasitoid recorded from bean fly in the rural area and the rate of parasitism varied from ten to twenty percent.

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**PROJECT:        *Thrips Palmi* Karny (Thysanoptera: Thripidae)  
Integrated Pest Management on Egg Plant**

**Project Period:        1998 - 2001**

**Project Officers:        G. Young and L. Zhang**

**Project Location:        Knuckey's Lagoon**

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**Objective:**

***IPM of Thrips palmi and other pests of eggplant.***

**Background:**

*Thrips palmi* has proved resistant to a wide range of pesticides. Bioassays using potassium soaps showed a high level of activity against the nymphs and adults of *T. palmi*. When populations of *T. palmi* on eggplant are suppressed with three applications of potassium soap, the pest's predators are able to keep it under control. Predators of *T. palmi* recorded from a Kuckey's Lagoon property are *Mallada basalis* (Walker) (Neuroptera: Chrysopidae); the mirid, *Deraeocoris* sp.; *Haplothrips* sp. (Thysanoptera: Phlaeothripinae).

While IPM of *T. palmi* has proved successful during the dry season, the eggfruit caterpillar (*Sceloides cordalis* Doubleday (Lepidoptera: Pyralidae) increases in numbers in the absence of chemical controls. Routine spraying for eggfruit caterpillar would destroy the natural enemy complex of *T. palmi*. More work is required on control methods for the caterpillar, particularly destruction of infested fruit and spot spraying of flowers and fruit with endosulfan or methomyl.

**Results:**

A shortage of trial sites has prevented any IPM trials on *T. palmi* and *S. cordalis*. Observations during the 1997 to 1999 growing seasons on infestations of *T. palmi* on bitter melon and other cucurbits confirmed previous work that *T. palmi* is an insecticide induced pest.

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**PROJECT:        Trials of Soft Chemicals Against Pests with  
Multiple Resistance to Chemical Insecticides**

**Project period:        1998 – 2000**

**Project officers:        G. R. Young and L. Zhang**

**Project location:        Darwin rural area and BARC**

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**Objective:**

***To develop effective control methods against insect pests that show multiple resistance to chemical insecticides.***

**Background:**

Insect pests such as the cotton aphid, *Aphis gossypii* Glover, cow pea aphid, *Aphis craccivora* Koch (Hemiptera: Aphididae) and the two spotted mite, *Tetranychus urticae* Koch (Acarina: Tetranychidae) rapidly become resistant to most chemical insecticides.

Chemicals such as petroleum spray oils and potassium soap have a different mode of action to chemical sprays and resistance to these physical insecticides is thought to take much longer to develop than to chemical sprays.

**Method:**

The pest species was raised on snake bean seedlings for cowpea aphid and TSM, and on eggplant for cotton aphid. The sprays were applied with a small hand sprayer.

**Results:**

Rough bioassays have shown that 2% potassium soap used against both species of aphids caused between 70 to 80% mortality.

TSM were not greatly affected by potassium soap used at insecticidal concentrations. Eucalyptus oil used at 1.25% to 2.5% caused 80% mortality for both TSM and cow pea aphid. It is not known if the action of eucalyptus oil is chemical or physical.

# FISHERIES

## PROGRAM: Aquatic Resource Management

### SUBPROGRAM: Coastal and Estuarine Fisheries

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#### PROJECT: Barramundi Population Assessment

Project Period: 1978-ongoing

Project Officers: R. Griffin (50%), G. White (50%).

Project Location: Darwin/NT Rivers, principally the Mary River.

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#### Objectives:

- *Provide long-term fishery independent assessment of the status of barramundi stocks in the Mary River (and other areas as resources permit) utilising a range of methods,*
- *Assess the level of recruitment of barramundi (spawning success) from year to year and evaluate fluctuations due to seasonal factors and environmental changes,*
- *Assess the overall status of the barramundi fishery on the basis of commercial fishermen's returns, research information and seasonal conditions.*

#### Background:

Regular sampling, mainly using gillnets and electro-fishing, is conducted at several locations in the Mary River, concentrating on the billabong environment where populations are isolated and relatively stable at the end of the dry season. Numbers of migrating juvenile barramundi have been monitored at several sites, beginning with the Daly River in 1982, to assess inter-annual changes in abundance. Since 1989 this recruitment monitoring has concentrated on the Mary River at Shady Camp where migrating recruits are concentrated at the saline intrusion control barrage. In response to expressions of concern from anglers at Borroloola a 5-day sampling of the barramundi population in the McArthur River was carried out in 1992. That sampling was repeated in 1995 but has not been undertaken since.

#### Method:

A major feature of this work since 1987 has been the development and application of a technique known as a Closed Area Depletion Experiment (BARRACADE). This involves virtual total sampling of a section of a billabong, some 400m in length, over a period of six days. The sampling area is isolated from the rest of the billabong by small mesh, heavy gauge block nets which prevent fish from entering or leaving the area unassisted. The fish are caught using gillnets ranging in mesh size from 75 mm to 200 mm. This range of mesh sizes effectively samples the whole population of barramundi in the billabong environment. After measurement, scale sampling and examination, the fish are tagged and released outside the enclosed area. This technique provides an estimate of the population of the sample area and an accurate assessment of the age structure of the population. The sampling period was reduced by one day in 1996 mainly to reduce costs.

As the floods recede migrating juvenile barramundi are captured at the Shady Camp Barrage by electrofishing and by trapping. Otoliths are taken from a sample for accurate age determination.

Data from commercial fishermen's monthly catch returns is analysed to assess trends in the population. This information, together with the research information, is used to model the way in which the population has responded to fishing in the past and to assess the likely impacts of various management scenarios in the future.

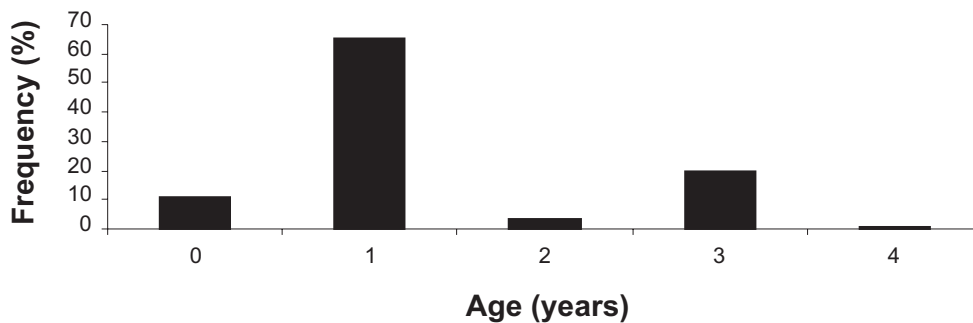
#### Results:

##### BARRACADE Sampling

In the four days of fishing 357 barramundi were captured. The incidence of the ulcer disease "red spot" was much lower than usual with only 9% of fish affected overall. The age distribution (Fig. 1) was dominated by one-year old fish, which were survivors of the huge recruitment of 1997, which make up 65% of the population. The 1994/95 class, now three years old, makes up 19% of the population. Almost all of the remaining 16%

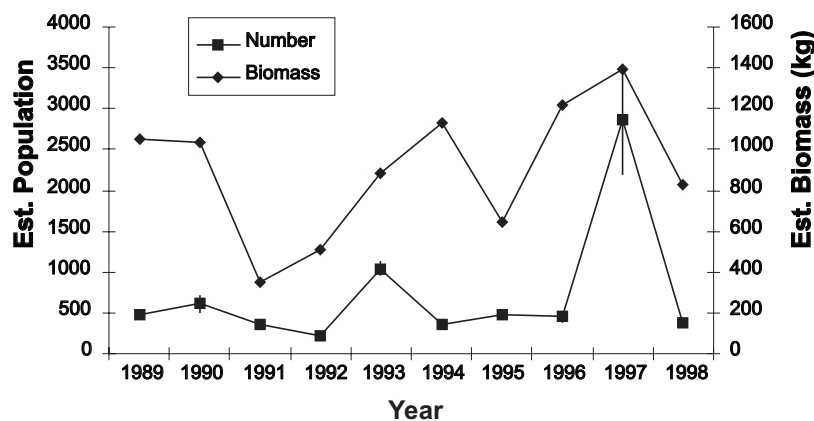
consists of some new recruits and a few two year olds from the 1995/96 spawning. The abundance of recruits has continued to follow the established cycle of low recruitment in one year followed by a very strong recruitment the next year.

**Figure 1. Age distribution of barramundi - BARRACADE 98.**



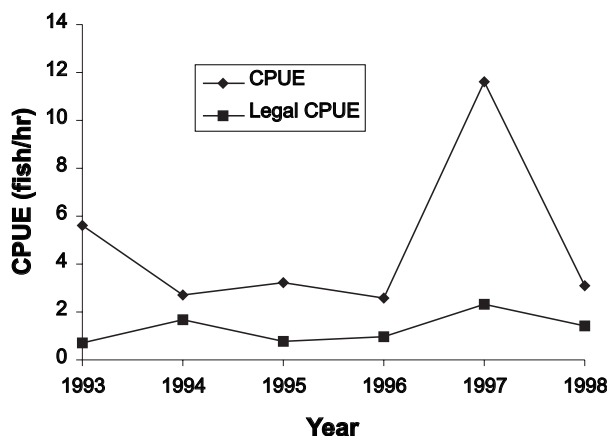
Several methods of estimating the population of barramundi in the enclosed area can be applied to typical data from this experiment. A good estimate is provided by the weighted maximum likelihood method of Carl and Strube (1978). The 1998 population is estimated to be 384 (between 368 and 400 with 95% confidence). Barramundi populations of the enclosed experimental area for the period 1989-1998, estimated by the Carl and Strube method, are shown in Figure 2.

**Figure 2. Estimated barramundi population of the BARRACADE experimental area; 1989-1998, determined by the Carl and Strube method, and the calculated biomass of barramundi based on that estimate. Error bar = 95% confidence interval for population estimate. Error is not calculated for the biomass estimate.**



Relative abundance is reasonably reflected in the catch per unit effort (CPUE - fish per 100 m of net per hour, hmh), which at 3.1 fish/hmh, is much lower than in 1997 (Fig.3) and close to the average.

**Figure 3. Total catch per unit of effort (CPUE) and CPUE of legal sized barramundi in Corroboree Billabong, 1993 to 1998.**



Of most relevance to the recreational sector is the relative abundance of legal size barramundi in the billabong (Fig. 3). The CPUE for fish greater than 55 cm was 1.4 fish/hmh this year, compared to the 2.3 fish/hmh observed in 1997 and 1.0 fish/hmh in 1996. These CPUE data clearly demonstrate that while the total abundance of barramundi varies greatly, the abundance of legal sized barramundi is somewhat less variable.

During this experiment, saratoga (*Scleropages jardini*), were also measured, examined and released outside of the enclosed area. They were not tagged. Over the four days of sampling 98 saratoga were caught. All were released alive. They ranged in size from 39-69 cm with a mean length of 54.8 cm.

**Recruitment monitoring:**

Activity in this area was again very limited in 1998/99 with resources focussed on the Mary River wetlands research project. A considerable backlog of data from this work remains to be analysed.

**Stock assessment:**

Assessment of the NT barramundi fishery has shown that the catch and effort have remained quite stable while the catch per unit effort, indicating relative abundance, has maintained a slightly increasing trend. A model describing and predicting fishery behaviour in response to fishing and to seasonal factors has been completed and was subject to some development and enhancement during the visit of Professor Carl Walters in November 1996. No further development has been undertaken. Problems with reliable database access have limited work in this area.

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**PROJECT: Mary River Wetland Project**

**Project Period: 1995-2000**

**Project Officers: P. de Lestang, R. Griffin, G. White, P. Johnson/Q. Allsop**

**Project Location: Darwin/Coastal areas from Cape Hotham to Wildman River.**

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**Background:**

DPIF Fisheries Division has carried out monitoring of barramundi within the Mary River floodplains since early 1994. The monitoring aimed primarily at determining the age, size and number of barramundi that utilise the wetlands. A range of sampling techniques were employed including gill nets, cast nets, hide traps and electro-fishing.

**Objective:**

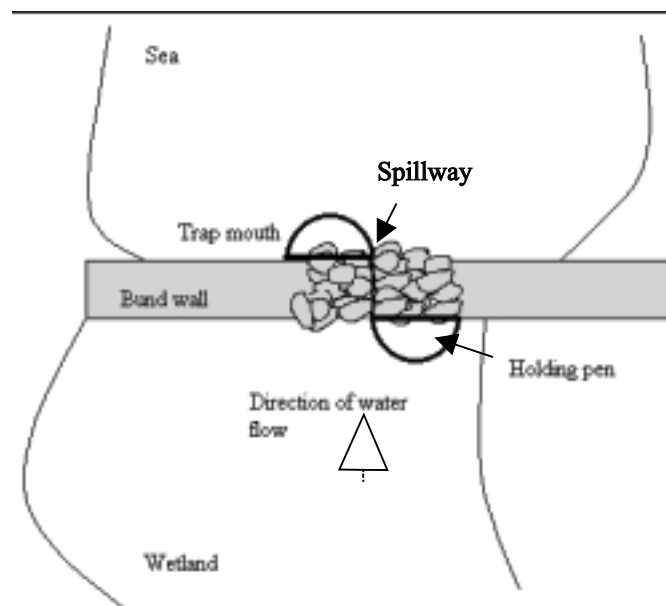
***Funding was received for the NHT project "Impacts of Saline Intrusion on Barramundi in the Mary River" in early April 1998. The aim of the project was to experimentally evaluate the effects of a rock spillway on fish migration and the relative abundance of teleost fish communities on the coastal wetlands of the Mary River and adjacent Carmor floodplains.***

In early September 1998 a wire mesh trap was built on a coastal rock spillway situated just west of the western border of Kakadu National Park. This site was unique, offering the only access point to a small wetland just upstream. A monitoring program was run in conjunction with the trap experiment, sampling fish at four sites along the coastal area of the Mary River and Carmor floodplains.

**Method:**

Various coastal swamp habitats in areas with and without saline intrusion control bunds were sampled. A combination of cast nets, multi-mesh paneled gill nets and scoop nets were used at each site.





**Figure 1. Diagram of the wire mesh trap built over a rock spillway located on Carmor plains.**

A wire mesh trap was built over a rock spillway, catching and holding all fish crossing the spillway both up and downstream (Figure 1). Water quality was measured in conjunction with sampling and included water temperature, pH, conductivity, salinity, DO and turbidity.

#### **Results:**

Intensive fieldwork was undertaken from November 1998 to June 1999. It included an investigation of areas that had entrapped freshwater due to the placement of saltwater exclusion bunds, an intensive monitoring program investigating recruitment of wetland areas during the 1998/1999 wet season and a catch / release program studying the effects of a rock spillway on fish passage.

The creek east of Sampan Creek, referred to as Carmor Creek, was the site of a mass fish kill in November 1997 with an estimated 5000 dead barramundi. In May 1998 this creek was sampled, catching and recording details of 435 fish of six species. Barramundi comprised 44% of the total number of fish caught and they ranged in size from 290 – 610 mm. The large number of trapped barramundi and poor water quality indicated a high probability of another large fish kill. An operation was carried out to remove a percentage of the fish thus reducing the pressure on those left. The operation went for six days and involved gill netting and flying the barramundi out in large cages, releasing them out to sea. Just under 1000 barramundi were caught and released and no fish kill was reported. A spillway was put in place in late November 1997 with the intention of preventing further mass fish kills in this system. Erosion during the 1998/1999 wet season removed the underlying soil from the spillway sinking and partly destroying both the spillway and adjoining bund wall. Carmor Creek is presently open to unrestricted tidal movement with saline water penetrating into the upstream freshwater wetlands. The Department of Lands, Planning and Environment is considering options to reduce saline intrusion into the creek. The favored option is to build a submerged weir. This will be designed to slow the tidal amplitude while still allowing fish passage at high tide.

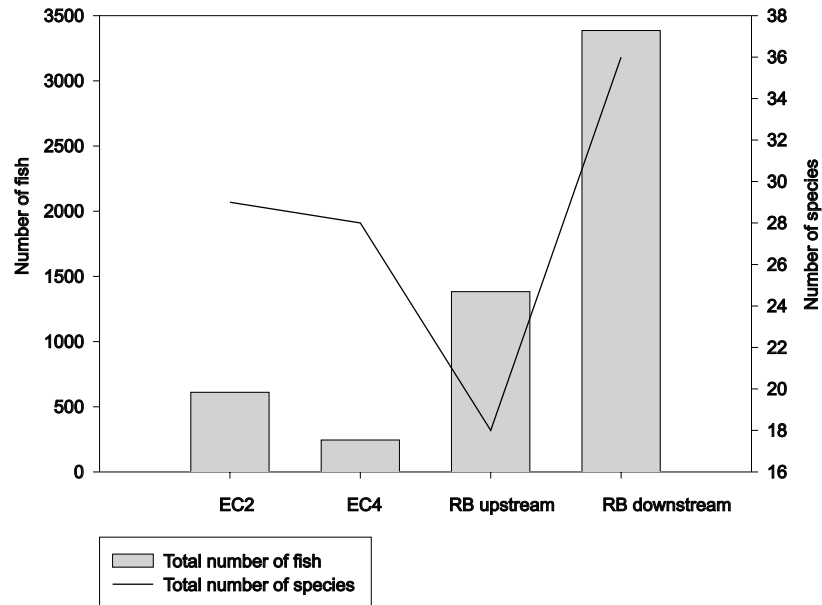
#### **Monitoring Program:**

During the 1998/99 wet season accessible coastal areas were sampled. Four sites were selected; two areas to the west of Tommycut (EC2 and EC4), and one site either side of a bund wall incorporating a rock spillway to the east of Sampan Creek (Rockbund).

**Table 1. A total of 6140 fish were caught at the four sites between December 1998 and June 1999. The samples contained 41 species, representing 23 families.**

Rank	Species	Number of Fish		Mean Length (mm)	Length Range (mm)
		(n)	(%)		
1	Ambassis agrammus	2914	47.5	35.0	8-56
2	Pseudomugil tenellus	977	15.9	18.9	12-28
3	Lates calcarifer	362	5.9	321.1	5.5-570
4	Selenotoca multifasciatus	301	4.9	39.4	11-107
5	Melanotaenia splendida inornata	297	4.8	31.3	10-110
6	Liza tade	263	4.3	105.3	14-450
7	Sillago lutea	160	2.6	74.6	27-114
8	Mugilogobius mertoni	129	2.1	19.4	10-32
9	Melanotaenia nigrans	93	1.5	19.4	12-48
10	Marilyna menaukensis	86	1.4	41.2	21-80
11	Valamugil buchanani	52	0.8	60.2	35-126
12	Neosilurus rendahli	47	0.8	84.3	60-160
13	Liza melinoptera	46	0.7	62.5	40-105
14"	Liza alata	44	0.7	95.5	23-290
14"	Nematolosa erebi	44	0.7	332.2	200-580
16	Arius graeffei	35	0.6	205.6	55-440
17"	Brachirus selheimi	31	0.5	57.0	31-118
17"	Mogurnda mogurnda	31	0.5	212.6	50-400
19	Arius leptaspis	30	0.5	35.3	18-81
20	Prionobutis microps	29	0.5	24.7	12-72
21	Ambassis gymnocephalus	27	0.4	39.0	15-52
22	Hypseleotris compressus	24	0.4	18.3	11-58
23	Megalops cyprinoides	21	0.3	116.0	16-102
24	Butis butis	18	0.3	22.2	11-32
25	Leiopotherapon unicolor	13	0.2	111.4	75-139
26	Eleutheronema tetradactylum	11	0.2	120.5	72-193
27	Scatophagus argus	10	0.2	14.5	11-18
28	Valamugil angali	9	0.1	178.3	84-340
29	Terapon jarbua	7	0.1	69.1	44-105
30	Elops hawaiiensis	6	0.1	189.3	104-310
31"	Amphitherapon caudovittata	5	0.1	62.0	25-102
31"	Squalomugil Nasutus	5	0.1	137.6	65-240
33	Periophthalmus novaeguireaus	4	0.1	35.5	32-39
34"	Pomadasyd kaakan	2	<0.1	235.0	170-300
34"	Strongylura incisa	2	<0.1	40.0	28-52
35"	Chanos chanos	1	<0.1	325.0	325-325
35"	Gerres filamentosus	1	<0.1	380.0	380-380
35"	Nibeas sp.	1	<0.1	60.0	60-60
35"	Redigobius bikolanus	1	<0.1	38.0	38-38
35"	Strongylura krefftii	1	<0.1	21.0	21-21
<b>Totals 40 species</b>		<b>6140</b>			

Each of the ten most abundant species contributed more than 1.0 % to the total number of fish, and together accounted for 90.91 % of that number. Sixty percent of the total fish caught were from the site immediately below the rock spillway (RB downstream) (Figure 2). This site also recorded the highest number of species (86% of the total species). The site immediately upstream of the spillway (RB upstream) recorded the second highest number of fish (25% of the total catch) but this represented only 43 % of the total species. The sites west of Tommycut Creek (EC2 and EC4) contributed 11% and 4% of the total catch, respectively with a similar number of species (69% and 67% of the total, respectively).



**Figure 2. The total number of fish and total number of species caught at each site from November 1998 to June 1999.**

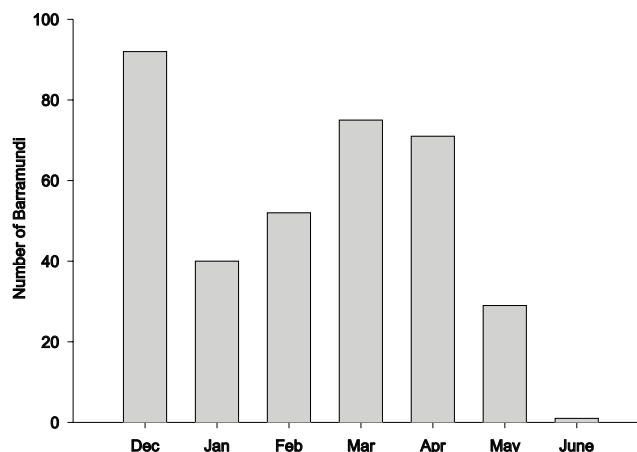
The site immediately downstream from the rock spillway represented the interface between the flow of freshwater from the upstream wetlands and the tidal saline water from the sea. During the early wet season, this area was predominantly inhabited by marine and estuarine species that migrated from the sea. During the middle and late wet season, fresh water species were able to migrate down from the permanent billabongs thus increasing the diversity of species in the area. The site upstream of the spillway represented a freshwater habitat. The species caught in this site were predominantly oligohaline (freshwater species living in low salinities) and migrants (those species which use this area as routes to and from rivers and open seas).

EC2 and EC4 represented areas that had little influence from the upstream wetlands and were depended on rainfall in the immediate area and tidal water. Estuarine, marine and migrant species predominantly inhabited these areas with a small number of oligohaline species in the latter part of the wet season. EC2 was situated on a slightly deeper, more defined channel which offered a larger route from the sea, thus this site recorded a larger number of fish compared to the number caught at EC4.

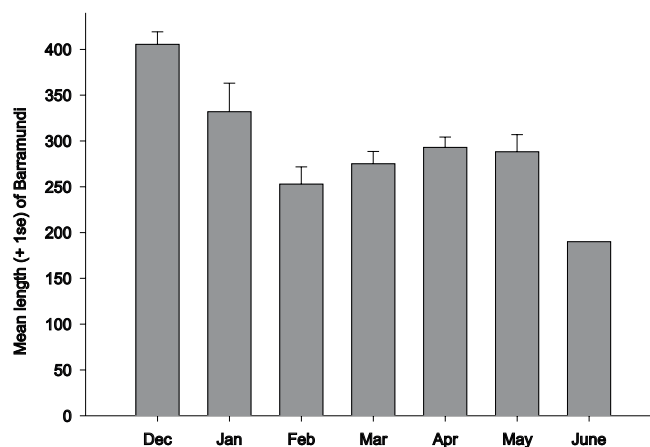
The results suggest the placement of spillways within the coastal saline intrusion control walls provide a larger, more defined interface between the fresh and salt waters thus providing a habitat which can be used by a greater range of species.

**Barramundi Recruitment:**

Barramundi was the third most common fish in the monitoring program, contributing 5.9 % (362) to the total number (Table 1.). The abundance of barramundi was highest in December (26%) and March (21%) (Figure 3). The barramundi caught represented three age classes: 0+ (66%), 1+ (26%) and 2+ (9%).



**Figure 3. The total number of barramundi caught over time.**



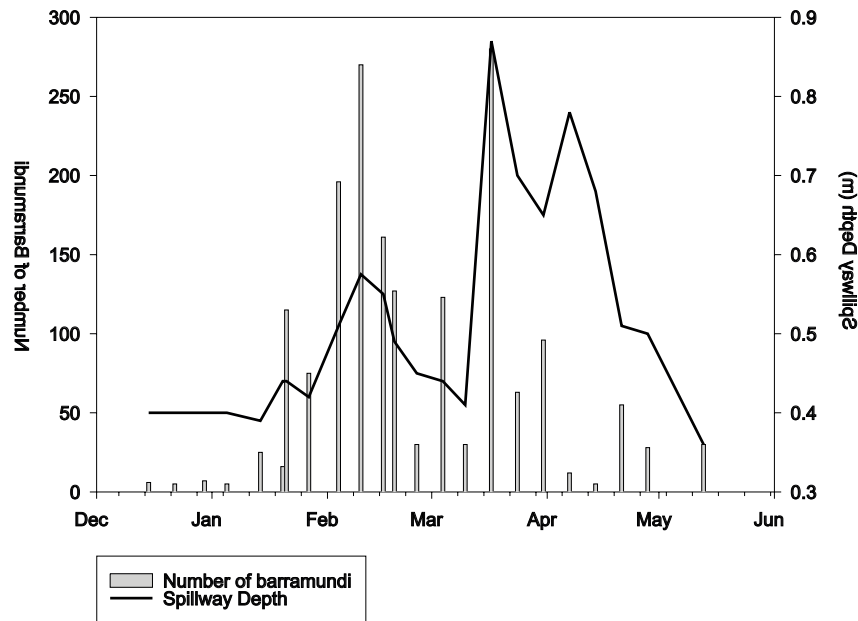
**Figure 4. The mean length (+ 1se) of barramundi over time. \*(Only one barramundi was caught in June 1999).**

The mean length of barramundi decreased in the period from December to February as juvenile barramundi moved into the wetland system (Figure 4). The length increased from March to May as the new recruits started growing.

**Spillway Program:**

A two-way fish trap with holding pens was on each side constructed over the rock spillway. The aim of this trap was to catch and hold all barramundi crossing both upstream and downstream.

A total of 1760 barramundi were caught, aged, measured, tagged and released in the period from December 1998 to May 1999. The majority of the fish were caught in February and March (44.5 % and 36 % respectively) (Figure 5). The barramundi caught represented four age classes, 0+, 1+, 2+ and 3+ with the majority of fish within the 0+ (89.3%) and 1+ (6.4%) age groups.



**Figure 5. The relationship between the number of barramundi caught in the trap and spillway depth from December 1998 to May 1999.**

The results indicate a strong relationship between the depth of water flowing over the spillway and the number of barramundi crossing the spillway (Figure 5.). The increase in water level in late April did not affect the decreasing trend in barramundi numbers over the latter part of the wet season, which is seen in both the trap and monitoring programs.

The sampling has shown no large congregation of fish immediately upstream or downstream of the rock spillway. This result and the results of the trap indicate that fish are not congested or being held back by the spillway. Tagging results indicate that barramundi do not use the spillway as a habitat i.e. crossing back and forth, but rather simply as a means to migrate either above or below the wall. These conclusions suggest that the rock spillway is effective in allowing uninhibited fish passage

The design of the spillway was found to be problematic due to the wire mesh, which was used to encase and hold the granite rock. A small percentage of the larger species including barramundi, catfish and mullet became entangled within the mesh while crossing. A new design of spillway which uses geo-textile material instead of the rock/mesh basket will solve this problem.

A proposal for further funding through the Natural Heritage program has been lodged with the aim of experimentally evaluating the effectiveness of several different fish passageway designs. The results will provide management options for future protective works for wetlands.

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**PROJECT: Coastal Fisheries Research**

**Project Period: 1995- 2000**

**Project Officer: T. Hay, D. McKey and C. Errity**

**Project Location: NT Coastal Waters - concentrating around major population centres**

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**Objectives:**

- **Provide baseline information on NT coastal fisheries.**
- **Identify major coastal fish species and collect biological information to assist in determining and implementing management priorities.**

- **Determine age and growth parameters for major species. (including validation of ageing process)**
- **Develop a plan of management for the fishery.**

#### **Background:**

In the Northern Territory (NT), coastal fisheries range from estuarine waters out to 15 nm offshore, including rivers, bays, inlets, intertidal areas, extensive areas of mangroves and seagrass as well as open water. As a consequence these habitats support a diverse range of fish and other aquatic species and are therefore accessed by a variety of user groups such as commercial and recreational fishers, fishing tour operators, and Aboriginal communities. In addition, marine parks are becoming an important consideration, as is the utilisation of coastal regions for tourism, education and passive use. Further pressures are placed on the coastal zone by continuing urban, tourist and commercial development and the growing Top End population.

In 1995 knowledge of the biology of major coastal fish species was scant and collection of this information was identified as a priority by the Fisheries Division and fully endorsed by the Coastal Line Fishery Advisory Committee (COLFAC). A preliminary research report on the first year's findings was prepared and endorsed by COLFAC and subsequent reports have identified and examined the dimensions and directions of research and management priorities for these fisheries.

There is potential for over exploitation in this fishery due to the high level of latent commercial effort and extensive recreational fishing pressure on the coastal stocks (Fishcount 1998). The data currently collected by compulsory monthly commercial logbooks is not sufficient for assessment of coastal fish stocks. Introduction of daily logs reporting detailed spatial and temporal fishing data is a high priority for this fishery.

#### **Method:**

- Monitor and review the literature on coastal fisheries in the NT and relevant fisheries in other regions;
- Provide annual summaries (Status Report) of the catch and effort data from compulsory logbooks with relevance to NT coastal fisheries;
- Increase the presence of the Department amongst user groups of the coastal fisheries;
- Develop liaison between the Department and various user groups with the ultimate aim of documenting the issues they believe are important and educating them in fisheries related matters;
- Collect base level biological information on a monthly basis (species composition, sex ratios, length-frequencies, otoliths, maturity indices, etc) on fish caught in coastal fisheries, especially jewfish, snappers and emperors;
- Conduct a tagging program to identify movement and growth rates, exploitation rates and validate ageing process.
- Prepare and submit an annual summary of research results to Coastal Line Fishery Advisory Committee (COLFAC).
- Participate in workshops and conferences held to assess the status of the stocks of NT coastal line species, state of the fishery and future management and research options.
- Continue to lobby industry for the introduction of daily logbooks.

#### **Results:**

A total of 128 field collection surveys have been conducted to date. Technical staff have collected biological information on important coastal fish species utilising the fisheries vessel *Instigator* and commercial vessels in areas such as Darwin Harbour, Fog Bay, Peron Islands, Cobourg Peninsular, Adelaide River, Bathurst and Melville Islands and the Borroloola region. A total of 4254 reef fish have been measured, weighed and sexed. Otoliths (earbones) were also collected and a selection of these has been aged. Tagging studies, incorporating oxytetracycline injections to mark bones for age validation, commenced in May 1998 resulting in 492 golden snapper, black jewfish, trickies and stripeys tagged and released around the Darwin and Borroloola regions. Results will provide much needed information on growth, age and movement of important species.

The initial results of this research have been outlined in four DPIF Fishnotes. Each Fishnote provides information on the population biology of the main species caught by the coastal fishery, namely: golden snapper (*Lutjanus johnii*); jewfish (*Protonibea diacanthus*); tricky snapper (*Lethrinus laticaudis*) and stripey (*Lutjanus carponotatus*). We have collected similar information on other species, and we will produce further fishnotes as the data becomes available.

Growth and age data collected to date has resulted in the implementation of two recreational fish possession limits. Recreational fishers are now restricted to a 5 black jewfish possession limit and a general reef fish possession limit of 30.

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**PROJECT: Mud Crab Project****Project Period:** 1989- ongoing**Project Officer:** T. Hay, D. McKey and C. Errity**Project Location:** NT coastline particularly Darwin, Borroloola and Roper regions

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**Objectives:**

- *To monitor biological aspects of mud crab growth and behavior and catch and effort data from commercial logbooks;*
- *To assess and develop new techniques for measuring species density in the NT for future stock assessment purposes;*
- *To provide advice on biological aspects of the fishery to management ensuring sustainable utilisation of the resource and maximum benefit to the NT;*
- *To comply with legislative requirements and foster strong industry liaisons.*

**Background:**

The mud crab, *Scylla serrata*, is the basis for the most valuable commercial, wild-harvest fishery in the Northern Territory, valued at over \$7 million in 1998. This fishery fosters high participation from both commercial and recreational fishers, and is an important food source for traditional people.

The mud crab research program has been in place since 1989. A substantial body of knowledge on the fishery has been gathered during that period. Positive results from this research include:

- the recommendation that the size limit for female mud crabs be increased from 130mm to 140mm to protect immature crabs;
- the parasite *Loxothylacus ihlei*, was identified for the first time in Australian waters and its effects on the mud crab documented;
- restricted bait nets were banned in Borroloola to assist in protecting the dugong from accidental capture and minimise the taking of juvenile fish.

**Current research consists of:**

- A monitoring program that has been underway for the past 8 years where biological measurements are collected on a monthly basis from three commercially important areas (McArthur River region, Roper River region and Adelaide River);
- A tagging program in the McArthur region where fisheries staff are permitted to tag and release soft and empty (recently molted) crabs from the commercial catch and return them to the water. We are monitoring crab movement patterns and growth rates utilising tag returns;
- An experimental procedure aimed to estimate localised crab density has been developed utilising mark-recapture and depletion techniques;
- Collection of spatially isolated samples of mud crab flesh for genetic identification.

Steep increases in police prosecutions indicate extensive over-potting in the commercial sector that diminishes the value of monthly logbook data and therefore CPUE data. This highlights the need for the collection of fishery independent data so that true estimates of exploitation and effort rates can be achieved.

**Method:**

- Monitor and review the literature on mud crab in the NT and relevant fisheries in other regions;
- Provide annual summaries (Status Report) of the catch and effort data from fishermen's logbooks and review logbooks as necessary;
- Increase the presence of the Department amongst user groups of the mud crab fishery.
- Undertake liaison trips to major crabbing regions;

- Collect biological data from 100 mud crabs from each of the three major regions on a monthly basis to monitor any change in the fishery. This data will be collected in Darwin utilising the contacts established during the course of the project;
- Prepare a Mud Crab Fishery Project Report for MCFAC;
- Disseminate information by preparing appropriate publications, including newsletters, brochures, Fishnotes and Scientific Papers and providing information at public forums;
- Develop techniques to measure mud crab densities and unit area of habitat;
- Refine methods of determining spatial habitat patterns and crab densities per unit habitat area which are prerequisites to future stock assessment;
- Undertake tagging studies to identify movement and growth, and
- Continue to lobby industry for the introduction of daily logbooks.

**Results:**

The mud crab research program continues to collect biological measurements and fishery information which, together with catch and effort data, provides an understanding of the effects of fishing on the population dynamics of the mud crab resource in the Northern Territory. The continued collection of this information, on a monthly basis, is vital in monitoring for signs of over-exploitation.

Samples have been collected from areas around the NT for genetic analysis

Liaison was maintained with the commercial mud crab fishermen through the provision of printed material and field trips to major crabbing areas.

The annual project report was presented to and endorsed by the Mud Crab Fishery Advisory Committee (MCFAC). This report details current results and proposed future directions. A key area identified as a prerequisite for future stock assessment requires the development of methods to determine the spatial habitat patterns and crab densities per unit habitat area.

The "Northern Australia Mud Crab Research Priority" workshop, supported by the FRDC, NT Fisheries, QDPI Fisheries and WA Fisheries, was held in Darwin on the 31 May 1999. Representatives of WA Fisheries, QFMA, QDPIF, NTDPFI, Queensland CRAB MAC, NT MCFAC, and NT mudcrab industry were present. A five year research plan for the Northern Australian (WA, NT, Qld) mud crab fishery was developed based on industry and management priorities. The research priorities identified in the five-year plan have subsequently been endorsed by the Chair of the NT Mud Crab Association, Qld CRABMAC, NSW Fisheries and have received support from WA Fisheries.

A three-year funding proposal addressing phase one of the research plan has been developed for submission of to the Fisheries Research and Development Corporation (FRDC). This project aims to develop methods to estimate mud crab abundance across northern Australia and involves NT, QLD and WA Fisheries agencies. A major component of this work is the mapping of critical habitat across northern Australia using satellite and aerial imagery. New techniques for estimating mud crab abundance have also been developed by NT and Qld Fisheries and these will be further tested with the aim of providing estimates of crab density per km of habitat.

**SUBPROGRAM: Offshore Marine Fisheries**

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**PROJECT: Troll Fishery for Spanish Mackerel**  
**Project Period: 1991- ongoing**  
**Project Officers: R. Buckworth, C. Bryce, S. Boubaris, D. White and R. Clarke**  
**Project Location: Darwin, NT coastal waters**

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**Objectives:**

- **Identify the sectors of the fishing industry exploiting mackerel, their target species, and fishing unit characteristics;**



- **Develop a logbook and biological monitoring system for the provision of both commercial catch and effort data, and biological data;**
- **Identify the geographic structure of stocks of the target species; and**
- **Draw together all available information, develop models of the fishery which allow stock assessment and exploration of different management regimes, and indicate required research.**

**Background:**

Spanish mackerel were taken by licensed Taiwanese drift netters, until the mid-1980s; there were some indications that their peak catches were not sustainable. Consequently, the troll fishery was declared as a limited entry fishery in 1991, with several measures to contain fishing effort and reduce capacity. It is regarded as a developing fishery. With increasing prices throughout the 1980s, annual catches in the domestic troll fishery grew, peaking in 1990 at about 270 tonnes. Catches in other fisheries and in the recreational fisheries have grown to be of a similar order to the troll fishery. The major activity in research of this fishery is the accumulation and analysis of monitoring data. Research into the fishery has chiefly been directed at providing information on potential sustainable harvest rates and yields for this stock.

**Method:**

Together with selected fishers, research officers collect biological information (catch species composition, sex ratios, length-frequencies, otoliths and reproductive information). Commercial fishers supply catch and effort information, either as summary monthly data or, voluntarily, as daily logbooks.

Stock assessment models have been constructed which use the biological and age data, as well as catch and fishing effort, and literature information. A workshop on assessment of the Spanish mackerel fisheries of northern Australia was conducted under the leadership of Professor Carl Walters of the Fisheries Centre, University of British Columbia, in 1997 (see Walters and Buckworth, 1997). This work is being used to define research and assessment directions for the fishery. Simulation modelling is being employed to examine monitoring options for the fishery.

**Results:**

Information on catch and distribution of commercial fishing effort has, on its own, proven to be inadequate to closely define sustainable yields for this fishery.

However, it indicates that the Spanish mackerel resource may be limited, with the commercial fishery currently operating near the lower range of sustainable levels. It was recommended that research focus on means of evaluating harvest rates and the spatial relationships of stocks. Preliminary results of the simulation work indicate that information collected in the daily logbooks might be particularly useful in future assessments.

Difficulty in deciding stock boundaries has also limited the applicability of assessments. A Fisheries Research and Development Corporation project (see below) is addressing this problem. A document describing the difficulties confronting fisheries on a global basis was recently published (Buckworth, 1998a).

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**PROJECT:           The Stock Structure of Northern and Western Australian Spanish Mackerel, FRDC 98/159**

**Project Period:     1998- 2001**

**Project Officers:   R. Buckworth, C. Bryce and D. White**

Project Funding

Source:               FRDC

Project Location:   Darwin

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**Objectives:**

- 1. Establish the degree of structure in the northern Australian Scomberomorus commerson stock over a wide geographic range;**

- 2. Having demonstrated structural differences within the northern stock on the large scale, describe finer scale spatial structure; and,**
- 3. Provide advice to the fishery administrations on the appropriate geographic scale of assessment and management actions**

**Background:**

As an FRDC-funded collaborative study between the fisheries agencies of the NT, Qld, WA, and the University of Queensland, this project aims to match the scales of fisheries management and population processes. This is fundamental to the sustainable, optimum harvest of the Spanish mackerel resource. Mackerel is the basis of important, growing commercial and recreational fisheries throughout northern Australia. However, the lack of understanding of spatial relationships among northern narrow-barred Spanish mackerel populations has been recognized as a barrier to effective assessment and management of these fisheries. Previous genetic analyses showed that northern Australian Spanish mackerel were markedly different from east coast members of the species, but did not indicate structuring in the northern "stock".

**Method:**

A phased approach has been adopted in which fish were first sampled at primary sites, on a broad geographic scale. Material collected included otoliths (ear bones) for chemical and isotopic analysis, various tissues for allozyme and mitochondrial DNA-based genetic analyses and parasites from gills and stomachs. The second phase of the project is to include sampling at secondary sites (between primary sites), as well as at the primary sites, to provide finer spatial resolution.

**Results:**

In terms of otolith carbon and oxygen isotope levels, fish sampled at sites near Abrolhos Islands, Groote Eylandt, Torres Strait, Cairns and Kupang all differed significantly from each other; samples from the Kimberley and Darwin were similar. However ambient temperatures at last two locations are similar and as the methodology is temperature-dependent, the analysis was not informative for these locations. The project has thus achieved the first objective of demonstrating large scale structuring in northern Australia. Initial examinations indicate that, in the tissues sampled, several parasite species will be suitable for stock analysis. Genetic analyses have been initiated and material from both primary and secondary sites will be collected during the next year. Preliminary results from these methods also indicate marked differences between sites. Two documents have been published to extend this work to operators (Buckworth 1998b, Ovenden 1998).

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**PROJECT: Northern Prawn Fishery Monitoring**

**Project Period: 1978- ongoing**

**Project Officers: D. Hall, N. Rayns and R. Buckworth**

**Project Location: Darwin**

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**Objectives:**

***To maintain a watching brief on the Northern Prawn Fishery (NPF) for issues specific to the NT.***

***To contribute to the effective sustainable management of the NPF through input into the Northern Prawn Fishery Management Advisory Committee (NORMAC).***

**Background:**

The NPF is one of Australia's most valuable fisheries and contributes a large proportion of the value of commercial fishery landings from waters off the NT. The fishery is managed by the Commonwealth and the NT contributes through the fishery's management advisory committee. The role of this program is thus to provide input to the fishery, and to monitor the interactions of the NPF with other NT fisheries and communities.

**Method:**

Access is maintained to NPF logbook data, the collection service and industry. Databases of information

collected during past NT research into the fishery are maintained and are available for research relevant to the NT.

Contribution is made to workshops and forums addressing management and research into the fishery.

**Results:**

Although this is a watching brief and thus does not in itself provide data, it provides a framework for assembling relevant projects (for example, studies into by-catch composition and reduction) and ensuring the integrity of historical data.

During 1998/99, bycatch data from regular trawls that were conducted in the Shoal Bay area from 1972-1976, were collated and entered into a database, ensuring their preservation and future availability (prawn catch data from this set was previously entered). Additionally, bycatch data from previous studies on board commercial NPF vessels is being collated with a view to future analysis.

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**PROJECT: Shark Fishery Research and Monitoring**

**Project Period:** 1991- ongoing

**Project Officers:** R. Clarke, R. Buckworth, K. Campbell, C. Bryce and D. White

**Project Location:** Darwin

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**Objectives:**

- *Estimate sustainable fishing levels, important biological parameters and monitor the fishery to ensure that harvest strategies implemented are consistent with ESD principles;*
- *Collate information on the northern shark fishery and identify and conduct appropriate research and monitoring programs for the fishery.*

**Background:**

Although the fishery for northern pelagic sharks was historically heavily exploited by Taiwanese gill-netters, it is only in recent years that domestic catches have exceeded 500 tonnes per year. Although in recent years the landings from this fishery have grown significantly, reflecting an increase in participation encouraged by improving markets and prices, the departure of a major operator during 1998/99 saw some reduction in shark catch. The fishery principally targets black-tip (*Carcharinus tilstoni*) and spot-tail (*C. sorrah*) sharks, which were the subject of intensive biological research during the 1980s. Grey mackerel (*Scomberomorus semifasciatus*), is a valuable secondary target, with around 300 tonnes landed annually. Significant catches are also made of hammerhead sharks.

**Method:**

Research activity for the fishery is limited to collation of catch and fishing effort information to assist in developing assessment models. Funding from an existing grant from the Fisheries Resources Research Fund with the Bureau of Resource Sciences was used to collate fishery data from the Australian and Indonesian sectors of the Arafura Sea.

**Results:**

Assessment workshops conducted during 1997 indicated that catches of shark in northern Australia are near optimum sustainable levels. Research projects are currently being developed to address elasmobranch species composition in catches by different sectors and to address the spatial structure of the fishery.

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**PROJECT: Fish and Mangrove Productivity**

**Project Period: 1998 – 2001**

**Project Officers: J. Martin, R. Buckworth and P. McHugh**

**Project Location: Darwin**

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**Objectives:**

*To identify the role that mangroves play in the trophic relationships of fish species that depend on them and the effect of mangroves on survival of these species.*

**Method:**

Fish from three mangrove locations in Darwin Harbour have been sampled every second month for two years to provide information on species composition and abundance.

The diet of each species will be noted to provide information that can be used in an ecosystem model. The study is being conducted in association with the Department of Lands, Planning and Environment and the Northern Territory University and has a doctoral research component by J. Martin.

**Result:**

Sampling methods have been refined and sampling is progressing as expected.

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**PROJECT: Timor Reef Fishery Research**

**Project Period: 1989-2000**

**Project Officer: J. Lloyd, G. White (30%) and M. Emslie**

**Project Location: Darwin/Timor Sea**

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Julie Lloyd, the research scientist for this project, has been on study leave for the second half of this reporting year.

**Objectives:**

- *Determine the sustainable yield of the Timor reef fishery, and provide managers with appropriate information for the sustainable utilisation of this fishery;*
- *Provide information on the biology and population parameters of goldband snapper (*Pristipomoides multidens*) and sharptooth snapper (*P. typus*) which can be incorporated into population models to determine the biomass of these species;*
- *Monitor the Timor Reef Fishery to ensure that over fishing does not occur.*
- *Obtain an approximation of Indonesian fishing effort on these stocks, from coastwatch flight information data.*

**Background:**

This program provides research information for the Timor Reef fishery to ensure the long-term viability of this resource. Over the period 1989-1992 there was a four-fold increase in the value of the Timor Reef fishery. The commercial catch has a current market value of over 2 million dollars. It is expected that this fishery will continue to develop over the next 5 years. Improved technology in this fishery has contributed to increased catch.

**Method:**

Monitoring of the fishery is undertaken onboard commercial vessels during normal fishing operations. Fishing practices are documented and updated regularly.

Daily logbooks were introduced in July 1995 to obtain more reliable information.

Ageing studies using earbones (otoliths) from *P. multidentis* and *P. typus* are carried out at the Day Street Laboratory. Otoliths are embedded in resin, sectioned, then read using image analysis software. This ageing information is used in age-structured population models to determine the biomass and sustainable yield for stocks.

Effects of barotrauma (damage caused by extreme pressure changes when fish are brought up from depth) were investigated by in situ examination of fish returned to the bottom of the sea in release cages after capture. Various treatments aimed at reducing the effects of barotrauma are being investigated. Two cruises to investigate barotrauma were undertaken and several treatments tested.

**Result:**

A newsletter outlining the latest research and management developments was sent to all Timor reef, demersal and trawl operators. Species differences in susceptibility to barotrauma and response to treatment were observed but more trials are required before conclusive results are possible. A draft Fishery Assessment Report has been produced.

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**PROJECT: Stock Structure of *Pristipomoides Multidentis* Resources Across Northern Australia**

**Project Period:** 1996-1999

**Project Officer:** J. Lloyd (NT), S. Newman (WA) and J. Ovenden (QLD)

**Project Location:** Northern Territory/Western Australia

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**Objectives:**

- **Investigate the stock structure of *Pristipomoides multidentis* in northern Australian waters;**
- **To assist in the development of appropriate management plans for the deepwater snapper fisheries of NT and WA.**

**Background:**

This is a joint project between the NT and WA Fisheries, funded by FRDC. Over the last 5 years there has been rapid development of deepwater snapper fisheries that target *Pristipomoides multidentis* in both states. Both WA and the NT are presently formulating management plans for their respective deepwater fisheries. A key issue in formulating these plans is whether there is a single shared stock or there are distinct isolated stocks. This important question must be resolved before accurate estimates of sustainable yield(s) can be determined and appropriate management plans implemented. This project was scheduled for completion in October 1998 but further sampling was required and the completion date is now October 1999.

**Objective:**

**To examine the stock structure of *Pristipomoides multidentis* between Western Australia and the NT in the most cost-effective way, a stepwise approach using both mitochondrial DNA and otolith microchemistry was proposed**

**Method:**

Samples for both mitochondrial DNA as well as otolith microchemistry were obtained from commercial boats in 5 areas where *Pristipomoides multidentis* is taken in commercial quantities, ie Timor Sea, Arafura Sea, Kimberley region, NW shelf and Exmouth area. A total of 100 samples per location were collected for mitochondrial DNA analysis and 40 samples were collected for otolith microchemistry. In addition 40 *P. multidentis* samples obtained from Indonesia will be included in the study. Initially only 25 samples were screened using the mitochondrial DNA technique to determine if there was any indication of genetic differences. This work was contracted to Queensland Department of Primary Industry. On the basis of this initial screening, a decision was made to increase sampling using this method and to supplement the genetic work with otolith microchemistry.

Initial screening results showed that there was an indication of stock structure, but because the level of genetic variability was higher than expected, the sample size needed to be increased so that the incidence of shared haplotypes becomes statistically meaningful. Therefore the collaborators decided to continue the project using

mitochondrial DNA technique and to apply to FRDC for further funding to analyse samples using otolith microchemistry as well. This application was successful and analysis of samples using this technique has been undertaken.

It was expected that the mitochondrial DNA results from all samples would be completed by July 1999 and the final report would be written by October 1999.

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**PROJECT: Demersal and Finfish Trawl Fisheries Research**  
**Project Period: 1996-2002**  
**Project Officer: J. Lloyd and M. Emslie**  
**Project Location: Darwin/Timor Sea**

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The research Scientist for this project, Julie Lloyd, has been on study leave for the second half of this reporting year.

**Objectives:**

- ***Determine the sustainable yield of the demersal and finfish trawl fisheries, and provide managers with appropriate information for the sustainable utilisation of these fisheries;***
- ***Provide information on the biology and population parameters of saddletail snapper (*Lutjanus malabaricus*), red emperor (*Lutjanus sebae*), and red snapper (*Lutjanus erythropterus*) which can be incorporated into population models to determine the biomass of these species;***
- ***Monitor the demersal and finfish trawl fisheries to ensure that over fishing does not occur.***

**Method:**

Due to limited staff resources it was not possible to undertake onboard monitoring on commercial vessels which had been planned for this year. Therefore monitoring of these fisheries was undertaken solely from commercial logbooks.

Otoliths obtained from previous sampling were embedded and sectioned for age determination.

Samples of juvenile red snapper were obtained and kept in tanks to enable validation of age/growth, using chemical otolith markers.

**Results:**

Over 2000 otoliths previously extracted from these snappers for ageing studies have been embedded and sectioned. Aging is continuing. Regular wharf contact has been maintained with demersal fishery operators, and regular contact by phone with the trawl fisher based at Nhulunbuy. One batch of juvenile red snappers was obtained from the Nhulunbuy area and transferred to the Darwin Aquaculture Centre for study. Results are yet to be obtained.

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**PROJECT: ACIAR Timor and Arafura Seas Red Snapper**  
**Project Period: 1999-2002**  
**Project Officer: J. Lloyd and M. Emslie**  
**Project Location: Darwin/Arafura Sea**

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**Objective:**

- ***Determine the extent to which stocks of red snappers (*Lutjanus malabaricus* and *L. erythropterus*) and goldband snapper (*Pristipomoides multidens*) in the Arafura and Timor seas are shared across Australian and Indonesian waters.***
- ***Develop appropriate management protocols according to the degree of stock sharing and joint exploitation which might occur.***

**Background:**

This project is a joint venture involving CSIRO, NT and Indonesian scientists and is funded by the Commonwealth through the Australian Centre for International Agricultural Research (ACIAR). That funding provides for a full-time technician in the NT to collect and process the biological samples. Most of the analysis will be conducted by CSIRO scientists. This project has substantial links and overlap with the demersal and finfish trawl fisheries research project.

**Method:**

Monthly samples of fish are collected from the Arafura and Timor Sea fisheries. Biological information and material, including length, weight, sex, maturity, and otoliths are collected and recorded in the research database.

**Results:**

Two monthly samples of catches have been collected and material successfully processed. There have been substantial difficulties in this work because of high turnover of technical staff. Otoliths of goldband snapper collected in this project have been embedded and sectioned and will be analysed locally. CSIRO staff will process other material.

## PROGRAM: Aquaculture

### SUBPROGRAM: Finfish

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**PROJECT: Barramundi Aquaculture**

**Project Period:** 1998-1999

**Project Officers:** G. Schipp, J. Bosmans and C.M. Kuo

**Project Location:** Darwin Aquaculture Centre, Channel Island

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**Objective:**

*An economically viable barramundi industry including production of larvae by the private sector.*

**Background:**

The barramundi program in 1998-99 involved regular production of larvae, operation of an extension service for industry, stocking of Manton Dam for recreational fishing and research aimed at improving farm productivity.

**Method:**

A number of nursery rearing trials were undertaken in preparation for the development of a large scale barramundi cage farming operation at Port Hurd, Bathurst Island.

**Results:**

The Darwin Aquaculture Centre functioned as a semi-commercial barramundi hatchery for the 1998-99 season. Relocation of the Aquaculture Centre to a new site at Channel Island, Darwin Harbour, created some delays in supply of larvae. Larvae were supplied to hatcheries in Western Australia, South Australia and the NT.

Assistance was provided to a local barramundi farm to enable them to develop the techniques for green water culture of fingerlings.

Nursery rearing trials were completed successfully. Survival rates for the larvae/ fingerlings were above expectations at 55% from hatching. New grading systems and raceway tanks helped simplify the nursery process.

Fingerlings (50-60 mm in length) produced from the nursery trials were sold to farmers in Queensland, Western Australia and the NT. Fingerlings were also stocked into Manton dam (3,500) and Lake Bennett (1,500).

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**PROJECT: Reef Fish Aquaculture**

**Project Period:** 1998-1999

**Project Officers:** G. Schipp, J. Bosmans and C.M. Kuo

**Project Location:** Darwin Aquaculture Centre

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**Objective:**

*To examine the feasibility of the commercial production of tropical reef fish for marine aquaculture farms.*

**Background:**

A production system for the golden snapper has been successfully developed at the Darwin Aquaculture Centre over the past 5 years. This technology is now at stage where it can be applied to other potential candidates for aquaculture, particularly fish of the grouper family, which attract high prices in the Asian markets. If successful



these new species will benefit fish farmers in the Northern Territory by giving them the opportunity to diversify production.

#### Results:

The success of the golden snapper breeding program resulted from the development of a culture system for a locally found copepod which proved to be essential in the diet of first feeding snapper larvae. During 1998/99 a provisional patent was applied for and granted, over the copepod production system. A paper outlining the method was published in the international journal, *Aquaculture*.

Poster presentations of the results of the copepod experiments were presented at the international conference, *World Aquaculture 99*, held in Sydney in April/ May 1999. An oral presentation of the golden snapper research was also presented at WA'99.

During 1998/ 99 two batches of golden snapper were on-grown in fibre glass tanks at the research centre to a size of 500g (plate size), for trial marketing. The fish were well received in the market place with many favourable comments on their appearance and flavour.

The attention of the reef fish program has now shifted towards exploring the culture conditions for other high value reef fish. The first species to be examined is barramundi cod *Cromileptes altivelis*. Brood stock of this species were purchased from a private hatchery in North Queensland in October 1998. The relocation of the Darwin Aquaculture Centre during 1998/99 prevented any breeding experiments being conducted during this breeding season. It is expected to commence breeding trials in September 1999 at the commencement of the new breeding season.

## SUBPROGRAM: Crustacea

### PROJECT: Mud Crab Aquaculture

Project Period: 1993 -1999

Project Officers: G.Williams and J. Wood

Project Location: Darwin Aquaculture Centre, Channel Island

#### Objective:

*To examine the feasibility of the commercial production of mud crab, *Scylla serrata*.*

#### Background:

If economical methods of rearing mud crabs can be developed, they would provide an additional opportunity for existing or potential farmers to diversify their production or to set up facilities specifically for mud crab culture. Once the methods have been developed, it would be possible for producers to target niche markets such as those for soft shell crabs, ovigerous females, "out of season" crabs or supply of juveniles to overseas crab farmers.

DPIF funding for research into the rearing of mud crabs at the Darwin Aquaculture Centre (DAC) started in 1993 and was supplemented by funds from ACIAR from January 1995 to December 1997. A final report to the ACIAR scientific steering committee was presented in March 1997 at Bribie Island (Qld.). Further limited funding was provided by ACIAR to allow for travel to attend meetings and conferences.

Difficulties were initially encountered with every phase of larval rearing from hatching through to stage one crabs. The problems associated with each of the six larval stages have gradually been overcome with rapid progress being made in 1997 and early 1998. The relocation of the DAC to Channel Island and water quality problems have limited the progress of the experimental programme during 1998-99.

#### Results:

The main focus of work has been to develop a reliable method of larval rearing that could serve as a control for further improvements. This was achieved in 1997 – 1998 in replicated small scale experiments with an excellent mean survival to megalopa stage of 80.3%. The procedure was again replicated in another experiment at Channel Island to determine if the procedure would be affected by any site specific factors and to provide continuity for

analysis of results. This experiment gave a survival rate from zoeal to megalopa of 71%, which although lower than the experiments at Stokes Hill, is still a very satisfactory result.

The challenge that still remains is to scale up the work to a commercially viable size. A commercial scale trial was carried out using 1,000 litre tanks which unfortunately produced a disappointing survival rate of <2%, possibly due to the poor quality of the sea water available during spring tides. Improving the survival rate of larvae at a commercially viable scale of production will be the focus of the coming year's work.

During the year we closed the mud crabs life cycle and had our first successful mating of crabs bred and reared at the DAC. Larvae resulting from this mating are currently being reared.

In November 1998, Colin Shelley and Graham Williams went to the Philippines to discuss with the Philippine partners ACIAR funding for a second phase of the mud crab project and to attend the International Conference on the Culture of Portunid Crabs. Graham Williams gave a presentation at the conference outlining the culture methods used at DAC. A poster presentation showing experimental results was produced and displayed at the World Aquaculture Society Conference in Sydney and publicity articles to raise the profile of research at DAC were published in *Fish Farming International*, *AustAsia Aquaculture* and the World Aquaculture Society magazine.

## **PROGRAM: Business Development**

### **SUBPROGRAM: Gear Technology and Fishery Development**

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#### **PROJECT: Development of the Demersal Fishery**

**Project Period:** 1998-1999

**Project Officers:** R. Mounsey and J. MacCartie

**Project Location:** Northern Territory Offshore Seas

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#### **Objective:**

*Locate new fishing grounds closer to Darwin, refine/improve passive fishing techniques and provide an extension service to the industry.*

#### **Method:**

The Demersal Fishery is struggling to develop. Although commercial quantities of red snapper have been landed using passive fishing methods in the Gove region, the vast distance from Darwin has made it difficult to effectively market the fish. Ideally, red snapper need to be caught close to Darwin so fishers can take advantage of cheap freight rates to the Brisbane and Sydney fresh markets.

#### **Results:**

Although little has happened in the trap and dropline fisheries due to effects of the El Nino, catches significantly in the finfish trawl fishery have increased through the operation of the new stern trawler "Ocean Harvest". Technical services and assistance carried out by extension officers have played an important role in this development.

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**PROJECT: Gear Loan Scheme**  
**Project Period: 1998-1999**  
**Project Officers: R. Mounsey and J. MacCartie**  
**Project Location: Darwin**

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**Objective:**

*To assist fishermen entering into new fishing or marketing operations by providing selected gears on a short-term basis.*

**Background:**

Many Northern Territory fish stocks are under exploited. Often fishermen interested in developing this resource are put off because of the high risk of investing in expensive fishing gear that could become a liability if the venture does not succeed.

**Method:**

In 1985 the NT Fishing Industry Council in collaboration with the Fisheries Division set up the Gear Loan Scheme. In recent years the Fisheries Division has taken over the scheme and maintained it through supplying gear used on exploration and development projects.

**Results:**

Hydraulic dropline machines, portable fish traps, large insulated fish transport boxes, inshore nets and vertical long lines were the main fishing gear made available to professional fishers. Large X-actic fish boxes were also in demand. Each month one or two boxes were utilised by NT fishers. The third most sought after gears were fish-traps. Approximately six traps were loaned each month. Mesh nets and other inshore nets were loaned to aboriginal development licence holders and coastal fishers.

Follow-up results from the loans this year include:

- Wilson Hydraulics (local drop line machine manufacturing company) sold 10 new hydraulic drop-line machines to NT fishers. In addition the company sold a number of new machines interstate and has started exporting them.
- It is estimated that NT fishers purchased between 30 and 40 large insulated fish boxes through local fishing supply stores.
- Aboriginal development licence holders purchased at least 1000 metres of net after successful trials with Divisional nets. A local fishing company purchased the Territory's first large ocean sea cage (\$35,000) which was used in conjunction with inshore nets from the gear loan scheme.

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**PROJECT: Juvenile Snapper/Emperor Trawl and *Penaeus Monodon* Stake Net and Pot Survey**

**Project Period: 1998-1999**  
**Project Officers: E. Mulholland, R. Mounsey, J. MacCartie and A. Donati**  
**Project Location: Gove Peninsula**

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**Objective:**

- *To assess stock sizes and locations of juvenile snapper/emperor within the Gove Pensinsula area; and*
- *To survey the same areas from the point of view of *P.monodon* broodstocks supplies.*

**Background:**

Following a request from the Gumatj Aboriginal Association to assist them in surveying the adjacent inshore waters to establish locations of potential supplies of *P.monodon*, the decision was taken to concurrently survey the same areas for juvenile snapper/emperor.

**Method:**

The snapper/emperor survey is being undertaken using small trawl gear whilst the *P.monodon* broodstock survey was carried out using stake nets and prawn traps within the intertidal zone and within small creeks.

**Results:**

The first surveys were carried out between 15<sup>th</sup> February and 3<sup>rd</sup> March 1999 and the second from 10-21 July 1999. Although trip reports have been prepared, there is insufficient field data from which to draw any conclusions at this time.

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