# वार्षिक प्रतिवेदन
# ANNUAL REPORT
# 2010 - 2011

## केन्द्रीय कृषि अनुसंधान संस्थान

**पोर्ट ब्लेयर - ७४४ १०१, अंण्डमान और निकोबार द्वीप**

## Central Agricultural Research Institute

Port Blair – 744 101, Andaman & Nicobar Islands

भाकृअनुप
ICAR

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CENTRAL AGRICULTURAL RESEARCH INSTITUTE
CARI
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# Moment of the Year


# Moment of the Year


# ANNUAL REPORT 2010-2011

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# प्राक्कथन

प्रतिवेदन का यह वर्ष संस्थान के इतिहास में सबसे अनोखा रहा । संस्थान को सर्वोत्तम संस्थान पुरस्कार के साथ ही साथ तीन अन्य पुरस्कार (हिंदी में लिखी गई तकनीकी पुस्तक के लिए डॉ. राजेन्द्र प्रसाद पुरस्कार, कार्यालय में हिंदी के अधिकाधिक प्रयोग के लिए राजर्षि टंडन राजभाषा पुरस्कार व संस्थान द्वारा तकनीकी सहायता प्राप्त एक किसान को जनजीवन राम पुरस्कार) प्राप्त करने का गौरव मिला । यह सभी पुरस्कार संस्थान के प्रत्येक अधिकारी व कर्मचारी के अथक परिश्रम का ही परिणाम है । इस अवसर पर मैं 'कारी' परिवार के प्रत्येक सदस्य को बधाई देना चाहूँगा । इन पुरस्कारों के अतिरिक्त, संस्थान के वैज्ञानिकों को भी विभिन्न पुरस्कार व सम्मान प्राप्त हुए । इसी वर्ष मुझे भी राष्ट्रीय कृषि अकादमी का फैलो चुना गया । इस वर्ष संस्थान ने उभरती हुई समस्याओं पर विचार करते हुए उनके समाधानों को खोजा और नयी ऊचाईयों को छुआ । संस्थान के स्थापना दिवस पर ''द्वीपों में पशुधन व मुर्गी पालन'' पर एक विज्ञ मंडल सत्र का अयोजन किया गया तथा इसी सत्र कि अनुशंसाओं के आधार पर ''अंडमान निकोबार द्वीप समूह में पशुधन व मुर्गी उत्पादन एक वैज्ञानिक परिदृश्य'' नामक एक नीति पत्र भी प्रकाशित किया गया ।

संस्थान ने अंडमान सोसाइटी व अंडमान निकोबार प्रशासन के साथ मिलकर ''उष्णकटिबंधीय द्वीपीय परिस्थितिकी तंत्र जीविकोपार्जन, निरंतर विकास व जलवायु परिवर्तन से जुडे मुद्दे'' नामक विषय पर अंतर्राष्ट्रीय सम्मलेन का 23 से 26 मार्च 2011 तक आयोजन किया । यह आयोजन बेहद सफल रहा जिसमें देश विदेश से आये 250 से भी अधिक प्रतिनिधियों ने भाग लिया । इसी के आधार पर ''पोर्ट ब्लेयर डीक्लेरेसन'' जारी किया गया जिसकी सभी ने सराहना की । इसी की एक प्रति इस प्रतिवेदन में अनुबंध के रुप में दी गई है ।

परिषद ने सितंबर, 2010 में क्षेत्रीय समिति द्वितीय की २० वीं बैठक आयोजित करने की जिम्मेदारी कारी को सुपुर्द की । जिसने हमें हमारी उपलब्धियों के प्रदर्शन करने का अवसर दिया और मुझे यह कहते हुए अपार खुशी होती है की सभी प्रतिभागी हमारी उपलब्धियों से बेहद खुश थे । अपनी यात्रा के दौरान माननीय महानिदेशक, भारतीय कृषि अनुसंधान परिषद, डॉ. एस. अयप्पन ने मैरीन हिल कैम्पस स्थित हमारी नई मत्स्य जैव सूचना विज्ञान, इंस्ट्रुमेंटेशन और सूचना प्रयोगशाला का उदघाटन भी किया ।

भारतीय कृषि अनुसंधान परिषद ने दक्षिण में स्थित द्वीपों में हमारी गतिविधियों का प्रसार करने के लिए निकोबार जिले के कार निकोबार में एक कृषि विज्ञान केन्द्र की मंजूरी दी । कृषि विज्ञान केन्द्र की आधारशिला माननीय महानिदेशक, भारतीय कृषि अनुसंधान परिषद, डॉ. एस. अयप्पन द्वारा श्री विवेक रे, मुख्य सचिव, अ.व नि. प्रसाशन, श्री राजीव महर्षी, अतिरिक्त सचिव, डेयर व सचिव भा.कृ.अनु.प., डॉ. एच.पी.सिंह, उप महानिदेशक (बागानी), डॉ. के. डी. कोकाटे, उप महानिदेशक (प्रसार), डॉ. ए.के सिंह, जेड.पी.डी., जोन–II, श्री. रूपेश कुमार ठाकुर, उपायुक्त, निकोबार मंडल व श्री अबरडीन ब्लेयर, प्रमुख जनजातीय परिषद व अन्य गणमान्य व्यक्तियों की उपस्थिति में रखी गई ।



ये द्वीप समुह विशाल जैव विविधता के घर हैं और हमारा प्रयास राष्ट्रीय लाभ के लिए इनका जैव पूर्वेक्षण करने का है । इस वर्ष हमारे वैज्ञानिकों ने बैरन द्वीप का अन्वेषण किया, जो के देश का अकेला सक्रिय ज्वालामुखी है, और उन सूक्ष्म जीव का पता लगाया जो $27^0$C और 25 ppt की लवणता तक जीवित रह सकते है । ये संसाधन हमारी नमक और नमीं प्रतिरोधी सामग्री की खोज में बहुत ही उपयोगी होगा जिनका उपयोग भविष्य मे जलवायु परिवर्तन से उत्पन्न चुनौतियों का सामना करने के लिए के लिए किया जा सकता है ।

मैं माननीय डॉ. एस. अयप्पन, सचिव, कृषि अनुसंधान व शिक्षा विभाग एवं महानिदेशक, भारतीय कृषि अनुसंधान परिषद के प्रति आभार प्रकट करना चाहूँगा जिनके निरंतर मार्गदर्शन और प्रोत्साहन से ही हम उन्नति के पथ पर अग्रसर हुए है । माननीय डॉ. एच.पी.सिंह, उप महानिदेशक (बागानी) हमेशा से ही हमारे प्रेरणा स्रोत रहे है और ये सभी उपलब्धियां उनके कुशल नेतृत्व के कारण ही प्राप्त हो सकी है । मैं डॉ. एस.एस.मगर, डॉ. के.प्रधान, अनुसंधान सलाहकार समिति व समस्त समिति सदस्यों का भी आभारी हूँ जिन्होंने इस उपक्रम को पूरा करने में अपना भरपूर समर्थन दिया । मैं डॉ. उमेश श्रीवास्तव, सहायक महानिदेशक (बागानी–2) का भी आभारी हूँ जिनका सहयोग हमें निरंतर प्राप्त होता रहा ।

मैं श्री विवेक रे व श्री शक्ति सिन्हा, मुख्य सचिव, अ.व. नि. प्रसाशन तथा अ.व नि. प्रसाशन के सभी अधिकारियों व कर्मचारियों का धन्यवाद करना चाहूँगा जिन्होंने द्वीप किसानों की सेवा के हमारे प्रयास को निरंतर समर्थन दिया

मई, 2011
पोर्ट, ब्लेयर

रमेश चन्द्र श्रीवास्तव
निदेशक

# PREFACE

The report year has been an eventful year unparallel in the history of the Institute. The Institute was bestowed with best Institute award of ICAR alongwith three more awards namely Dr. Rajendra Prasad Award for Best Technical Hindi book, Rajarshi Tandon Rajbhasha Award for performance in use of Hindi in official use and Jagjivan Ram Award for a farmer technologically supported by the Institute. These awards are testimony of hard work and dedicated service put up by each and every member of the Institute. I take this opportunity to congratulate every member of CARI family on this unique achievement. In addition to these awards, several recognitions came to the scientists of the Institute starting with election of myself as Fellow of National Academy of Agricultural Sciences. The Institute continued its journey to explore new horizons through discussing the emerging problems. On our foundation day, a brainstorming session on "Livestock and Poultry production in Islands" was organized and based on deliberations a policy paper entitled 'Livestock and Poultry Production Policy for Andaman & Nicobar Islands – A Scientific Perspective' was prepared.

Institute in close collaboration with Andaman Science Society and A&N Administration organized an International Conference on Tropical Island Ecosystems: Issues related to Livelihood, Sustainable Development and Climate Change' from 23$^{rd}$ to 26$^{th}$ March 2011. It was a resounding success with a participation of more than 250 delegates. A resolution aptly named 'Port Blair Declaration' was adopted which has been widely appreciated. A copy of it is annexed in this report.

Council entrusted CARI to organize XX meeting of Regional Committee -II in September, 2010. It gave us an opportunity to showcase our achievements and its gives me immense pleasure to report that all participants were immensely happy with our achievements. During his visit, Hon'ble Director General, ICAR, Dr. S. Ayyappan inaugurated our new Fisheries Bio-Informatics, Instrumentation and Informatics Laboratory at Marine Hill Campus.

To spread our activities to Southern Group of Islands, ICAR sanctioned a KVK at Car Nicobar to serve Nicobar district. The foundation stone of the KVK was laid by Hon'ble Director General, Dr. S. Ayyappan, in presence of Shri Vivek Rae, Chief Secretary, A&N Administration, Shri Rajiv Mehrishi, Addl. Secretary, DARE and Secretary, ICAR, Dr. H.P. Singh, DDG (Hort.), Dr. K.D. Kokate, DDG (Extn.), Dr. A.K. Singh, ZPD, Zone-II, Shri Rupesh Kumar Thakur, Deputy Commissioner, Nicobar District and Shri Aberdeen Blair, Chief Tribal Council alongwith other dignitaries.

These islands are home to huge biodiversity and our efforts have been to bioprospect this for national benefit. This year our scientists explored Barren Island, the only active volcano of country and have found microbe which can survive upto 72$^0$C and 25 ppt salinity. This resource will be very useful in our quest for salt and heat resistant material to cope up future challenges arising out of climate change.



I express my sincere gratitude to Dr. S. Ayyappan, Secretary, DARE and DG, ICAR for his constant guidance and encouragement. Hon'ble Dr. H.P. Singh, DDG (Hort.) has been our source of inspiration and all the achievements have been possible only due to his able leadership. Dr. S.S. Magar & Dr. K. Pradhan, Chairmen and all the members of Research Advisory Committee for their unflinching support in our endeavors. I shall also thank Dr. Umesh Srivastava, ADG (Hort.II) for his support.

I will like to express my sincere thanks to Shri Vivek Rae and Shri Shakti Sinha, Chief Secretaries of and all officers and staff of A&N Administration who supported us in our effort to serve the island farmers.

**R.C. Srivastava**
Director

May, 2011
Port Blair

# अधिशासी सार
# EXECUTIVE SUMMARY

## प्राकृतिक संसाधन प्रबंधन
## Natural Resource Management

- मीठे पानी के तालाबों से प्राप्त कुल आय को रूपये 52,000 तक बढ़ाया जा सकता है। इसके लिये तालाब के पानी को किनारे की सिंचाई के साथ ही साथ, साथ वाले एक हेक्टेयर खेत की सिंचाई के लिए भी प्रयोग किया जाना चाहिए। खाड़ी वाले जल क्षेत्रों में बतख पालन वैकल्पिक रोजगार हो सकता है क्योंकि बतखें 15 पी.पी.टी. स्तर की लवणता को सहते हुए अपनी संवर्धनता को कायम रख सकती हैं।

  Net income from the fresh water pond can be enhanced to Rs. 52000 by utilizing the water for irrigation to one ha area of adjacent field instead of irrigating only to embankments. Ducks in brackish water areas can provide alternate livelihood as ducks can be productive up to 15 ppt level of salinity.

- सिंचाई की विभिन्न विधियों जैसे सतही, ड्रिप और माइक्रो स्पिरिंकलर सिंचाई तथा नियंत्रक जिनमें आई.डब्लू./सी.पी.ई. अनुपात 0.40, 0.60 और 0.80 का होता है उनमें 0.80 वाले आई.डब्लू./ सी.पी.ई. अनुपात की ड्रिप सिंचाई 0.60 के आई.डब्लू./सी.पी.ई. अनुपात वाले ड्रिप सिंचाई की तुलना में अन्नानास के अधिक उत्पादन के लिये सर्वोतम है।

  Among the irrigation methods (surface, drip and micro sprinkler irrigation) and regimes (IW/CPE ratio of 0.4, 0.60 and 0.80), drip irrigation at IW/CPE of 0.80 is found to be the best for higher yield of pine apple on par with IW/CPE of 0.6.

- भिंडी में कार्बनिक खेती के लिए वर्मीकम्पोस्ट के साथ आर.डी.एफ. की 75 प्रतिशत की दर से मुर्गी खाद के मिश्रण का प्रयोग सर्वोतम है।

  Application of vermicompost + poultry manure @75% of RDF was found to be the best combination for practicing organic farming in okra.

- कुल खनिज एन. (आरम्भिक + खनिजीकृत) आई.ओ. + वी.सी. में सबसे अधिक 209.2 किलोग्राम/ हेक्टेयर, उसके बाद इनक्यूबेशन अध्ययन के दौरान 100 प्रतिशत आर.डी.एफ. नियंत्रण के साथ वी.सी. + पी.एम., आई. ओ., वी.सी. में पाया गया।

  Total mineral N (initial + mineralized) was highest (209.2 kg/ha) in I.O+V.C followed by V.C+P.M, I.O, V.C and Control at 100 % RDF under incubation study.

- सिंचाई और पोषण प्रबन्धन के द्वारा सुपारी के चाली वजन और पैदावार में काफी बढ़ोतरी हुई जबकि प्रयोग के पहले वर्ष केवल पोषण प्रबन्धन के द्वारा फलों की संख्या में काफी बढ़त देखी गई।

  Irrigation and nutrient management in arecanut has significantly increased the chali weight and yield while nutrient management alone significantly increased the number of nuts during first year of experiment.

- पूरी फसल के दौरान दो सिंचाई पुआल से ढक कर 45 डी.ए.एस. पर करने पर खाने वाली मूंगफली की फलियों की पैदावार, कुल लाभ, बी.:सी. अनुपात, ऊर्जा और जल की उत्पादकता में काफी बढ़ोतरी हुई। 0.34 हेक्टेअर क्षेत्र के नारियल बागान में सूखे के मौसम के दौरान स्वयं बीजों का उत्पादन कर उनकी लागत में 72 प्रतिशत की कटौती कर और अधिक लाभ कमाया जा सकता है। बुआई और गंभीर स्थितियों व मिट्टी में नमी की कमी के दौरान सिंचाई का कार्यक्रम निर्धारित करते हुये 'क्रापवाट' और जड़ क्षेत्र की मिट्टी की नमी के समीकरण का प्रयोग किया जा सकता है।



Two irrigations at life and pegging with paddy straw mulch on 45 DAS in table purpose groundnut can be advocated for realizing higher pod yield, net returns, B:C ratio, energy and water productivity. Net returns from dry season can be further enhanced by self seed production in 0.34 ha area of coconut plantations during wet season which can reduce 72 % of seed cost. CROPWAT and root zone soil moisture equation can be used for time of sowing and scheduling of irrigation based on critical stages and soil moisture deficit.

- दालों व सब्जियों को ऊँचाई वाले क्षेत्रों में जहाँ कम से कम 2 से.मी. की समुचित जल निकासी हो बोना चाहिए जबकि मध्यम और निचले क्षेत्रों में किसी भी सूखे मौसम वाली फसल को बोने या रोपने के पहले 5 से 6 से.मी. जल निकासी को अवश्य विकसित कर लेना चाहिये।

  Pulses and vegetables are to be sown in upland areas with proper drainage to drain out the water quantity of at least 2 cm while in medium and lowland areas, sowing and planting of any dry season crops needs to be taken up after developing the drainage facility to drain out 5 to 6 cm of water.

- शिमला मिर्च में संरक्षित खेती के दौरान उत्पादन और जलीय क्षमता पर सिंचाई द्वारा पड़ने वाले एक अध्ययन के दौरान यह पाया गया कि अधिक उत्पादन, आय और जलीय उत्पादकता प्राप्त करने के लिये 0.75 आई. डब्लू./ सी.पी.ई. की ड्रिप सिंचाई सबसे अधिक उपयोगी है। हालांकि कम जल वाले क्षेत्रों में जलीय उत्पादकता को बढ़ाने के लिये 0.50 आई.डब्लू./ सी.पी.ई. की ड्रिप सिंचाई प्रयोग में लाई जा सकती है।

  Study on effect of irrigation regimes on yield and water use efficiency of capsicum under protected cultivation revealed that drip irrigation at IW/CPE of 0.75 is the optimum irrigation regime for getting higher yield, net return and water productivity. However, IW/CPE of 0.50 through drip irrigation can be recommended under water constraint conditions in order to have higher water productivity.

- चार तकनीकों – तालाब सह कुंआ प्रणाली, सूक्ष्म सिंचाई, तालाब आधारित समन्वित कृषि प्रणाली और चौड़ी क्यारी व नालिका प्रणाली के द्वारा फसल विविधता के प्रदर्शन चार द्वीपों – दक्षिणी अंडमान, नील, हैवलॉक और लिटिल अंडमान के 22 गांवों में 48 किसानों के खेतों में पूरे हो चुके हैं।

  Completed demonstrations of four technologies *viz.,* tank-well system, micro irrigation, pond based integrated farming system and crop diversification through broad bed and furrow system in 48 farmers field spread over 22 villages in 4 Islands (South Andaman, Neil, Havelock and Little Andaman islands).

- वर्षा के पूर्वानुमान की पुष्टि से पता चला है कि मानसून और मानसून के बाद 63.5 प्रतिशत के मामलों का मिलान हुआ जबकि मानसून के पहले मात्र 46.7 प्रतिशत ही मामलों का मिलान हो सका।

  Verification of forecasted rainfall indicated that monsoon and post monsoon season recorded 63.5% as matching cases while pre monsoon registered only 46.7% as matching cases.

## उद्यान विज्ञान व वानिकी
## Horticulture & Forestry

- *पारट्यूल्का ओलीरेशिया* और *सॉरोपस एन्ड्रोगाइनस* के मेथानाल एक्सट्रेक्ट में सबसे अधिक एंटीआक्सीडेन्ट सक्रियता क्रमशः 89.03 प्रतिशत और 85.63 प्रतिशत देखने को मिली।

  The methanol extracts of *Portulca oleracea* and *Sauropus androgynus* showed highest antioxidant activity 89.03% and 85.63%, respectively.

- पोषण विरोधी कारकों के विश्लेषण से यह पता चला है कि कोलोकेसिया एसक्यूलेन्टा की पत्तियों में सबसे अधिक 113.75 मि.ग्रा. /100 ग्रा. नाइट्रेट, इरेन्जियम फोटीडम में 41.4 मि.ग्रा./ 100 ग्रा. फाइटेट, एलटरनानथेरा फाइलोक्सीरॉयडस में 48.38 मि.ग्रा./ 100 ग्रा. आक्सलेट और कुकरबिटा मोसचेटा की पत्तियों में 386.0 मि. ग्रा./ 100 ग्रा. सैपोनिन पाया गया।

Analysis of anti-nutritional factors showed that nitrate was maximum in *Colocasia esculenta* leaves (113.75mg/100g), phytate in *Eryngium foetidum* (41.4mg/100g), oxalate in *Alternanthera phyloxeroids* (48.38mg/100g) and saponin in *Cucurbita moschata* leaves (386.0mg/100g).

- आर.ए.पी.डी. और आई.एस.एस.आर. मार्कर के सम्मिलित आंकड़ों का विश्लेषण करने पर पाया गया कि द्वीपों से इकट्ठी की गई मिर्च के पांच मुख्य समूहों में 54 से 84 प्रतिशत तक समानता है।

  The combined data analysis for both RAPD and ISSR markers showed five major clusters in chili collections from islands with similarity of 54 to 84 percent.

- उच्च क्षमता के द्रव्य क्रोमेटोग्राफी (एच.पी.एल.सी.) विश्लेषण से पाया गया है कि *हिबसकस सेबडारीफा* के अर्क में उच्च स्तर पर ल्यूटिन, जियाजेन्थिन, अल्फा कैरोटीन और इसके लाल फलों के अंश में बीटा कैरोटीन पाया गया।

  High Performance Liquid Chromatography (HPLC) analysis revealed that *Hibiscus sabdariffa* extracts showed peaks for lutein, zeaxanthin, α-carotene and β-carotene content in red fruit fractions.

- *इरीन्जियम फोटीडम कैरी धनिया* – 1 के एक जीनोटाइप को वृहत् चुनाव विधि द्वारा विकसित किया गया है। यह अधिक उत्पादन देने और प्रकाशरसायन गुणों से भरपूर है।

  One genotype of *Eryngium foetidum* CARI-Dhaniya-1 has been developed through mass selection method with high yield and phytochemical rich characters.

- 30 प्रकार के नारियलों की परख की गई जिनमें केवल 8 प्रकारों (14, 15, 16, 17, 20, 21, 27 और 28) को ही विशेषज्ञों ने अच्छा पाया शेष 22 प्रकार के नारियल स्वाद की दृष्टि से अच्छे नहीं थे।

  Out of 30 accessions of coconut tested, about 8 accessions (14, 15, 16, 17, 20, 21, 27 &28) were found to be good and remaining 22 accessions were poor in terms of taste score given by the expert.

- यह पाया गया कि ओपीएफ – 19, ओपीएफ – 13, ओपीएफ – 20, ओपीएच – 25 और ओपीपी – 15 जैसे आर.ए.पी.डी. प्राइमर्स के डब्लूसीजीसी के 30 जीनोटाइपस में पॉलीमारफिज्म पाया गया।

  It was found that the RAPD primers such as OPF-19, OPF-13, OPF-20, OPH-25 & OPP-15 have shown polymorphism across the 30 accessions of WCGC genotypes.

- आर.ए.पी.डी. प्राइमर्स का प्रयोग सुपारी के अणु गुणात्मकता के लिये किया गया और पाया गया कि कैरी सेल – 1 मंगला और समृद्धि के बीच का प्राकृतिक संकर है।

  The RAPD primers were used for molecular characterisation of arecanut and found that the CARI-Sel-1 is a natural cross between the Mangla and Samruddhi.

- ट्रेमा टोमेन्टोसा के नीचे चारा वृक्षों पर आधारित चारागाह प्रणाली में घासों की अधिकतम पैदावार 173.9 टन प्रति हैक्टेयर प्राप्त हुई और इन घासों में गिनी घास का रिकार्ड उत्पादन 224.0 टन प्रति हेक्टेयर हुआ।

  Fodder tree based silvipasture system under the *Treama tomentosa* highest yield of grasses were obtained (173.9 t $ha^{-1}$) and among the grasses Guinea grass recorded the highest yield of 224.0 t $ha^{-1}$.

- *डायस्कोरिया* प्रजाति, *एमारफोफेलस कारनोसस, एमारफोफेलस मुल्लेरी, एमारफोफेलस लांजीस्टाइलस* के लगभग 11 प्रकार के पौधे जिमीकंद यानी *एमारफोफेलस काम्पैनुलेटस* के चार प्रकार के पौधों की पहचान कर उन्हें संवर्धन के लिये इकट्ठा किया गया है।

  About 11 different accessions of *Dioscorea* sp, *Amorphophallus carnosus*, *Amorphophallus muelleri, Amorphophallus longistylus* and 4 cultivated types of elephant foot yam (*Amorphophallus companulatus*) have been identified and collected for multiplication.



- *मोरिंडा सिट्रीफोलिया* के चालीस 'इकोटाइपस' का उपज और इनके प्रकाशरसायन अवयवों के लिए मूल्यांकन किया गया और पाया गया कि एमसीबी 1, 3 एस 1 और 4 एस 1 प्रभावी इकोटाइप के रूप में पाए गए।

  Forty ecotypes of *Morinda citrifolia* were evaluated for yield and phytochemical contents and MCB 1, 3S1 and 4S1were found as promising ecotypes.

- उच्च क्षमता की द्रव्य क्रोमेटोग्राफी (एच.पी.एल.सी.) विश्लेषण से पाया गया है कि *मोरिंडा सिट्रीफोलिया* की अतिरिक्त प्रजाति टीआरए – 1 और टीआरए – 2 में एन्थोसाइनिन, कैरिटोनाइडस और फिनोलिक वर्गों के अलग जैवसक्रिय यौगिक होते हैं।

  High Performance Liquid Chromatography (HPLC) analysis revealed that *Morinda citrifolia* accessions TRA-I and TRA-II contains different bioactive compounds such as anthocyanin, carotenoids and phenolic groups.

- *मोरिंडा सिट्रीफोलिया* के फलों के गूदे में सबसे अधिक एन्टीआक्सीडेन्ट सक्रियता (74.39 प्रतिशत), पॉलीफिनॉल्स (250.66 मि.ग्रा./100 ग्रा.) और एसकॉबिक अम्ल (149.54 मि.ग्रा./ 100 ग्रा.) पाए गए जबकि इसके जड़ के सत्व में फलैवोनाइड और कैरोटिनाइड क्रमशः 321.42 मि.ग्रा./ 100 ग्रा. और 766.37 माइक्रोग्राम/ 100 मि.ली. पाए गए।

  The highest antioxidant activity (74.39%), polyphenols (250.66 mg/100g) and ascorbic acid (149.54 mg/100g) was observed in fruit pulp of *Morinda citrifolia* where as root extract was found to contain flavonoid and carotenoids (321.42 mg/100g; 766.37 µg/100ml).

- अंडमान द्वीपों के विभिन्न भागों से इकट्ठे किए गए करंज में बदमाश पहाड़ से एकत्र किए गए नमूनों में तेल की मात्रा सर्वाधिक 34.7 प्रतिशत पाई गई।

  Among the Karanja accessions collected from various parts of Andaman Islands, highest oil content of 34.7% was recorded from material of Badmaashpahad.

## क्षेत्रीय फसलें
## Field Crops

- धान की लम्बी अवधि की सुधरी हुई/ जीनोटाइप अस्सी प्रजातियों का मूल्यांकन करने पर पाया गया कि छः कल्चर – सीबी – 05 – 022, जगन्नाथ, एमटीयू – 1075, उर्बशी, रोलागालाकुल्लु और रामचंद, कैरी धान – 5 की तुलना में बेहतर पाए गए।

  Evaluation of eighty long duration rice improved lines/genotypes indicated that, six cultures viz CB-05-022, Jaganath, MTU-1075, Uurbashi, Rolagalakullu and Ramchand were found significantly better than the variety CARI Dhan 5.

- खेतों की प्राकृतिक अवस्था में रख कर प्रमुख कीटों और बीमारियों के प्रति प्रतिरोध क्षमता की परख करने के लिए लम्बी अवधि की उगाई जाने वाली उन्नत प्रजाति के धान की 80 प्रजातियों की जांच करने पर पता चला कि 13 जीनोटाइप, अमलमाना, सीबी – 05 – 156, सीएसआर – 4, डीआरआर – 1418, एमटीयू – 4870, सीएसआर – 36, एमटीयू – 1001, लूनीश्री, आईएम – 1536, डीआरआर – 1501, कैनिंग – 7, इन्द्रावती और रम्भा प्रजातियों में बहुउद्देशीय रोधक क्षमता है।

  Screening of 80 long duration rice cultivars/improved lines for resistance against major diseases and insect pests under natural field conditions showed that 13 genotypes, Amalmana, CB-05-156, CSR-4, DRR-1418, MTU-4870, CSR36, MTU-1001, Lunishree, IM 1536, DRR 1501, Canning-7, Indravati and Rambha showed resistance against multiple biotic stresses.

- धान की इकतालिस अगेती और मध्यम अगेती किस्मों के मूल्यांकन से पता चला कि 12 प्रजातियां चेक प्रजातियों की तुलना में बेहतर हैं।

Evaluation of forty one early and medium early duration rice lines showed 12 lines significantly better than the check variety.

- धान की 89 जीनोटाइप के 6 एआईसीआरपी परीक्षणों से पता चला कि 18 जीनोटाइप बेहतर हैं।

  Evaluation of 89 rice genotypes under six AICRP Trials of Rice showed 18 genotypes better.

- धान की तीन अन्तर्राष्ट्रीय परखों – अन्तर्राष्ट्रीय वर्षा पोषित धान उपज नर्सरी (पानी में डूबी हुई अवस्था), एरोबिक धान पर्यवेक्षण नर्सरी और अन्तर्राष्ट्रीय सिंचित धान पर्यवेक्षण नर्सरी – माडयूल – 2 के अन्तर्गत 81 प्रजातियों की परख से पता चला कि इनमें से छः प्रजातियां बेहतर हैं।

  Out of 81 rice lines tested under under three international rice trials viz. International Rainfed Lowland Rice Yield Nursery (Submergence Set), Aerobic Rice Observational Nursery and International Irrigated Rice Observational Nursery-Module-2, six lines performed better.

- रबी के दौरान हरे चने की सोलह और काले चने की 28 उन्नत प्रजातियों का मूल्यांकन किया गया और इनमें से हरे व काले चने की क्रमशः छः व सात अच्छी उपज देने वाली प्रजातियां पाई गई और उनका समुचित चुनाव किया गया।

  Sixteen improved lines of green gram and 28 lines of black gram were evaluated during *Rabi* season. Six and seven high yielding varieties respectively, of green gram and black gram have been identified and selected.

- छः फसलों के जिनमें धान के 214, हरे चने के 26, काले चने के 29, मटर के 2, लोबिया के 5 और तिल के 56, कुल 332 जीनोटाइप इकट्ठा कर उन्हें संरक्षित किया गया।

  A total of 332 genotypes of six crops viz. rice (214), green gram (26), black gram (29), pigeonpea (02) cowpea (05) and sesame (56) were collected/maintained.

- धान का 568 किलोग्राम, हरे चने का 12 किलोग्राम, काले चने का 8 किलोग्राम और तिल का 0.5 किलोग्राम ब्रीडर बीज पैदा किया गया। साथ ही धान की प्रजातियों का 29 किलोग्राम न्यूक्लियस बीज भी पैदा किया गया।

  Breeder seed of rice (568 kg), green gram (12 kg), black gram (8 kg) and sesame (0.5 kg) was produced. Besides, 29 kg nucleus seed of rice varieties was also produced.

- धान के पुआल पर उगाए गए मशरूम में *कैलोकाइबी इंडिका* में 30 से 40 प्रतिशत और *हिप्सजाइगस अल्मेरियस* में 40 से 50 प्रतिशत जैविक क्षमता पाई गई। मशरूम की ये दोनों ही प्रजातियां इन द्वीपों के लिये काफी उपयुक्त पाई गई हैं।

- In mushroom, *Calocybe indica* gave 30-40% biological efficiency and *Hipsyzygus ulmarius* gave 40-50% biological efficiency on paddy straw. Both these mushroom species were found to be very promising for cultivation in these Islands.

- पौधों में विपरीत वृद्धि को प्रोत्साहित करने और हाइड्रोलिटिक एंजाइम के गुणों के लिये कुल अलग किये गये 218 बैक्टीरिया और 22 ट्राइकोडरमा की जांच की गई। जांच के परिणामों से पता चला कि बहुत ही कम बैक्टीरियल स्ट्रेन्स में सम्मिलित गुण विद्यमान हैं। यह भी पाया गया कि अलग किए गए कुछ बैक्टीरिया सोडियम क्लोराइड (भार/ आयतन) के 30 प्रतिशत की लवणीयता को 80 डिग्री सेल्सियस तक सह सकते हैं। इन अलग किए गए बैक्टीरिया में अद्भुत गुण हैं और इन्हें आगे अध्ययन के लिये सुरक्षित रखा गया है।

  A total of 218 bacterial isolates and 22 *Trichoderma* isolates were screened for the antagonistic, plant growth promoting and hydrolytic enzymes properties. The results showed that very few bacterial strains have all the combined properties. It was also observed that few bacterial isolates could tolerate salinity upto 30% NaCl (w/v) and 80°C heat stress. The bacterial isolates having novel properties have been stored for further studies.



- उच्च उपज देने वाले विभिन्न प्रकार के रोग मुक्त नारियल के पेड़ों से कुल 5000 स्वस्थ नारियलों को इकट्ठा कर उन्हें गाराचरमा और सिप्पीघाट की फार्म नर्सरियों में लगाया गया। नारियल की ये अच्छी किस्म की पौध वितरण के लिये 3 से 4 महीनों के बीच तैयार हो जाएगी।

  A total of 5000 healthy nuts from disease free elite coconut palms of different high yielding cultivars were selected and sown in nurseries at the Garacharma and Sippighat farms. The elite coconut seedlings will be ready for distribution in 3-4 months.

- सब्जियों में कीटनाशक रसायनों के अवशेषों की परख के लिये छौलदारी, सीतापुर, रामनगर और हम्फ्रीगंज समेत दक्षिणी अंडमान के विभिन्न भागों से बैंगन, भिंडी, फूलगोभी, बंदगोभी और हरी मिर्च के नमूने इकट्ठे किए गए। इस स्थानों से इकट्ठे किए गए नमूनों में कीटनाशक रसायनों के अवशेष का स्तर मध्यम पाया गया जबकि मायाबंदर से इकट्ठे किए गए नमूनों में तनिक भी अवशेष नहीं पाया गया।

  Regarding pesticide residues in vegetables, the samples of brinjal, okra, cauliflower, cabbage and green chilly collected from different parts of South Andaman including Chouldari, Sitapur, Ramnagar and Humfrigunj showed moderate level of pesticide residue whereas samples collected from Mayabunder showed no residue at all.

- फलमक्खियों (*बैक्ट्रोसेरा कुकुरबिटी*) की जनसंख्या में अप्रैल (13.51/ ट्रैप/ सप्ताह) और दिसम्बर (16.94/ ट्रैप/ सप्ताह) के दौरान साल में दो बार बढ़ोतरी देखी गई है। अध्ययन से पता चला है कि साल भर फलमक्खियों की बहुतायत रहती है और इसलिये इनके समुचित प्रबन्धन की रणनीति तैयार करने की आवश्यकता है।

  Two peaks in fruit fly (*Bactrocera cucurbitae*) population were observed viz., April (13.51/trap/week) and December (16.94/trap/week). The study indicated that fruit flies were prevalent throughout the year and need proper management strategy accordingly.

- क्षेत्र सर्वेक्षण से पता चला है कि अंडमान में नारियल के बागानों में चूहों का प्रकोप 2.5 से 74.52 प्रतिशत होता है। नष्ट होने वाले फलों का अनुपात 4.16 से लेकर 6.25 प्रतिशत है। चूहों का औसत प्रकोप 26.09 प्रतिशत है। इनके प्रकोप से औसतन 5.10 प्रतिशत नारियल के फल नष्ट होते हैं।

  Field survey revealed that the rodent infestation in coconut ranged from 2.5 to 74.52% in Andaman. The nut damage ratio ranged from 4.16 to 6.25%. The average rodent infestation was 26.09% and average nut damage was 5.10%.

- चूहों की कुल 18 प्रजातियों की पहचान और रिपोर्टिंग हुई है। इनमें से 3 प्रजातियां – लिटिल इंडियन फील्ड माउस *(मुस बूदुगा),* एशियन हाउस रैट *(रैटस टैनीजूमी अंडमार्नेसिस)* और कच्छ रॉक रैट *(क्रिमनोमिस कचीकस)* को हाल ही में रिकार्ड किया गया है।

  A total of 18 rodent species were identified and reported. Out of these, 3 species [Little Indian field mouse *(Mus booduga),* Asian House Rat (*Rattus tanezumi andamanensis)* and Cutch rock-rat (*Cremnomys cutchicus*)] are newly recorded spp.

- दक्षिणी, मध्य और उत्तरी अंडमान के लगभग सभी क्षेत्रों में नारियल के पेड़ों में बड़े पैमाने पर राइनोसिरस बीटल यानी का प्रकोप देखा गया है। यह प्रकोप 0.5 से लेकर 41.32 प्रतिशत तक पाया गया है। राइनोसिरस बीटल की तुलना में स्केल कीड़े का प्रकोप कम रहा है। दक्षिणी अंडमान के मीठाखाड़ी स्थित अंडमान प्लांटेशन में स्केल कीड़े का प्रकोप 9.46 प्रतिशत आंका गया है।

  The high intensity of Rhinoceros beetle infestations in coconut palms was noticed all over the South, Middle and North Andaman. The pest incidence ranged from 0.5 to 41.32%. Infestation of the scale insect was low compared to Rhinoceros beetle. High intensity of scale insect was recorded in Andaman Plantations (Meethakhadi) of South Andaman (9.46%).

- लिटिल अंदमान के वी.के. पुर गांव में नारियल की बड रॉट बीमारी का बड़े पैमाने पर प्रकोप देखा गया है। यह प्रकोप 31.25 प्रतिशत तक है। हैवलॉक द्वीप के कृष्णा नगर में 9.6 प्रतिशत तक नारियल तना स्त्राव रोग से ग्रसित पेड़ पाए गए।

  High intensity of bud rot disease of coconut was found in V.K. Pur of Little Andaman (31.25%) and stem bleeding was found in Krishna Nagar of Havelock Island (9.6%).

## पशु विज्ञान
## Animal Science

- गहन प्रणाली के अर्न्तगत निकोबारी और वनराजा मुर्गियों की गुणवत्ता का तुलनात्मक अध्ययन किया गया और पाया गया कि ब्रूडिंग अवस्था के दौरान निकोबारी प्रजाति की भूरी, काली और सफेद सभी प्रजातियों की तुलना में वनराजा प्रजाति के शरीर का भार काफी अधिक ($p<0.05$) पाया गया। शून्य से 4 सप्ताह तक की उम्र में कुल एफसीआर वनराजा में सबसे अधिक उसके बाद काली निकोबारी, सफेद निकोबारी और भूरी निकोबारी प्रजातियों में पाया गया।

  Comparative performance of Nicobari and Vanaraja Fowls under intensive system showed a significantly ($p<0.05$) higher body weight of Vanaraja compared to all the varieties of Nicobari fowl viz. Brown, Black and White during brooding phase. The overall FCR from 0 day to 4$^{th}$ week of age was best in Vanaraja followed by Black Nicobari, White Nicobari and Brown Nicobari.

- वनराजा और निकोबारी मुर्गियों की तीनों प्रजातियों के बीच छः एफ–1 संकरण किए गए। प्रारम्भिक परिणामों से यह पता चला है कि 2, 3 और 4 सप्ताह आयु की सफेद निकोबारी X वनराजा क्रास के शरीर का भार अन्य क्रासों की तुलना में अधिक था।

  Among the six F-1 crosses of Vanaraja and three varieties of Nicobari fowls, the preliminary results showed higher body weight at 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ week of age in White Nicobari X Vanaraja cross than all the other crosses.

- रक्त के अवयर्यों के अध्ययन से पता चला है कि सफेद निकोबारी मुर्गियां सबसे अच्छी हैं। उसके बाद भूरे निकोबारी नर, काले निकोबारी नर, काली निकोबार मादा और वनराजा नर। अंडमान निकोबार की गर्म और नम जलवायु के लिये सफेद निकोबारी मादा अपने को बहुत कम समायोजित कर सकती है। सामान्य रूप से नर, मादाओं की तुलना में अधिक समायोजन कर सकते हैं।

  The study on blood parameters revealed White Nicobari fowl as the best followed by Brown Nicobari male, Black Nicobari male, Black Nicobari female and Vanaraja male. White Nicobari female was least adaptable under hot and humid climate of A&N Islands. In general males were found more adaptable than female.

- अलग किए गए सुअर के बच्चों को प्रतिदिन 80 पी.पी.एम. जस्ते की अतिरिक्त खुराक देने के बाद उनके शरीर के भार में बढ़ोतरी ($p<0.01$) देखी गई।

  Supplementation of 80 ppm Zinc per day per piglet resulted significant ($p<0.01$) increase in body weight of weaned piglets.

- दूध पिलाने वाली सुअरी के लिए उसके उच्च शरीर भार की वजह से 30 वर्ग फीट रहने के स्थान की तुलना में 60 वर्ग फीट वाला आवास बेहतर होता है।

  A floor space of 60 sq ft for a nursing sow was found better in terms of higher weaning body weight than 30 sq ft floor space.

- निकोबार में किये गये एक सर्वेक्षण से पता चला है कि निकोबारी सुअर ऊर्जा से भरपूर भोजन ग्रहण करते हैं जिनमें प्रोटीन की मात्रा कम होती है। इन सुअरों के भोजन की गुणवत्ता में सुधार लाने के लिए उनमें प्रोटीन और खनिजों को सम्मिलित करना आवश्यक है।



The survey study at Nicobar revealed that the Nicobari pigs are fed with energy rich feeds with low content of protein. In order to improve feed quality, protein and mineral need to be supplemented.

- दक्षिणी अंडमान के पशु आहार व चारे के नमूनों में जस्ते और तांबे के अवयव सामान्य स्तर से कम पाये गए हैं। इसलिये इन तत्वों को पशुओं के आहार में सम्मिलित करना आवश्यक है।

  In both feed and fodder samples of South Andaman, the Zn and Cu content were found below the critical level. Hence, supplementation through feed is suggested.

- बटेरों के आहार में गेहूँ, मक्का और धान की भूसी के स्थान पर 15 प्रतिशत तक *मोरेन्डा सिटरीफोलिया* के फलों को सम्मिलित करने पर यह देखा गया है कि जापानी बटेरों के शरीर के भार में बढ़ोतरी हुई है।

  Feeding of *Morinda citrifolia* fruit as feed ingredient up to 15% in quail ration replacing wheat, maize and rice bran showed higher body weight gain in Japanese quail.

- अंडमान और निकोबार द्वीपों के किसानों द्वारा अपने पशुओं के उत्पादन और उनके स्वास्थ्य को बनाए रखने के लिए जन प्रचलित पशु चिकित्सा और औषधीय पौधों को इकट्ठा कर उन्हें अभिपत्रित किया गया है।

  Information on ethno veterinary practices and medicinal plants used for the animal heath and production by the farmers of Andaman and Nicobar Islands have been collected and documented.

- अंडमान सागर तट और तलछट से कुल 142 एक्टीनोमाइसेस को अलग किया गया है। अलग किए गए एक्टोनोमाइसेस में 70 प्रतिशत *स्ट्रेपटोमाइसेस* प्रजाति और उसके बाद 20 प्रतिशत *माइक्रोमोनोस्पोरा* प्रजाति तथा 10 प्रतिशत *स्ट्रेपटोवरटीसीलियम* प्रजाति और *नोकारडिया* प्रजाति पाई गई।

  A total of 142 Actinomyces were isolated from the sediments and sea of Andaman coasts. Most of the isolates belongs to *Streptomyces sp* (70%) followed by *Micromonospora sp* (20%), *Streptoverticillium sp* and *Nocardia sp* (10%).

- 18वीं पशुधन गणना (2007) के माध्यमिक आंकड़ों के विश्लेषण से यह पता चला है कि किसानों में बड़े पशुओं की तुलना में छोटे पशुओं को पालने की प्रवृति बढ़ रही है।

  The increasing interest of farmers in small livestock farming as compared to large animal farming was inferred as per analysis of the secondary data of 18$^{th}$ livestock census, 2007.

- विभिन्न द्वीपों के लिये पशुओं की विभिन्न प्रजातियों के लिए चारे और आहार की आवश्यकता का आंकलन कर लिया गया है। 1.37 लाख टन/ वर्ष हरे चारे, 0.66 लाख टन/ वर्ष सूखे चारे और 1.23 लाख टन/ वर्ष सांद्र पशु आहार की आवश्यकता होगी।

  Island wise fodder and feed requirement for different livestock species was worked out. Requirement of green fodder was 1.37 lakh t/ annum while requirement of dry fodder was 0.66 lakh t/annum. Requirement of concentrates for livestock was only 1.23 lakh t/annum.

- मनुष्यों और पशुओं के लिये इन द्वीपों की वहन क्षमता का आंकलन किया गया। वर्ष 2011 में इन द्वीपों की वास्तविक मानव जनसंख्या 4.45 लाख है। 2007 में की गई 18वीं पशुधन गणना के आधार पर अंडमान और निकोबार द्वीपसमूह में 1.74 लाख पशु और 9.79 लाख मुर्गियाँ हैं। मनुष्य और पशुओं की आवश्यकताओं की पूर्ति के लिये उपलब्ध भूमि और दूसरे प्राकृतिक संसाधनों का प्रयोग बुद्धिमानी से करने की आवश्यकता है।

  Carrying capacity of islands with respect to human and livestock was estimated. The actual human population of these islands is about 4.45 lakhs in 2011. According to 18$^{th}$ livestock census 2007, Andaman Nicobar Islands have 1.74 lakh and 9.79 lakh livestock and poultry population respectively. Available land and other natural resources have to be utilized judiciously to cater the needs of human and livestock population.

- खेती योग्य भूमि की कमी के कारण धान की फसल लेने के पहले और बाद में चारा उगाने की सोच को सफलता मिली है। यह पाया गया है कि पशुओं के लिये चारे की आपूर्ति को बनाए रखने के लिये धान की फसल के पहले और बाद में चारे की फसलें सफलता पूर्वक उगाई जा सकती हैं।

  Concept of growing pre paddy and post paddy fodder was exercised successfully due to shortage of cultivable land and it was found that fodder crops can be taken as pre and post paddy crops successfully to augment the fodder supply to the livestock.

- संकर नस्ल की गायों की दूध देने की क्षमता दर्शाती हैं कि 351.17±43.36 दिनों तक ये 5.5±0.7 'वैट' औसत के साथ 1857.74±272.21 दूध दे सकती हैं। दूध का अधिकतम उत्पादन 27.17±4.33 दिनों में 8.88±0.95 लीटर तक पहुँच गया।

  Lactation performance of cross bred cows showed lactation length of 351.17±43.36 days with lactation yield of 1857.74±272.21 litre with a wet average of 5.5±0.7 litre. The peak yield of 8.88±0.95 litre reached at 27.17±4.33 days.

- औषधीय पौधा *मोरिन्डा सिटरीफोलिया* में एन्टीआक्सीडेन्ट गुण देखे गए हैं। इसके द्वारा बछड़ों और नवजात शिशुओं के रक्त में एसओडी और कैटालेस के स्तर में धीरे – धीरे बढ़ोतरी देखी गई है।

  Medicinal plant *Morinda citrifolia* showed antioxidant properties by gradually increasing the SOD and catalase levels in blood of calves and kids.

- बकरियों में नियोजित संवर्धन व शिशु पालन अवधि को कम करने के उद्देश्य से नियंत्रित संवर्धन तकनीक के अन्तर्गत अन्तर्योनि स्पन्जों का प्रयोग किया गया।

  Controlled breeding technology using intravaginal sponges found as the means of facilitating planned breeding and to reduce the kidding interval in goats.

- बकरों के संवर्धन या चिकित्सकीय परीक्षण के लिये वाटर बाथ आधारित अल्ट्रासोनोग्राफी बिना काट–छांट के, सहज व सरल विधि है।

  Ultrasonography using a water bath based approach resulted in a non-invasive, easy and simple method for breeding soundness or clinical examination of male goats.

- दुधारू पशुओं में बांझपन के कारणों में 35 प्रतिशत 'पोस्ट पारटम एनोस्ट्रम' यानी बच्चा देने के बाद गर्मी में न आना, 10.55 प्रतिशत पुनःसंवर्धन सिंड्रोम, 1.3 प्रतिशत 'पोस्ट प्यूबर्टल एनोस्ट्रम' यानी जवान होने के बाद गर्मी में न आने, 3.9 प्रतिशत सांड़ों में लिंग के पूरी तरह से विकसित न होने के कारण और 5.3 प्रतिशत जनन रोग जैसे एन्डोमैट्राइटिस और अंडाशय के सिस्ट हैं।

  The incidence of various causes of infertility among dairy cattle were 35% for post partum anoestrum, 10.55% for repeat breeding syndrome, 1.3% for post pubertal anoestrum, 3.9% for underdeveloped genitalia in heifers and 5.3% for reproductive disorders viz., endometritis and cystic ovary.

- खेती, आहार, स्वास्थ्य, संवर्धन में सीमित संसाधन तकनीक का प्रयोग और डेयरी सहकारी समिति के गठन के बलबूते पर दक्षिणी अंडमान के इंदिरा नगर गांव में दूध देनी वाली गायों की क्षमता में काफी बढ़ोतरी हुई है और यह गांव अब एक आधुनिक डेयरी गांव के रूप में जाना जाने लगा है।

  Constraint based technological interventions on farming, feeding, health, breeding practices and formation of dairy cooperative at Indira Nagar village of South Andaman improved the performance of dairy cows and resulted in establishing a model dairy village.

- निकोबारी सूअर पालन पद्धतियों का सर्वेक्षण किया गया और 25 निकोबारी सूअरों के रक्त के नमूने इकट्ठे किए गए।

  Survey on Nicobari pig farming practices was carried out and blood samples from 25 Nicobari pigs was collected.



- अंडमान जंगली सूअर के फीनोटाइपिक गुणों को अभिपत्रित किया गया और 11 माइक्रोसेटलाइट स्थानों में देशी सूअरों का माइक्रोसेटलाइट विश्लेषण किया गया।

  Phenotypic characterization of Andaman wild pig has been documented and microsatellite analysis of indigenous desi pig has been carried out for 11 microsatellite loci.

## मत्स्य विज्ञान

## Fisheries Science

- *क्लेरियस बेट्राकस (Clarias batrachus)* पर लवणीयता के प्रभाव से सम्बन्धित एक अध्ययन में यह पाया गया कि ग्लाइकोजन, एसकॉरबिक एसिड और एसीटल कोलीन एस्टिरेज जैसे जैविक निर्माता, क्षारीय फासफाटेज सक्रियता, एडीनोसीन ट्राईफासफाटेज और लेक्टेट डिहाइड्रोजिनेज 90 दिनों की कल्चर अवधि के बाद काफी कम हो गए।

  A study on the impact of salinity on *Clarias batrachus* indicated that glycogen, ascorbic acid and selected biomarkers like Acetyl choline esterase, Alkaline phosphatise activity, adenosine triphosphosphtase and Lactate dehydrogenase were significantly reduced in different tissues after the 90 days culture period.

- *हरे शैवालों (Cholrella marina)* की तुलना में *भूरे शैवाल (Nanochloropsis oculata)* रोटीफर्स के लिये अधिक उपयुक्त आहार हैं जो कि समुद्री सजावटी मछलियों का मुख्य जीवित आहार होता है। फिन मछलियों की हैचरी में यह पाया गया कि शैवालों का घनत्व रोटीफर्स और कोपेपॉडस के वान्छित घनत्व को बनाए रखने के लिये आवश्यक है।

  The brown algae, *Nanochloropsis oculata* was found to be a better feed than the green algae, *Chlorella marina* to the rotifers, which constitute the major live feed of marine ornamental fishes. The algal density required for maintaining the desired density of rotifers and copepods in the finfish hatchery was determined.

- दक्षिणी अंडमान में गोबरा मछलियों यानी ग्रूपर्स और स्नैपर्स के दोहन का व्यवस्थित विश्लेषण करने के बाद पाया गया कि औसतन वार्षिक प्रति इकाई प्रयास (CPUE) 130 किलोग्राम/बोट था। सितम्बर 2010 के दौरान अधिकतम वार्षिक प्रति इकाई प्रयास (CPUE) 186 किलोग्राम/ बोट था।

  A systematic analysis of landings of groupers and snappers in South Andaman revealed that the average annual catch per unit effort (CPUE) was 130 kg/boat, with maximum CPUE (186 kg/boat) being recorded in September, 2010.

- निकोबार द्वीपसमूह में कृषि हानि से सम्बन्धित एक अध्ययन से पता चला है कि इन द्वीपों की मिट्टी सामान्यतः मध्यम है और इसमें नाइट्रोजन की उपलब्धता 4.47 से लेकर 7.19 किलोग्राम प्रति हेक्टेयर है और पोटेशियम कम मात्रा में 115 से 194 किलोग्राम प्रति हेक्टेयर उपलब्ध है। पता चलता है कि जलवायु परिवर्तन से अधिक वर्षा हुई या फिर समुद्र के पानी के चढ़ने से भूमि का कटाव हुआ। समुद्र के किनारे की भूमि में नमक की वजह से खारापन बढ़ा और इस प्रकार यहाँ की मिट्टी खेती के लिये अनुपयुक्त हो गई।

  The study on the agricultural vulnerability of Nicobar group of islands showed that the soils in these islands are generally medium in available N (4.47-7.19 kg/ha) and low in available K (115-194 kg/ha), which imply that climate change-induced increase in rain fall or seawater ingression would lead to soil erosion, leaching of salts and salination of coastal lands thus rendering the soils unproductive for agriculture.

- मत्स्य उत्पादक क्षेत्रों की जानकारी (PFZ advisories) के द्वारा मछली पकड़ने और मत्स्य संसाधनों के समुचित दोहन हेतु बहुत ही उपयोगी सिद्ध हुई है। अंडमान निकोबार द्वीपसमूह की मछली पकड़ने वाली नौकाओं के वार्षिक प्रति इकाई प्रयासं (CPUE) में 34 प्रतिशत की वृद्धि हुई है। विभिन्न प्रकार की मछली पकड़ने वाली नौकाओं के जरिये वैधता को सिद्ध करने के लिए किए गए प्रयोगों से पता चला है कि गिलनेटर, ट्रालर और

लॉग लाइनर के जरिये पकड़ी गई मछलियों में कुल बढ़ोतरी क्रमशः 37±1-8 प्रतिशत, 34±1-24 प्रतिशत और 30±1-36 प्रतिशत रही।

PFZ advisories have proved to be a potent tool in harvesting the under-exploited fishery resources with a significant increase (34%) in CPUE of fishing vessels in the A&N Islands. Validation experiments employing different vessels viz., gillnetters, trawlers and long liners showed an average increase in total catch of 37±1.8%, 34±1.24% and 30±1.36% respectively.

- अंडमान के विभिन्न द्वीपों में प्रवालों के स्वास्थ्य के आकलन के लिए समय – समय पर किए गए सर्वेक्षणों से पता चला है कि मई 2010 के दौरान प्रवाल भित्तियां समुद्र की सतह के तापक्रम के बढ़ जाने के कारण 70 प्रतिशत तक बड़े पैमाने पर ब्लीचिंग की शिकार हुई थीं। ब्लीचिंग से प्रभावित प्रवाल भित्तियां अब पूरी तरह से स्वस्थ हो गई हैं। प्रवाल बड़े पैमाने पर ठीक हो रहे हैं जबकि *एक्रोपोरा* प्रजाति के शाखायुक्त प्रवाल मर चुके हैं।

  Periodic surveys conducted to assess the reef health across different islands in Andaman indicated that the reefs suffered extensive bleaching (upto 70%) during May 2010 due to elevation of sea surface temperature. The bleached reef associates have fully recovered, massive corals are recovering while all the affected branching corals (*Acropora* sp) have died.

- कुल 51 समुद्री स्पंजों का संकलन किया गया जिनमें से 27 का पारम्परिक रूप से वर्गीकरण किया गया। 8 प्रकार के स्पंजों – *माइकेले* प्रजाति *(Mycale sp.), सेमोचेल्ला* प्रजाति *(Psamochella sp.), सूडोसिराटिना परपुरिया (Pseudoceratina purpurea), गैलियोडस फेबुलेटस (Galliodes fibulatus), एक्सीनेला एकेन्थीलोइडस (Axinella acanthelloides), स्टालिस्सा कारटेरी (Stylissa carteri), लोटरोचोटा बैकुलीफेरा (Lotrochota baculifera) और लैमिलोडिसेडिया हरबेसिया (Lamellodysidea herbacea)* में रह रहे जीवाणुओं के विरूद्ध उनकी प्रतिरोधक शक्ति व इसके विपरीत जीवाणुओं की स्पंजों के विरूद्ध उनकी प्रतिरोधक शक्ति का आकलन किया गया। अध्ययन से ज्ञात हुआ कि केवल *सूडोसिराटिना परपुरिया (Pseudoceratina purpurea)* में जैवसक्रियता आश्रयदाता स्पंज की चयापचयी क्रियाओं के कारण थीं जबकि दूसरी सभी प्रजातियों में आश्रयदाता स्पंज की तुलना में उनसे सम्बन्धित बैक्टीरिया कहीं ज्यादा जैवसक्रिय थे।

  Altogether 51 marine sponges were collected of which 27 have been described through conventional taxonomy. Antimicrobial assay of host vis-à-vis the associated bacteria was carried out for eight sponges viz., *Mycale* sp., *Psamochella* sp., *Pseudoceratina purpurea, Gelliodes fibulatus, Axinella acanthelloides, Stylissa carteri, Iotrochota baculifera and Lamellodysidea herbacea*. The study revealed that only in case of *Pseudoceratina purpurea,* the bioactivity was predominantly due to host metabolites, while in all others the associated bacteria displayed higher inhibitory bioactivity than their hosts.

## सामाजिक विज्ञान

## Social Science

- सब्जियों की खेती की लागत का विश्लेषण करने पर पता चला कि कुल लागत का 80 प्रतिशत मजदूरी में खर्च होता है। लोबिया सबसे अधिक लाभ देनी वाली सब्जी की फसल है और इसके बाद फ्रेन्च बीन यानी ग्वार फली आती है। सब्जियों के विपणन का विश्लेषण करने पर ज्ञात हुआ कि विपणन लागत उपभोक्ता मूल्य का 32.8 से लेकर 47.7 प्रतिशत तक है।

  Analysis of cost of cultivation of vegetables showed that labour cost constituted up to 80 percent of total working cost. Cowpea was the most profitable vegetable crop followed by French bean. Analysis of vegetable marketing showed that marketing cost ranged from 32.8 to 47.7 percent of consumer's price.

- मैंग्रोव के सामाजिक–आर्थिक अध्ययन से पता चला है कि लाभार्थियों को इससे प्रत्यक्ष लाभ के स्थान पर कहीं अधिक अप्रत्यक्ष लाभ जैसे सामाजिक आर्थिक विकास, पर्यावरण सुधार व पर्यावरण संरक्षण प्राप्त होता है।



अंडमान निकोबार द्वीपसमूह में प्रतिवादियों द्वारा मैंग्रोव संरक्षण की आवश्यकता को महसूस किया जा रहा है।

Socio economic study of mangroves indicated that beneficiaries drew more indirect benefits than direct benefits in terms of socio- economic development, eco- restoration and environmental protection. An urgent need to protect the mangroves in A & N islands was felt by the respondents.

- अंडमान निकोबार द्वीपसमूह में मछलियों का विपणन मुख्यतः महिलाओं द्वारा किया जाता है। यहाँ के मछुवारे मुख्य रूप से पश्चिमी बंगाल, आन्ध्र प्रदेश और तमिलनाडु से आकर बसे हैं। इनमें से अधिकांश निम्न आय वर्ग में आते हैं। पोर्ट ब्लेयर के बाजार में मछलियों की विभिन्न प्रजातियों की कीमत 50 रुपये प्रति किलोग्राम से लेकर 240 रुपये प्रति किलोग्राम तक होती है। झींगा, सुरमई, कोकारी और कुणाल जैसी मछलियों की अधिक कीमत होती है जबकि शंकर, टोपी, थिलापिया और बांगणी इत्यादि मछलियां कम कीमत में बेची जाती हैं।

  Fish marketing in A & N islands is practiced mainly by women. The fishermen have been migrated mainly from WB, AP and TN and majority of them were found to be belonging to low income group. The prices of different fish species varied from Rs.240 to below Rs 50 per kg in Port Blair market. Fishes like P*rawn, Surmai, Kokari and Koral* received higher price whereas fishes like *Shankar,Ttopi, Tilapia and Bangdi* etc. were sold at cheaper rates.

- महिला स्वयं सहायता समूहों द्वारा जीविकोपार्जन के लिये बकरी पालन को प्राथमिकता दी जाती है। इसके पश्चात सब्जियों की खेती, फूलों की खेती, मुर्गी पालन, सुअर पालन, हस्त शिल्प और मशरूम की खेती आती है।

  Livelihood options preferred by the women SHGs were the goat farming followed by vegetable cultivation, floriculture, poultry farming, piggery, handicraft and mushroom cultivation.

- धान की उपज की भविष्यवाणी के लिये एएनएन मॉडल विकसित किया गया है। इस प्रकार की भविष्यवाणी में प्रयोग वर्ष के दौरान धान की सभी किस्मों की पैदावार का पता किया जाता है।

  Developed ANN model for rice yield forecasting. The forecast outputs trace the actual production very well for all levels of rice yields in those years which were used in the experiment.

- नारियल, सुपारी के लिये आंकड़ों के आधार को विकसित कर सूचना प्रणाली तैयार की गई है और अंडमान निकोबार द्वीपसमूह में आम के लिये ईएसटी सिक्वेंस सूचना प्रणाली विकसित की गई है।

  Data base developed for Coconut, Arecanut information system and Mango EST Sequence information system of Andaman & Nicobar Islands.

- कैम्पबेल बे के आधार रेखा सर्वेक्षण से पता चला है कि सुनामी के बाद कृषि योग्य 979.2 हेक्टेयर भूमि में से केवल 613.1 हेक्टेयर भूमि शेष बची है। इस समय केवल 35.7 हेक्टेयर भूमि खेती की फसलों के अन्तर्गत है और 211.2 हेक्टेयर भूमि पर बागानी फसलें हैं। शेष भूमि खाली पड़ी है। परिवारों की मासिक आय रु0 16060 है जिनमें से कृषि से होने वाली आय केवल रु0 4744 है। कैम्पबेल के किसानों की पशुधन से होने वाली आय बहुत ही कम है। प्रति परिवार केवल रु0 15841 कीमत के पशु रखे गए हैं। प्रति परिवार मासिक उपभोक्ता व्यय रु0 3961 है जिनमें से अधिकांश भुगतान दूध व सब्जियों के लिए किया जाता है।

  Base line survey of Campbell Bay showed that out of 979.2 ha, only 613.1 ha have been left after Tsunami which is suitable for agriculture. At present, only 35.7 ha were under field crops and 211.2 ha were under plantation crops. Rests were lying unattended. The monthly income of the families was Rs 16060 out of which income from agriculture was Rs 4744 only. Livestock economy of the Campbell Bay farmers was very weak. Animals worth Rs 15841 only were kept per family. The per family consumption expenditure per month was Rs 3961 out of which maximum payments were made towards milk consumption followed by vegetables.

- डिगलीपुर में नाबार्ड (NABARD) के सहयोग से संस्थान का एक बाह्य केन्द्र स्थापित किया गया है। इसके द्वारा आवश्यकता पर आधारित टेक्नोलोजी का कृषि व अन्य कार्यों में प्रयोग करने के उद्देश्य से 27 प्रशिक्षण,

किसानों के खेतों में खरीफ के दौरान 53 और रबी में 63 तकनीकी प्रत्यक्षण प्रदान किए गए। इसके अतिरिक्त शीघ्र खराब होने वाली वस्तुओं के विपणन व्यवहार का भी अध्ययन किया गया।

The Out Reach Centre of the Institute supported by NABARD established at Diglipur has taken up need based technological intervention in the field of agriculture and allied by organizing 27 trainings, 53 technological demonstration in Kharif and 63 in Rabi season in the farmers' field. Beside marketing behaviour of perishable commodities was studied.

## कृषि विज्ञान केन्द्र, दक्षिणी अंडमान

## Krishi Vigyan Kendra, South Andaman

- कृषि विज्ञान केन्द्र की ओर से किसानों के खेतों पर 53 प्रशिक्षण कार्यक्रम, 13 एफएलडी और 7 ओएफटी चलाए गए जिससे कि कृषि और दूसरे कार्यों के लिये चुनी गई टेक्नोलोजी का मूल्यांकन व सुधार हो सके। इसके अलावा दक्षिणी अंडमान के किसानों के बीच टेक्नोलोजी को लोकप्रिय बनाने के उद्देश्य से कई विस्तार गतिविधियां आयोजित की गई।

  KVK has conducted fifty three training programe, thirteen FLD and seven OFT at farmers field to assess and refine the selected technology in agriculture and allied field. Besides numerous extension activities has undertaken to popularize the technology among the stakeholders of South Andaman.

## कृषि विज्ञान केन्द्र, निकोबार

## Krishi Vigyan Kendra, Nicobar

- 13 सितम्बर 2010 को कृषि विज्ञान केंद्र, निकोबार का उद्घाटन हुआ। इस केंद्र की ओर से जानकारी प्राप्ति के लिये भ्रमण, किसान मेले में प्रतिभागिता और सम्बन्धित क्षेत्र में इसके उद्देश्यों को प्रदर्शित करने के ध्येय से कई विस्तार गतिविधियां आयोजित की गई।

  Krishi Vigyan Kendra, Nicobar got inaugurated on 13th September, 2010. It has performed numerous activities like exposure visit, participation in Kisan Mela and other extension activities to showcase its aims and objectives in the mandated area.

# INTRODUCTION

## ORGANIZATION

Realizing the importance of island agriculture to meet the requirement of local population and tourists, Indian Council of Agricultural Research (ICAR) established Central Agricultural Research Institute, Port Blair on June 23rd, 1978 by merging different regional research stations of ICAR institutes located in islands. The ultimate aim of CARI is the developments of island agricultural production technologies which utilizes the strengths of the island and convert the constraints in opportunities, without causing any ill effect to its fragile ecosystem.

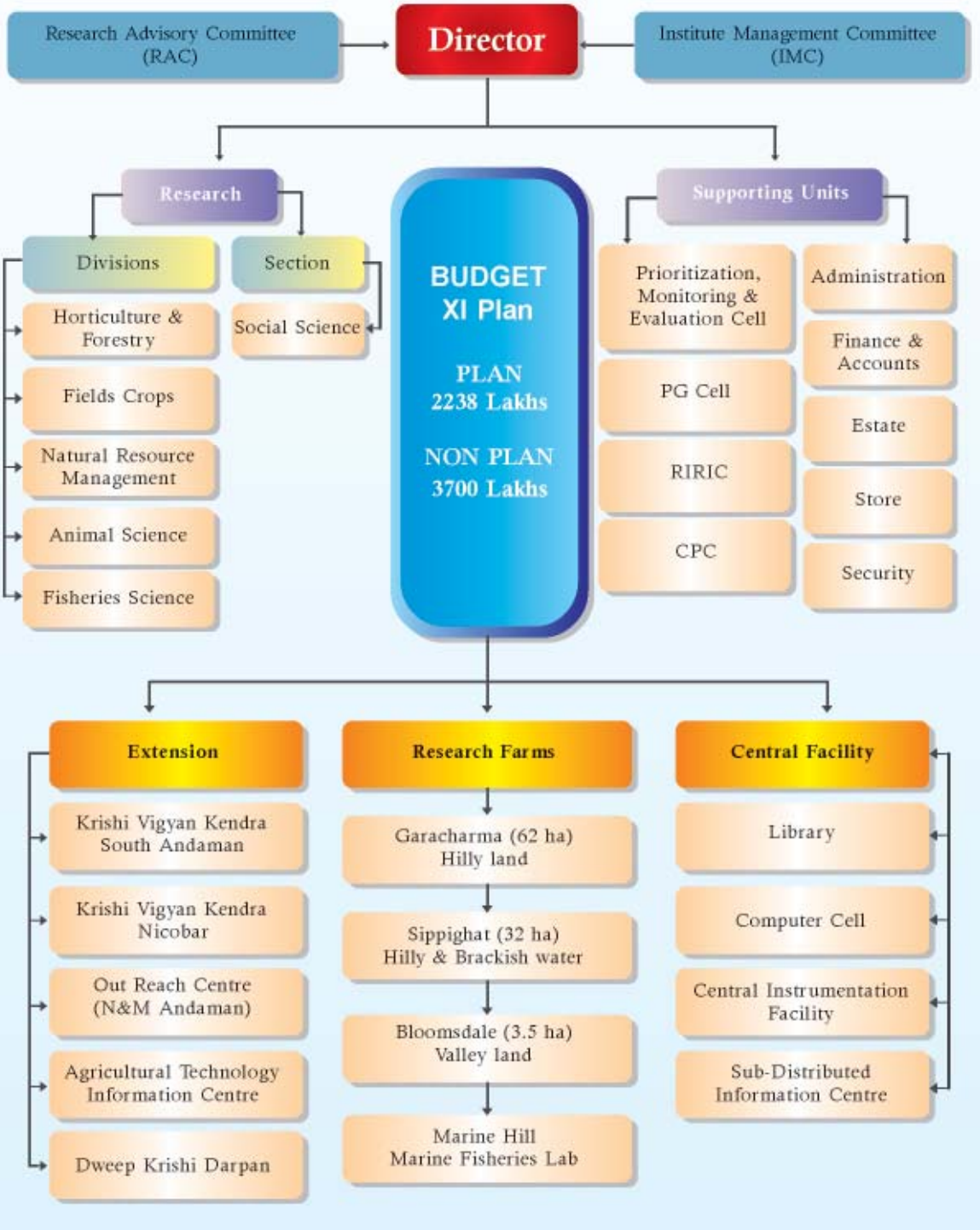
## MANDATE

- ✓ To provide a research base to improve the productivity of important agri-horticulture, livestock and fisheries of A & N Islands through adaptive and basic research for attaining economic self-sufficiency.
- ✓ To develop appropriate plans for conservation of natural resources and their sustainable use.
- ✓ To standardize technologies for animal health coverage and livestock production.
- ✓ To standardize techniques for capture and culture fisheries including coastal aquaculture.
- ✓ First line transfer of technology and training to the relevant State Departments.

## ORGANISATIONAL SET UP

Administration of the institute rests with the Director, who receives support from both research divisions and administration. The Research Advisory Committee (RAC), Institute Management Committee (IMC) and Institute Research Council (IRC) reviews and monitor the research programmes and facilitates to identify new research thrust areas for the Institute. To accomplish the mandate, the research activities are organized under five divisions namely, Natural Resource Management, Horticulture & Forestry, Field Crops, Fisheries Science, Animal Science and one section i.e. Social Science.

# ORGANOGRAM


Research Advisory Committee (RAC)
Director
Institute Management Committee (IMC)
Research
Divisions
Horticulture & Forestry
Fields Crops
Natural Resource Management
Animal Science
Fisheries Science
Section
Social Science
BUDGET XI Plan
PLAN 2238 Lakhs
NON PLAN 3700 Lakhs
Supporting Units
Prioritization, Monitoring & Evaluation Cell
PG Cell
RIRIC
CPC
Administration
Finance & Accounts
Estate
Store
Security
Extension
Krishi Vigyan Kendra South Andaman
Krishi Vigyan Kendra Nicobar
Out Reach Centre (N&M Andaman)
Agricultural Technology Information Centre
Dweep Krishi Darpan
Research Farms
Garacharma (62 ha) Hilly land
Sippighat (32 ha) Hilly & Brackish water
Bloomsdale (3.5 ha) Valley land
Marine Hill Marine Fisheries Lab
Central Facility
Library
Computer Cell
Central Instrumentation Facility
Sub-Distributed Information Centre

## VISION

- ✓ As the island level food security is not achievable, Panchayat level food requirement should be estimated and food production planning should be tailored to provide local level food security with town area being served by food import from mainland.
- ✓ Reorientation of agricultural production system to provide local level food security and to meet the demand of perishable products, viz. milk, egg, meat, fish, fruits, vegetables and flowers with specific reference to demand of booming tourism industry.
- ✓ Making the isolation as our strength, conversion of spices cultivation in an organic farming with a decoratively packaged Andaman brand organic spices being marketed.
- ✓ Development of suitable production to consumption level chain involving SHGs and retailers/ armed forces / processors.
- ✓ Biodiversity richness of the island should be preserved and exploited for national benefit.
- ✓ Proper rain water management technology to create micro level water resources to increase irrigated area from present 1% to a significant level.
- ✓ Making CARI a model for NARS of other small island nations.

## THRUST AREAS FOR XI PLAN

- ✓ Conservation and management of natural resources.
- ✓ Intensification and diversification of the rice based integrated cropping system by including vegetables, pulses and oilseeds through land modification, moisture conservation and supplementary irrigation.
- ✓ Development of technology for water resource development through rain water management and its efficient utilization for diverse cropping system.
- ✓ Production technology for vegetable crops for increasing productivity.
- ✓ Improving the varietal productivity of plantation and horticultural crop based systems through intercropping of spices, vegetables, fodder etc. as well as irrigation from rain water harvesting system.
- ✓ Development of fish-poultry-crop farming system for fresh and brackish water.
- ✓ Improving the productivity of cattle, goat, pig, poultry and aquaculture by cross breeding, health care and nutrition.
- ✓ Frontier research for knowledge and increased productivity.
- ✓ Undertaking basic / strategic research for generating knowledge of applied significance.
- ✓ High value agriculture with special reference to vegetables and protected cultivation of high value crops.
- ✓ Minimizing post harvest losses and maximizing value through appropriate technological intervention.
- ✓ Integrated management of existing insect, weeds and abiotic stresses with special reference to salinity.
- ✓ Production technology for inputs and their optimal utilization in organic farming.
- ✓ Transfer of technology and socio-economic impact analysis.
- ✓ Identification of appropriate technological options for rehabilitation of tsunami affected farming community.

## NEW RESEARCH INITIATIVES

- ✓ Assessment of impact of climate change on island ecosystem with special reference to Nicobar group of islands.
- ✓ Estimation of carrying capacity of islands under constraints of limited cultivable land resources and fragile ecology.



- ✓ Design of irrigation systems for various farming and topographic situations along with nutrient and water schedule for fruit and vegetables.
- ✓ Pulses & oilseed breeding programme.
- ✓ Evaluation of existing long duration paddy varieties (160-170 days) as well as breeding program for new strains to take advantage of long rainy season and adding fodder component in pre and post paddy period to enhance the cropping intensity to 300% under rainfed conditions.
- ✓ Micro propagation of orchids, ferns and medicinal plants.
- ✓ Protected cultivation for high value crops and their value addition.
- ✓ Production technology including IPM & varietal evaluation of beans, okra, brinjal & tomato.
- ✓ Cage culture of groupers and sea bass in creeks and bays to enhance livelihood options.
- ✓ Low cost and alternate feed for poultry.
- ✓ Characterization and management of natural resources.
- ✓ Improving capture fisheries output per unit effort and mariculture.
- ✓ Adaptation of crop-livestock-fish farming system for fresh & brackish water bodies.
- ✓ Management of emerging pests and diseases.
- ✓ Post harvest technologies and high value agriculture.
- ✓ Organic farming inclusive of production technology for inputs.
- ✓ Transfer of technology and socio-economic impact analysis.

## STAFF POSITION

| Sl. No. | Category | Sanctioned | Filled |
|---|---|---|---|
| 1. | Scientific | 56+1 | 37+1 |
| 2. | Technical | 43 | 40 |
| 3. | Administrative | 25 | 27* |
| 4. | Supporting | 78 | 64 |

* Excess post of Junior Steno due to restructuring of cadre strength of administrative staff.

## BUDGET UTILIZATION DURING 2010-2011

| Head of Account | Plan (In Lakhs) | | Non-Plan (In Lakhs) | |
|---|---|---|---|---|
| Particulars | RE 2010-11 | Expt. 2010-11 | RE 2010-11 | Expt. 2010-11 |
| Establishment Charges | -- | -- | 935.00 | 934.62 |
| Travelling Allowances | 16.00 | 15.99 | 14.26 | 14.23 |
| Other charges | 145.00 | 144.98 | 80.00 | 79.94 |
| Equipment | 123.00 | 122.90 | —- | —- |
| Library (Books) | 15.00 | 15.08 | 14.74 | 14.73 |
| Works | 128.00 | 128.00 | 36.00 | 35.99 |
| HRD | 3.00 | 3.00 | —- | —- |
| **Total** | **430.00** | **429.95** | **1080.00** | **1079.51** |


# RESEARCH Programmes

# Division of Natural Resource Management

# Development of Fresh and Brackish Water Based Integrated Farming System (IFS) in Bay Islands

*R.C. Srivastava, N. Ravisankar, Shrawan Singh, Abhay Kumar Singh, Subhash Chand and Grinson George*

Experiments on fresh water based integrated farming system was continued during the year with an objective to identify, characterize and optimize the crop, animal, poultry and fish components for fresh and brackish water based farming system.

## Evaluation of crops

Okra was evaluated during the dry season using the water from the pond for estimation of yield, economics and water productivity. On an average, gross return of Rs 5580/ha was registered only from two harvests with water productivity of Rs 4.83/$m^3$ (Table 1). A gross return of Rs 72,720/ha has been recorded with French bean cultivated in the adjacent fields of pond using the pond water against the return of only Rs 1460/- from the crops grown in the embankment only. The water productivity can also be increased to Rs 22.60/$m^3$ in place of only Rs 7.3/$m^3$ from embankment irrigation mainly due to higher productivity crops in the main field.

**Table 1. Comparison of water productivity of pond used for cultivation of crops in embankment alone and adjacent fields**

| Parameters | Vegetables in embankment only (Mean of 2 years) | French bean (dry season, 2010) | Okra (only 2 harvests till date) |
|---|---|---|---|
| Yield (kg/ha) | 121 | 6060 | 279 |
| Gross returns (Rs/ha) | 1460 | 72720 | 5580 |
| Water applied ($m^3$) | 200 | 2330 | 1153(5 irrigations) |
| Water productivity (kg/$m^3$) | 0.61 | 2.60 | 0.24 |
| Water productivity (Rs/$m^3$) | 7.30 | 22.60 | 4.83 |

## Growth performance of freshwater fish

An experiment of fish culture was also carried out in the fresh water pond at Garacharma farm. In the pond area of 0.15 ha, 200 fingerlings were released at a ratio of density of Catla : Mrigal : Rohu : Silver carp : Grass carp @ 30:30:20:10:10. The waste materials from the integration of duckery and related activities formed the food for the fish. No supplementary feed was given. The intention of the study was to utilize the water column available to generate some income for the farmers without disturbing the productivity of the pond water for irrigation. The stock was maintained for two years as the pond water column was deep during the summer months also making the harvesting difficult. In second year, 34 kg of fish were harvested towards the end of summer months in May. Survival of Catla and Rohu was good compared to Silver carp and Grass carp which have grown well in size but with less survival. It can be concluded from the various experiments that the net income from the fresh water pond can be enhanced to Rs 52000/ha by utilizing the water for irrigation to adjacent fields. Ducks can provide alternate livelihood for brackish water areas as ducks can survive up to 15 ppt level of salinity.



# Planning, Augmentation and Efficient Utilization of Water Resources in Kaju Nalha Watershed

*S.K. Ambast, R.C. Srivastava, T. Subramani, B.L. Meena, S. Chand, M. Sankaran and Shrawan Singh*

In order to efficient utilization of developed water resources, pressure compensatory drippers in arecanut, coconut and *Morinda citrifolia* plantations, micro-sprinkler in vegetable blocks and inline dripper and micro-sprinkler in pineapple block was installed in 9.1 ha area of Kajunallah watershed. Further, performance of pineapple and okra with different irrigation regimes through micro-irrigation is in progress. Study has also been made to establish rainfall-runoff relationship.

## Evaluation of irrigation methods and regimes for pine apple

A sub-experiment was conducted to study the effect of irrigation methods and regimes on yield and water use efficiency of pineapple. Irrigation treatments comprising of three method of irrigation (surface, drip and micro sprinkler irrigation) and three regimes (IW/CPE ratio of 0.40, 0.60 and 0.80) were laid out in Factorial Randomized Block Design with three replications. Irrigation scheduling has been done on the basis of pan evaporation. The irrigation treatments were imposed in 18 months old Kew variety pineapple during dry season of 2011. Recommended package of practices were adopted other than irrigation treatments. Though the rainfall of 930 mm was received during the season, it was not evenly distributed. Hence, irrigation treatments influenced the growth of pineapple (Table 2). The results revealed that among the method of irrigation, drip irrigation registered taller plants (58.7 cm), higher crown length (24.3 cm), fruit length (15.5 cm), fruit girth (36.5 cm) and fruit weight (1.47 kg) followed by micro sprinkler irrigation. Drip irrigation at IW/CPE of 0.80 recorded higher plant height (61.7 cm), crown length (26 cm), fruit length (16.8 cm), fruit girth (39.1 cm) and fruit weight (1.68 kg) and on par with drip irrigation at IW/CPE of 0.60 followed by micro sprinkler irrigation at IW/CPE of 0.80. From the results, it can be concluded that drip irrigation at IW/CPE of 0.60 can be recommended for pineapple as it was on par with IW/CPE of 0.80. (Plate 1)

**Table 2. Effect of irrigation methods and regimes on pineapple crop**

| Treatments | Plant height (cm) | Crown length (cm) | Fruit length (cm) | Fruit girth (cm) | Fruit weight (kg/fruit) |
|---|---|---|---|---|---|
| $T_1$ - SI at IW/CPE = 0.4 | 50.7 | 19.0 | 11.9 | 29.7 | 0.81 |
| $T_2$ - SI at IW/CPE = 0.6 | 52.8 | 19.5 | 12.6 | 30.6 | 1.04 |
| $T_3$ - SI at IW/CPE = 0.8 | 53.0 | 20.7 | 13.2 | 32.8 | 1.05 |
| $T_4$ - DI at IW/CPE = 0.4 | 54.2 | 22.3 | 13.7 | 33.4 | 1.15 |
| $T_5$ - DI at IW/CPE = 0.6 | 60.2 | 24.7 | 16.0 | 37.0 | 1.57 |
| $T_6$ - DI at IW/CPE = 0.8 | 61.7 | 26.0 | 16.8 | 39.1 | 1.68 |
| $T_7$ – MSI at IW/CPE =0.4 | 52.5 | 21.0 | 12.8 | 32.4 | 1.02 |
| $T_8$ – MSI at IW/CPE =0.6 | 54.4 | 22.9 | 13.5 | 34.2 | 1.30 |
| $T_9$ – MSI at IW/CPE =0.8 | 58.1 | 23.4 | 15.3 | 34.8 | 1.37 |
| SEd | 3.2 | 1.1 | 0.9 | 1.2 | 0.10 |
| CD (0.05) | 6.8 | 2.3 | 1.8 | 2.5 | 0.20 |

(SI – Surface Irrigation, DI - Drip Irrigation, MSI - Micro Sprinkler Irrigation, IW- Irrigation water, CPE- Cumulative Pan Evaporation)

Plate 1. Drip Irrigation, Micro-Sprinkler Irrigation and Surface Irrigation

# Effect of Vermicompost on Nutrient Dynamics and Yield of Vegetable Crop

*A. Velmurugan, N. Ravisankar, T.P. Swarnam and R.C. Srivastava*

During the year 2010-11, study on the effect of vermicompost on soil properties and yield of okra was continued in a field experiment while the nutrient release pattern in vermicompost applied soil was determined in an incubation study under laboratory conditions.

## Effect of vermicompost on okra yield

A field experiment was carried out with okra (Mahyco Bhendi Hybrid No. 10) as a test crop with 12 treatments viz. 100%, 75% and 50% of N through vermicompost (VC), VC + poultry manure (PM) (50:50), inorganic N (IO), IO+VC (50:50) ($T_2$ to $T_{12}$, respectively) and control ($T_1$) with three replications in a randomized block design by following the standard package of practices for okra. The required quantities of manures were calculated based on N equivalent basis. Growth and yield parameters of okra were recorded at periodic intervals. Application of manures and fertilizer has significantly increased the number of fruits per plant and fruit weight (Fig.1). Application of inorganic N at 100% of recommended dose has recorded the highest number of fruits per plant (14.0) which is statistically on par with VC and IO+VC. It was also observed that number of fruits and fruit weight is better in IO+VC than vermicompost and poultry manure alone or in combination. In general, at all the levels of N application (100, 75 and 50% of recommended dose) the yield was in the order of Inorganic alone > IO+VC > VC alone > VC + PM. The lowest yield was observed in control which is at par with $T_4$ and $T_7$.

The benefit cost ratio, net productivity and net return were worked out at the end of the cropping season. B:C ratio was in the order of IO > IO+VC > VC+PM > VC (100% dose). Low B:C ratio of VC is due to cost of manure (Fig.2). However, the cost of inorganic fertilizers includes the subsidy as well without which the B:C ratio may narrow down. The net productivity and return analysis revealed that at moderate input supply IO+VC (75% RDF) is the better option. VC+PM (75% RDF) were on par with IO+VC (50% RDF) and found to be best combination if only organic sources are to be used as in the case of organic farming.

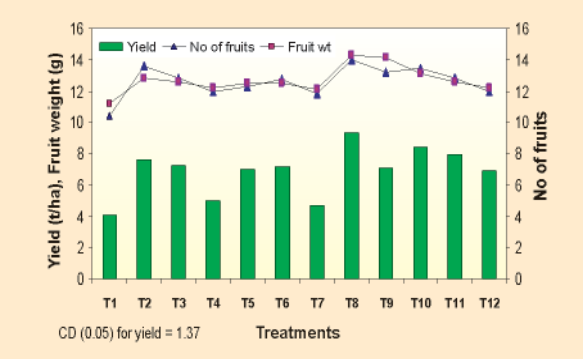



Fig.1. Effect of vermicompost, poultry manure, inorganic fertilizer and their combinations on okra

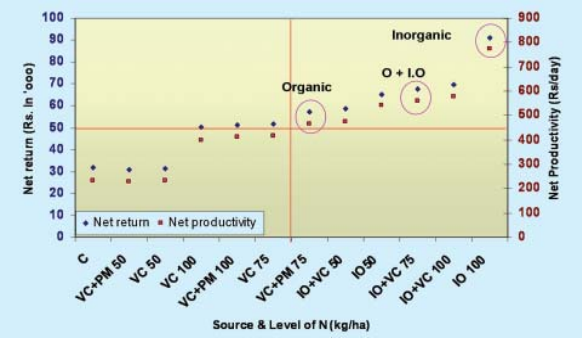



Fig.2. Sources of nutrient supply and return analysis

## Study on nitrogen release pattern

The nutrient release pattern (nitrogen) in vermicompost applied soils was studied using incubation-leaching assembly with the same set of treatments as that of the field experiment. Leaching of soil was carried out at 0, 2, 4, 9, 16, 23, 34, 48, 62, 76 and 90 days after incubation. Nitrate and ammonical N was determined from the leachate, using kjeldhal distillation unit (Fig.3).

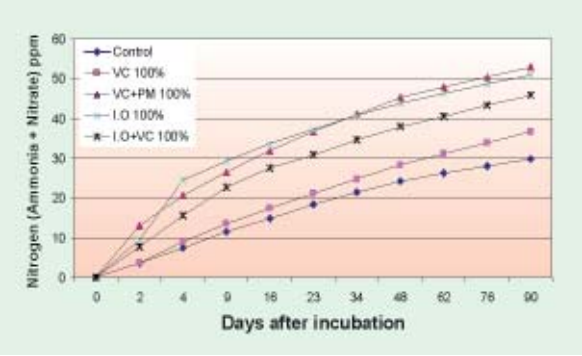



Fig.3. Cumulative nitrogen mineralization

During the mineralization process of organic manures both ammonical as well as nitrate nitrogen are released into the soil. Plants can take both these forms of nitrogen which constitute the soil mineral nitrogen pool available to crop plants. The results indicated that at 100 % RDF the total mineral N (initial + N mineralized) was highest in IO+VC followed by VC+PM > IO > VC > Control (Table 3). The low total mineral N of inorganic was possibly due to volatilization losses of N in the form of ammonia from inorganic fertilizer. On the other hand higher mineral N of IO+VC were due to favorable soil environment. The rate of release of N in the first one week of the incubation was highest in VC+PM treatment than the inorganic treatment alone and in combination with vermicompost possibly due to the readily available ammonical N in poultry manure. Vermicompost alone maintained the slow rate of release, however all were significantly higher than the control. It is also to be noted that VC+PM can supply upto 208 kg/ha of mineral N which is on par with inorganic and IO+VC If managed properly VC+PM could be the best option for supplying nutrients to okra.

**Table 3. Total Mineral N in different treatments at 90 days after incubation**

| Treatments | Mineral N (ppm) | | | Total mineral N (Kg/ha) |
|---|---|---|---|---|
| | Initial | Mineralized | Total | |
| Control | 23.50 | 29.75 | 53.25 | 117.15 |
| VC 100% | 34.64 | 36.63 | 71.27 | 156.79 |
| VC+PM 100% | 41.70 | 52.97 | 94.67 | 208.28 |
| IO 100% | 35.84 | 50.93 | 86.77 | 190.90 |
| IO+VC 100% | 49.40 | 45.71 | 95.11 | 209.24 |

# Effect of Nutrient Levels and Irrigation on Arecanut Yield and Soil Fertility

*A. Velmurugan, T. Subramani, S.K. Ambast, M. Sankaran and R.C. Srivastava*

A field experiment, as reported earlier, has been continued since November 2009 with three levels of irrigation treatments based on IW/CPE ratio viz. control ($I_0$), 0.5 ($I_1$) and 0.75 ($I_2$) and five levels of nutrient treatments viz. Control ($N_0$), NPK through inorganic fertilizers at 100% ($N_1$) and 50% RDF ($N_2$), vermicompost + inorganic (50:50) at 100 % ($N_3$) and 50% ($N_4$) RDF. The recommended dose of fertilizer (RDF) is 100g N, 40g $P_2O_5$ and 140g $K_2O$/tree/year. The results showed that during the experimental period the soil EC reduced from the initial value of 0.77 to 0.15 at the end of the monsoon season due to leaching of soluble salts during the rainy season (Plate 2). It was observed that the soil pH varied from 4.6 to 6.1 and the lowest was observed in 100% NPK applied through inorganic sources ($N_1$). The analysis of soil samples collected one year after initiation of the experiment indicated that the available soil P at initial (2009) was 3.5 mg $kg^{-1}$ which increased to 4.10 mg $kg^{-1}$ by December 2010. Available P content was lowest in the control (3.5 mg $kg^{-1}$) and highest in 100% NPK as inorganic (4.48 mg $kg^{-1}$). Inorganic NPK at 100% recommended dose recorded higher available P content than vermicompost and similar trend was observed at 50% recommended dose of fertilizes. There is no significant difference in available P due to irrigation.

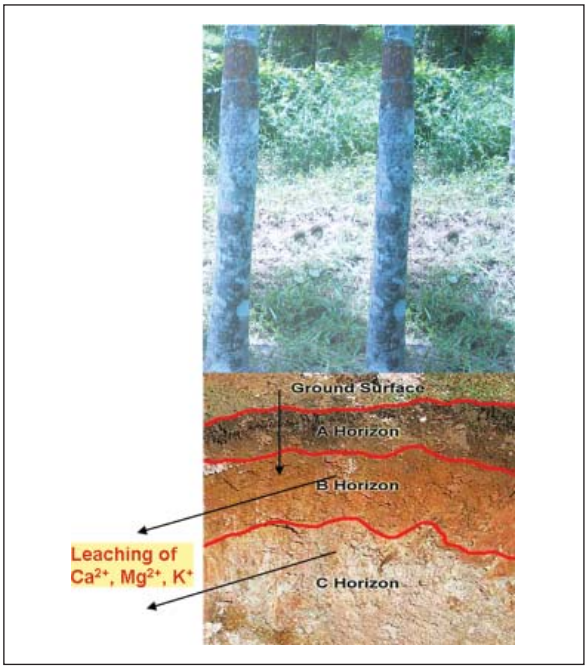



Plate 2. Nutrient leaching during the rainy season

Different nutrient and irrigation levels certainly influences plant growth parameters but any significant difference is expected only after a period of time as it is a tall growing tree with a trunk. The results showed no significant difference either in height or number of scars in the trunk of arecanut in the first year of experiment (Nov 2009 - Nov 2010). But, the results indicated that due to irrigation the incremental growth (girth in 2010-girth in 2009) of girth of the tree has significantly increased in $I_2$ (0.093 m) and $I_3$ (0.107 m) when compared to control. Irrigating the arecanut during the dry season has significant impact on chali weight and yield while number of nuts was significantly increased only by nutrient application through organic and inorganic sources (Table 4). The results indicated that chali weight was more (13.93 g) in inorganic fertilizer treatment ($N_1$) followed by VC + inorganic fertilizer ($N_3$) at 100% RDF. The highest yield was observed in $I_2$ (2.45 kg/tree) which is 13% higher than the control followed by $I_1$. Similarly nutrient application has also shown significant impact with the highest yield recorded in inorganic + VC at 100% of RDF ($N_3$). However, the interaction is non significant. There is no significant difference between inorganic and VC + inorganic treatments both at 100 % and 50 % of NPK application probably due to irrigation and quick release of nutrient from vermicompost. Any significant change in soil physical properties is expected only after the stabilization of added organic manures.

Table 4. Effect of irrigation and fertilizer treatments on arecanut yield parameters

| Treatments | $N_0$ | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean |
|---|---|---|---|---|---|---|
| | **Chali weight (g)** | | | | | |
| $I_0$ | 10.83 | 11.62 | 11.15 | 11.53 | 10.59 | 11.15 |
| $I_1$ | 11.17 | 13.93 | 11.44 | 13.87 | 12.02 | 12.49 |
| $I_2$ | 11.05 | 13.24 | 11.94 | 13.14 | 11.95 | 12.26 |
| Mean | 11.02 | 12.93 | 11.51 | 12.85 | 11.52 | 11.97 |
| SED | 0.06 | 0.08 | 0.14 | 0.13 | | |
| CD (0.05) | I 0.18 | N 0.16 | I at N 0.30 | N at I 0.27 | | |
| | **No of nuts/tree** | | | | | |
| $I_0$ | 154.27 | 203.00 | 191.67 | 217.10 | 203.87 | 193.98 |
| $I_1$ | 161.03 | 197.33 | 195.43 | 203.33 | 192.20 | 189.87 |
| $I_2$ | 172.10 | 215.90 | 196.80 | 214.77 | 196.00 | 199.11 |
| Mean | 162.47 | 205.41 | 194.63 | 211.73 | 197.36 | 194.32 |
| SED | 2.62 | 4.35 | 7.24 | 7.54 | | |
| CD (0.05) | NS | 8.99 | NS | NS | | |
| | **Yield (kg/tree)** | | | | | |
| $I_0$ | 1.68 | 2.36 | 2.14 | 2.49 | 2.14 | 2.16 |
| $I_1$ | 1.80 | 2.74 | 2.23 | 2.82 | 2.30 | 2.38 |
| $I_2$ | 1.89 | 2.83 | 2.35 | 2.82 | 2.34 | 2.45 |
| Mean | 1.79 | 2.64 | 2.24 | 2.71 | 2.26 | 2.33 |
| SED | 0.02 | 0.05 | 0.08 | 0.08 | | |
| CD (0.05) | I 0.06 | N 0.09 | NS | NS | | |

## Assessing the Impact of Pesticide Use on Soil and Water Resources in Intensive Vegetable Growing Areas of Andaman Islands

*T.P. Swarnam, A. Velmurugan, Someshwar Bhagat and Kamal Sarma*

In Andaman Islands, vegetables are cultivated in 4400 ha and the per capita application of the pesticides (3860 mg $ha^{-1}$) in these areas far exceeds the national average of around 540 mg $ha^{-1}$. As this exorbitant use of pesticides is a serious concern for the Island ecosystem diversity, an attempt was made to test soil, water and vegetable samples from vegetable growing areas of Andaman Islands for presence of pesticide residues and their impact on soil microbial population. Surface soil samples (0-15 cm) as well as vegetable samples were collected from vegetable fields of Wandoor, Manglutan, Neil Island Diglipur and Rangat during October 2010 to January 2011. The modified QuEChERS method was used for multi residue extraction from soil as well as vegetable samples. The detection and quantification of different compounds were carried out using GC/GC-MS. The soil samples were tested for presence of 24 important pesticides of organochlorine (OC) and synthetic pyrethroid (SP) compounds. Of the total compounds tested, only OC compounds were found in all the locations. The total

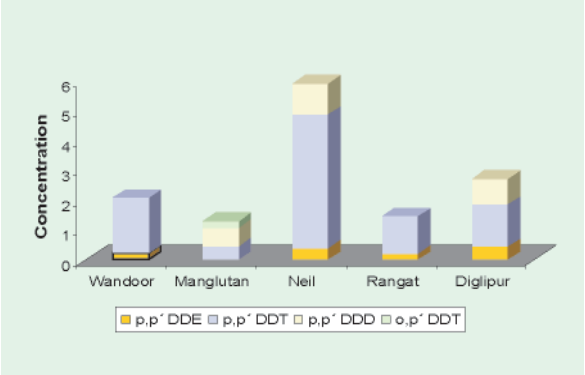



Fig.4. Concentration (µg $kg^{-1}$of soil) of DDT and its metabolites in soils of vegetable growing areas

concentration of residues varied from 0.35 to 13.38 µg kg$^{-1}$of soil and the highest residue level was found in Wandoor followed by Diglipur and Rangat. The DDT and its metabolites were detected in all the locations and it varied from 1.3 to 5.90 µg kg$^{-1}$of soil (Fig.4).

The presence of p,p′ DDT indicates more recent use of DDT and it was found in all the locations. In natural environment, the chemical and biological processes slowly degrade DDT into DDE and DDD. The ratio of (p,p′ DDE+ p,p′ DDD) / p,p′ DDT provide an indication of how recently DDT has been entered into the soil. All the locations except Manglutan found to have values less than 1 indicating that p,p′ DDT was recently introduced into the soil. In the study area presence of DDT and its metabolites could be due to extensive use of DDT for malarial control because of existing humid tropical climate and their drifting into agricultural fields. Besides, the presence of these chemicals in vegetable fields also indicated the possible misuse of these chemicals by farmers though it is banned for agricultural use in India. The other major OC residue found in the study area was endosulfan sulfate ranging from 5.83 to 12.99 µg kg-1 found in Wandoor, Rangat and Diglipur soil samples. The data revealed that residue level of both DDT and endosulfan sulfate was lesser compared to the values reported elsewhere (DDT - 10.3 to 1110 g kg-1 of soil and endosulphan sulfate - 29.2 to 95.9 g kg-1 of soil) but needs immediate due attention. SP compounds were not detected in the soil as their retention time is very low.

To understand the impact of pesticide application on soil microbial population the results were compared with those of home garden soil as control in which pesticides were not applied. The microbial diversity and count was higher in soil collected from home garden soil. The results indicated a significant reduction in total microbial population in vegetable fields due to prolonged pesticide use (Table 5) as compared to control. Among the organisms studied fungi was least affected and azotobacter sp. (non-symbiotic N fixer) was the most sensitive to the presence of pesticide residues in soils.

**Table 5. Total microbial population in pesticide applied and control fields**

| Location | Residue concentration (µg kg$^{-1}$) | Total microbial count (cfu g$^{-1}$ dry soil) | | | |
|---|---|---|---|---|---|
| | | Bacteria | Fungi | Actinomycetes | *Azotobacter* sp. |
| Wandoor | 13.38 | 1.13 x $10^5$ | 45.2 x $10^3$ | 4.3 x $10^4$ | 0.6 x $10^4$ |
| Manglutan | 1.31 | 1.35 x $10^5$ | 47.5 x $10^3$ | 5.1 x $10^4$ | 1.3 x $10^4$ |
| Neil | 5.90 | 0.28 x $10^5$ | 39.5 x $10^3$ | 4.8 x $10^4$ | 0.8 x $10^4$ |
| Rangat | 7.28 | 1.27 x $10^5$ | 42.6 x $10^3$ | 5.3 x $10^4$ | 0.9 x $10^4$ |
| Diglipur | 15.7 | 0.24 x $10^5$ | 27.4 x $10^3$ | 4.9 x $10^4$ | 0.7 x $10^4$ |
| Control | 0.43 | 9.73 x $10^5$ | 51.3 x $10^3$ | 9.4 x $10^4$ | 16 x $10^4$ |

The presence of pesticide residues were tested in brinjal and okra, the two major vegetables grown in these region. Of the two vegetables tested, α Cypermethrin and λ Cyhalothrin residues were found in brinjal to the extent of 0.018 to 0.070 ppm. Cypermethrin is widely used compound which was found in three out of six samples tested positive for pesticide residues. This is also confirmed from the field survey which indicated the large scale use of Cypermethrin for vegetable crops. Though the residue level of these pesticides (0.018 to 0.070 ppm) is below the Maximum Residue Level (MRL) prescribed by Prevention of Food Adulteration (PFA) standards, the presence of residues in food product poses a greater risk for human health, hence temporal monitoring of residues in soil, water and vegetable produce is in progress.



# Application of Organic Amendments for Managing the Acid Soils of Andaman

*T.P. Swarnam, A. Velmurugan and Jai Sunder*

Soil acidity is the major constraint for crop production in islands. Application of lime is a costly proposition because of lack of its local availability and its transportation cost from mainland, besides, the existence of low input agriculture in these Islands. In view of this a pot experiment was set up to study the effect of application of organic amendments viz., vermicompost, poultry manure and coconut husk on soil pH and their relative liming efficiency. The experiment was conducted in March to November 2010 using surface soil (0-15 cm) collected from agricultural land. The soils are acidic with pH 4.8 in $CaCl_2$, sandy clay loam in texture, low in organic carbon content. The soil was air dried, passed through 2mm sieve, mixed with 50 gram of pure quarts sand and filled in 50 kg pots. The experiment was laid out in randomized block design with seven treatments *viz.,* $T_1$ - control, $T_2$ - coconut husk, $T_3$ - vermicompost, $T_4$ - poultry manure, $T_5$ - coconut husk + vermicompost, $T_6$ - coconut husk + poultry manure, $T_7$ - lime and three replications. The organics *viz.,* coconut husk, vermicompost, poultry manure were applied at the rate of 20g $kg^{-1}$ soil and 10 g each when combined. The coconut husk was air dried and cut into pieces of 3-5 cm size before incorporation il so as to promote faster decomposition. The lime requirement of the soil was calculated by equilibrating the soil with a buffer solution of pH 7.5. The required quantities of organic amendments were thoroughly mixed with soil before filling the pots to avoid any localized effect. The pots were kept at room temperature (28° ± 2 C) at 60-70 % field capacity moisture by periodic wetting. The soil samples were taken at 0, 15, 30, 60, 75, 90, 120, 150 and 180 days after initiation of the experiment and air dried before determining the selected parameters. The coconut husk was oven dried at 60° C and ground to powder and the poultry manure and vermicompost were air dried, sieved through 2 mm sieve before doing initial characterization. The soil pH was measured in 0.002 M (2 mille Molar) $CaCl_2$ in a soil to solution ratio of 1:2. The pH of organic amendments was measured in suspension of 1.5g sample in 30 ml of 0.002M $CaCl_2$. Total N content of the soil as well as organic amendments were extracted in diacid (perchloric, sulfuric acid) mixture and estimated in Kel plus Nitrogen estimation system. Total Ca, Mg, Na and K were extracted in wet digestion with triple acid (perchloric, sulfuric acid, and nitric acid), estimated in AAS (Ca & Mg) and flame photometer (Na & K). Some of the physico-chemical properties of soil as well as organic amendments used in the study is given in Table 6.

**Table 6. Selected properties of organic amendments used**

| Organic amendments used | pH in $CaCl_2$ | Total Chemical composition (g $Kg^{-1}$) | | | | | Total base content (g $Kg^{-1}$) | $CaCO_3$ equivalent (g $Kg^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | | N | Ca | Mg | K | Na | | |
| Soil | 4.8 | 3.1 | 1.8 | 1.6 | 0.8 | 0.7 | 8.0 | - |
| Coconut husk (CH) | 5.1 | 3.5 | 2.2 | 1.9 | 4.2 | 4.6 | 8.3 | 12.2 |
| Vermicompost (VC) | 7.6 | 11.8 | 13.1 | 6.6 | 5.8 | 3.2 | 25.5 | 55.9 |
| Poultry manure(PM) | 8.9 | 22.1 | 24.9 | 10.1 | 8.2 | 11.0 | 43.2 | 99.0 |
| CH + VC | 6.1 | 7.7 | 7.7 | 4.3 | 5.0 | 3.9 | 17.0 | 34.0 |
| CH + PM | 7.4 | 12.8 | 13.6 | 6.0 | 6.2 | 7.8 | 25.8 | 54.9 |

Application of organic amendments increased the soil pH relative to control where no amendment was applied, but the effect is less than that of lime addition. It was observed that immediately upon the addition of organic amendments the soil pH increased due to proton (H+) transfer from soil to the organic materials before any microbial decomposition starts. This increase is a chemical process and mainly governed by initial soil pH and the nature of organic materials used. This can be evidenced from the significant increase in poultry manure (pH 6.0) followed by vermicompost (pH 5.5) and no significant change in coconut husk amended soils which have followed the same order of pH of organic materials used. Therefore, the amount and direction of flow of protons between the soil and organic amendments dictate the degree and direction of pH change. The temporal changes showed that application of poultry manure significantly increased the soil pH through out the observation period and it was followed by coconut husk + poultry manure treatment. The differences among organic amendments could be due to rate of ammonification of organic N which is controlled by the C/N ratio of the materials used and their lignin and poly phenol contents. As the C/N ratio and lignin content of coconut husk is higher which results in slow rate of decomposition and hence pH increase was low. The materials with lower C/N ratio like poultry manure and vermicompost showed a slight decrease in pH between 15 to 30 days after initiation of the experiment. This decrease could be attributed to the release of protons (H+) on nitrification of the NH4+ produced in the earlier stage of mineralization of organic N during decomposition process. Subsequently pH has increased due to the release of base cations especially Ca and Mg which results in acid neutralization during microbial decarboxylation.

The Relative Liming Efficiency (RLE) indicates the capacity of organic amendments to increase the soil pH in comparison to lime and it was calculated for each organic amendments used alone or in combination (Fig.5). The RLE of a given amendment may vary with time as the rate of decomposition of organic materials is not a uniform process and influenced by its composition especially C/N ratio, lignin and polyphenol content. It was found that relative liming efficiency was highest for poultry manure through out the observation period mainly because of its higher initial pH and total base content as compared to other organics. Coconut husk used alone showed the least liming effect among the treatments because of its initial low pH and poor base content. The RLE for all the treatments increased and found to be highest between 120 to 150 days mainly due to release of base cations and their neutralization of H+ ions on decomposition. Coconut husk + poultry manure combination was found to be significantly better than coconut husk used alone. The liming effect has persisted for whole of the observation period in all the treatments.

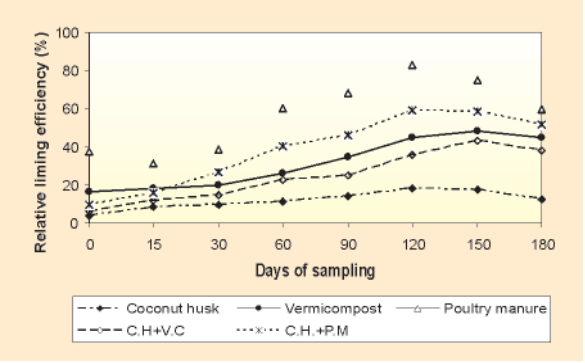


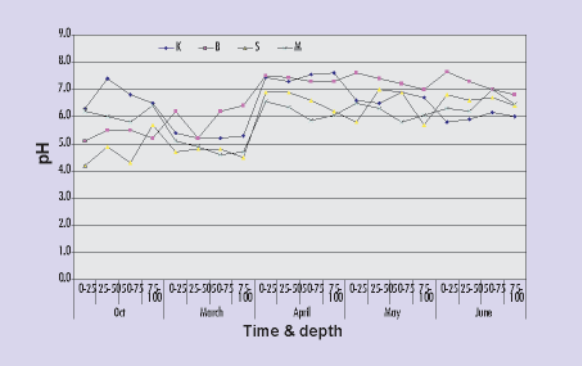

Fig.5. Relative liming efficiency of various organic amendments

This study showed the potential of organic amendments for increasing soil pH and could be an alternative amendment for acid soils in low input agricultural system. The liming potential of the organic materials is mainly influenced by their initial pH and total base content. Poultry manure alone or in combination with coconut husk which is locally available was found to be better in improving the pH of acid soil. Composting of coconut husk will increase the relative liming efficiency. These organic wastes and manures besides increasing the soil pH, can also supply plant nutrients and increase the microbial activity there by increasing the crop productivity in acid soils. Field experiment was initiated and is in progress to test the efficiency of organic amendments under field condition.

# Salt-Water-Nutrient Dynamics in Broad Bed and Furrow System

*S.K. Ambast, T. Subramani, N. Ravisankar and T.P. Swarnam*

During the period, the soil samples collected up to 1 m depth at an interval of 25 cm every month in the selected BBF systems were analysed (Fig.6). It has been observed that average soil pH decreased up to March and thereafter increased in all the BBF's till June 2010. Soil $EC_2$ values were converted to ECe using standard methodology up to March, whereas soil salinity was measured in ECe till June. In normal area, it has been observed that the soil salinity was within the acceptable limit till March and in general remained static. In saline area, soil salinity has increasing trend in sub-surface due to capillary rise during dry season. Further, it has been observed that salinity of the sub-surface layers was more compared to surface layer. This may be due to periodic inundation of the selected fields by sea water during high tides. During the months of April and May soil salinity was observed high (about 6 dS/m) and after onset of monsoon and subsequent leaching of salts, soil salinity reduced considerably within the acceptable limit (< 2 dS/m).




BBF Locations: B-Bloomsdale; K-Kashi (Badmashpahar); S-Singh (Chouldari), M-Madhu (Chouldari)

Fig.6. Average pH and salinity of soil in selected BBF systems

The analysis of organic carbon (OC) of the selected BBF indicated that OC content of beds of BBF in normal soil was higher (0.5 to 1.2 %) compared to saline soil (0.2 to 0.9%). It was lowest in May (0.6%) and highest in April (0.7%) irrespective of condition of soils. Higher organic carbon in normal soil can be attributed to intensive cropping in the beds compared to saline soils. The nutrient status in the adjacent paddy fields before planting and harvesting of paddy indicate considerable depletion of nutrients by paddy crop whereas pH and EC of soils are in acidic condition having pH of 4.6 to 6.2 while EC is higher in the field located at Chouldari (S) where in observations of saline soil in BBF is taken. Nutrient depletion by cole crops such as cabbage and cauliflower was much higher compared to okra, pumpkin and bottle gourd. The depletion of N was to the tune of 80% for crops while it is only 21% in case of okra. Similarly in the furrows also, 16% depletion of nitrogen was observed in rice-ratoon system under normal conditions. The pH of soil remained in acidic condition (between 4 -5.3).

# Standardization of Package of Practices for Table Purpose (HPS) Groundnut in Andamans

*N. Ravisankar, M. Balakrishnan, S. Ghoshal Chaudhuri, S.K. Ambast, R.C. Srivastava and N. Bommayasamy*

During the year, crop of confirmatory experiment on irrigation with moisture management strategies and nutrient management have been harvested and data were subjected to statistical analysis. Apart from the experiments, seed to seed analysis for economics and energetic along with identification of model for date of sowing and irrigation were attempted.

## Confirmatory evaluation of irrigation and mulching practices

A confirmatory experiment was conducted in split plot design with irrigation scheduling (No irrigation, one irrigation at pegging, two irrigation at life and pegging, three irrigation at life, flowering and pegging and four irrigation at life, flowering, pegging and pod development stages) in main plot and mulching treatments (Paddy straw, Banana, *Gliricidia* and No mulch) in sub plot with three replications. The period coinciding with critical stages *viz.,* life, flowering, pegging and pod development stages are 3, 45–50, 50-55 and 65–85 DAS respectively. Mulching treatment was imposed on 45 DAS. Weather during the cropping period was congenial in general for the crop growth. Life irrigation was given on 3 DAS. However, 115 mm of rainfall was recorded in 7 days after sowing which led to water logging in the field (Fig.7). Due to the water logging, the previous crop rice seeds present in the field got germinated leading to mixed crop of paddy + groundnut. However, when the field got dried and weeding was carried out, 80% germination of groundnut was observed. It indicates that ICGS 76 variety is tolerant to short term water logging of 3 to 5 days, and therefore can be recommended in the event of unseasonal rainfall during dry season. The other weather parameters were favourable for crop growth.

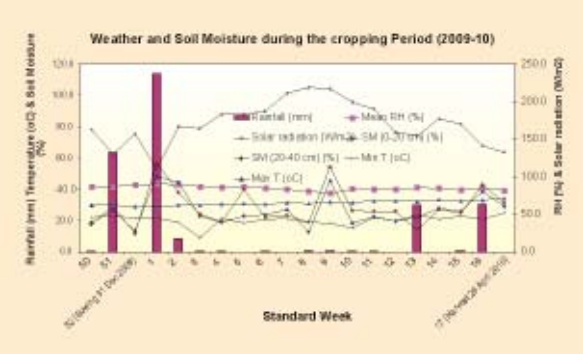



Fig.7. Weather and Soil moisture during cropping period

Water logging after sowing

Mixed crop of paddy & groundnut

Groundnut after weeding

Established crop

Plate 3. Glimpses of confirmatory experiment on irrigation & mulching

Application of two irrigation at life and pegging recorded higher pod yield of 3327 kg ha$^{-1}$ compared to no irrigation (2722 kg ha$^{-1}$). Three and four irrigation recorded reduction in yield which is mainly attributed to increased soil moisture at flowering and pod development affecting the pod formation. No irrigation also recorded 2722 kg of pods ha$^{-1}$ which is due to the optimum moisture at critical stages as a consequence of initial rain. Similarly, application of paddy straw mulch recorded pod yield of 3256 kg ha$^{-1}$ compared to no mulch (2884 kg ha$^{-1}$). One irrigation at pegging recorded the higher water productivity of 5.5 kg m$^{-3}$ and Rs 56 m$^{-3}$. However, application of two irrigations at life and pegging registered water productivity of 3.2 kg m$^{-3}$ and Rs. 35.9 m$^{-3}$. Similarly, paddy straw recorded irrigation water productivity of 2.8 kg m$^{-3}$ and 30.7 m$^{-3.}$ The relationship between number of irrigations, yield and water productivity indicates that thresh hold limit is one irrigation at pegging for higher water productivity while the yield is maximum with two irrigations applied at life and pegging stages.

## Evaluation of nutrient management practices

Experiment was conducted in split plot design with organic manures (Farm yard manure @12.5 t/ha, poultry manure @5t/ha, vermicompost @5 t/ha, No organic manure) in main plot and sulphur sources (No sulphur, sulphur through gypsum and sulphur through single super phosphate) in sub plot with three replications.

Application of organic amendments had significant influence on pod and green haulm yield compared to no manure application. Application of vermicompost @ 5 t ha$^{-1}$ registered pod yield of 3467 kg ha$^{-1}$ which is 65% higher than no manure application. However, application of vermicompost and poultry manure @ 5 t ha$^{-1}$ was on par. Though the application of sulphur through SSP had recorded higher pod yield of 3193 kg ha$^{-1}$, it is on par with application of gypsum (3002 kg ha$^{-1}$). Green haulm yield also recorded similar trend as that of pod yield. Gross return was higher with application of vermicompost @5 t ha$^{-1}$ (Rs 64241 ha$^{-1}$) which is on par with poultry manure (Rs. 58658 ha$^{-1}$). The cost of cultivation was higher with vermicompost as the rate of compost is Rs. 4 kg$^{-1}$. Hence, net ret returns were higher with poultry manure and farm yard manure. The net return per rupee invested is higher with FYM @ 12.5 t ha$^{-1}$ which recorded 1.7 compared to poultry manure (1.5) and vermicompost (0.8). Like wise among the sulphur sources, though sulphur through SSP registered higher net return of Rs. 33742 ha$^{-1}$ it is on par with sulphur through gypsum. Net returns per rupee invested were not influenced by sulphur sources.

## Seed to Seed analysis for economics and energetics

Around 0.34 ha area of coconut plantations are required to produce seeds required for one hectare area in dry season by which the productivity,

profitability and energetics can be improved and groundnut cultivation can be sustained in the Islands in the long run. The seed cost can be brought down by 72% by promoting groundnut seed production during wet season (sowing in August) in plantations. Crop sown during August in coconut plantations will come to harvest in the month of November which is relatively dry month. This makes it drying and processing of seeds easier and it can be used for dry season sowing in the month of December.

### Model for sowing and irrigation

CROPWAT model was used to evaluate the scheduling of irrigation based on soil moisture deficit and critical stages approach. Irrigating the crop based on critical stages and soil moisture deficit using the CROPWAT model found to be better in terms of yields and water productivity compared to soil moisture deficit alone. It infers that CROPWAT can be used for scheduling of irrigation based on critical stages and soil moisture deficit to table purpose groundnut.

It can be concluded that two irrigations at life and pegging with paddy straw mulch on 45 DAS can be advocated for realizing higher pod yield, net returns, B:C ratio, energy and water productivity. More than two irrigations leads to reduced pod yield. Also, application of FYM @12.5 t $ha^{-1}$ can be recommended for realizing higher net returns and B:C ratio. Net returns can be enhanced by self seed production in coconut plantations during wet season. Around 0.34 ha area needs to be taken up in coconut plantations for seed production to meet the requirement of 1 ha during dry season. CROPWAT and Root zone soil moisture equation can be used for time of sowing and scheduling of irrigation based on critical stages and soil moisture deficit to table purpose groundnut.

## Improved crop planning for minimizing production losses in low lying areas during dry season

*N. Ravisankar, A. Velmurugan, T.Subramani, S.K. Ambast and R.C. Srivastava*

Pulses and vegetable crops are grown during dry season (Dec-April) in Island ecosystem. Oftenly, sowing of pulses and vegetables gets delayed due to extended period of rainfall in December and January. Though the crops were sown in December and January months during 2010 and 2011, due to heavy downpour of rainfall during first week of January in 2010 and third week of January in 2011, pulses and vegetables in the field got damaged which led to the loss in potential production. The other dimension of the problem is that if these crops are sown after first week of February, it may not be possible to harvest these crops as harvesting will coincide with the onset of pre monsoon which normally happens during third week of April. In order to address the issues of short term water logging during crop growing season due to unseasonal rainfall, improved crop planning is essential to offset the production losses. A study has been initiated from November 2010 to identify various options of cropping for waterlogged areas of early dry season. Observations of soil moisture and depth of submergence were taken in low lying valley areas at on station (Bloomsdale farm) and on farm (Chouldari and Portmout) under three topo sequences namely up, medium and lowland areas in each locations from 45$^{th}$ to 10 Standard Meteorological Weeks (SMW). The soils of the study area were sandy loam (water holding capacity 110-115 mm/m) in up and medium lands whereas clay loam to silty clay (water holding capacity 135-160 mm/m) in lowland areas.

Observation on depth of submergence indicates that across the locations, upland areas registered 1.7 cm depth of water during 50$^{th}$ SMW while medium and lowland areas had higher depth of water as 2.8 cm and 5.2 cm respectively in the same week. The depth of ponded water decreased steadily in upland areas over the period of time. During 1$^{st}$, 5$^{th}$ and 6$^{th}$

meteorological week, rainfall of 11, 12 and 14 cm was recorded respectively which led to higher depth of water in lowland (5.3 cm in 1st week) compared to uplands (1.7 cm). Out of 14 weeks of observations, upland areas were submerged for 4 weeks (28.5 %) with depth of submergence ranging from 1 to 1.7 cm while lowland areas were submerged in all the 14 weeks with depth of water ranging from 1 to 5.3 cm (Fig.8). In all the fields wherein observations are taken was having the bund height of 15 to 40 cm. Medium land areas were submerged for 11 weeks with depth of water ranging from 1 to 3.4 cm. The results infers that pulses and vegetables are to be sown in upland areas with proper drainage to drain out the water quantity of at least 2 cm while in medium and lowland areas, sowing and planting of any dry season crops needs to be taken after developing the drainage facility to drain out 5 to 6 cm of water at given point of time.

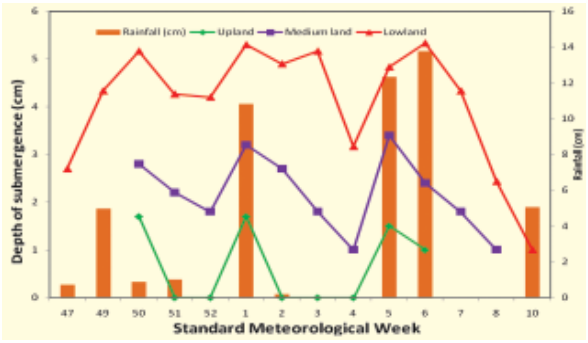



Fig.8 : Depth of submergence under various topo sequences during 47th to 10th meteorological week

## Water and Nutrient Management in Capsicum through Drip System under Protected Cultivation

*T. Subramani, S.K. Ambast, N. Ravisankar, S. Bhagat, A. Velmurugan and R.C. Srivastava*

An experiment was conducted to study the effect of irrigation regimes on yield and water use efficiency of capsicum under protected cultivation. Four irrigation treatments (IW/CPE ratio of 0.25, 0.50, 0.75 through drip and 0.75 through surface irrigation) were laid out in RBD with five replications. Open pan evaporimeter was installed near to the polyhouse for scheduling irrigation on the basis of pan evaporation. Capsicum Hybrid 'Indra' has been planted at 60 cm x 60 cm spacing during July to December, 2010. Recommended package of practices were adopted other than treatments. The experimental soil at the beginning of the study was coarse sandy loam, medium in organic carbon (0.52%), moderately acidic (6.3) in reaction. The initial soil fertility analysis indicated that the soil was low in N (213 kg/ha), P (12.5 kg/ha) and K (168 kg/ha). After the harvest of capsicum the soil pH and EC slightly decreased while the soil organic carbon slightly increased. The available N (203 kg/ha) and K (150 kg/ha) decreased due to crop uptake whereas P content remained same. It was found that drip irrigation recorded higher growth attributes as compared to surface irrigation. Among the irrigation schedules, drip irrigation at IW/CPE of 0.75 recorded significantly higher plant height and dry matter production. Drip irrigation at IW/CPE of 0.75 registered significantly higher number of fruits per plant (9.4) and fruit weight (84.3 g) resulting higher capsicum yield of 753 g/plant and 20 t/ha and it is on par with drip irrigation at IW/CPE of 0.50 (Table 7). Highest water productivity of 11.5 kg/m$^3$ and Rs.1150 m$^3$ of water were recorded in drip irrigation at IW/CPE of 0.25. This was followed by drip irrigation at IW/CPE of 0.50, while surface irrigation at IW/CPE of 0.75 recorded lesser water productivity due to lower yield and more application of water. Drip irrigation at IW/CPE of 0.75 recorded higher net return of Rs. 28,841/250 m$^2$ followed by irrigation at IW/CPE of 0.50 (Rs 24,270/250 m$^2$). Similar to the net return, the higher B:C ratio of 2.33 and 2.13 were also registered in drip irrigation at IW/CPE of 0.75 and 0.50, respectively. (Plate 4)

**Table 7. Effect of irrigation regimes on yield, water productivity and economics of capsicum under protected cultivation**

| Irrigation regimes | Yield (g/plant) | Yield (kg/250 $m^2$) | Yield (t/ha) | Water Productivity | | Economics Net return (Rs/250 $m^2$) | B:C ratio |
|---|---|---|---|---|---|---|---|
| | | | | Kg/$m^3$ | Rs/$m^3$ | | |
| Surface irrigation at IW / CPE = 0.75 | 512 | 338 | 13.5 | 2.3 | 225 | 16,880 | 2.00 |
| Drip irrigation atIW / CPE = 0.25 | 582 | 391 | 15.7 | 11.5 | 1150 | 17,875 | 1.84 |
| Drip irrigation atIW / CPE = 0.50 | 680 | 457 | 18.3 | 6.7 | 672 | 24,270 | 2.13 |
| Drip irrigation atIW / CPE = 0.75 | 753 | 504 | 20.2 | 4.9 | 489 | 28,841 | 2.33 |
| SEd | 32 | 25 | 1.0 | - | - | - | - |
| CD (0.05) | 68 | 53 | 2.1 | - | - | - | - |

Plate 4. Growth and fruit size of capsicum as influenced by irrigation regimes

It can be concluded that drip irrigation at IW/CPE of 0.75 is the optimum irrigation regime for getting higher yield, net return and water productivity under protected cultivation in Andaman and Nicobar Islands. However, IW/CPE of 0.50 through drip irrigation can be recommended under water constraint conditions in order to have higher water productivity. After the harvest of capsicum, crop rotation with coriander has been done. The confirmatory trial is in progress.

## Post Harvest Management of Rice and Pulses in the Island

*S. Swain, P.K Singh and R.C Srivastava*

Rice and pulse are the most important field crops cultivated in most of the inhabited Andaman and Nicobar Islands. These constitute about 28% of the total cultivated area of 50,000 ha and produce 22,100 tonnes of rice and 1154 tonnes of pulses (2008-2009). The ultimate goal of the rice/pulse processing is to achieve maximum head rice yield (HRY)/value added split pulse which is one of the primary factors that determine the market grade and the economic value of rice since it is an indicator of the milling quality.

During the year, a survey has been undertaken regarding the status of rice mill in these islands in a well defined questionnaire that included information on type of dehusker, year of establishment, capacity, source of power, HRY, percentage of broken rice and husk with their utilization. 35 rice mills in the South,

Middle and North Andaman regions were surveyed. The result indicated that paddy such as C14-8, Jaya, Ratna, Jagannath are extensively cultivated in these islands. Most of the rice mills are 25-30 years old in South Andaman whereas in North and Middle Andaman, nearly 70% rice mills are 6-7 years old which has been installed after tsunami through subsidy provided by A&N Administration. Nearly all rice mills found in South Andaman are electrically operated unlike North and Middle Andaman, where most of the rice mills are diesel operated. The density of rice mills are more in North and Middle Andaman in comparison to South Andaman where one rice mill is found out of every 3-4 houses. However, the quality of rice is low due to improper/indigenous processing step. The HRY is only 45-50% and the large broken (4/8 to 6/8$^{th}$ of kernel portion) along with head rice consumed as food. The broken rice constitutes 18-20% in raw rice. The status of parboiled rice is 5-10% due to the fact that farmers do not have sufficient dried fuel for making the parboiled rice. The tropical humid climate is the major constraint in this region. Moreover, there is no polisher or grader used after milling wherein the small broken along with husk is used as animal feed instead of separating it to use as other rice based product in home or selling to the market.

For pulse processing, the survey revealed that there is only one dal mill in Diglipur which is also very recently installed. Farmers produce pulses and but have no processing facilities at the rural level to process the produce. However, apart from a small quantity of pulses used for local consumption using indigenous methods of splitting by locally made *Chaki*, they sale it at low prices to the middle man @Rs 35/kg only. More than, 85% of the pulses are transported to mainland for processing and the same pulses after processing from mainland sold at Rs. 80-85/kg at the locals market. Therefore, a mini dal mill was procured (M/S Shriram Associate firm on MOU with Punjabrao Deshmukh Krishi Vidyapeeth, Akola under AICRP-PHTS) and tested for locally available pulses. The machine comprised of four units viz. dehulling unit with emery roller, separation unit, splitting unit and screw conveyor. It has 3-hp single phase electric motor for complete operation. The horizontal cone type abrasive roller is provided for dehulling of grain with the provision of inlet and outlet control. Out of dehulled mixture, powder and husk are separated by an aspirator and come out through cyclone separator. The remainder mixture fall down by gravity on the reciprocating sieve unit provided with two sieves. The upper sieve separates grain with gota and lower separates dal. The brokens are collected below sieves on pan. The grains are fed to the screw conveyor where either oil or water can be uniformly applied to the pulses. After 2-3 passes, dal can be splitted after water treatment and drying.

Plate 5. Traditional rice mill and mini dal mill

Fresh green gram procured from local market were cleaned and dried under Sun to reduce its initial moisture content (13% on w.b.) to the desired moisture content (9% on w.b.) for milling. Five kg of raw dal was used for milling. The result indicated that after first pass through emery roller, the dal recovery was only 35-40%. Thereafter, oil @125-150g/0.1 tonne and water @2 lit/0.1 tonne were applied to the unsplitted pulses, kept over night and sun dried for 1-2 days for milling again. The resulted dal recovery increased to 55-60%. The repeat process with oil and water application yielded dal recovery to 75-80%. (Plate 5)

## Post harvest management and value addition of spices in the Island

*S. Swain, S.K. Ambast, R.C. Srivastava, Shrawan Singh and Jai Sunder*

Spices are grown under the multi-tier cropping system and the major spices include black pepper (697 ha), clove (200 ha), cinnamon (153 ha), ginger (200 ha) and nutmeg (83 ha) with total annual production of about 1878 tonnes (2009-2010). A survey has been conducted regarding cultivation, production and processing status of different spices like cinnamon, clove and black pepper to 30 farmers at different villages of North, Middle and South Andaman. The questionnaire is made accordingly based on area under cultivation, varieties, production, labour requirement, level of processing, constraints and annual income etc. The result indicated that despite of congenial environment for cultivation and production of spices, the Island has not been able to push its product to the export market mainly due to poor, lack of reliable and unified method and traditional methods which are not promising. Most of the spices are harvested during rainy season which resulted into heavy loss due to decay as well as humid climate favours for incidence of pest and diseases that again damage the produce e.g. black pepper. The crops are usually grown on upland and hilly slopes. But due to high rainfall and steep slopes, the rate of runoff is very high than the rate of percolation, the crop suffer from water scarcity in the hills and the mortality rate is high in summer. After harvest, mainly women take part in picking/harvesting, grading, drying, peeling and packaging of various spices which are labour intensive and drudgery-laden operation. For the purpose of spice processing, farmers are still adopting sun drying method or traditional way of processing.

Harvested spices are spread on mats, cement floors, roof tops or even on soil along the roadsides so as to expose to solar intensity until the completion of drying. In this method the spices are exposed to direct sun light and consequently the spice pieces heat up and internal temperatures rise without regulation which destroys colour, vitamins and flavour giving rise to low quality produce that can not compete with the imported spices from the mainland. So, the lack of quality consciousness and poor handling of the commodity during post harvest period is the primary factor for quality deterioration. In order to promote post harvest processing of spices, drying by means of mechanical dryers with the controlled processing condition, and packaging facilities will be done in next year for the production better quality spices.

# Farmers Participatory Action Research Programme

*R.C. Srivastava (NO), S.K. Ambast (PC), N. Ravisankar, S. Jeyakumar, Kamal Sharma and S.K. Zamir Ahmed*

Demonstration of four technologies *viz.,* tank well system, micro irrigation, pond based integrated farming system (IFS) and crop diversification through Broad Bed and Furrow (BBF) based farming system in farmers field were completed during the year under Farmers Participatory Action Research Programme (FPARP). The demonstrations were carried out in 22 villages of four Islands namely South Andaman, Little Andaman, Havelock and Neil in 48 farmers field. Assessment of impact of the pond based IFS have been taken up in five farmers field at South Andaman Island. Gross return from 0.2 ha area ranged from Rs. 12000 to 40000/- (Table 8) depending upon the components such as vegetables, goat, poultry and duckery integration. Similarly, net return was more wherever vermicompost production was made by the farmer himself. Shri Ramachandran of Mile tilak village made self production of vermicompost and applied to the crops through which he received Rs. 18000/- as net return from 0.2 ha of pond based IFS. The net return per rupee invested ranged from 0.6 to 2.8 while average net productivity of Rs 35.1/day can be obtained by adopting pond based IFS in 0.2 ha area. Few farmers have adopted their own innovative practices during the demonstration. Mr Sudhansu Mondal, Netaji Nagar, Little Andaman made vermicompost cum vermiwash unit from the RCC rings supplied for making of vermicompost. Vermiwash is sprayed to vegetables after enriching with *Trichoderma* and *Pseudomonas* for control of pest and diseases. (Plate 6 and 7)

**Table 8. Net income from 0.2 ha area of pond based integrated farming system demonstrated in farmers field at South Andaman**

| Farmer | Gross return (Rs) | Net returns (Rs) | Net return per rupee invested | Net Productivity (Rs/day) |
|---|---|---|---|---|
| Shri Jayaseelan, Calicut | 40000 | 15000 | 0.6 | 41.1 |
| Shri Krishna Bairagi Gupta Para | 20000 | 12000 | 1.5 | 32.9 |
| Shri Sri Singh Chouldhari | 12000 | 8000 | 2.0 | 21.9 |
| Shri Bishnu Pada Dey Chouldhari | 15000 | 11000 | 2.8 | 30.1 |
| Shri Rama Chandaran, Mile Tilak | 25000 | 18000 | 2.5 | 49.3 |
| Mean | 22400 | 12800 | 1.9 | 35.1 |

Plate 6: Pond based IFS at Neil Island and distribution of 2HP Pump to IFS farmer

Plate 7. Installation of micro-irrigation system in farmers fields

## Integrated Agromet Advisory Services

***R.C. Srivastava (NO), S.K. Ambast (PC), N. Ravisankar (C-AAB), A. Velumurugan, Ajanta Birah, Krishna Kumar, P.K. Singh, D.R. Singh, M. Sankaran, A. Kundu, S. Jeyakumar, Grinson George, Kamal Sharma, Subhash Chand, M. Balakrishnan and S.K. Zamir Ahmed***

Integrated Agromet Advisory Service unit has rendered its effective services through Agromet Advisory Bulletin (AAB). On receipt of forecast from Regional Meteorological Centre, India Meteorological Department, Kolkata, AAB are prepared on every Tuesday for Andaman region and Friday for Nicobar region. During the year, 50 bulletins were issued for Andaman while 44 were issued for Nicobar. The bulletins were regularly published in The Daily Telegram, The Echo of India and Dweep Samachar. It is also broadcasted in Dweep Darpan of Doordarshan and All India Radio. Feed back on Agromet Advisory Bulletin (AAB) indicate that 85% of farmers are aware about AAB out of which 86% farmers are receiving the AAB through Doordarshan and 11% are getting it through All India Radio. Only 3% of farmers are getting the bulletin from press media.

Verification of forecasted and observed values of rainfall was carried out for pre monsoon, monsoon and post monsoon period. Out of 62 days observed and forecast of occurrence of rainfall are matching only for 29 days during pre monsoon season. Similarly, it is 116 days for monsoon and 77 days for post monsoon season. In terms of percentage, monsoon and post monsoon season recorded 63.5% as matching of forecast and observed. While pre monsoon registered only 46.7% as matching cases (Table 9).

Verification of forecast with observed data by using Ratio Score and HK Score indicates that during the pre monsoon season, 55.2% of forecast of rainfall are found to be correct and 3.5 % are useable and remaining are unusable. In the post monsoon or dry season, only 9.1% of forecast are found to be correct and 6.5% are useable. In the case of monsoon, only 7% are correct and another 13% can be useable.

Out of 52 days of first day forecast in monsoon season (June-Nov, 2010) 31 days of observed value and forecast value is matching (59.61%) Fig.9 and for the remaining period observed value was lower than the forecast value.

**Table 9. Verification of forecast during pre monsoon, monsoon and post monsoon period**

| Particulars | Pre-monsoon (April-May, 2010) | Monsoon (June-Nov, 2010) | Post-Monsoon (Dec, 2010 – March, 2011) |
|---|---|---|---|
| No. of days when rain was forecasted and also observed (YY) | 13 | 111 | 70 |
| No. of days when rain was observed but not forecasted (YN) | 2 | 10 | 21 |
| No. of days when rain was not observed but forecasted (NY) | 31 | 57 | 23 |
| No. of days when rain was not observed and also not forecasted (NN) | 16 | 5 | 7 |
| No. of matching cases (YY+NN) | 29 | 116 | 77 |
| Skill score or ratio score of rainfall | 46.7 | 66.4 | 63.6 |
| Hanssen & Kuipers index (HK Score) | 0.2 | 0.1 | 0 |
| Error Structure for rainfall (for matching cases)<br>a) Correct<br>b) Usable<br>c) Unusable | 55.23.541.4 | 6.912.380.9 | 9.16.584.4 |
| Correlation of rainfall R | -0.05 | 0.15 | 0.01 |

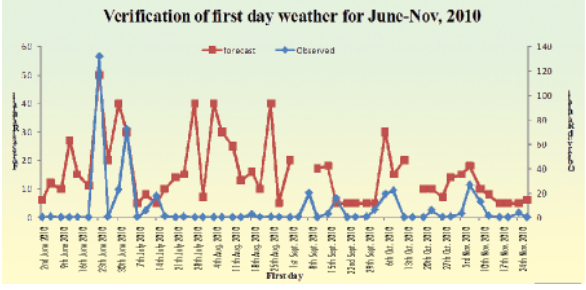



Fig.9. Verification of first day rainfall (mm) forecast for monsoon period (June-Nov, 2010)

## Economic Impact

In the dry season, forecast indicated heavy rain during the next five days and farmers were advised to postpone land shaping activities in low lying areas. This lead to saving in cost of labour in the farmers field as labour cost is very high in this Island. Similarly, timely advice to the farmers based on low rainfall forecast in monsoon season, farmers have strengthened the field bunds of rice and did mud plastering of bunds to store rain water. This saved the cost of irrigation in critical period of growth of rice plant. After advisory, farmers provide clean water with glucose and vitamin C to the back yard birds to avoid heat stress and increase the immortality rate compared to those farmers who were not followed this advisory. In the advisory bulletin it was mentioned that postpone the application of pesticide when rainfall was forecasted. One farmer in Neil Island applied pesticide during rainfall which drifted/ leached to farm pond and mortality of fingerling were observed. Those farmers who have not applied the pesticide based on the advisory got benefited by saving around Rs. 500/- towards cost of fingerlings.

# Strategies for Sustainable Management of Degraded Coastal Land and Water for Enhancing Livelihood Security of Farming Community

*S.K. Ambast, N. Ravisankar, A. Velmurugan, M.S. Kundu, C.S. Chaturvedi, Subhash Chand and R.C. Srivastava*

Four land clusters viz. Chouldari (Port Blair), Shoal Bay (Ferrargunj), Dashrathpur (Rangat) and Deshbandhugram (Diglipur) have been identified for implementation of the project (Fig.10). These clusters contain both low-lying waterlogged paddy lands and hilly plantation lands. The land and water quality in Dashrathpur and Deshbandhugram were reported poor since long mainly due to their proximity to coast but land and water quality in Chouldari and Shoal Bay degraded severely after tsunami. Low-yielding long duration C14-8 in low-lands is commonly grown rice variety during wet season in these clusters. Most of the land remains fallow due to waterlogging and or soil salinity during dry season except in some areas where farmers grow vegetables. In hilly areas, coconut, arecanut and spices are the common plantation crops.

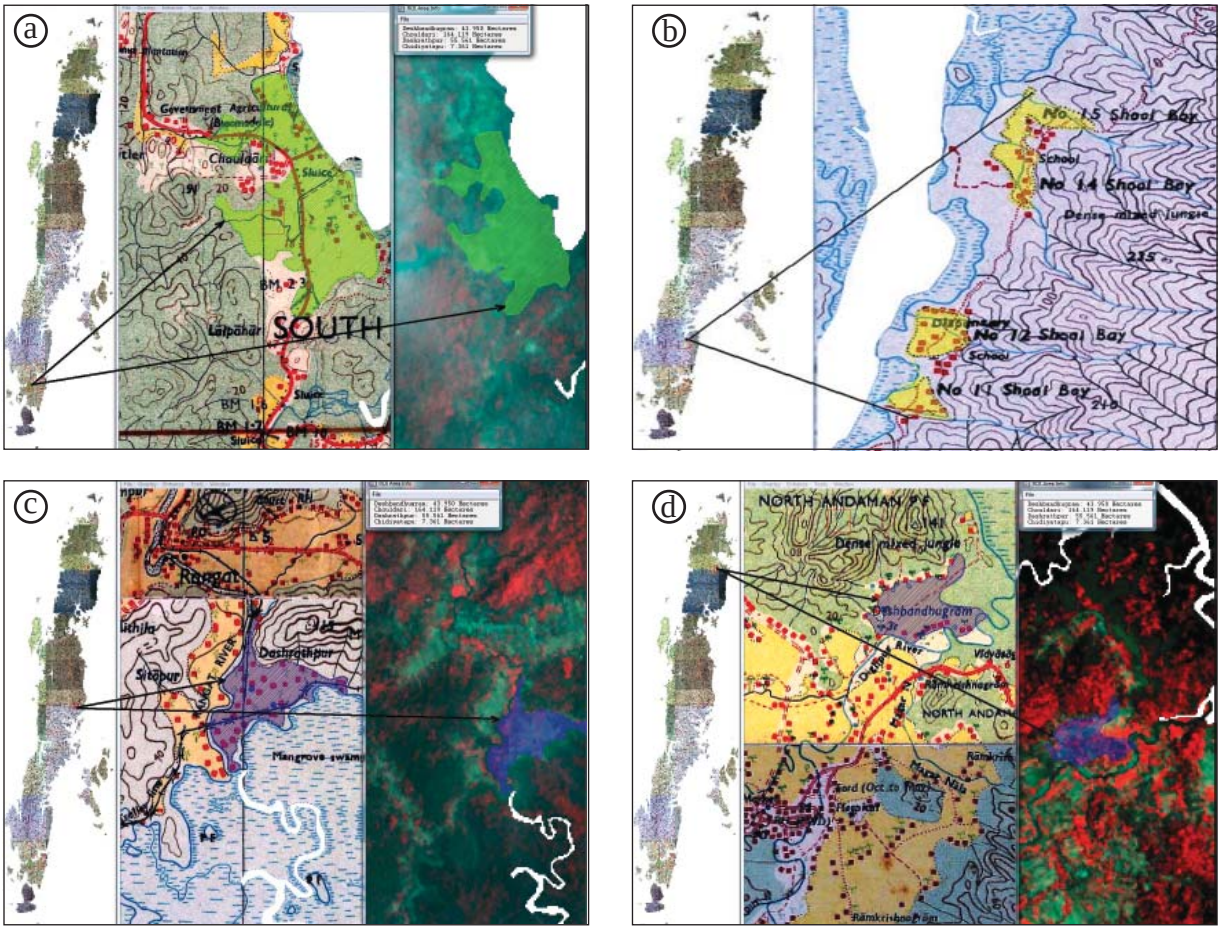



Fig.10. Location of (a) Chouldari (b) Shoal Bay (c) Dashrathpur and (d) Deshbandhugram

## Constraints analysis

A total 158 farmers were surveyed for bench mark survey on socio-economic information as per prescribed questionnaire for cluster wise constraint analysis. The major constraints inhibiting agriculture in these clusters include soil salinity and water

logging in the low-lying areas particularly areas closed to the drainage channel where sea water enters during high tides. The analysis indicated that in Chouldari, Shoal Bay, Dashrathpur and Deshbandhugram 40, 11.8, 18.8 and 18.8 percent areas, respectively are suffering from various degree of water logging whereas soil salinity ranges between 2.9-14.2, 2.1-5.4, 5.4-12.6 and 3.2-4.6 dS $m^{-1}$, respectively. Various land shaping activities like broad bed and furrow system, paddy-fish system and ridge-furrow system can help in restoring the agriculture in these lands and sustaining the livelihood of the farming communities. However, the major constraints in implementing these techniques in farmers field is late drying of land and thus availability of very short period for implementation of interventions limited to the months of February to April. The other constraint is non-availability of water for irrigation of crops, particularly vegetables, during dry season. Creation of farm pond, three-tier farming system and introduction of integrated farming system can help farmers in enhancing their livelihood in these degraded lands. With regard to fisheries, soil acidity and non-availability of fingerlings at desired time are the major constraints. Capacity building to educate the farmers on lime treatment may help farmers in minimizing the adverse effect of soil acidity. Introduction of fish hatchery to one to two farmers in the cluster will help in ensuring the timely availability of fingerlings. With regard to captured fisheries, providing medium range weather information through rural technology centre will help them. Non-availability of chicks, goat kids, processing units and post harvest facilities are the other constraints.

### Improvement interventions

A total six SHGs have been formed in these clusters for smooth operation and implementation of improvement interventions as

(a)

(b)

(c)

(d)

Plate 8. (a) Paddy-fish system at Chouldari (b-c) BBF systems at Shoal Bay and Dashrathpur, and (d) three-tier farming system at Deshbandhugram in degraded land and water areas

per the guidelines of the NAIP. During the year, 3 training programmes focusing fisheries, farming systems and animal husbandry beside land shaping and water management have been organized for capacity building of the stakeholders. Further, 1 rice-fish system has been adopted in Chouldari, 1 three-tier farming system and 1 BBF has been made in Deshbandhugram and 1 three-tier farming system has been made in Dashrathpur.(Plate 8 and 9)

Plate 9. Capacity building of farmers of selected clusters

## All India Coordinated Research Project on Integrated Farming System

***R.C. Srivastava (NO), N. Ravisankar (PI), T.P. Swarnam, S.K. Ambast, S. Swain, M. Sankaran, Shrawan Singh, M.S. Kundu, Kamal Sarma and Ajmer Singh Kundu***

On station programme on Integrated Farming System has been initiated from April 2010 in which two farming systems *viz.* Broad Bed and Furrow (BBF) based farming system for low lying valley areas and coconut + pig system suitable for hilly areas are taken for study. Component integration is in progress for both the systems. A survey to identify the predominant farming system in A&N Islands was also carried out.

### Survey on predominant farming system

A quick survey was conducted for identifying the predominant farming system of each district in the Islands as per the format of PDFSR, Modipuram. The farming system identification is for preparation of national atlas. Accordingly 29 farmers from South Andaman, 42 farmers from North-Middle Andaman and 12 farmers from Nicobar districts were asked to fill the questionnaire during the Island Kisan Mela 2011 held during 2-3 Feb 2011. The results revealed that vegetables contribute highest (Rs 28167) towards annual income in South Andaman followed by arecanut (Rs 22375) and fisheries (Rs 21923). The average farm size in South Andaman is 1.91 ha while it is 1.77 ha in North-Middle Andaman district. Contribution of different enterprises to annual income from North-Middle Andaman district is in the order of spices, fisheries and cereals. Likewise in Nicobar, the predominant system is pig + coconut + livestock based on the net returns.

### Broad Bed and Furrow based farming system

Soil texture and Initial soil properties were assessed before initiation of the experiment. Sandy clay loam and sandy loam texture is present in the sites of IFS model for low lying valley areas. Initial assessment of soil properties indicates that pH is in the range of 5.4 to 6.5 while EC is 0.1 to 0.5 dS/m. Organic carbon content was higher (1.2 to 3.1 %) in all the plots while Nitrogen and Potassium are found to be in medium range (Table 10). During the wet season,

long duration varieties Ranjit, Gaytri and Savitri were planted. Apart from paddy, 131 kg of cowpea (5.5 t/ha), 57.5 kg of cucumber (2.4 t/ha) and 6.95 kg of bitter gourd (1.7 t/ha) were harvested from beds of BBF system during wet season. Their residues were recycled in to the system. Integration of other components such as cattle, fodder, flowers and vermicompost are in progress. The production of different farm components integrated into an IFS model and their impact on livelihood security of normal-size farm family (4 persons) of small and marginal category is summarized in Table 11. Around Rs 11274/= can be obtained as gross value of surplus after meeting the household consumption worth Rs 15800/= from the 8600 $m^2$ area under crop production.

Plate 10. General view of IFS experiment at Bloomsdale

**Table 10. Bench mark data of soil properties of IFS experiments at Bloomsdale and Garacharma farm**

| Sample ID | Field label/ depth (cm) | pH (1:2) | EC (dS/m) | OC (%) | Available Nutrients (kg/ha) | | DTPA extractable micronutrient concentration (ppm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | N | K | Fe | Mn | Zn | Cu |
| **I. Bloomsdale (0-50 cm)** | | | | | | | | | | |
| Rice | Plot A | 6.1 | 0.2 | 1.1 | 389 | 168 | 114 | 37.8 | 0.40 | 3.8 |
| | Plot B | 5.8 | 0.3 | 1.9 | 452 | 213 | 132 | 37.6 | 0.43 | 4.1 |
| | Furrow (BBF) | 5.6 | 0.1 | 2.2 | 389 | 127 | 129 | 11.7 | 0.38 | 3.6 |
| BBF system | Bed 1 | 5.4 | 0.3 | 2.4 | 452 | 189 | 71 | 23.5 | 0.49 | 4.1 |
| | Bed 2 | 5.7 | 0.5 | 2.2 | 439 | 192 | 85 | 23.1 | 0.42 | 4.0 |
| | Bed 3 | 5.8 | 0.2 | 3.1 | 351 | 160 | 90 | 15.1 | 0.40 | 3.9 |
| | Bed 4 | 6.5 | 0.2 | 2.2 | 326 | 163 | 52 | 9.5 | 0.36 | 3.4 |
| **II. Garacharama** | | | | | | | | | | |
| Coconut + spices block | 0-25 | 5.1 | 0.05 | 0.5 | 314 | 64 | 62 | 2.7 | 0.35 | 1.2 |
| | 25-50 | 5.0 | 0.03 | 0.5 | 305 | 62 | 50 | 2.8 | 0.91 | 1.9 |
| | 50-75 | 4.8 | 0.02 | 0.4 | 300 | 88 | 37 | 2.7 | 1.77 | 1.1 |
| | 75-100 | 4.6 | 0.02 | 0.4 | 300 | 45 | 28 | 2.6 | 0.46 | 0.4 |
| Tapioca block | 0-25 | 4.8 | 0.04 | 0.4 | 324 | 86 | 56 | 3.2 | 0.44 | 2.0 |
| | 25-50 | 4.9 | 0.03 | 0.5 | 314 | 81 | 37 | 3.1 | 0.37 | 0.1 |
| | 50-75 | 5.0 | 0.03 | 0.7 | 314 | 56 | 33 | 3.1 | 0.41 | 1.3 |
| | 75-100 | 5.0 | 0.02 | 0.7 | 291 | 34 | 30 | 3.0 | 0.49 | 1.3 |
| Pineapple block | 0-25 | 5.0 | 0.04 | 1.1 | 314 | 67 | 65 | 2.9 | 0.35 | 1.1 |
| | 25-50 | 5.2 | 0.04 | 0.8 | 564 | 133 | 43 | 2.76 | 0.32 | 0.5 |
| | 50-75 | 5.0 | 0.02 | 1.0 | 296 | 107 | 36 | 2.8 | 0.33 | 1.2 |
| | 75-100 | 5.2 | 0.01 | 0.9 | 285 | 66 | 271 | 2.9 | 0.49 | 0.8 |

**Table 11. Livelihood security under BBF based farming system in low lying valley**

| Farm produce | Gross area, $m^2$/ Unit size | % of total | Annual production (kg) | Estimated requirements of a Family (4 members) (kg) | Value of household consumption (Rs) | Surplus for sale (kg) | Gross value of surplus* (Rs.) |
|---|---|---|---|---|---|---|---|
| **A. Crop Production** | | | | | | | |
| **i) Cereals** (Paddy) | 2500 | 29.1 | 771 | 750 | 7500 | 21 | 210 |
| **ii) Vegetables** | | | | | | | |
| a. Okra | 3600 | 41.8 | 435 | 225 | 4500 | 553.2 | 11064 |
| b. Vegetable cowpea | | | 131 | | | | |
| c. Cucumber | | | 57.5 | | | | |
| d. Bitter gourd | | | 6.95 | | | | |
| e. Chillies | | | 4.25 | | | | |
| f. Radish | | | 143.5 | | | | |
| **Total** | | - | 778.2 | 225 | 4500 | 553.2 | 11064 |
| **iii) Dry fodders** | 2500 | 29.1 | 1900 | 1900 | 3800 | - | - |
| **Total A** | 8600 | 100 | - | - | 15800 | 574.2 | 11274 |

** Integration of dairy, vermicompost and fruits in borders of BBF are in progress.*

## Coconut + pig based farming system

Gravelly sandy clay texture was observed in the coconut + pig system at Garacharma farm. Assessment of initial soil properties indicated that the pH of the soil ranged from 4.6 to 5.2 while EC is in the range of 0.1 to 0.5 dS/m. Organic carbon content ranged from 0.47 to 1.14%. Available nitrogen is found to be in medium range while potassium is in low. Four pigs are found to be optimum for one ha plantation based on the requirement of energy for pigs and accordingly, pigs are identified for integration. Coconut plantations are intercropped with clove, nutmeg, colacasia, tapioca and pine apple for developing self sustainable farming system. Around 208 kg of tapioca harvested are made in to chips for drying and feeding to pigs.

Plate 11. View of the experiment at Garacharma and Coconut+Tapioca intercropping system

The initial moisture content is found to be 55% and after drying in hot air oven at 70$^0$C for 24 hrs, the final moisture content is 9% which is the safe moisture content to be stored for feed supplement to pigs. Colacasia also planted in terraces across the slope. Integration of other components is in progress.

Plate 12. Water harvesting system through farm pond and drying of tapioca for pig feed

## Energy and Mass Exchange in Vegetative Systems

***S.K.Ambast (PC), A.Velmurugan (PI) and T. Subramani***

Vegetation growth depends on its ability to capture and use solar radiation, $CO_2$, water and nutrients. The amount of solar radiation reaching at and within crop canopy is determined by atmospheric turbidity. Partitioning of surface insolation into direct and diffuse components has strong bearing on canopy photosynthetic rate depending on vegetation types. With the changing climatic scenarios it is imperative to document and understand the vulnerability of islands to such changes hence, a comprehensive study has been initiated with the collaboration of Space Application Centre (ISRO, Ahmedabad) to characterize atmosphere induced effect to vegetation productivity through modeling of energy, water and $CO_2$ exchanges at regional level using indigenously developed agro-meteorological tower. The major objectives are to analyze the interrelationship and change pattern of key surface radiation parameters, hydrological indicators and atmospheric gases on spatial scale; Modeling of atmospheric transmissivity and exchange processes through soil-plant-atmosphere-continuum (SPAC) over different vegetative systems; Upscaling using satellite data and generating enhanced data inputs for climate models.

An agro-meteorological tower has been installed (February 2011) at Keralapuram, Diglipur, North Andaman in a typical island agro-climatic conditions. The major land use of the site is rice-pulse, rice-vegetables surrounded by plantation crops and forests (Fig.11). It has a total of 21 sensors which directly measures 13 parameters *viz.*, air temperature, relative humidity, wind speed, atmospheric pressure, rainfall, incoming long wave & short wave radiation, outgoing long wave & short wave radiation, diffuse radiation, soil heat flux, soil temperature and soil moisture.

Immediately after downloading the data from the data logger, it is verified for the sensor performances and quality of the data recorded both at CARI, Port Blair and SAC, Ahmedabad which was found to be very good. Initial data analysis (11$^{th}$ February to 24$^{th}$ April 2011) has been carried out and the results

are given in Fig.11. A close look at the radiation parameters shows that the incoming short wave radiation is more than the out going short wave radiation while the incoming long wave radiation is less than the outgoing long wave radiation. Soil heat flux, soil moisture, air temperature, wind speed and RH are measured at three vertical intervals in soil and atmosphere. The results show that soil temperature is higher than the air temperature and in general the soil flux becomes positive when the surface soil moisture increases. Sensible heat flux and latent heat flux can be derived using Bowen ratio energy balance approach. The flux-gradient technique based on Fick's law of diffusion will be applied to model the mass, heat and vapour transfer against the aerodynamic resistance of the boundary layer. The observed parameters will be modeled to estimate the energy and mass exchange at the observational sites which can be upscaled using satellite derived inputs at regional scale. Also the log term observation and analysis of the data will be linked to the vegetation parameters of the study site. (Plate 13)

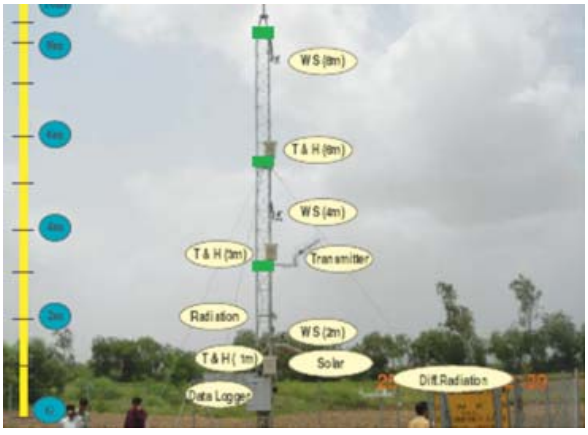



Plate.13. A view at the sensors mounted on the tower at Diglipur, N. Andaman

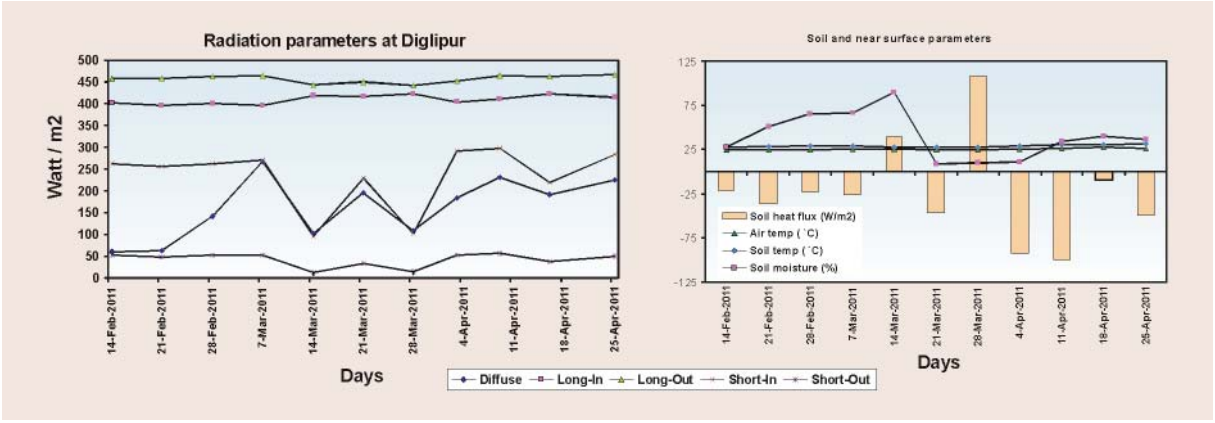



Fig.11. Trend in some of the observed parameters

# Division of Horticulture and Forestry

# Collection, Conservation, Characterization and Documentation of Indigenous Vegetables of Andaman & Nicobar Islands

*Shrawan Singh, D. R. Singh, V. B. Pandey, M. Balakrishnan, S. K. Zamir Ahmed, L. B. Singh and R. C. Srivastava*

A germplasm block of 15 indigenous vegetables was maintained with 77 collections from bay islands. Six new collections added to the germplasm block were *Tricosanthes tricuspidata* (2), *Hibiscus sabdariffa* var. *alba* (1), Red Alternanthera (1), *Momordica cochinchinensis* (small) (1) and *Mentha arvensis* (1).

## Antioxidant activity of indigenous vegetables

Antioxidant activity of ten indigenous vegetables was estimated through DPPH method with three different polar solvents viz. methanol, acetone and aqueous. Among three solvents used for extraction in the study, methanol performed well for scavenging DPPH free radicals. The highest antioxidant activity with methanol, acetone and aqueous solvents were estimated in *Portulaca oleracea* (89.03%, 85.77% and 80.13%) and *Sauropus androgynus* (85.63%, 81.07% and 79.27%), respectively. This is because of variations in type and concentration of phyotochemcals in these vegetables. Incubation period showed significant influence on antioxidant activity of methanol extracts of *Hibiscus sabdariffa* and *Sauropus androgynus* as it increased from 75.27 (10 min) to 83.13% (60 min) and 83.07 (10 min) to 93.07% (60 min), respectively (Fig. 1). *Portulaca oleracea* scavenged 89.27 percent of DPPH free radicals after 10 min of incubation in methanolic extract and further increase was insignificant.

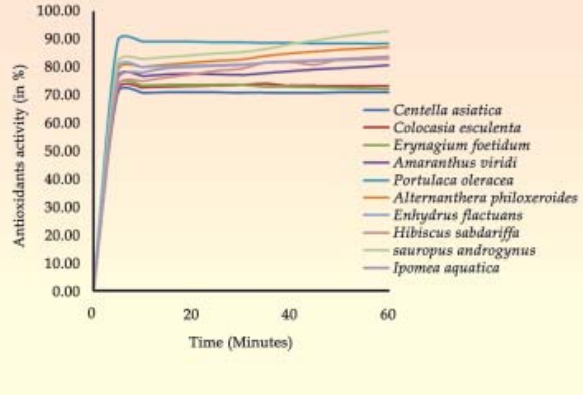



Fig. 1. Antioxidant activity of indigenous vegetables with increasing incubation period

## Anti-nutritional factors in indigenous vegetables

Anti-nutritional factors were analyzed on fresh weight basis in 24 traditional vegetables sources using titration methods (Fig. 2). The highest nitrate content was observed in *Colocasia esculenta* leaves (113.75mg/100g) and phytate content in *Eryngium foetidum* (41.4mg/100g). Oxalate content was highest in *Alternanthera phyloxeroids* (48.38mg/100g) and saponin content in *Cucurbita moschata* leaves (386.0mg/100g). Tannin content was highest in *Hibiscus sabdariffa* (107.56mg/100g) followed by *Portulaca oleracea* (88.94%). The contents of these antinutritional factors are high in vegetables but boiling processes reduces their contents by 67.7%, 28.5%, 12.12% and 9.6% of oxalate, saponin, phytate and nitrate, respectively and brought them to safe levels.

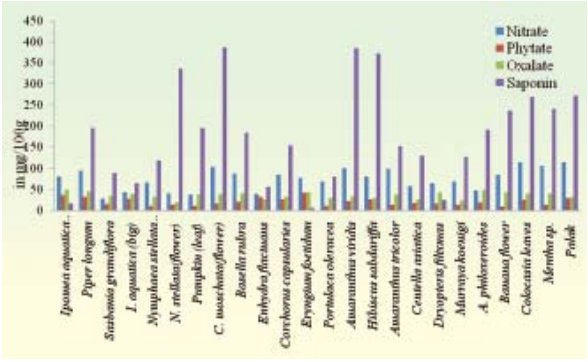



Fig. 2. Antinutritional factor in 24 traditional vegetable sources of islands

## Genetic diversity analysis of *Colocasia esculenta*

Genetic diversity analysis of local collections (21) and cultivated varieties (3) of *Colocasia esculenta* was done using DNA and morphological markers. For

this, 42 RAPD and 78 ISSR primers were screened and 11 RAPD and 20 ISSR markers were used in the study. In case of RAPD, 491 amplified fragments were obtained of which 70.67% were polymorphic. With ISSR markers, the collected samples amplified 2432 fragments of which 77.30% were polymorphic. The collections were grouped into two major clusters with both RAPD and ISSR markers with 56% and 57% diversity, respectively. High genetic diversity was revealed as the coefficient value ranged from 0.98 to 0.50. The distinct genetic diversity of *Colocasia esculenta* in Islands shows its potential use in germplasm enrichment and designing appropriate breeding strategies.

### Genetic diversity analysis of chilli germplasm

Twenty six accessions of chilli was collected from islands and analyzed for diversity using morphological and biomolecular markers. For this 16 genotypes/varieties collected from AICRP (vegetable crops) were also included in preset study. The collections were evaluated for 20 morphological markers and diversity in accessions was observed for all traits including fruit length (1.1- 7.5 cm), fruit girth (0.3- 1.6cm) and peduncle length (2.1-3.8cm). At molecular level, 30 RAPDs and 37 ISSR markers were screened in chilli germplasm and 5 RAPD and 5 ISSR markers showed polymorphic pattern. In 42 accessions of chilli, these polymorphic markers generated 920 and 1148 scorable markers, respectively. With RAPD markers (Plate 1) the diversity was observed to be 46% with polymorphic information content ranged from 0.33 to 0.43 while for ISSR markers (Plate 2) it was 52% with PIC value of 0.31 to 0.41. Dendrogram generated through RAPD markers showed four major clusters while ISSR markers grouped 42 collections into six clusters. The combined data analysis for both RAPD and ISSR markers (Fig. 3) showed five major clusters. Cluster-I (SPG-3) and II consists of one and nine accessions with intra cluster similarity 54 to 78%. Cluster-III consists of 5 accessions with intra clusters similarity 64 to 76 %. Largest numbers of accessions were grouped in Cluster-IV with 20 accessions including seven from mainland and 12 from Islands with intra cluster similarity 69 to 84 %. Cluster-V consists of 6 accessions including five from mainland and one from Island with intra cluster similarity 62 to 72 %. Biochemical markers viz. proximate and phytochemical compounds were evaluated in chilli collections. Free amino acids ranged from M-1 and CCG (0.20 mg LE/ml) to CCB-1 (3.46 mg LE/ml). Reducing sugar in germplasm ranged from 0.12 mg GE/100 ml (M-3) to 2.06 mg GE/100 ml (CCO) and non-reducing sugar from 1.59 mg GE/100 ml (CCO) to 4.07 mg GE/100 ml (CCR). Phytochemicals were estimated in collected accessions of chilli and polyphenol content was maximum in LMCF (74.15 mg GAE/100 g), flavonoids in CARI-1 (791 mg RE/100 g), tannin in CARI-1 (328.89 mg TAE/100 g) and anthocyanin in SPG-7 (41.68 mg C3GE/100 g), carotenoid in SPG-7 (552.69 mg/100 g) and chlorophyll in CARI-1 (579.47 µg/100 ml). Vitamin C content was maximum in SPG-6 (123.3 mg ASE/100 g). Anti-nutritional factors were also

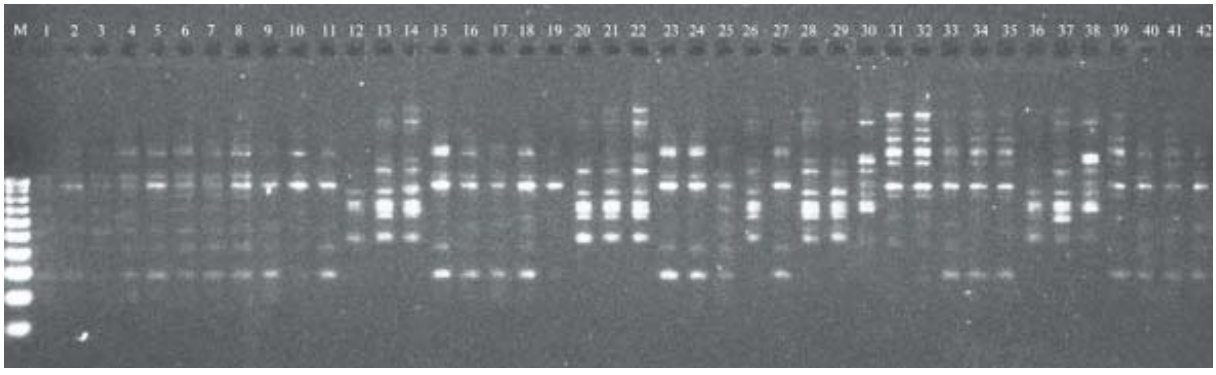



Plate 1. PCR profile of chilli germplasm using RAPD marker OPD-10

observed and nitrate content was maximum in CARI-1 (83.81 mg/100 g), phytate in LMCF (669 mg/100 g), oxalates in SPG-3 (9.5 mg/100 g) and saponin in M-2, G-1, H-1 and SPG-4 (95 mg/100 g). The maximum colour value was observed in SPG-3 (214.57 ASTA Units) while the minimum in LMCF (14.90 ASTA Units).

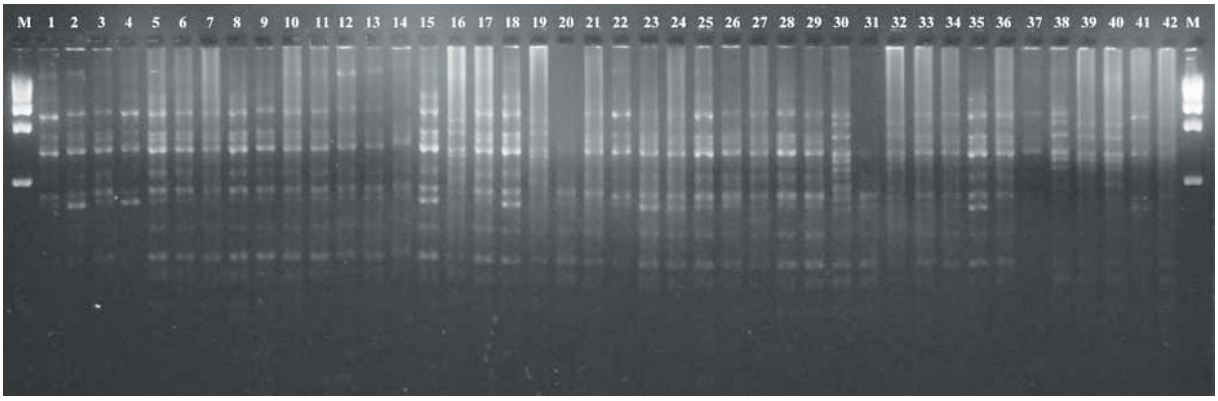
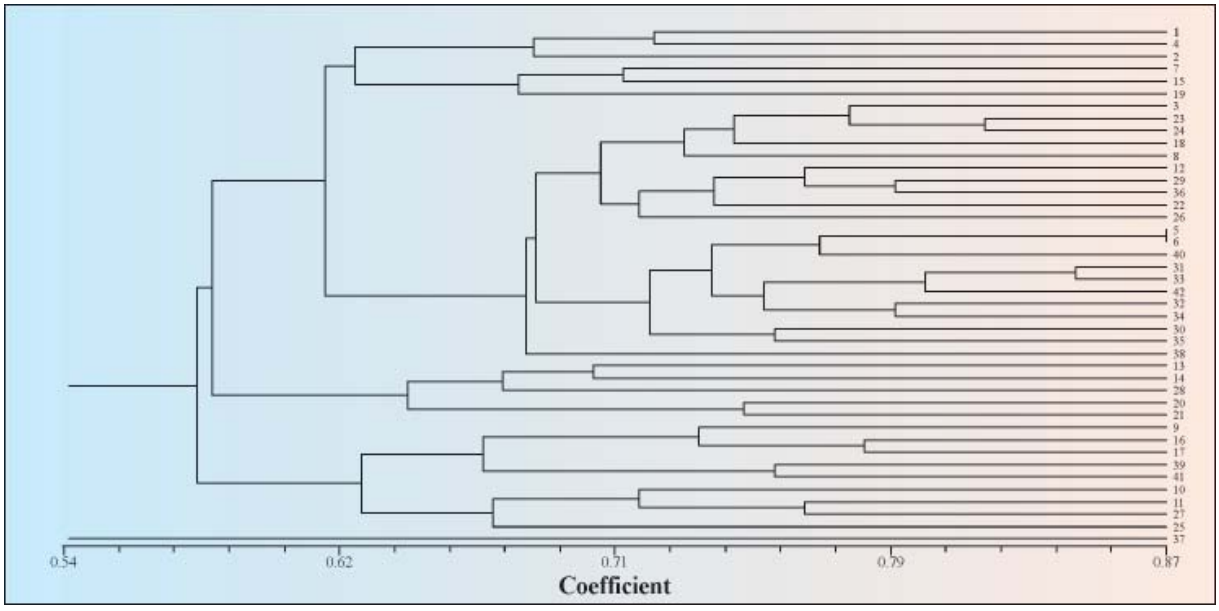



Plate 2. PCR profile of chilli germplasm using ISSR marker UBC-855




The genotypes/accessions given in order of 1 to 42 are CHIVAR-1, CHIVAR-3, CHIVAR-4, CHIVAR-5, CHIVAR-6, CA-334 and KA-2 (IET materials); CARI-1, CARI-2, M-1, M-2, M-3, N-1, G-1, G-2, H-1 and H-2 (CARI collections); CHIVAR-1, CHIVAR-2, CHIVAR-3, CHIVAR-4, CHIVAR-5, CHIVAR-6, CHIVAR-7, CHIVAR-8, LCA-334 (AICRP-VC AVT-II materials); CCB-1, CCB-2, CCB-3, CCW, CCO, CCR, CCLG, CCG, SPG-1, SPG-2, SPG-3, SPG-4, SPG-5, SPG-6, SPG-7 and LMCF (CARI collections).

Fig. 3. Dendrogram constructed for 42 accessions of chilli by RAPD and ISSR markers

**Characterization of phytochemicals**

Fruits of *Hibiscus sabdariffa* were fractionated into calyx, seeds and pericarp. The red coloured calyx dried and powdered (Plate 3) and anlysed for characterization of anthocyanin, phenolics and carotenoids using High Performance Liquid Chromatography (HPLC). The carotenoids characterization showed peaks for lutein, zeaxanthin, α-carotene and β-carotene content in red fruit fractions of *Hibiscus sabdariffa* (Fig. 4a). In phenolic acids, peaks were observed for vanilic acids, gallate, catachin-3-gallate, procatacheuic acids and

astaxanthin compounds (Fig. 4 b). Only one peak was observed for anthocyanin which was identified as procyanidin B2 through retention time analysis (Fig. 4 c).

*Momordica cochinchinensis* also fractionated into different parts (Plate 4) and seed membrane was analysed using HPLC. Carotenoids characterization showed peaks for lutein, α-carotene, cis-lycopene and trans-lycopene in fruit seed membrane fraction. In phenolic acids, peaks were observed for gallate and astaxanthin compounds. Only one peak was observed for anthocyanin which was identified as cyaniding-3-diglucoside-5-glucoside.

Plate 3. Fractions and processed product of Hibiscus sabdariffa

Plate 4. Fractions and processed product of Momordica cochinchinensis

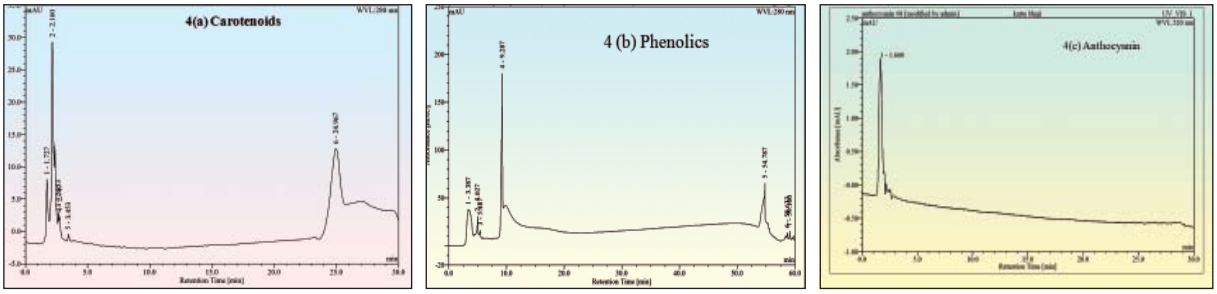



Fig. 4 (a, b & c). High performance Liquid Chromatograph (HPLC) graph for Hibiscus sabdariffa extract

## Improvement of indigenous vegetables

Superior genotypes were selected in *Eryngium foetidum*, *Centella asiatica*, *Hibiscus sabadriffa, Amaranthus* and *Capsicum annum*. One genotype of *Eryngium foetidum* CARI-Dhaniya-1 (Plate 5) has been developed through mass selection method and its proposal for release through SVRC has been submitted to the State Seed Sub Committee.

Plate 5. Promising line of Eryngium foetidum (CARI-Dhaniya-1) selected at CARI

# Standardization of Technologies for Protected Cultivation of Vegetable Crops under Bay Island Ecosystem

*Shrawan Singh, D. R. Singh, V. B. Pandey and Bijay Nanda*

## Evaluation of leafy vegetables

Seven leafy vegetables tested under shadenet and open conditions and maximum percent increase in plant height was recorded in *Basella rubra* (209.4 percent) and red amaranthus (175.1 percent) over open condition. The highest increase in total biomass per plant was recorded in red amaranthus and palak while tenderness was more in green amaranthus, *A. hybridus* and *Brassica compestris*. The vegetables were scored in scale of 1-5 of which 1 was highly tender and 5 was rigid/fibrous. Highest tenderness was observed in *Amaranthus viridis* followed by *A. hybridus* and *Brassica compestris*.

## Standardization of rooting media for tomato

A potted experiment on tomato with six treatments of rooting media viz. T1: Coconut husk: Vermicompost (1:1), T2: Coconut husk: Vermicompost: Soil (1:1:1), T3: Soil: FYM (1:1), T4: Coconut husk: Vermicompost: Lime (1:1:0.1), T5: Soil: Bleaching Powder (1:0.01) and T6: Control (only field soil) was started under polyhouse to study incidence of bacterial wilt. The minimum bacterial wilt incidence (20.0 %) was recorded in T4 (Coconut Husk + Vermicompost + Lime) media along with maximum root weight (186.7g/plant). Soil less rooting media in T4 avoided initial inoculum of wilt pathogen (*Ralstonia solanacearum*) and further improvement in rooting media pH through lime and coconut husk also reduced the wilt incidence significantly.

## Evaluation of green onion and carrot

Five varieties of onion viz. NHRDF Red, Agrifound Dark Red, Agrifound Light Red, Agrifound Rose and Agrifound White were evaluated in polyhouse for green onion purpose out of which two varieties viz. NHRDF Red (6.3t/ha) and Agrifound Dark Red (5.7t/ha) were found promising. IPC-HT-2 (4.9t/ha) and Pusa Harita (4.2t/ha) were found to be promising among five varieties of carrot brought from IARI.

## Variety x spacing trial of cauliflower

Two varieties of cauliflower White Marbal and White Shot were evaluated with four spacing levels under polyhouse condition (Plate 6). The highest yield of Cauliflower var. White Marbal was observed at spacing level of 45x30cm (22.4t/ha) which was significantly higher than 50x40cm (16.0t/ha) and 50x30 cm (17.4t/ha) while non-significant difference was observed with 40x30cm (21.4t/ha). Similarly, highest curd yield (17.73 t /ha) was recorded from cauliflower cv. White Shot transplanted at 45 x 30 cm spacing level followed by 50 x 40cm (14.09t/ha). (Table 1)


Plate 6. Field view of cauliflower trial



**Table 1. Performance of cauliflower varieties at different spacing levels in polyhouse**

| Variety | Spacing level | No. of leaves | Leaf weight (g) | Curd weight (g) | Stem weight (g) | Stem length (g) | Curd yield (t/ha) |
|---|---|---|---|---|---|---|---|
| White Marbal | 50x40cm | 21.2 | 560 | 300 | 106 | 18 | 16.02 |
| | 45x30cm | 22.0 | 395 | 337 | 68.6 | 14.4 | 22.47 |
| | 40x30cm | 23.2 | 320 | 286 | 73 | 14.8 | 21.45 |
| | 50x30cm | 18.4 | 410 | 290 | 87 | 17.4 | 17.40 |
| White Shot | 50x40cm | 16.6 | 333 | 313 | 75 | 17.8 | 14.09 |
| | 45x30cm | 17.4 | 305 | 266 | 70 | 16.4 | 17.73 |
| | 40x30cm | 19 | 270 | 161 | 58 | 17.2 | 12.07 |
| | 50x30cm | 15.8 | 268 | 203 | 59 | 17.6 | 12.18 |
| | SE(m) | 1.32 | 37.54 | 32.61 | 7.30 | 0.71 | 0.83 |
| | C.D.(P=0.05) | 3.86 | 109.33 | 94.95 | 21.26 | 2.09 | 3.58 |
| | C.V. (%) | 15.45 | 23.47 | 27.05 | 21.89 | 9.62 | 20.36 |

## Physiochemical and Molecular Characterization of Multiple and Single Season Flowering Genotypes of Mango

*Dipak Nayak, Shrawan Singh, M. Sankaran, D. R. Singh, V. Damodaran, Naresh Kumar and R. C. Srivastava*

A series of exploration were undertaken in different parts of south, middle and north Andaman districts to identify multiple and single season flowering genotypes of mango. Out of 136 genotypes identified, 47 genotypes were found multiple seasons flowering in nature (Table 2). The maximum number of multiple seasons flowering genotypes were obtained from South Andaman while minimum number from Middle Andaman. The entire identified genotypes will be taken for molecular characterization and genotypes identified from Port Blair areas will be taken to carryout the physiological and biochemical characterization. It was found that very few genotypes had good fruit quality and most of the identified genotypes were chance seedling in origin. Eight superior genotypes were selected on the basis of fruit quality parameters and among them three genotypes were multiple seasons and five genotypes were early flowering in nature.

**Table 2. Identification of multiple and single season flowering mango genotypes from Andaman**

| Districts of Andaman | Places | No. of identified genotypes | | Total number of identified genotypes | No. of identified superior genotypes |
|---|---|---|---|---|---|
| | | Multiple season flowering | Single season flowering | | |
| South Andaman | Port Blair | 12 | 22 | 34 | 1 |
| | Calicut, Pema, Bimblitan | 3 | 5 | 8 | 0 |
| | Burmanala, Kodyaghat | 3 | 6 | 9 | 1 |
| | Sipighat, Humfreygunj, Memio, Manglutan, Manjery | 4 | 12 | 19 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| | Lalpahar, Chouldari, Ograbranj, Tushnabad, Ferrargunj, Brindaban, Mathura, Shore point | 4 | 10 | 14 | 1 |
| Middle Andaman | Rangat, Nimbutala, Dashrathpur, Sabri, Bakultala, Shyamkund, Kadamtala, Baratang | 4 | 6 | 10 | 4 |
| | Mayabunder, Danapur, Pokodera | 4 | 4 | 8 | 1 |
| North Andaman | Kalipur, Shivpur, Durgapur, Aerial Bay, Keralapuram, RK Gram, D B Gram, Subhash Gram | 7 | 10 | 17 | 0 |
| | Madhupur, Laxmipur, Milan Gram, Swaraj Gram, Radhanagar, Shyamnagar, Hathilevel | 4 | 8 | 12 | 0 |
| | Kishorinagar, Naba Gram, Kalighat | 2 | 6 | 8 | 0 |
| **Total** | | **47** | **89** | **136** | **8** |

Characterization of selected superior genotypes has been done (Table 3 & Plate 7). The highest fruit weight (278.20 g) was recorded in DNP-Basanti while lowest in NBTL-SKS-3 (169.88 g). The genotype GCR-Balsan showed the maximum pulp content (193.43 g). The highest TSS (brix value) was recorded in KDG-Albi (23.42 $^0$B) while minimum in LPR-Mridha (20.60 $^0$B).

**Table 3. Characterization of superior mango genotypes for fruit quality**

| Genotypes | Place of collection | Fruit weight (g) | Pulp weight (g) | Stone weight (g) | Stone length (mm) | TSS ($^0$B) |
|---|---|---|---|---|---|---|
| DNP- Basanti | Danapur: N12$^0$53'49.4'' E92$^0$53'58.5'' | 278.20 | 168.42 | 44.89 | 80. 50 | 21.60 |
| NBTL-SKS-1 | Nimbutala: N12$^0$30'16.8'' E92$^0$57'11.9'' | 174.91 | 112.79 | 25.25 | 70.80 | 22.80 |
| NBTL-SKS-2 | Nimbutala: N12$^0$30'16.8'' E92$^0$57'11.9'' | 172.92 | 108.23 | 30.23 | 60.50 | 21.40 |
| NBTL-SKS-3 | Nimbutala: N12$^0$30'16.8'' E92$^0$57'11.9'' | 169.88 | 102.84 | 21.87 | 70.60 | 20.80 |
| GCR-Balsan | Garacharma | 275.91 | 193.43 | 33.60 | 86.50 | 22.50 |
| NBTL-Gouri | Nimbutala: N12$^0$30'16.8'' E92$^0$57'11.4'' | 197.24 | 122.21 | 34.91 | 80.50 | 21.40 |
| KDG- Albi | Kodyaghat : N11$^0$33'43.6'' E92$^0$43'16.9'' | 241.24 | 160 .72 | 34.87 | 86.50 | 23.42 |
| LPR-Mridha | Lalpahar | 218.50 | 129.70 | 36.47 | 81.50 | 20.60 |

The genotype KDG-Albi was early in maturity and ripened in the first week of March while others started ripening in the last week of March. In recent past, fruit borer and anthracnose emerged as major problems of mango grown in tropical humid conditions of Bay Island. Interestingly, all the identified superior genotypes were found free from fruit borer and anthracnose. These superior genotypes will be multiplied and conserved in our institute farm for detail study and future possible release as variety for Bay Island condition.

Multiple seasons flowering genotypes


Plate 7. Identified superior genotypes of mango from Islands

## Standardization of Technology for Production of Quality flowers under Island ecosystem

*Dipak Nayak, R. Sudha and V. B. Pandey*

### i) Gerbera

The performance of different varieties of Gerbera was studied for third consecutive year under protected condition. Observations on growth and reproductive parameters viz. plant spread, number of leaves/plant, stalk length, number of ray florets, number of suckers/plant, flower diameter and number of flowers/plant were recorded (Table 4).

The variety Lorca (69.57 cm) showed the maximum plant spread followed by Marinilla (69.47 cm), Galileo (68.27 cm) and Villsar (67.26 cm). The number of leaves per plant were recorded highest in var. Sonata (28.67 no.) which was at par with var. Judy (24.22) and Manizale (23.78). The longest stalk length was observed in var. Palmira (67.62 cm) while minimum in var. Lorca (44.47 cm). Variety Loriana (4.33) produced the highest number of suckers/ plant followed by Province (3.78) and Manizale (3.78). The largest size of flower was observed in var. Galileo (12.96 cm) followed by Palmira (12.77 cm) and Judy

(11.74 cm), while the maximum number of ray florets was observed in Judy (325.78). The variety Manizale (31.11) produced the highest no. of flowers per plant which was at par with var. Sonata (30.78) and Loriana (29.89) while minimum in Figaro (7.44).

**Table 4. Performance of gerbera varieties under protected condition in Bay Islands.**

| Varieties | Plant spread (cm) | No. of Leaves/ Plant | Stalk Length (cm) | No. of Ray Florets | No. of Suckers/ Plant | Flower Diameter (cm) | No. of Flowers/ Plant |
|---|---|---|---|---|---|---|---|
| Antonio | 63.01 | 16.56 | 50.76 | 219.44 | 2.78 | 10.27 | 9.56 |
| Figaro | 64.74 | 14.22 | 47.33 | 237.33 | 3.00 | 10.16 | 7.44 |
| Galileo | 68.27 | 16.33 | 54.92 | 228.33 | 3.44 | 12.96 | 20.00 |
| Judy | 62.47 | 24.22 | 46.11 | 325.78 | 2.89 | 11.74 | 7.56 |
| Lorca | 69.57 | 14.56 | 44.47 | 233.56 | 3.00 | 8.69 | 13.44 |
| Loriana | 66.29 | 11.89 | 50.92 | 155.33 | 4.33 | 11.32 | 29.89 |
| Manizale | 63.28 | 23.78 | 45.20 | 242.33 | 3.78 | 11.15 | 31.11 |
| Marinillia | 69.47 | 15.89 | 59.07 | 155.00 | 3.56 | 8.64 | 10.11 |
| Palmira | 55.33 | 15.56 | 67.62 | 230.00 | 3.00 | 12.77 | 14.33 |
| Pia | 63.99 | 13.22 | 56.68 | 188.33 | 3.56 | 9.09 | 23.11 |
| Province | 60.27 | 17.33 | 54.63 | 216.11 | 3.78 | 10.47 | 19.78 |
| Ravel | 61.94 | 19.78 | 52.2 | 214.00 | 3.22 | 10.61 | 14.78 |
| Sonata | 64.48 | 28.67 | 52.9 | 203.22 | 3.33 | 10.42 | 30.78 |
| Teresa | 63.2 | 14.11 | 52.42 | 163.56 | 3.33 | 11.00 | 15.33 |
| Villsar | 67.26 | 16.00 | 51.9 | 155.89 | 3.11 | 10.83 | 18.67 |
| Mean | 64.24 | 17.47 | 52.48 | 211.21 | 3.34 | 10.67 | 17.73 |
| Se(m) | 0.66 | 0.79 | 1.01 | 6.71 | 0.09 | 0.22 | 1.28 |
| Lsd @5% | 5.19 | 5.52 | 7.01 | 20.56 | 0.81 | 1.54 | 6.88 |

### ii) Rose

The varietal evaluation trial with seven cut flower roses was continued for the third year under protected condition. Data pertaining to third year observations are given in Table 5.

The plant height ranged from Tineka (36.95 cm) to Movie Star (94.65 cm). Maximum number of secondary branches was recorded in Tineka (5.89). Variety Tineka (5.51 cm) produced the largest flower followed by var. Biyanka (4.90 cm) and First Red (4.34 cm). The maximum no. of petals per flower was observed in Noble Se (22.89) while minimum no. of petals in var. Ravel (12.78). The longest flower stalk length was found in var. First Red (14.88 cm) followed by Grand Gala (14.42 cm) and Movie Star (14.36 cm).

**Table 5. Performance of rose varieties under protected condition in Bay Islands.**

| Genotypes | Plant Height (cm) | No. of Secondary Branches | No. of Flowers/ Plant | Flower Diameter (cm) | No. of Petals/ Flower | Stem Girth (cm) | Flower Stalk Length (cm) | No. of Buds/ Plant |
|---|---|---|---|---|---|---|---|---|
| Biyanka | 58.08 | 4.56 | 15.67 | 4.90 | 19.00 | 2.16 | 9.13 | 4.00 |
| Firstred | 67.58 | 4.78 | 22.89 | 4.34 | 13.22 | 2.86 | 14.88 | 4.00 |
| Grand gala | 43.44 | 4.00 | 14.78 | 3.87 | 15.56 | 2.17 | 14.42 | 2.78 |
| Movie star | 94.65 | 4.44 | 27.44 | 3.71 | 14.56 | 2.29 | 14.36 | 3.78 |
| Noble se | 51.24 | 4.67 | 12.00 | 3.67 | 22.89 | 2.41 | 13.04 | 3.11 |
| Ravel | 86.91 | 3.11 | 13.67 | 4.29 | 12.78 | 2.33 | 6.96 | 3.67 |
| Tineka | 36.95 | 5.89 | 29.00 | 5.51 | 18.44 | 2.12 | 12.51 | 3.56 |
| Mean | 62.69 | 4.49 | 19.35 | 4.33 | 16.63 | 2.33 | 12.19 | 3.56 |
| SE (m) | 4.58 | 0.27 | 1.50 | 0.19 | 0.81 | 0.09 | 0.66 | 0.15 |
| LSD @ 5% | 8.827 | 1.981 | 4.952 | 1.296 | 2.656 | 0.718 | 2.118 | 1.088 |

### iii) Tuberose

Observations on growth and reproductive parameters were taken to evaluate the performance of tuberose var. Shringar under the protected structure covered with 50% agro shed net and in open condition. The performance under protected conditions was better in terms maximum number of leaves (60.15), spikes/ plant (2.17), florets/ spike (22.17), length of spikes (60.15 cm) and florets diameter (23.78 mm) .

## Improvement of Coconut and Arecanut

***M.Sankaran, V. Damodaran, D.R.Singh, R.C.Srivastava, I.Jaisankar and L.B Singh***

About 24 exotic and 6 Nicobar accessions are being maintained at WCGC, Sipighat and all those accessions have been described with International Descriptor (COGENT) given by IPGRI (Plate 8). The parameters like weight of fruit (gm), length of fruit (cm), breadth of fruit(cm) ,thickness of husk (cm), weight of husk(gm), weight of nut(gm), volume of nut water(ml), volume of cavity(ml), thickness of kernel (cm), thickness of shell(cm) weight of wet kernel (gm), weight of shell(gm), weight of copra/nut(gm) oil percentage (%), free amino acid, leaf phenol, total sugar and reducing sugar were estimated with the use of standard procedure. Out of 30 accessions tested, about 8 accessions (14, 15, 16, 17, 20, 21, 27 &28) were found to be good and remaining 22 accessions were poor in terms of taste score given by the expert (Plate 9). Highest quantity of tender nut water recorded in accession 14 (915ml/nut), accession-28 (575ml/nut), accession-15 (547ml/nut) as compared to 117 ml/nut in *accession-8*. The accessions 14, 15 & 28 can be promoted for tender nut & copra production. The highest quantity of free amino acid was recorded in accession 15 (3.55 mg/ml) where as the lowest in accession 16 (1.31mg/ml) was recorded .The highest amount of total sugar was recorded in accession 7 (461.22mg/100ml) and lowest (218.96mg/100ml) in accession 15. Similarly, the total reducing sugar content was highest (328.89mg/100ml) in accession 21 and lowest (198.65mg/ml) in accession 18.

Plate 8. COGENT descriptor of CARI- Omkar

Plate 9. Organoleptic test for tender nut water

### Genetic diversity analysis of World Coconut germplasm by using RAPD Markers

The genetic relationship of 24 exotic collections and 6 indigenous accessions were analyzed by using the RAPD primers. Out of 35 primers tested, only 13 primers were amplified with the genomic DNA and shown the polymorphic patterns (Plate 10). The results reveal that the polymorphic information content (PIC) was highest with OPF-19 primer (0.86) and lowest PIC value (0.59).

The size of amplicon was varying from 100bp to 1395 bp with tested RAPD primers. However, the lowest amplicon (100bp) was observed with OPH-29 and the highest (1395) with OPF-1395 (Table 6). It was found that the primers such as OPF-19, OPF-13, OPF-20, OPH-25 & OPP-15 have shown polymorphism across the genotypes tested.

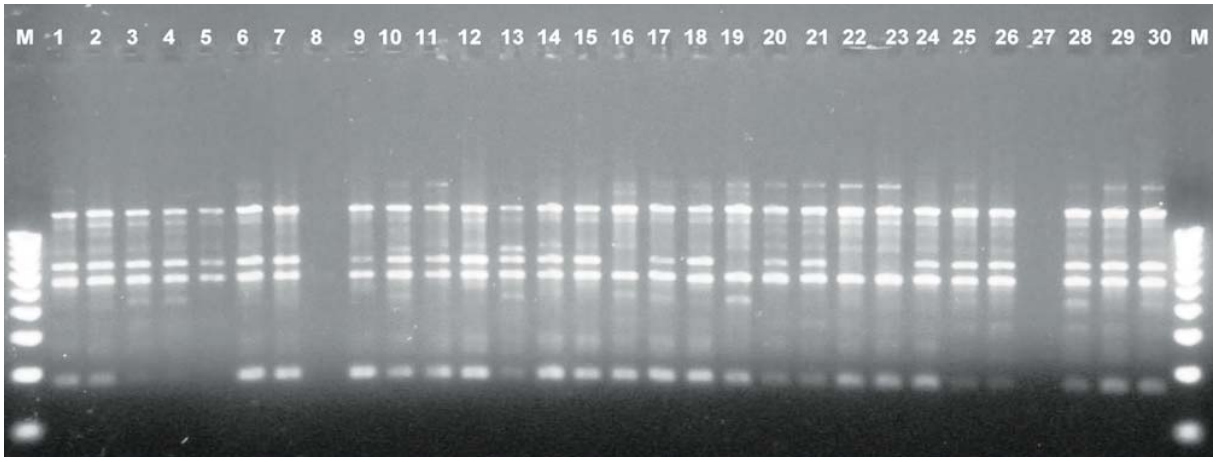



Plate 10. PCR profile of WCGC accessions by using RAPD primer OPF-19

**Table 6. Polymorphic information content and range of product size with RAPD primers**

| RAPD Primer | Sequence | Polymorphic (No.of accessions) | PIC Value | Product size |
|---|---|---|---|---|
| OPF-04 | GGTGATCAGG | 14 | 0.86 | 400-1100 |
| OPF-05 | CCGAATTCCC | 6 | 0.59 | 720-1300 |
| OPF-06 | GGGAATTCGG | 16 | 0.81 | 290-1210 |
| OPF-07 | CCGATATCCC | 21 | 0.76 | 350-665 |
| OPF-12 | ACGGTACCAG | 22 | 0.69 | 390-790 |
| OPF-13 | GGCTGCAGAA | 27 | 0.86 | 180-1070 |
| OPF-19 | CCTCTAGACC | 28 | 0.86 | 190-1395 |
| OPF-20 | GGTCTAGAGG | 23 | 0.76 | 185-1235 |
| OPH-28 | GGACCCAACC | 20 | 0.48 | 170-1200 |
| OPH-29 | CGCCCGTTCC | 6 | 0.24 | 100-1300 |
| OPH-25 | AGCGTCACCC | 23 | 0.47 | 500-1150 |
| OPH-24 | TCGCCGCCCA | 17 | 0.48 | 250-1000 |
| OPP-15 | GGAAGCCAAC | 22 | 0.49 | 250-1150 |

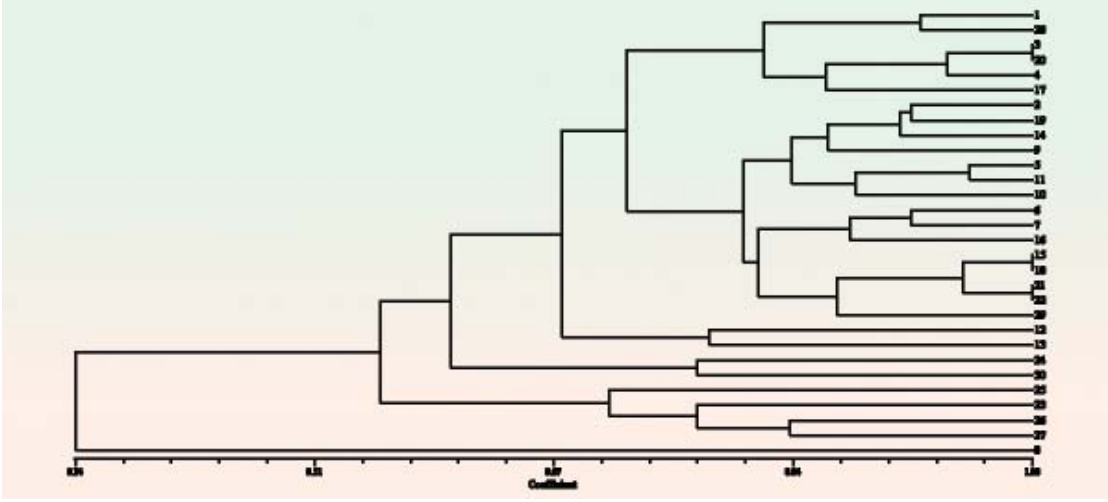


Fig 5. Dendrogram constructed for WCGC accessions by using RAPD primers

According the similarity matrix, it was found that the existence of huge variability among the accessions of WCGC (1-5 clusters) and some of the indigenous accessions (28 & 29) has shown high similarity with exotic accessions (Fig 5.)

### Genetic diversity analysis of areca nut by using RAPD primers

The genetic diversity of arecanut varieties such as Mangla, Samruddhi, CARI-Sel-1, Calicut-35, Calicut-1, Dwarf and Wild arecanut were done by using RAPD markers. Out of 30 primers tested, only 11 primers amplified. The highest number of bands was obtained with primer OPH-48 (48) followed by OPH-8 (47) and OPH-46 (46) (Plate 11) while minimum number of band was generated with OPH-41 (39). The maximum number of bands per marker per genotype was obtained from OPH-35 (4.8) followed by OPH-8(4.7) and OPH-46 (4.6) and OPH-42(4.5).

The highest PIC value was obtained (0.60) with OPH-35 followed by OPF-10 (0.44) where as the lowest PIC value was obtained in (0.17) with OPH-41 primer (Table 7).

**Table 7. Polymorphic Information Content and Range of amplicon obtained in Arecanut**

| Sl. No. | RAPD markers | Marker sequence (5' to 3') | PIC value | Range of amplicons in individual genotypes | Range of amplicon size (bp) |
|---|---|---|---|---|---|
| 1. | OPH-8 | GTCCGTACTG | 0.29 | 1-7 | 150-1000 |
| 2. | OPH-35 | CGATCGGGAA | 0.60 | 1-5 | 380-800 |
| 3. | OPH-41 | ATTTGATCGC | 0.17 | 1-8 | 300-1500 |
| 4. | OPH-42 | ACGCTGATCA | 0.28 | 1-6 | 270-1000 |
| 5. | OPP-46 | GCAGTACTCC | 0.29 | 1-6 | 300-1000 |
| 6 | OPF-1 | ACGGATCCTG | 0.38 | 1-9 | 200-800 |
| 7 | OPF-8 | GGGATATCGG | 0.30 | 1-12 | 250-1400 |
| 8 | OPF-9 | CCAAGCTTCC | 0.35 | 1-8 | 250-850 |
| 9 | OPF-10 | GGAAGCTTGG | 0.44 | 1-10 | 350-1050 |
| 10 | OPF-15 | CCAGTACTCC | 0.29 | 1-7 | 450-1500 |
| 11 | OPF-16 | GGAGTACTGG | 0.33 | 1-10 | 270-1080 |

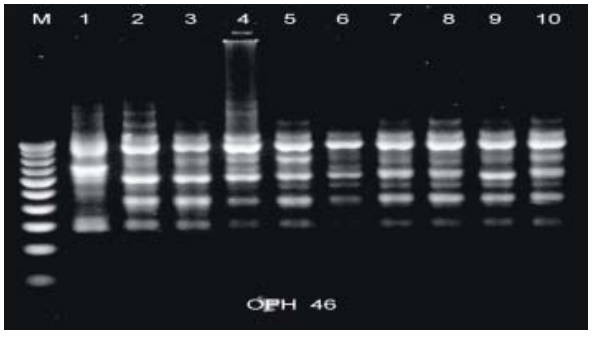
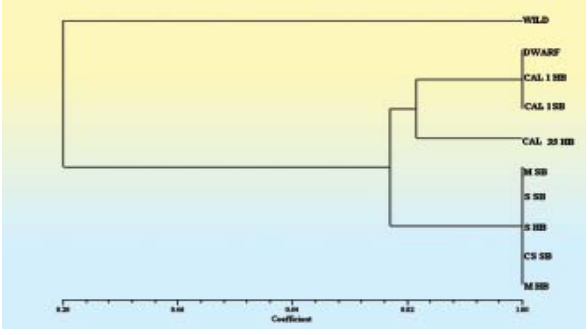



Plate 11. PCR profile of areca nut varieties by uisng RAPD primer (OPH-46)




( M- Mangla, S- Samrudhi, CS-CARI-Sel-1, SB-South Block & HB-Hill block)

Fig 6. Dendrogram constructed for arecanut varieties by using RAPD primers

The dendrogram shows that huge variability exists between wild arecanut and cultivated varieties (Fig. 6) It was found that CARI-Sel-1 is a natural cross between the Mangla and Samruddhi

### Performance of arecanut varieties at different locations of CARI

The yield and yield contributing traits of arecanut varieties such as CARI-Sel-1, Mangala, Samrudhi

and Calicut-35 were recorded from three blocks viz., Fodder block, Hill block and KVK block. The CARI-Sel-1 was found to be high yielding (421.70 nuts/palm) in all three blocks. The highest chali weight was recorded in Samrudhi (10.30 g/nut) followed by CARI-Sel-1 (9.60 g/nut) as compared to the Calicut-35 (7.60 g/nut). Similarly, the chali yield was found to be high in CARI-Sel-1 (4.40 kg/ palm) against the yield of Mangla (3.0 kg/ palm) as check .

## Identification, Evaluation and Development of Silvipastoral System for Bay Island Condition

***I. Jaisankar T.P. Swarnam S. Jeyakumar M. Sankaran and N.C. Choudhuri***

Three fodder grasses viz. Para ($G_1$), Guinea ($G_2$) and *Ischaemum rugosum* ($G_3$) were grown under the four indigenous fodder trees i.e. *Mussanda macrophylla* ($T_1$), *Treama tomentosa* ($T_2$), *Ficus hispida* ($T_3$), *Euphorbia sp.* ($T_4$) and open ($T_5$) under natural forest system and estimated the yield and other parameters at Garacharma farm (Plate 12).

Plate 12. Established fodder tree based silvipasture system at Garacharma farm

The results revealed that among the fodder trees *Ficus hispida* grew to the maximum height (9.0 m) which is significantly higher than the *Mussanda macrophylla* and the lowest height was recorded in *Treama tomentosa* (7.2 m) in natural condition. In respect of DBH, *Euphorbia sp.* registered higher value of 9.8 cm which was followed by *Ficus hispida* (8.1 cm). However, the number of branches per tree was highly influenced by the tree species. *Mussanda macrophylla* registered significantly higher number of branches (19.3) followed by *Ficus hispida* and *Treama tomentosa*. Average fodder yield of 31.8 kg/tree was recorded in *Ficus hispida* which was significantly higher than the *Mussanda macrophylla* (26.3 kg/tree). Though, the *Mussanda macrophylla* has recorded higher number of branches, the fodder yield is lesser than *Ficus hispida* mainly due to the higher leaf weight and number of leaves (Table 8).

The nutritional analysis of leaves indicated that *Ficus hispida* has higher crude protein (18.53 %) crude fibre (14.93 %), calcium (3.05 %) and phosphorus (0.34 %) content followed by *Trema tomentosa*. The *Trema tomentosa* has registered the higher gross energy value of 3753 kcal/kg and *Ficus hispida* 3627 kcal/kg of gross energy which indicates *Ficus hispida* could be a potential tree fodder source for cattle and goat particularly for lactating animals to improve milk yield and these tree fodders could be used as an ingredient for preparing the total mixed ration using locally available feed resources. Interaction between grasses and trees were significant for the parameters like height and number of tillers of the grasses. However, the yield of fodder grasses was not influenced either by trees or open condition. Grasses planted under the *Treama tomentosa* ($T_2$) have grown taller (131.1 cm) and recorded more number of tillers as compared to other fodder trees. Among the grasses, Para grass has grown taller (147.7 cm) with more number of tillers (15.8) and the lowest was



observed in *Ischaemum rugosum.* Similar trend was observed for yield of other fodder grasses. Growing of grasses in open condition recorded lowest yield of 151.1 t $ha^{-1}$ which might be due to the fact that these grasses develop higher biomass under shade condition. Among the grasses Guinea grass ($G_2$) registered highest yield of 209.2 t $ha^{-1}$ followed by Para grass (193.7 t $ha^{-1}$) irrespective of fodder trees. The interaction effect between trees and grasses are found to be insignificant. Under *Treama tomentosa* highest yield of grasses were observed (173.9 t $ha^{-1}$) and among the grasses Guinea grass recorded the highest yield of 224.0 t $ha^{-1}$(Table 9). During 2009-10 also it was observed that the performance of grasses was better under *Treama tomentosa*. Similarly Guinea grass performed better under all the treatments. In general the yield has increased in all the treatments in the second year due to recycling of nutrients from the leaves of the fodder trees.

Analysis of soil sample (0-30 cm) collected from different grasses grown under various fodder trees indicated that the available N, P and K varied from 161.3 to 175.2, 13.4 to 15.0 and 73.4 to 82.0 kg $ha^{-1}$, respectively. The available N was found to be significantly higher in open ($T_5$) condition and among the grasses $G_1$ and $G_3$ contains higher N than $G_2$. However, there is no significant difference in available P and K content under different grasses and fodder trees. The interaction effect under open condition ($T_5$) was found to contain significantly higher N than other treatments. The lower available N, P and K in Guinea grass ($G_2$) could be attributed to the higher biomass production of this grasses and higher removal of nutrients from the soil compared to the Para grass ($G_1$) and *Ischaemum rugosum* ($G_3$).

**Table 8. Growth and yield parameters of fodder trees**

| Treatments | Height(m) | DBH*(cm) | No. of branches | Ave. fodder yield kg/tree |
|---|---|---|---|---|
| *Mussanda macrophylla* ($T_1$) | 8.5 | 5.2 | 19.3 | 26.3 |
| *Treama tomentosa* ($T_2$) | 7.2 | 6.4 | 13.3 | 15.3 |
| *Ficus hispida.* ($T_3$) | 9.0 | 8.1 | 15.0 | 31.8 |
| *Euphorbia sp.* ($T_4$) | 7.6 | 9.8 | 11.0 | 14.0 |
| Mean | 8.0 | 7.3 | 14.6 | 21.8 |
| SEd | 0.7 | 0.2 | 1.0 | 2.3 |
| CD(P=0.05) | 1.6 | 0.5 | 2.3 | 5.1 |
| CV% | 12.3 | 4.4 | 9.7 | 14.7 |

* Diameter at Breast Height Level

**Table. 9 Effect of fodder trees on the growth parameters of fodder grasses (Average of seven cuttings)**

| Treatments | Height of the grass(cm) | | | | Number of tillers | | | | Yield (t $ha^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | G1 | G2 | G3 | Mean | G1 | G2 | G3 | Mean | G1 | G2 | G3 | Mean |
| *Mussanda macrophylla* ($T_1$) | 142.0 | 132.7 | 68.7 | 114.5 | 16.9 | 22.6 | 9.5 | 16.3 | 193.4 | 208.2 | 80.5 | 160.7 |
| *Treama tomentosa* ($T_2$) | 165.8 | 143.6 | 83.9 | 131.1 | 18.0 | 23.8 | 9.3 | 17.0 | 210.5 | 224.0 | 87.4 | 173.9 |
| *Ficus hispida* ($T_3$) | 165.0 | 133.8 | 62.6 | 120.4 | 17.0 | 24.1 | 8.8 | 16.6 | 191.1 | 209.8 | 92.1 | 164.3 |
| *Euphorbia sp.* ($T_4$) | 170.3 | 127.2 | 53.3 | 117.0 | 15.5 | 23.7 | 9.0 | 16.1 | 194.9 | 207.6 | 94.2 | 165.5 |
| open ($T_5$) | 95.6 | 127.4 | 56.8 | 93.2 | 11.4 | 16.7 | 6.7 | 11.6 | 178.5 | 196.5 | 78.4 | 151.1 |
| Mean | 147.7 | 132.9 | 65.1 | 115.2 | 15.8 | 22.6 | 8.6 | 15.5 | 193.7 | 209.2 | 86.5 | 163.1 |
| | CV=6.7% | | | | CV=4.4% | | | | CV=5. 6% | | | |
| | SEd | | CD(P=0.05) | | SEd | | CD(P=0.05) | | SEd | | CD(P=0.05) | |
| Tree (T) | 3.7 | | 7.4 | | 0.3 | | 0.7 | | 3.3 | | 6.7 | |
| Grass(G) | 2.8 | | 5.7 | | 0.3 | | 0.5 | | 2.6 | | 5.2 | |
| TG | 6.3 | | 12.8 | | 0.6 | | 1.2 | | 5.8 | | NS | |

G1: Para grass G2 : Guinea G3 : Ischemum rugosum

# Standardization of agrotechnique for organic black pepper cultivation in A&N Islands

*I.Jai Sanker, Krishna Kumar and S. Bhagat*

An experiment was laid out in randomized block design with four replications to standardize the organic source of nutrients for organic cultivation of black pepper under coconut based intercropping system (Plate 13). The treatments comprised of Vermicompost+Biopotash (T1), recommended dose of NPK (T2), Vermicompost (T3), Gliricidia leaf manure (T4) and Control (T5). The organic sources were estimated for nutrients level to supply the recommended dose of NPK to black pepper (100:40:140 g/ vine) and coconut (500:320:1200 g/tree) respectively. The results revealed that the growth and yield of black pepper was highly influenced by application of organic amendments along with inorganic nutrients. The highest number of vines, fruiting branches and total spikelet (17.5, 104.8 and 209.3 respectively) were recorded under inorganic NPK application, which is on par with the application of vermicompost + Bio potash and vermicompost alone. The growth attributes yield attributes such as berries weight/ Spikelet in terms of fresh and dry weight (18.3g and 5.5g respectively) were also recorded higher in inorganic NPK followed by vermicompost and bio potash(18.0g and 5.3g respectively). Application of inorganic NPK (420.8 kg $ha^{-1}$) resulted in significantly higher in black pepper yield followed by T1 (398.4 kg $ha^{-1}$). This might be due to the quick release of nutrients from the inorganic sources as compared to organic sources. Control recorded the lowest yield of 161.6 kg $ha^{-1}$. Application of organic and inorganic nutrients along with spray formulation significantly influenced the growth and yield attributes of black pepper. The application of spray formulation with organic and inorganic nutrients resulted in improved growth and yield attributes of black pepper which is evident that inorganic NPK + Bordeaux mixture registered the maximum total yield of black pepper by registering 473.0 kg $ha^{-1}$ followed by NPK + Neem Leaf Decoction and NPK + Biopotash + Pseudomonas. The lowest total yield of 148.9 kg $ha^{-1}$ was recorded in control (Table 10.).

Plate 13. Black pepper on Gliricidia standards as intercrop of coconut garden

**Table 10. Effect of organic and inorganic nutrients along with spray formulations on the growth and yield of black pepper**

| Treatments* | No. of vines/ 1m ht | No. of fruiting branches | Total spikelet /tree | Fresh spikelet wt (g) | Dry spikelet wt (g) | Total yield (Kg/ha) |
|---|---|---|---|---|---|---|
| Vermicompost+BP +NLD($T_1$) | 15.3 | 99.7 | 207.7 | 18 | 5.3 | 403.1 |
| Vermicompost+BP+BM($T_2$) | 18.7 | 105.3 | 215.7 | 22 | 5.5 | 429.1 |
| Vermicompost+BP+ Pseudomonas ($T_3$) | 13.3 | 97 | 207 | 18.3 | 5.8 | 439.6 |
| NPK+NLD($T_4$) | 17 | 107 | 213.7 | 21 | 5.9 | 458.9 |
| NPK+BM ($T_5$) | 19.3 | 110.3 | 219 | 27.3 | 5.9 | 473 |
| NPK+Pseudomonas ($T_6$) | 16.3 | 105 | 210 | 22.7 | 5.6 | 425.61 |
| Vermicompost+NLD ($T_7$) | 14.3 | 91 | 153 | 15.3 | 3.8 | 211.7 |
| Vermicompost+BM($T_8$) | 15.3 | 89.7 | 159.7 | 19 | 5.2 | 302.4 |
| Vermicompost+Pseudomonas ($T_9$) | 12.3 | 88.3 | 150 | 15.7 | 4.2 | 227.6 |
| Gliricidia leaf+NLD ($T_{10}$) | 12 | 72.3 | 148.7 | 15 | 3.9 | 210.9 |
| Gliricidia leaf+BM($T_{11}$) | 11.7 | 71 | 149.7 | 15.3 | 4 | 216.3 |
| Gliricidia leaf+Pseudomonas ($T_{12}$) | 10.3 | 61 | 112.3 | 14.7 | 4.4 | 181.3 |
| Control ($T_{13}$) | 9.3 | 51.3 | 99 | 13.7 | 4.1 | 148.9 |
| SEd | 0.7 | 2.2 | 3.8 | 0.8 | 0.2 | 13.4 |
| CD (0.05%) | 1.4 | 4.5 | 7.8 | 1.6 | 0.4 | 27.7 |
| CV% | 5.8 | 3.1 | 2.7 | 5 | 4.4 | 5.2 |

*BP- Biopotash; NLD-Neem Leaf Decoction; BM-Bordeaux Mixture

## AICRP on Tuber Crops

***M. Sankaran, V. Damodaran, D.R. Singh and R.C. Srivastava***

The collection, conservation, characterization, cataloguing of different types/ cultivars of genetic resources of root and tubers were done (Plate 14 & 15). About 11 different types *Dioscorea* sp *Amorphophallus carnosus*, *Amorphophallus muelleri, Amorphophallus longistylus* and 4 cultivated types have been identified and planted at Garacharma farm for multiplication.

*Amorphophallus carnosus* *A.carnosus* *A.companulatus*

Plate 14. Amorphophallus diversity from Islands

Plate 15. *Dioscorea* diversity from Islands

## Molecular Characterization of *Dioscorea* sp by using RAPD

Out of the 15 RAPD primers screened for polymorphism survey in pooled DNA of 14 varieties of *Dioscorea* sp. In tuber crops sample collections, 8 primers were amplified while 7 primers were not amplified and showed polymorphic bands (Plate 16). These 7 polymorphic primers were used for generating molecular data for genetic diversity analysis of *Dioscorea* sp (Table 11.).

**Table 11. RAPD primers and their polymorphic information content used in *Dioscorea* sp.**

| Sl. No. | RAPD markers | Marker sequence (5' to 3') | PIC value | Range of amplicons in individual genotypes | Range of amplicon size (bp) |
|---|---|---|---|---|---|
| 1 | OPH-8 | GTCCGTACTG | 0.32 | 1-9 | 100-1100 |
| 2 | OPH-35 | CGATCGGGAA | 0.35 | 1-6 | 350-800 |
| 3 | OPH-44 | TGCCCTGCCT | 0.43 | 1-7 | 200-1000 |
| 4 | OPH-46 | GCAGTACTCC | 0.35 | 1-11 | 300-1200 |
| 5 | OPP-15 | GGAAGCCAAC | 0.44 | 1-10 | 200-1000 |
| 6 | OPF-14 | TGCTGCAGGT | 0.41 | 1-3 | 400-600 |
| 7 | OPF-16 | GGAGTACTGG | 0.28 | 1-8 | 350-1000 |

In 14 accessions of Dioscorea sp, the highest number of bands was obtained with primer OPH-35 (60) followed by OPP-15 (58) OPH-46 (42) and OPH- 44 (32) OPH-8 (26) OPH-16 (21) while minimum number of band was generated with OPH-14 (15). Maximum number of bands per marker per genotype was obtained from OPH-35 (4.3) followed by OPP-15 (4.1) and less number of bands were generated by OPH- 14 (1.1). The amplicon size from all 5 studied primers was ranged from 100 to 1200 bp.

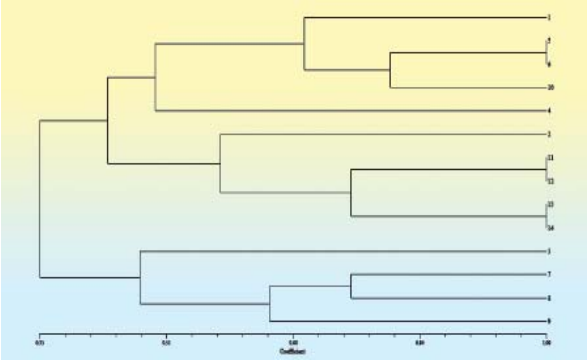


Fig. 7. Dendrogram constructed for Dioscorea sp. by using RAPD primers

Above dendogram shows the value of genetic variation and similarity between 14 verities of Dioscorea sp. value range between 0.13 - 0.34. Other 4 cluster species were mostly related range between 0.53 -0.71. Another 5 cluster in sub group related range between 0.68- 1.0.

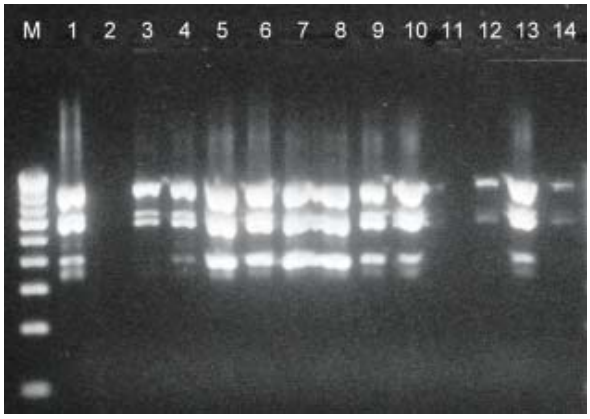



Plate 16. PCR profile of Dioscorea sp. by using RAPD primers

## Molecular Characterisation of Amorphophallus sp. by using RAPD primers

About ten tuber samples (varieties/local types) of elephant foot yam were collected from polyhouse at horticulture farm, CARI, Andaman, India. This was amplified with 5 RAPD primers to ascertain the level of genetic diversity within different germplasm different geographical regions. A total of 158 bands RAPD loci were scored (Plate 17 & 18). The primers such as OPH-36, OPH-8, OPH-46, OPF-12 & OPF-10 have shown the polymorphism. The PIC value is ranging from 0.36-0.42 and maximum no. of scorable bands obtained with OPH-46 (52) & OPH-8 (52).

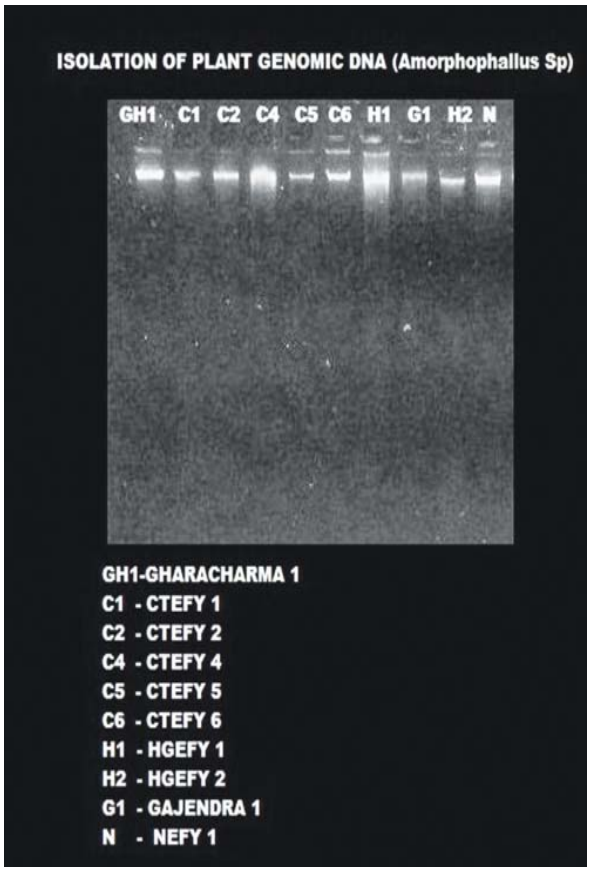



Plate 17.Genomic DNA obtained from corm

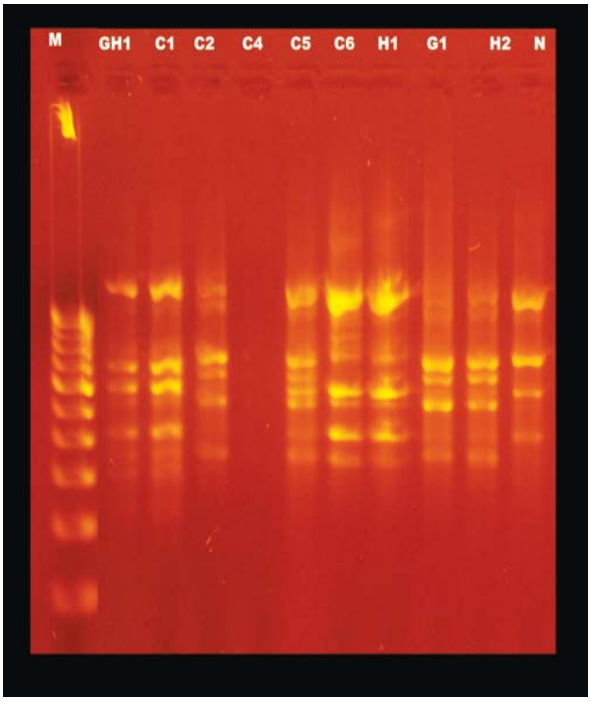



Plate 18. PCR profile of Amorphophallus sp

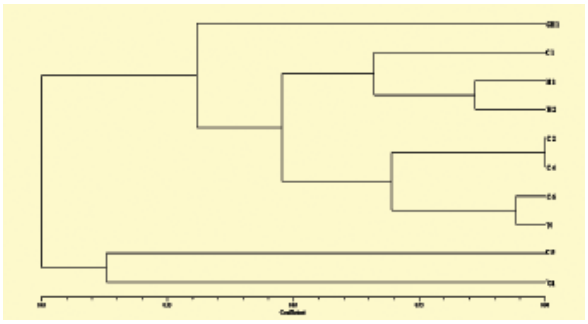


Fig 8. Dendrogram constructed for Amorphophallus sp. by using RAPD primer

The *A.carnosus* (H1) ,*A.muelleri* ( H2), *A.longistylus* are in cluster -2 and all local types & cultivated are in cluster 3 which shows the occurrence of variability (Fig 8).

## All India Coordinated Research Project on Vegetables

***Shrawan Singh, D.R. Singh and V. B. Pandey***

Evaluation of 30 entries of brinjal showed that three entries in resistant trial *viz*. BRBWRES5 (IET -BW) (0.19 kg/sq m), BRBWRES2 (AVT-1 BW) (0.18kg/sq m) and BRBWRES5 (AVT-1 BW) (0.17kg/sqm) performed well upto two harvests. While in varietal evaluation trials (IET Long and IET Round), heavy incidence of bacterial wilt (23.81 to 95.24%) and fruit borer (44.0 to 100.0%) was observed. The wilt incidence in resistance trial was highest in BRBWRES3-IET (96.67%) while minimum in BRBWRES1-AVT-1 (11.67%). In varietal evaluation trial, wilt was maximum in KS 224 -IET Round (94.24%) and minimum in BLB 11 -IET Long (23.81%).

Evaluation of 17 entries of chilli showed that 11 entries were severely damaged by wilt incidence (>50% incidence). However, initial yield observations showed that CA 334 (70g/sq m), CHIVAR 1 (69g/sq m), CHIVAR 3 (62.67g/sq m) of IET trial and CHIVAR 5 (61.36g/sq m) and CHIVAR-2 (40.54g/sq m) of AVT-1 are performing well.

Under germplasm collection and evaluation, two collections of each *Trichosanthes tricuspidata* (2) and *Momordica cochinchinensis* (One), *Luffa spp*. (two) were collected from Islands and sown for evaluation. The collected wild fruits of *Trichosanthes tricuspidata* (Plate 19) were fractionated into different parts and evaluated for biochemical parameters. *Tricosanthes tricuspidata* was analyzed for phytochemicals and antinutritional factors using standard protocols. It was observed that pulp portion contains high amount in tannin (703.09 mg/100g), carotenoid (350.65 µg/100ml) anthocyanin (226.35 mg/100g) and vitamin C (187.78 mg/100g) while polyphenol (323.70 mg/100g) and flavonoid (269.66 mg/100g) are rich in pericarp fraction of fruits. The antioxidant activity was found to be maximum for methonolic extract of pericarp fraction of fruits (81.15%). Among antinutritional factors, phytate content was highest in pulp fraction while saponin and nitrate in seeds 109.3 mg/100g and 23.3 mg/100g, respectively. The oxalate content was maximum in pericarp fraction of the *Trichosanthes* fruits (38.5 mg/100g). The phytochemical composition of different parts shows potential for extraction of specific compounds for health purpose from this unexplored species.

Plate 19. Fractionation of Trichosanthes tricuspidatafruits collected from Island



# Technological Innovations for Commercial Exploitation of *Morinda Citrifolia* as a Livelihood for Island Farmers (NMPB)

*D.R. Singh, R.C. Srivastava, Shrawan Singh, Jai Sunder, Subhash Chand and Krishna Kumar*

## Standardization of planting geometry

Three different treatments viz., removal of all branches except 3 pairs of branches from lower end ($T_1$), removal of all branches except 4 pairs of branches from lower end (($T_2$) while treatment $T_3$ is removal of all branches except 5 pairs of branches from same were designed. The highest yield was observed from T3 (3.34 kg/plant/quarter) which is statistically at par with T2 (2.99 kg/plant/quarter). The T3 treatment produced maximum number of fruits (33.75/plant/ quarter) which was statistically not significant over T2 (33.5/plant/quarter). Better performance of T2 was observed from tertiary branches with more number of fruits (2.43fruits/ branch/quarter) followed by T3 (1.87 fruits/tertiary branch/quarter).

## Standardization of plant canopy architecture

The experiment on standardization of plant canopy architecture was conducted with six treatments *viz.*, alternate removal of branches ($T_1$), alternate removal of branches + removal of main stem tip ($T_2$), removal of main stem tip only ($T_3$), removal of main stem tip + cutting of 50% of each leaf ($T_4$), removal of main stem tip + cutting of tip of each branch ($T_{5)}$ and one consequence cutting ($T_6$). The highest yield was recorded from T2 (2.59 kg/plant/quarter) followed by T4 (2.45 kg/plant/quarter).

## Influence of spacing on yield of *Morinda citrifolia*

The crop geometry experiment with five spacing levels viz. 1 x 1m, 1.5 x 1.5m, 2 x 2m, 3x3m and 4x4 m was conducted with five replications and yield parameters were observed. The highest fruit yield was observed from 4x4 m spacing level (1.57 kg/ plant/quarter) followed by 3x3 m (1.11 kg/plant/ quarter). However, the plants grown at 3x3 m spacing level performed well for plant growth parameters and plant stature. The interaction between spacing levels and canopy architecture showed that 4 primary branches/plant with 4 x 4 m spacing level produced highest fruit yield (1.41 kg/plant/quarter) followed by 3 primary branches with 4 x 4 m spacing level (1.34 kg/plant/quarter).

## Influence of canopy architecture on *Morinda citrifolia* in intercropping systems

Among three treatments on canopy architecture in Arecanut+ Noni system, 4 primary branches/plant produced maximum number of fruits (7.50fruits/ plant/quarter) followed by 3 primary branches/plant (7.45fruits/plant/quarter). However, the highest fruit yield was observed from plants with 3 primary branch (0.69kg/plant/quarter) followed by plants with 4 primary branches (0.59kg/plant/quarter). In similar kind of experiment in Arecanut+Noni+ Banana system, the highest yield was recorded in plants with 3 primary branches (0.78kg/plant/ quarter) which was significant than 4 and 3 number of primary branches (0.64kg/plant/quarter). However, the observations need to be continued for two more years to confirm the findings.

## Influence of different organic sources on *Morinda citrifolia* in sloppy lands

The study on influence of different organic sources of nutrients on noni was started with six number of treatments viz. T1 (poultry manure), T2 (goat manure), T3 (Farm yard manure), T4 (Gliricidia leaves), T5 (coconut husk) and T6 (Arecanut husk) and one control in sloppy land. The yield parameters were recorded at quarterly interval. It was observed that T2 performed well in June month for fruit yield (1.66 kg/plant/quarter) and fruit numbers (15.84/ plant/quarter). In December, the fruit yield was highest in T1 (1.01 kg/plant/quarter) followed by T2 (0.95 kg/plant/quarter). The variations might be

due to difference in decomposition and nutrient release properties of these two sources. The yield from other sources as well as control was significantly less than poultry manure and goat manure.

### Evaluation of bush type accessions of *Morinda citrifolia*

The highest fruit yield was observed in TRA-II (3.03kg/plant/quarter) followed by TRA-I (2.92kg/plant/quarter) and TRA-IV (2.9kg/plant/ quarter). However, the number of fruits were highest in TRA-IV (44.0 fruits/plant/ quarter) followed by TRA-I I (43.87 fruits/plant/ quarter). The yield difference is due to small size of fruits in TRA-IV than TRA-II. The consistency in above bearing nature of plants was observed to be more in TRA-II and TRA-III.

Phytochemical characterization using High Performance Liquid Chromatography (HPLC) was done in TRA I and TRA II accessions and it was observed that major Anthocyanins in TRA-I were Procyanidin, Procyanidin B3, Pelargonidin 3-glucoside, Cyanidin 3-diglucoside-5-glucoside, Cyanidin-3-glucoside, Pelargonidin, Peonidin, Malvidin and Delphinidin-3-glucoside while in TRA-II only one Procyanidin B2 compound was identified. Among Carotenoids, Leutin and Zeaxanthin were observed in both accessions. The phenolics characterization showed that Procatechuic acid, Procyanidin B3, Epigallocatechin gallate, Catechin-gallate, Naringin and Vanilic acid compounds were present in TRA-I while Procatechuic acid and Procyanidin B3 were reported in TRA-II.

### Evaluation of ecotypes of *Morinda citrifolia*

The evaluation of 40 ecotypes of *Morinda citrifolia* was done for yield and other parameters. Three categories for fruit size (small- 50-100g; medium-100-150g and big- >150g) were made to characterize ecotypes. Maximum ecotypes produced fruits with small and medium category. Six ecotypes *viz*., MC1, MC2, MC5, MCB3, MCA2 and MCA5 did not produce big sized fruits. The promising ecotypes were identified as MCB-1 (3.12kg/plant/quarter), 3S1 (2.73kg/plant/quarter), 4S1 (2.70kg/plant/quarter), MC-5(2.36kg/plant/quarter) and 3S5 (2.34kg/plant/quarter). Further evaluation of ecotypes for yield and other traits is under progress.

The highest total polyphenol content was observed in HDT-66 (856.18 mg/100g) and the lowest was observed in MCB-1 (226.80 mg/100g). The total anthocyanin content was found to be highest in MCB-1 (960.18 mg/100g), carotenoids in 4S-1 (64.76µg/ml) and flavonoid in 1S-5 (291.5 mg/100g). The tannin content was maximum in 1S-5 (927.78 mg/100g) while ascorbic acid was maximum in MC-5 (145.25 mg/100g). The antioxidant activity of fruit extracts was estimated to be highest in 1S-2 (94.53%).

### Evaluation of Nicobar collections

The *Morinda citrifolia* accessions collected from Nicobar Islands showed large variation for growth parameters. The maximum increase in plant height was observed in Nic 14 (344.76%) followed by Nic 17 (146.11%), while minimum growth rate was recorded from Nic 11 (28.57%). Similar pattern was observed for stem girth and number of leaves in Nic 14. However, number of primary branches were recorded maximum in Nic 11 (3.5/plant) followed by Nic 17 (3.33/plant). The fruit bud differentiation and fruiting was observed only in two accessions namely Nic 11 and Nic 17. The initial observations from the collected materials showed great variation for growth rate which can be good indication for identifying suitable dwarf lines/accessions for breeding purpose.

### Estimation of bioactive compounds in different parts of *Morinda citrifolia*

Phytochemicals estimation in different parts of *Morinda citrifolia* showed that antioxidant activity was highest in fruit pulp (74.39%) which may be due to high polyphenols (250.66 mg/100g) and ascorbic acid (149.54 mg/100g) content in fruit pulp as both compounds have strong positive correlation with antioxidant activity. Anti-nutritional factors were estimated to be highest in branch portion viz. nitrate (24.29 mg/100g), oxalate (41.10 mg/100g) and

phytate (520.03 mg/100g) while saponin was maximum in immature fruit (235.98 mg/100g). Immature fruits contains lowest amount of nitrate (17.26 mg/100g), phytate (369.63 mg/100g) and oxalate (29.21 mg/100g). Differences in physiological role and polarity of parts in plant system may be the reason for variations in phytochemical constitution in different parts.

### Anti-nutritional factors in 33 accessions

Estimation of anti-nutritional factors in 33 accessions of *Morinda citrifolia* revealed that nitrate content was highest in HD-6 (98.80 mg/100g) and lowest in MEM-3 (22.23 mg/100g). Maximum phytate content was observed in CHTAP-13 (967.98 mg/100g) and lowest in TRA I (185.06 mg/100g). Oxalate content was found be highest in ABF-1 (67.05 mg/100g) and the lowest in LH-12 (30.15 mg/100g) and saponin content was maximum in LH-12 (440 mg/100g) while lowest in LH-1 (130 mg/100g).

### Diversity analysis in superior clones of *Morinda citrifolia*

Genetic diversity in superior clones of *Morinda citrifolia* was estimated using RAPD and ISSR markers. For this, 52 RAPD and 63 ISSR markers were screened and 16 RAPD and 5 ISSR markers showed polymorphism. The banding pattern of RAPD (Plate 20) and ISSR (Plate 21) markers was analyzed and accessions were scored for presence and absence of bands. The combined data for RAPD and ISSR markers were analyzed and Dendrogram was constructed (Fig. 9). Two major clusters were observed with 36 percent similarity. FRW-14 was found to distinct accession of *M. citrifolia*. The remaining accessions were grouped into two clusters with 45 percent similarity. MEM-3 and MANJ-9 were found to most similar clones in the pool of superior clones of *M. citrifolia*.

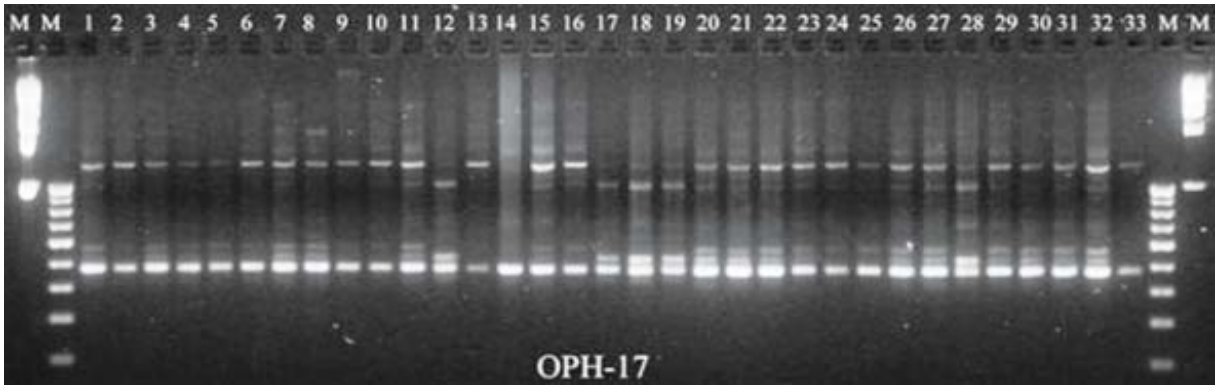



Plate 20. Banding pattern of RAPD markers in 33 accessions of Mor*inda citrifolia*

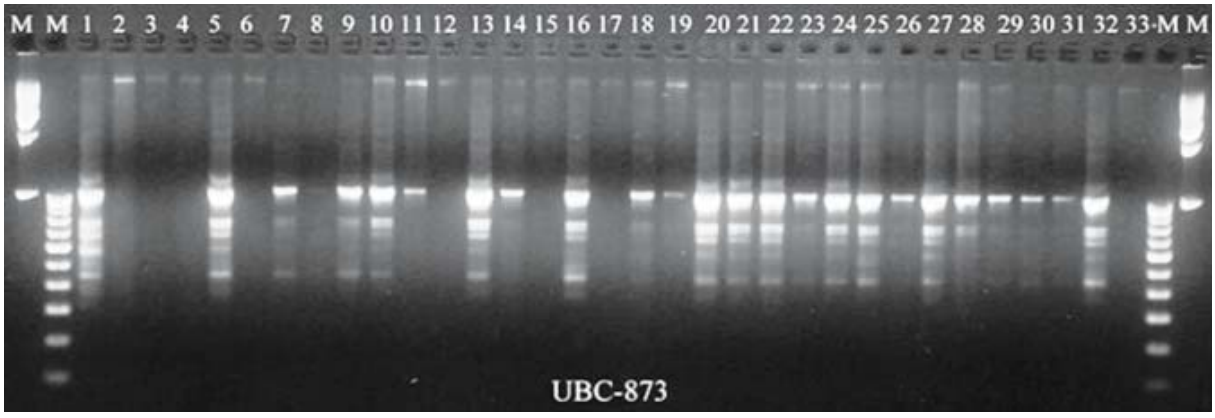



Plate 21. Banding pattern of RAPD markers in 33 accessions of Mor*inda citrifolia*

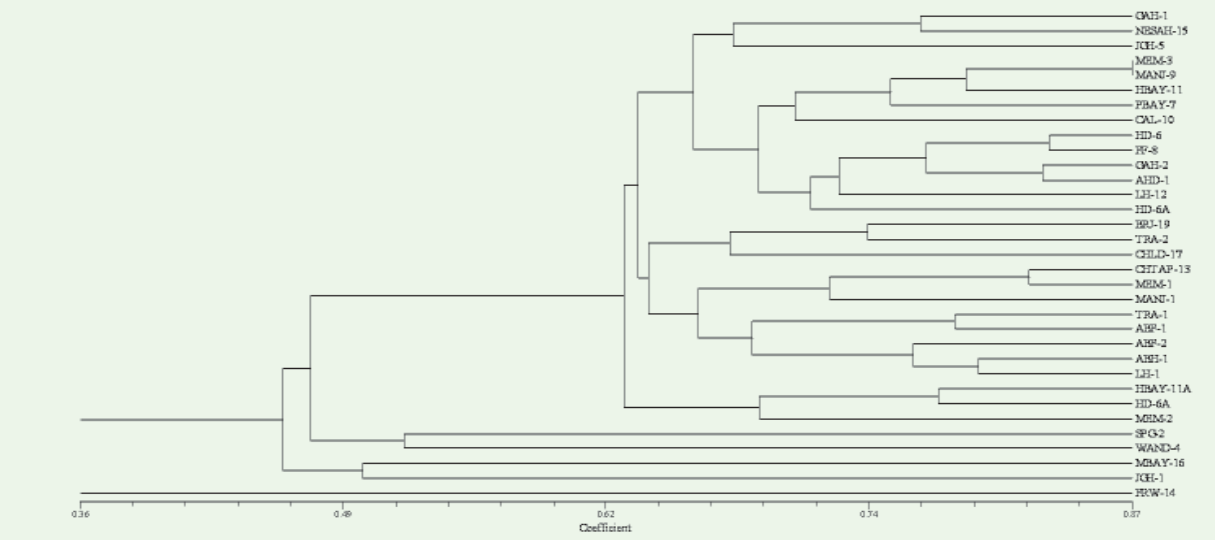



Fig. 9. Dendrogram showing genetic diversity for ISSR and RAPD markers in *Morinda citrifolia*

# Collection, Conservation, Characterization and Identification of Superior Clones of *Morinda Citrifolia* (WNRF)

***D.R. Singh and R.C. Srivastava***

## Fruit yield parameters of accessions

Yield performance of 22 accessions of *Morinda citrifolia* accessions was recorded and highest yield was observed in TRA-II (12.16kg/plant/year) followed by TRA-I (11.71kg/plant/year). Both accessions were dwarf and above bearer in nature. However, among vigorous accessions HD-6a (8.25kg/plant/year) and SPG-2 (7.60kg/plant/year) found promising in second year. However, TRA-II and TRA-I also performed well for consistent harvest on monthly basis. Thus, these two accessions were found better for regular supply of fruits for industrial purpose.

## Estimation of proximate composition in *Morinda citrifolia*

Thirty three accessions of *Morinda citrifolia* were analysed for proximate composition. The highest juice content was found in HD-6A (65.5%) an lowest in MEM-1 (22.41%), crude protein was maximum in FRG-14 (6%) and minimum in (MANJ-9 (2.9%). Carbohydrate content ranged from 930.40 mg/100g (LH-1) to 224.16 mg/100g (MANJ-1). The highest fat content was observed in MAN-1 (0.24%) and lowest in JGH-5 (0.09%). Crude fibre was highest in MEM-1 (9.97%) while TSS content was highest in ABH-1 (9.8$^0$Brix) and lowest in MBAY-16 (6$^0$Brix).

## Fatty acid profiling seeds of *Morinda citrifolia* accessions

Fatty acids were extracted from the whole seeds of three accessions viz. CARI-1, TRA-1 and TRA-2 and analysed using GC-MS after methyl esterification and it was found that major acid was linolic acid followed by oleic acid and palmatic acid (Fig 10). The highest linolic acid was recorded in TRA II (8.31mg/lt) followed by TRA-I (6.9431mg/lt) and CARI 1 (5.9831mg/lt). Similarly, oleic acid and palmitic acid were also maximum in TRA-II (1.9131mg/lt; 1.4731mg/lt) followed by TRA-I (1.5831mg/lt; 1.3031mg/lt) and CARI-1(1.0131mg/lt; 0.8631mg/lt). It has got more of unsaturated fatty acids when compared to saturated fatty acids in the three accessions. Lauric acid and erucic acid not

detected in these accessions. High linoleic acid is in all accessions show their potential industrial use as this fatty acid acts as precursor molecule for the production of other essential fatty acids needed by our body, including arachidonic acid, which is involved in muscle growth, brain development, and inflammation. The richness of three accessions for oleic acid also show potential of this crop for its exploitation as fatty acid source. (Fig 10).

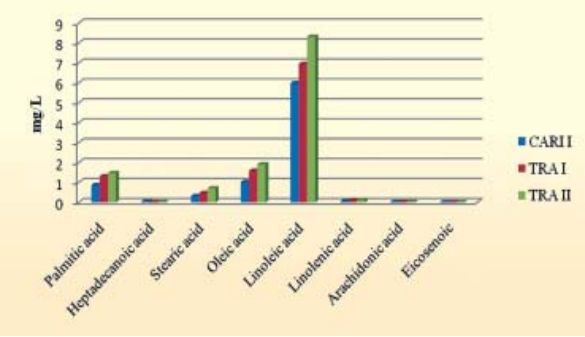



Fig 10. Fatty contents in different *Morinda citrifolia* accessions

## Antioxidant activity and phytochemicals in fresh fruits of Morinda citrifolia accessions

Estimation of antioxidant activity in fresh fruits from 33 accessions showed that SPG-2 scavenged highest amount of DPPH free radicals (81.86%) (Fig. 11). Phytochemical estimation in 33 accessions was done and observed that polyphenol content was maximum in TRA-1 (370.26 mg/100g) while minimum in MBAY-16 (165.40mg/100g). Anthocyanin in accessions was found to be ranged from 163.25mg/100g (MEM-3) to 340.39 mg/100g (MANJ-1).

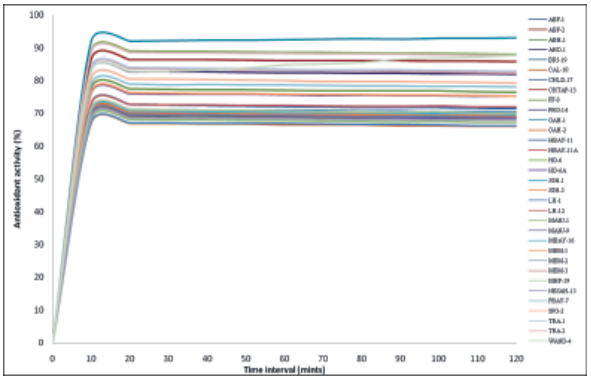


Fig 11. Antioxidant activity of 33 accessions of *Morinda citrifolia* at different time interval

Carotenoid content was maximum in LH-12 (696.26µg/ml) while minimum in NESAH-15 (114.68mg/100g). Total flavonoid content was maximum in JGH-5(656.18 mg/100g) and tannin content HD-6 (395.2 mg/100g). The ascorbic acid content was found to be maximum in TRA-2 (94.9mg/100g) while minimum in MBAY-16 (71.0mg/100g).

## Antioxidant activity and phytochemicals in juice of *Morinda citrifolia* accessions

Antioxidant activity estimation of juice portion of 22 accessions revealed that GAH-1 scavenged maximum DPPH free radicals (92.64%) (Fig. 12). Phytochemicals were also estimated and highest tannin content was observed in CAL-10 (983.22 mg/100g), anthocyanin in PBAY-7 (876.69 mg/100g) and polyphenol in TRA-2 (604.49 mg/100g) and flavonoid in JGH-5(980.90 mg/100g).

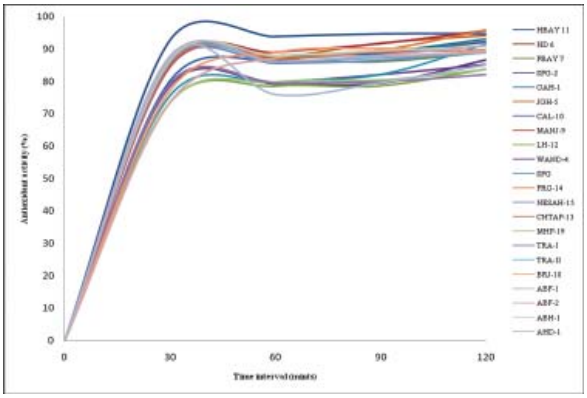


Fig 12. Antioxidant activity at different time interval of Morinda juice

## Micronutrient estimation

Micronutreint estimation in fourteen accessions of *Morinda citrifolia* revealed that Cu content was maximum in HBAY-11 (95.44 ppm/100gm) followed by MBAY-16 (94.16 ppm/100gm). Zn content was maximum in MANJ-9 (984.86 ppm/100gm) followed by PBAY-7 (975.38 ppm/100gm). Mn content was maximum in JGH- 5 (739.88 ppm/100gm), Fe content in CAL-10 (8168.14 ppm/100gm) and Ca content in HD-6 (9352.98 ppm/100gm). Mg content was maximum in PBAY-7 (3036.76 ppm/100gm) and MEM-3 (2992.72 ppm/100gm).

### Shelf life studies on accessions

The shelf life of 33 accessions was studied in ambient conditions and accessions were classified into four categories on the basis of their physical appearance. In Category-1, those accessions which are having fruits with greenish appearance and hard texture at 10$^{th}$ day of storage were included. It was observed that three accessions viz. TRA-1, FRG-14 and MEM-3 were found to be having better storage life upto 10 days. While maximum genotypes were grouped into Category-3 (14) followed by Category-2 (9 accessions).

### Grafting studies on *Morinda citrifolia*

The experiment was started to standardize the protocol for grafting technique in *Morinda citrifolia*. The growth and yield parameters were recorded from grafted plants after one and half year and average plant height (110cm), stem girth (15.5cm), total number of leaves (121/plant) and number of primary branches (15/plant) were recorded. The average fruit weight from grafted plants 65.45g/plant and average fruit length was 7.9cm and fruit girth was 26.25cm.

## National Network Project on Underutilized Fruits

***D.R. Singh and R. Sudha***

Proximate composition was analyzed in selected underutilized fruits and observed that protein content was maximum in *Syzygium aquem* (158.19mg/100g) while minimum in *Anona muricata* (79.09mg/100g). Total carbohydrate content was observed to be highest in *Malphigia glabra* (548.04mg/100g) and lowest in *Anona muricata* (97.60mg/100g). Ascorbic acid was maximum in *Mangifera andamanica* (211.81mg/100g) and minimum in *Averrhoa billimbi* (61.42mg/100g).

Phytochemical analysis showed that wild jamun seeds are rich in tannin (665.19 mg/100g) while phenolics were maximum in *Hypherzia* sp. seed powder (323.81mg /100g). Alligator apple leaves analysis for phytochemicals showed that leaves contains high amount of tannins (840.0mg TAE/100g) with high antioxidant activity (70.8%). Phytochemicals estimation of different fruit fractions of *Uvaria* sp. revealed that it is a rich source of flavonoids (542.13 mg /100g), phenolics (400mg/100g), carotenoids (383.18 µg/100ml), tannins (275.56mg TAE/100g), ascorbic acid (225.56mg/100g) and anthocyanin (275.56mg/100g) with high antioxidant activity (79.29%). It shows its potential for health and phytoceutical related studies. Antinutritional factors estimation revealed that phytate content was maximum in wild jamun seeds (585.0 mg/100g) followed by pericarp portion of *Uvaria* sp. (506.8 mg/100g). The results support the processing and pharmaceutical prospect of these underutilized crops from Islands.

## Germplasm collection, evaluation and identification of high yielding genotypes of Jatropha and Karanja and their multiplication in bay Islands.

***I. Jaisankar and S. Bhagat***

An exploration survey was conducted for identifying the high yielding plus trees of *Jatropha* and *Pongamia* in different locations of Andaman. The parameters such as seeds, seed morphology, growth characters, plant height, fruiting and oil percentage were recorded. The number of plus trees identified were *Jatropha curcas* (31no's), *J. Podagrica* (6 no's), *J. gossypifolia* (23 no's), *J. multifida* (8 no's), *J. integerrima* (1no), *J. glandulifera* (1no.) and *Pongamia pinnata* (24 no's). Among the genotypes collected, the highest germination was registered in CARI AN JC -2

(75.8%) followed by CARI JC 1 (75.4%) and the lowest germination of 63.8 % in FC RI-JC (Plate 22). Among the *Pongamia pinnata* genotypes collected, the tree at Burmanallah recorded maximum number of fruits per bunch (19). Whereas, the parameters such as higher pod length (8.35 cm), pod width (3.13cm), pod weight of 10.62 g and maximum shelling percentage of 61.22% was recorded from the pods collected from Badmaashpahad area. Similarly, the seeds collected from New Wandoor (33.92%), Sand pocket (33.48%) and Marine dockyard (33.37%) gave better oil percentage as that of Badmaashpahad (34.07%). The variation of the oil content may be due to variation in edapho- climatic factors (Plate 23).

Plate 22. *Jatropha curcas* in National trial

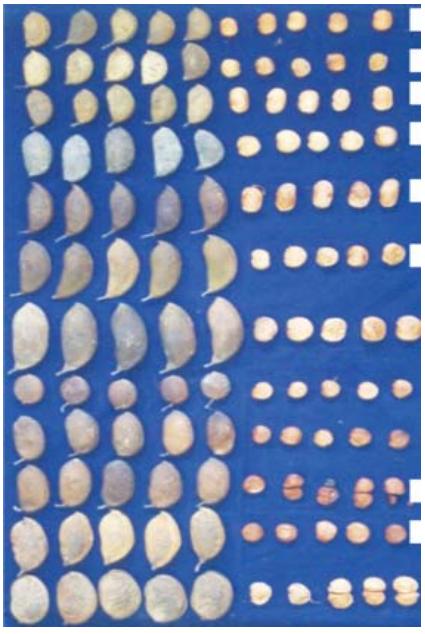


Plate 23. Fruit variation in Karanj from Andaman Islands

# Division of Field Crops

# Genetic Improvement of Long Duration Rice for Andaman and Nicobar Islands

*P.K. Singh, Krishna Kumar and Ajanta Birah*

Following station, national and international trials were conducted during kharif 2010 at Bloomsdale Farm.

## Station trials

### Evaluation of long duration rice germplasm

Eighty long duration rice improved lines/genotypes along with three check were evaluated under lowland rainfed transplanted conditions. The significantly better performing 12 lines over the popular check C14-8 were selected for further evaluation and improvement (Table1). Of these six cultures viz CB-05-022(5.34 t/ha), Jaganath (4.75 t/ha), MTU-1075 (4.75 t/ha), Uurbashi (4.67 t/ha), Rolagalakullu (4.65 t/ha) and Ramchand (4.55 t/ha) also significantly out yielded the best check variety CARI Dhan 5 (3.84 t/ha). (Plate 1)

**Table 1. Performance rainfed long duration rice cultivars**

| Varieties | Plant height (cm) | Days to maturity | Yield (t/ha) | Grain type |
|---|---|---|---|---|
| Moti | 136 | 140 | 4.25 | LS |
| Amalmana | 167 | 129 | 4.34 | LS |
| Sumati | 125 | 143 | 4.17 | LS |
| Swarna-3 | 110 | 133 | 4.17 | LS |
| Rolagalakullu | 132 | 141 | 4.65 | LS |
| Uurbashi | 128 | 143 | 4.67 | LS |
| Ramchand | 139 | 146 | 4.55 | LS |
| Jaganath | 114 | 140 | 4.75 | LS |
| MTU-1075 | 119 | 140 | 4.75 | LS |
| Jagabandhu | 138 | 134 | 4.00 | LS |
| Swarna Sub-1 | 110 | 134 | 4.00 | LS |
| CB-05-022 | 119 | 139 | 5.34 | LM |
| CARI Dhan 5 (Check 1) | 126 | 144 | 3.84 | MS |
| C14-8 (Check 2) | 198 | 174 | 3.00 | MS |
| Ranjeet (Check 3) | 146 | 147 | 3.58 | MS |
| C.D.(5%) | 17.30 | 14.33 | 0.59 | - |

Plate 1. (a) Varietal evaluation of long duration rice, (b) Best performing line CB-05-022

## Evaluation of rice lines for disease and insect pest resistance

Eighty long duration rice cultivars/improved lines were evaluated for resistance against diseases (sheath blight, bacterial leaf blight and brown spot) and insect pests (gundhi bug, stem borer, leaf folder and brown plant hopper) under field conditions. Of these, 13 genotypes, Amalmana, CB-05-156, CSR-4, DRR-1418, MTU-4870, CSR-36, MTU-1001, Lunishree, IM 1536, DRR 1501, Canning-7, Indravati and Rambha showed multiple resistance against major pests and diseases and have been selected for further utilization.

## Evaluation of early and medium early lowland rice lines

Forty one early and medium early duration rice lines were evaluated in the randomized block design with three replications (Plate 2). Though 12 lines were found numerically better in yield than best check variety IR 64, yet these were statistically at par with the check variety. These lines have been selected for further evaluation and utilization (Table 2).

**Table 2. Identification of significantly better genotypes in early and medium duration rice**

| Varieties | Days to Maturity | Plant height (cm) | Yield (t/ha) | Grain type |
|---|---|---|---|---|
| IR 78581-12-3-2-2 | 128 | 110 | 4.04 | LS |
| IR-622-66-42-2 | 129 | 97 | 3.87 | LS |
| KARJAT | 129 | 102 | 3.84 | LS |
| IR 78585-64-2-43 | 126 | 107 | 4.03 | LS |
| SABITA (NR-492) | 126 | 110 | 3.74 | LS |
| IR 78555-3-2-2-2 | 126 | 108 | 3.97 | LS |
| IRRI 67 | 129 | 114 | 4.33 | LS |
| IR-7926-8-2-3-1 | 131 | 111 | 4.13 | LS |
| IR-79195-42-1-3-1 | 129 | 108 | 3.94 | LS |
| IR-73546202-2-2 | 129 | 109 | 4.16 | LS |
| IR 20 | 127 | 128 | 3.97 | LS |
| IRR66 | 127 | 118 | 4.40 | LS |
| IR 64 (Check) | 125 | 98 | 3.47 | LS |
| **C.D. (5%)** | **7.32** | **10.15** | **1.10** | |


Plate 2. Varietal evaluation of early and medium duration lowland rice lines.

## National trials

Six All India Coordinated Varietal Improvement Trials of Rice (AVT VE TP, AVT-BT 1, AVT-BT 2, IVT L, AVT L 1 and AVT L 2) were conducted in rainfed low land conditions. Under these trials, 89 improved lines were evaluated for yield and its attributing characters. Out of these, 18 elite lines have been identified and selected for further improvement (Table 3).

**Table 3. National rice trials conducted during 2010-11**

| Trials | No. of lines evaluated | Design | Check varieties | Lines significantly better than best check variety identified. |
|---|---|---|---|---|
| AVT VE-TP | 8 | RBD | CARI Dhan 2 | 701 |
| AVT BT 1 | 8 | RBD | CARI Dhan 2 | |
| AVT BT 2 | 6 | RBD | CARI Dhan 2 | 2201 |
| IVT L | 43 | RBD | CARI Dhan 5 | 1901, 1903, 1916, 1919 and 1923 |
| AVT L 1 | 12 | RBD | CARI Dhan 5 | 1801 and 1802 |
| AVT L 2 | 12 | RBD | CARI Dhan 5 | 1703, 1704, 1705, 1706, 1707, 1708, 1710, 1711 and 1712 |
| **Total** | **89** | | | **18** |

## International trials

Three international rice trials viz. International Rainfed Lowland Rice Yield Nursery (Submergence Set), Aerobic Rice Observational Nursery and International Irrigated Rice Observational Nursery-Module-2 received from IRRI were conducted. A total of 81 improved lines were evaluated for yield and its attributing characters. Best performing 6 lines have been identified for further evaluation and improvement (Table 4).

**Table 4. International rice trials conducted during 2010-11**

| Trials conducted | No. of lines evaluated | Design | Check varieties | Promising lines Identified (Against best check) |
|---|---|---|---|---|
| **International rice trials** | | | | |
| International Rainfed Lowland Rice Yield Nursery Submergence Set (IRLYN-SS) | 17 | RBD | CARI Dhan-5 | IR 66876-11-NDR 1-1-1-1, IR 82355-5-2-3 and PSB RC 68 |
| Aerobic Rice Observational Nursery (AERON) | 38 | RBD | CARI Dhan-2 | RC 2340-10 and UPL RI-7 |
| International Irrigated Rice Observational Nursery-Module-2 (IIRON) | 26 | RBD | CARI Dhan-3 | IR 77032-47-2-3-3 |
| **Total** | **81** | | | **6** |

## Evaluation and improvement of pulses in *Rabi* season

Sixteen improved lines of green gram along with local check were evaluated during *Rabi* 2010-11 in a replicated trial (Table 5; Plate 3). Observations were recorded for yield and contributing characters. Similarly, 28 black gram lines were evaluated during *Rabi* 2010-11 in a replicated trial. Thirteen high yielding lines (over the best check) have been identified and selected (Plate 3).

## Germplasm introduction/collection and maintenance

A total of 332 genotypes of six crops viz. rice (214), green gram (26), black gram (29), pigeonpea (02) cowpea (05) and sesame (56) were collected/ procured from different parts of India and other countries and maintained during 2010-11 for future utilization.

**Table 5. Pulse trials conducted during 2010-11**

| Name of trial | No. of lines evaluated | Design | Check varieties | Name of the lines better the best check |
|---|---|---|---|---|
| **Green gram** | | | | |
| IVT 2 | 6 | RBD | Local | RM 10-512 |
| Germplasm evaluation | 11 | RBD | Pusa Vishal | RM 9 -136, RM 9 -128, Diglipur local 1, Diglipur local 2, Diglipur local 3 |
| **Black gram** | | | | |
| AVT 1 | 11 | RBD | Local | RU 10 -603, RU 10 -604 and RU 10-621 |
| Germplasm evaluation | 17 | RBD | Local | RU 9 -183,IPU 2 -43, CBG 647, Pant 4-31 |
| **Total** | **45** | | | |

Plate 3. Varietal evaluation of a) green gram and b) black gram.

## ICAR Seed Project: Seed Production for Agricultural Crops

*R.C. Srivastava and P. K. Singh*

### Quality seed production during 2010-11

Breeder and nucleus seed production was undertaken for different varieties of rice, sesame and pulses. A total of 593 kg breeder seed of different crops including rice (568 kg), green gram (12 kg), black gram (8 kg), lady finger (4.2 kg) and sesame (0.5 kg) was produced. Besides 29 kg nucleus seed of rice varieties was also produced (Table 6).

**Table 6: Seed production of rice during 2010-11**

| Crop | Varieties | Seed production (Kg) | | |
|---|---|---|---|---|
| | | Nucleus seed | Breeder seed | Farmers participatory seed production |
| Rice | CARI Dhan 1 | 4 | 11.0 | - |
| | CARI Dhan 2 | 2 | 8.0 | - |
| | CARI Dhan 3 | 3 | 12.0 | - |
| | CARI Dhan 4 | 1.2 | - | - |
| | CARI Dhan 5 | 9 | 279.0 | 678 |
| | Ranjeet | | 37.0 | - |
| | Varsha | - | 48.0 | 586 |
| | Gayatri | - | 35.0 | - |
| | Savitri | - | 70.0 | 160 |
| | MLT-10 (ANR1) | 10 | 18.0 | 478 |
| | Triguna | - | 27.0 | - |
| | Pusa Sugandh 4 | - | 6.0 | - |
| | Pusa Sugandh 5 | - | 7.0 | - |
| | Pusa basmati 1 | - | 10.0 | - |
| Green gram | | - | 12.0 | - |
| Black gram | | - | 8.0 | - |
| Sesame | | - | 0.5 | - |
| Lady finger | | - | 4.2 | - |
| **Total** | | 29.2 | 593 | 1902 |

Plate 4. Breeder seed production of rice

# Molecular Tagging of Biotic Stress Resistance in Rice (*Oryza sativa*)

*Naresh Kumar, P.K. Singh, Krishna Kumar and Ajanta Birah*

A total of 953 lines of rice were screened during Kharif 2010 for biotic stresses under natural field conditions (Plate 5). Incidence of diseases and insects was scored as per the standard evaluation system for rice. Two hundred and eight lines were observed to be free from disease (immune) while 130 lines were having score of 1 to 3 (moderately resistant) of bacterial leaf blight (BLB) whereas 615 lines were having score more than 5 (susceptible). A total of 523 lines were free from blast and 215 lines were having only 2-10% incidence of blast disease. Eighty five lines were having more than 50% incidence of sheath blight. The observations clearly indicated that bacterial leaf blight is the main disease of rice in Andaman followed by blast and sheath blight. There were around 5% lines having spores of false smut. Overall perusal of data indicated that nineteen lines viz. NSN 1-48, NSN 2-40, 43, 44, 48, 50, 91, 92, 93, 98, 103, 116, 132, 153, DHSN1, 12, 15, 16 and 81 showed resistance against multiple diseases. These lines were also free from damage of insect pests (stem borer and leaf folder). However, there was 20-25 percent damage due to gundhi bug.

Plate 5. Field scoring for disease and insect incidence in rice

# Development of biotic stress resistant lines in brinjal (*Solanum melongena L.*)

*Naresh Kumar, Shrawan Singh, Ajanta Birah, P.K. Singh and Krishna Kumar*

Three wild relatives of brinjal viz. *Solanum torvum, S.indicum and S. surratence* were collected from the Islands (Plate 6). These were evaluated under laboratory conditions against shoot and fruit borer (*Leucinoides orbonalis*). The active larvae of pest were collected from the field and were given force feeding of tender fruits of wild relatives in separate vessels along with cultivated brinjal (*S. melongena*) as check. A total of 30 larvae were released in each vessel and were observed for 5 days. There was no larval mortality on first day after treatment (DAT) in all the cases. However, there was up to 50% larval mortality when fed on *S. surratence* for five days after treatment followed by 33% larval mortality in case of *S. torvum* and 20% larval mortality in case of *S. indicum*. The cultivated brinjal showed only 6.6% larval mortality. The observation suggested that among wild relatives the pest has highest affinity for *S. indicum* while least preference for *S. surratence*

Plate 6. Wild species of brinjal. a) Solanum torvum b) S. indicum and c) S. surratence

**Table 7: Incidence of bacterial wilt, shoot & fruit borer and fruit damage in cultivated brinjal.**

| Genotypes/entries | Wilt incidence (%) | Shoot & fruit borer incidence on fruit number basis (in %) | Cumulative fruit damage on weight basis (in %) |
|---|---|---|---|
| BRBWRES1-A | 11.67 | 20.00 | 37.50 |
| BRBWRES4-A | 31.67 | 21.74 | 78.57 |
| BRBWRES5-A | 31.67 | 9.23 | 32.61 |
| BRBWRES2-A | 63.33 | 38.46 | 61.73 |
| ARKA NIDHI-A | 40.00 | 60.94 | 61.54 |
| SM6-6-A (Check) | 38.33 | 32.26 | 69.77 |
| BRBWRES6-A | 66.67 | 20.00 | 28.57 |
| BRBWRES5-I | 90.00 | 22.22 | 25.53 |
| BRBWRES6-I | 48.33 | 10.00 | 46.43 |
| BRBWRES4-I | 68.33 | 36.11 | 57.89 |
| BRBWRES2-I | 43.33 | 21.21 | 30.43 |
| ARKA NIDHI-I | 35.00 | 42.11 | 57.14 |
| BRBWRES3-I | 96.67 | NF | NF |
| BRBWRES1-I | 85.00 | 50.00 | 100.00 |
| SM6-6-I | 36.67 | 16.67 | 49.09 |
| Pb. Sadabahar (Check) | 51.67 | 66.67 | 46.88 |
| 10/BRLVAR-6-IL | 38.33 | 33.33 | 91.67 |
| 10/BRLVAR-2-IL | 35.71 | 100.00 | 100.00 |
| BLB-11 (Check)-IL | 23.81 | 54.17 | 60.55 |
| 10/BRLVAR-1-IL | 42.86 | 58.33 | 54.55 |
| 10/BRLVAR-4-IL | 95.24 | 25.00 | 44.44 |
| 10/BRLVAR-3-IL | 92.86 | NF | NF |
| 10/BRRVAR-6-IR | 61.90 | 100.00 | 100.00 |
| 10/BRRVAR-1-IR | 64.29 | 83.33 | 75.86 |
| 10/BRRVAR-4-IR | 57.14 | 83.33 | 82.35 |
| 10/BRRVAR-5-IR | 57.14 | 83.33 | 83.33 |
| 10/BRRVAR-7-IR | 28.57 | 73.33 | 67.39 |
| KS 224-IR | 95.24 | NF | NF |
| Swarna Mani-IR | 90.48 | NF | NF |
| 10/BRRVAR-3-IR | 95.24 | NF | NF |
| Mean | 57.24 | 38.73 | 51.46 |
| Range | 11.67-96.67 | 9.23-100.00 | 25.53-100.00 |
| Standard Error | 4.63 | 5.70 | 5.72 |
| Standard Deviation | 25.36 | 31.20 | 31.34 |
| Sample Variance | 643.17 | 973.35 | 982.00 |
| Confidence Level (95.0%) | 9.47 | 11.65 | 11.70 |

The bacterial wilt (BW) incidence ranged from 11.67 to 96.67 % with mean value of 57.24 %. The shoot and fruit borer incidence ranged from 9.23 to 100% with cumulative fruit damage of 25.53 to 100%. Interestingly, there was low incidence of borer in lines which showed higher incidence of BW but the reverse is not true. The reason for low damage could be lesser number of fruits in susceptible lines of BW. There was no line observed which showed complete resistance to BW. However, BRBWRES1-A showed better performance as compared to check and other lines with only 11.67% BW incidence. The surviving plants of highly susceptible lines did not bear any fruit even after 4 months of transplanting mainly due to severe damage to plant by pathogen (Table 7).

## Standardization of Production and Protection Technology of Tropical Mushrooms

*Krishna Kumar and Ajanta Birah*

### Standardization of milky mushroom *(Calocybe indica)* production

The milky mushroom (Calocybe indica) is a tropical mushroom that can be grown at a higher temperature of 28°C to 35°C (Plate 7a). The keeping quality of milky mushroom is comparable to both button and oyster mushrooms. It requires more light as compared to oyster or button mushrooms and has a higher biological efficiency up to 140%. The dried sporophore contains 17% protein, 4.1% fat, 3.7% crude fiber, 60% carbohydrate. In addition to this, it has vitamins and mineral salts such as sodium, phosphorus, iron, zinc, calcium, potash, copper and manganese. The main problem encountered during growing period is low humidity in cropping room thus increasing the moisture evaporation from fruiting body and resulting in a scaly surface of fruit body than can eventually kill the pin heads. To overcome this, chopped paddy straw was soaked in water for 10-12 hrs. After that the substrate was treated for one hour treatment of hot water. 5% spawning was done and subsequently kept in growth chamber. The biological efficiency on paddy straw was recorded between 30 to 40%.

### Standardization of blue oyster mushroom *(Hypsizygus ulmarius)* production

The elm or blue oyster mushroom (Hypsizygus ulmarius) is a relatively rare mushroom variety (Plate 7b). It looks similar to oyster mushroom but it is far better in flavor and texture. The average biological efficiency is quite promising (90-100%). This mushroom is popular in Japan but it is yet to be cultivated and popularized in India. Since the climate and other cultivation requirements of this mushroom are similar to the already commercially grown oyster

Plate 7. a) Calocybe indica on paddy straw b) Hipsyzygus ulmarius on paddy straw



mushrooms, attempts have been made to grow it at CARI, Port Blair. The culture was brought from IIHR, Bangalore. The substrate was prepared as per method described for milky mushrooms. The 5% spawn was used for spawning in 45-60 cm poly bags and appropriate temperature (22°C to 28°C) and relative humidity (80-90%) were maintained. The spawn run was obtained within 15-17 days. The sporophore ranged between 50-90 g and the biological efficiency on paddy straw (dry weight basis) ranged between 40-50% among the different treatments.

## Exploration of Plant Pathogenic and Antagonistic Microbial Resources Associated with Vegetable and Spice Crops of Andaman and Nicobar Islands

*Krishna Kumar*

Microorganisms constitute a huge and almost unexplained reservoir of resources that are likely to provide innovative applications and usefulness to man. The systematic exploration, exploitation, characterization and conservation of culturable microbial diversity in have opened up opportunities to explore the vast potentialities of native micro flora to preserve it as a precious asset of the country.

### *Trichoderma* diversity

A total of 22 *Trichoderma* spp isolated from the Middle and North Andaman and Hut Bay (Latitude 6° to 14°N and Longitude 92° to 94°E) Islands were characterized based on cultural, morphological and antagonistic properties. Based on the cultural and morphological characterization, the isolates were classified into three sections viz., *Trichoderma* (clade: Rufa and Pachybasium A), Pachybasium B (clade: Pachybasioides, Lutea, Virens and Lixii/Cataptron) and Longibrachiatum. Under the section *Trichoderma,* three species were identified as *T. atroviride* (5 nos), *T. konigii* (1) and *T. hamatum* (1). Under the Pachybasium B section, six species were identified as *T. minutisporum* (1), *T. polysporum* (1), *T. brevicompactum* (1), *T. virens* (4), *T. crassum* (1) and *T. harzianum* (1). The i*n vitro* antagonistic potential of *Trichoderma* spp showed 27.0%, 22.0%, 50.0% and 36.0% activity against *R. solani*, *Macrophomina* sp, *S. rolfsii* and *Fusarium* sp respectively. Among the isolates, *T. longibrachiatum* and *T. virens* showed statistically significant antagonistic activity against all the three pathogens tested.

### Barren Island diversity (Active Volcano)

A total of 102 bacterial isolates were recovered from the site of only active volcano (Barren Island) in India which is located in the Andaman and Nicobar islands (Latitude - 12°17'40.1 N; Longitude- 93°50'54.5 E). These isolates were screened for antagonistic, plant growth promoting (PGP) activities, salt tolerance and thermo-tolerant properties. The results revealed that for salinity 10.8% of the isolates grew well upto 25% NaCl (w/v) concentration and isolates BAN52, BAN88, BAN96 and BAN100 grew up to 30% NaCl (w/v) concentration. Around 20.6% of the isolates showed thermotolerant properties when grown at 72°C. The four isolates viz., BAN53, BAN74, BAN76 and BAN92 grew successfully at 82°C whereas, the isolate BAN53 grew even at 92°C. In PGP studies, the hydrolytic enzymes secreted by various isolates showed the following characteristics: IAA production - 57.8%, siderophore production-55.9%, $PO_4$ solubilization-33.3%, protease-41.2%, cellulose-23.5%, amylase -41.2% and lipase-25.5% of isolates. During screening for antagonistic properties, many isolates showed antagonistic activity against *S. rolfsii* (14.7%), *R. solani* (19.6%), *Macrophomina* sp (29.4%), respectively. A total of 21 isolates (20.6%) showed all four properties viz., antagonistic, PGP, salt tolerant and thermo-tolerant properties. These isolates can be used as

bioinoculants in the extreme environments. Classical staining and biochemical properties showed that most of the isolates are Gram positive and belong to the genus *Bacillus* spp. Further identification and confirmation with Biolog and 16S rRNA gene sequences are in progress.

### Rhizosphere soil from Middle and North Andaman

A total of 114 isolates from Middle and North Andaman Islands were screened *in vitro* for their Plant Growth Promoting (PGP) traits and hydrolytic enzymes. Among the isolates, 50.8% were better for IAA production, 58.6% for $PO_4$ solubilization and 95.6% for siderophore production. All the isolates showed ammonia production whereas none of the isolates showed HCN production. These isolates also produced cell wall degrading enzyme such as amylases (63.7%), cellulases (51.7%), lipases (22.4%), pectinases (13.1%), chitinases (26.7%) and proteases (81.8%) on agar plate. The potential isolates were identified using the physiological and biochemical method (Himedia kit) and belonged to the genus *Pseudomonas* sp, *Enterobacter* sp and *Bacillus* spp.

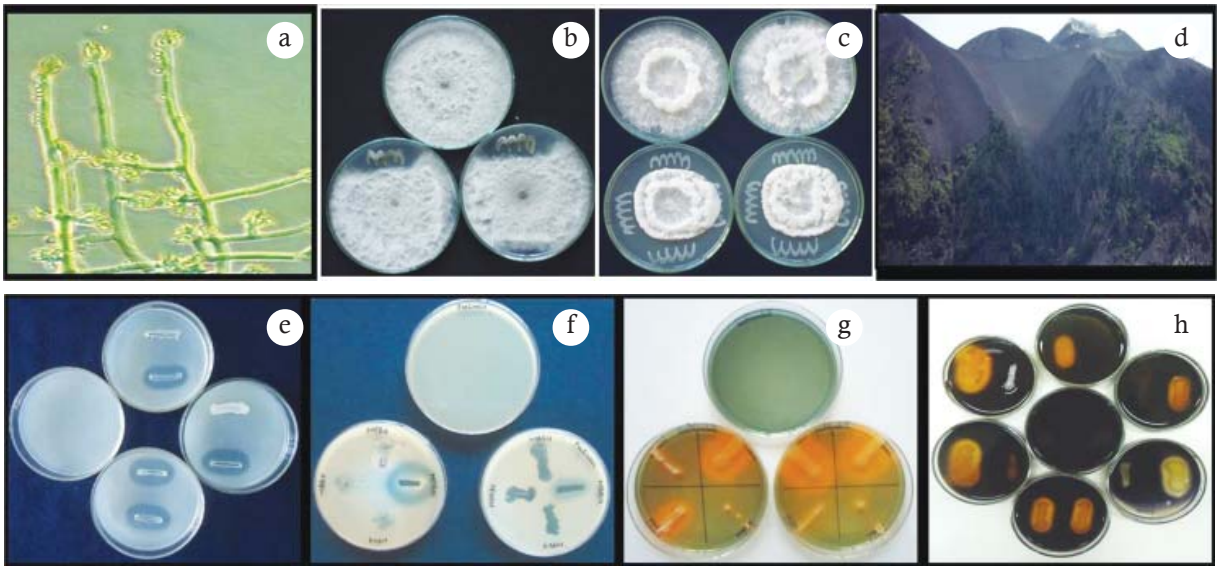



Plate 8. a) Microscopic view of *T. virens* b & c) Antagonistic potential of active volcano isolates d)Overview of Barren Island (Active Volcano)
e) $PO_4$ solubilization f) Pectinase production g) Siderophore production h) Cellulase production.

## Production of Disease Free Elite Planting Materials for Improving the Productivity of Coconut in Bay Islands

*Krishna Kumar and Ajanta Birah*

Coconut (*Cocos nucifera*) an important plantation is grown in an area of about 25,600 ha with a production of 87.10 million nuts annually in the A&N Islands. The average yield of the palm in the islands is very low (24 nuts/palm/year) as compared to the national average of 44 nuts /palm/ year. The post tsunami survey conducted by the Department of Agriculture, Andaman & Nicobar administration revealed that out of 25,000 ha under coconut about 6660 ha area has been badly damaged due to the inundation of sea-water during the *tsunami*. For replanting the damaged plantations near to the sea about 13 to 14 lakhs coconut seedlings are required.

Considering the low productivity status of the damaged old palms, the priority was focused on production and supply of quality planting materials from the selected elite and high yielding mother palms of Andaman Ordinary Tall.

An extensive survey was carried out for the selection of disease free and high yielding palms of coconut from various parts of South Andaman. A total number of 5000 nuts comprising 18 different cultivars of coconut palm were collected from "Coconut World Germplasm Centre" and sown at Garacharma and Sippighat Farm (Plate 9). A total of 20,744 mother palms were surveyed from different parts of South Andaman, out of which 5000 nuts were selected based on their phenotypic observation. Among these nuts, 3297 nuts were of Andaman Ordinary Tall cultivar collected from WCGC (World Coconut Germplasm Centre) Sippighat and Malabar Plantations, Kurmadera, South Andaman. Seedlings were also raised from Niu Bulavu (217), Tomaloo (171), Kinmai (149), Kimios (145), Katchal Tall (138), Rangiroa Tall (130), Andaman Tall (116), Niu Hake (110), Natawa Tall (109), C'bay Tall (102), Local tall (Haipati) (101), Local Tall (Pao Pao) (84), Tall Muva (56), Local Tall (47), Local Tall (Tutiala) (14), Auck Chang (11) and Tahiti Tall ( 3).

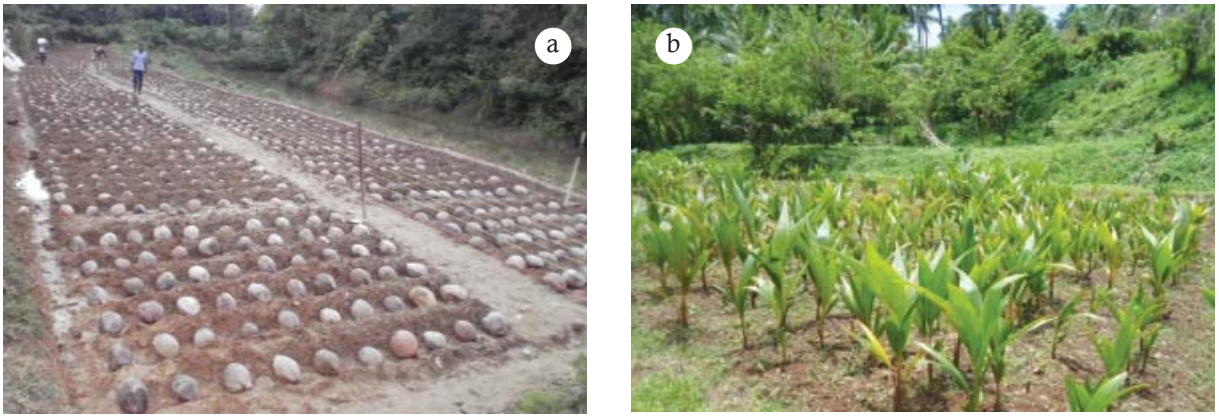



Plate 9. a) Sowing of disease free nuts at Garacharma Farm, Port Blair, South Andaman b) Disease free seedlings at Sippighat Farm, Port Blair, South Andaman.

## Monitoring of Pesticide Residue in Vegetables

*Krishna Kumar*

Pesticides used in agriculture and public health programmes can affect the environment in a number of ways depending upon the method and proficiency of application. The pesticide residues are the deposits of pesticide active ingredient, its metabolites or breakdown products present in some component of the environment after its application, spillage or dumping. Residue analysis provides a measure of the nature and level of any chemical contamination within the environment and of its persistence. It is often difficult to correlate pesticide residues in the environment with effects on fauna and ecological processes. The samples of important vegetables (cabbage, cauliflower, okra, tomato, brinjal, capsicum, chilly, bitter guard etc.) were randomly collected from Diglipur, Chouldari, Humfrigunj, Port Blair and Mayabunder on weekly basis. The analysis of pesticide residue level revealed that samples of brinjal, okra, bitter guard, green chilly collected from South, Middle and North Andaman district contained pesticides contents within the safe limits (<0.2 mg/kg). On the other hand, samples of brinjal, cauliflower and green chilly collected from Diglipur recorded unsafe levels of pesticide residues.

# Development of Eco-friendly IPM Modules for Okra and Cucurbits in Andaman

*Ajanta Birah, Shrawan Singh, Subhash Chand, Krishna Kumar, Someshwar Bhagat and Jai Sunder*

Cucurbits are the most commonly cultivated vegetable crops of the Andaman Islands and are grown throughout the year. The pests attacking these crops can result in severe yield losses in these areas. The *Bactrocera cucurbitae* (Coquillett) or fruit fly is the most serious pest of cucurbits but the most preferred host is bittergourd followed by cucumber and ridge gourd. Indiscriminate use of pesticides by farmers to control the pest has endangered the safety of the environment and increased the chances of accumulation of poisonous residues in the produce.

## Field monitoring of cucurbit fruit fly

Monitoring of fruit fly is very essential to observe the variation in the pest population over a long period of time and to map their relative abundance in different seasons so that proper management strategies could be effectively executed. In the year 2010-11, five cue lure baited traps were installed at different locations in the Garacharma farm. Weekly observations were recorded and finally fruit fly catch per trap per week was calculated (Fig. 1). Two peaks were observed in their population viz., April (13.51/trap/week) and December (16.94/trap/week). This study indicated that fruit flies were prevalent throughout the year and need proper management strategy accordingly. A study was undertaken to evaluate the different pest management modules against fruit flies in the field conditions. The trial was laid in RBD five treatments (modules) in four replication. All the cucurbit crops were raised by adopting standard farming practices and recommended rates of fertilizers (Plate 10). The percentage of damaged fruits was calculated in terms of weight. The cumulative yield of all the pickings was computed and expressed in kg/plot and finally quintals/hectare was calculated. The data were subjected to statistical analysis following standard methods.

The fruit damage by fruit flies was significantly lower in all the modules as compared to untreated control. Damage percentage varied significantly in different control methods (Table 8). The average data revealed that integrated and bio-intensive module recorded significantly lower fruit damage of 12.26 and 14.52% respectively in bitter gourd than the chemical (34.23%) and mechanical control (22.33%). The percent reduction over control was 73.15 and 68.20% in $M_3$ and $M_2$ modules, respectively. Similar trend was also noticed in case of ridge gourd and cucumber. Mass-trapping of fruit flies through pheromone bait traps reduced the fruit fly population, thereby minimizing the use of pesticides

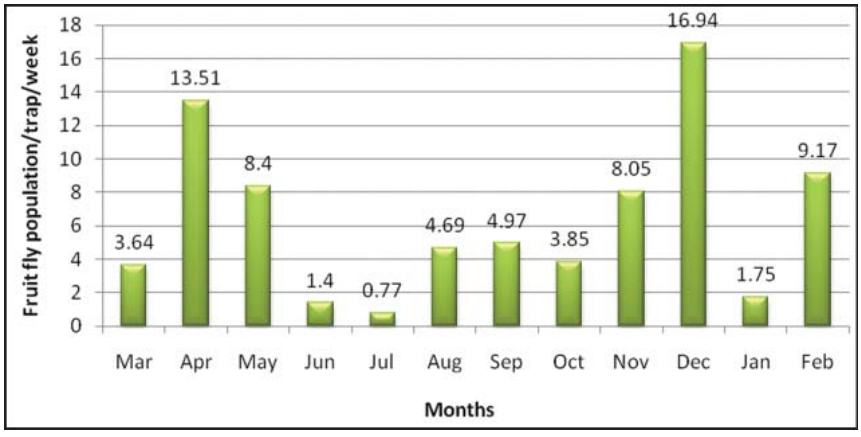



Fig. 1: Variation in fruit fly population during different months.

and helps to establish a safe control measure for the production of pesticide-free cucurbit crops. The cucurbits produced through bio-intensive module were also healthy and entirely free from pesticides. No phytotoxic effect due to any treatment could be noticed during the entire crop season.

**Table. 8: Evaluation of pest management modules against fruit damage (%) in cucurbitaceous vegetables.**

| Modules | Fruit fly damage (%) | | | % Reduction over control | | |
|---|---|---|---|---|---|---|
| | Bitter gourd | Ridge gourd | Cucumber | Bitter gourd | Ridge gourd | Cucumber |
| $M_1$ (Mechanical module : Installation of cue -lure baited traps @ 10 traps/acre) | 22.33 (28.2) | 21.56 (27.6) | 26.51 (30.9) | 51.10 | 47.73 | 38.81 |
| $M_2$ (Bio-intensive module : $M_1$ + Foliar spra y of aqueous leaf extracts of *Morinda citrifolia* @ 100g/l at 10 DAF)* | 14.52 (22.4) | 13.67 (21.7) | 15.64 (23.3) | 68.20 | 66.86 | 63.90 |
| $M_3$ (Integrated module : $M_1$+ $M_2$+ spray of spinosad @ 0.3ml/l alternate with $M_2$ at 15 DAF) | 12.26 (20.5) | 11.50 (19.8) | 14.23 (22.1) | 73.15 | 72.12 | 67.16 |
| $M_4$ (Chemical module : Spray deltamethrin 2.5 EC @ 0.5 ml/l at 15 DAF) | 34.23 (35.8) | 29.33 (32.8) | 37.50 (37.8) | 25.04 | 28.89 | 13.45 |
| $M_5$ (Control : Untreated) | 45.67 | 41.25 | 43.33 | -- | -- | -- |
| SE(d) | 1.18 | 1.24 | 1.34 | | | |
| CD (P=0.05) | 2.74 | 2.85 | 3.09 | | | |
| CV(%) | 4.87 | 6.46 | 5.99 | | | |

* Sticker mixed @0.5ml/l during the foliar spray of insecticides and plant extracts,
DAF : days after flowering, figures in parentheses are arcsin transformed values

A

B

Plate 10. Field view of the evaluation of pest management modules in ridge gourd (a), bitter gourd (b), healthy and damaged fruit of bitter gourd due to fruit fly (c and d).

## All India Network Project on Rodent Control

*Ajanta Birah*

Several species of rodents including rats and squirrels damage coconuts at different stages of growth. Among these rodents, the black rat (Rattus rattus) which is primarily responsible for tender nut damage is considered to be the major pest (Plate 11). Apart from the tender nuts, the black rats were also observed to damage leaf stalks, unopened spathe, female flowers and mature nuts in the orchards. An extensive survey in thirty nine locations of the Andaman district was carried out for estimation of losses due to rat damage to tender nuts based on unit count method. Highest rodent infestation was found in Adajik with 74.52%, whereas lowest infestation was recorded in Dolly Gunj with 2.50%. The nut damage ratio ranged from 4.16 to 6.25 %. The average rodent infestation percentage was 26.09% and average nut damage was 5.10%. Data on trapping revealed that at Garacharma location, trapping index was high in the month of August (9), whereas, it

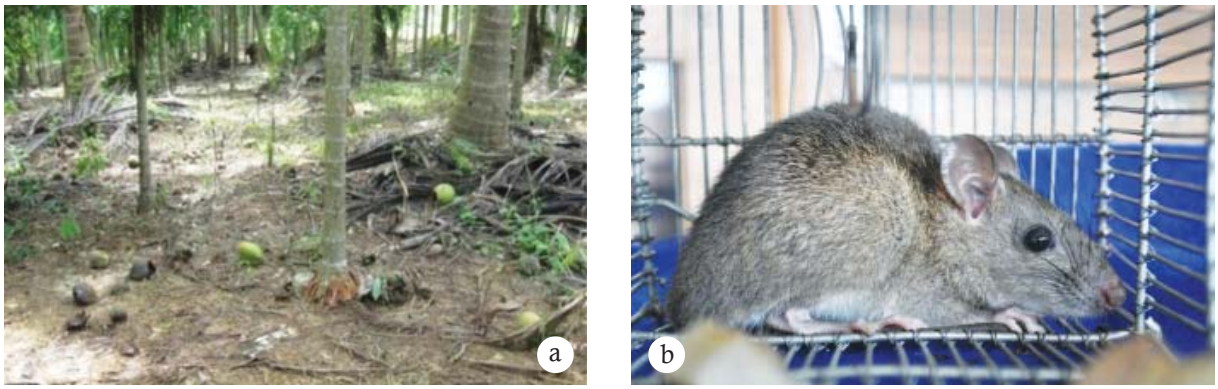



Plate 11. (a) Rodent damage in coconut trees (b) *Rattus rattus* specimen

was least in the month of April (5). At Sippighat location also, in the month of August trapping index was high (9) whereas it was least in the month of April (4). Least trapping index was obtained in the month of April and October. Maximum number of rodents was trapped in the month of July at Minniebay location (14), whereas least number was trapped in the month of April (8). The damage in most of the areas was significant and it was generally severe.

## New records of rodents

The rodents collections were made from fields, houses, shops and godowns as well as from poultry/ animal farms. After recording the morphological observations, these samples were sent to Zoological Survey of India, Kolkata for proper identification. A total of 18 rodent species have been identified and reported, out of which, 3 species are new records from Andaman Islands in 2010-11 (Plate 12). The details of the species are as follows:

### *Little Indian field mouse (Mus booduga)*

The little Indian field mouse (*Mus booduga*) belongs to a species of rodent in the Muridae family. It was found in Andaman Island. The Little Indian field mouse was found in evergreen tropical forests and cultivated lands of Andaman Islands and are grey in body color like elsewhere. Their body weight ranged from 9.6 grams to 10.1 grams. Their head, body and tail length ranged from 1.5 cms to 2.2 cms, 4.6 cms to 5.2 cms and 7.0 cms to 7.4 cms, respectively.

### *The Asian House Rat (Rattus tanezumi andamanensis)*

The Asian house rat (*Rattus tanezumi andamanensis*) was found in many man made habitats including agricultural and urban areas and it is a supremely adaptable species. This species is closely related to the Rattus rats but recent studies suggested that it is a separate species and it is omnivorous, feeding on farmyard waste and food scraps. The Asian house rat consumes and hoards more arecanuts. Their body weight ranged from 118 grams to 170 grams. Their head, body and tail length ranged from 3.5 cms to 5.1 cms, 10.2 cms to 14.5 cms and 14.7 cms to 20.5 cms, respectively.

### *The Cutch rock-rat (Cremnomys cutchicus)*

The Cutch rock-rat, *Cremnomys cutchicus,* is discontinuously distributed in India but it was not found in Andaman. Earlier studies have revealed that *C. cutchicus* prefers to feed upon flowers of trees and shrubs in the desert region. Now this species is found in Andaman Island. Their body weight ranged from 20.1grams to 23.8 grams. Their head, body and tail length ranged from 3.8 cms to 4.0 cms, 6.3 cms to 6.8 cms and 9.8 cms to 10.1 cms, respectively.


Plate 12. a) Preserved species of rodents in Laboratory, b -d) three new rodent species reported from Andamans.

# Monitoring and Surveillance of Infestation of Pests and Diseases of Coconut

*Ajanta Birah, Krishna Kumar, P. K. Singh and Someshwar Bhagat*

Coconut is a unique plantation crop of Andaman & Nicobar Islands and has been associated with socio cultural life of people of these Islands. The average yields of the palm in the islands are very low (24 nuts/ palm /year). However, by adopting proper cultural practices and integrated pest management, it can be improved to 60-80 nuts/palm/year and even more. Eventhough it is cultivated in a large area, there is always decline in the yield of coconut due to disease and pests attack. Out of the 750 insects reportedly attacking the coconut palms from all over the coconut growing tracts of the world, only less than 15 species are present in these islands. The major pests and diseases monitored under our survey are Rhinoceros beetle and Scale insect and Bud rot and Stem bleeding, respectively (Plate 13). The survey studies were conducted across different locations comprising of South (South Andaman, Little Andaman, Havelock Island and Neil Island), Middle and North Andaman based on proportionate random sampling. A total of 121 villages were selected all over the Andaman Islands and the data on the infected coconut palms were collected.

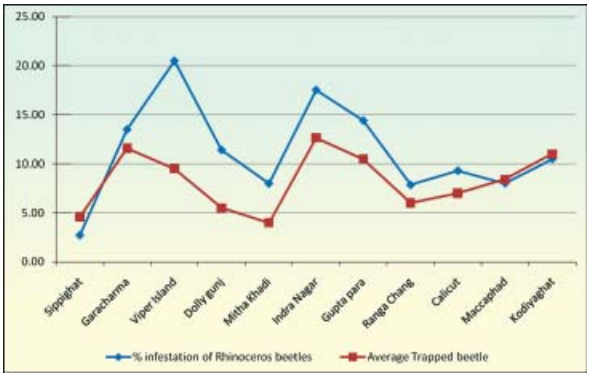



Fig. 2: Comparison of Rhinoceros beetle infestations and trapped beetles in South Andaman

## Status of insects pests and diseases of coconut

The only insect pest that seriously ravages the coconut plantations in the Bay islands is the Rhinoceros beetle (*Oryctes rhinoceros*). The adult rhinoceros beetle damages coconut palms by boring into the center of the crown, where they injure the young, growing tissues and feed on the exuded sap. While monitoring the rhinoceros beetle infected palms, the conditions observed were short horizontal burrow cuts across the petiole and on unfurling depicts characteristics "V" shaped cut on them. The pheromone traps for rhinoceros beetle were installed at 11 different locations of South Andaman where the rhinoceros beetle infestations were high. The observations of collected beetles were recorded on monthly basis. The average trapped beetles ranged from 3.5 to 11 and the maximum numbers of beetles were trapped from Kodiyaghat and minimum from Calicut (Fig 2). The infestations of rhinoceros beetle were very high in Viper Island and average trapped beetles were also high. Similarly, in case of Sippighat, the percentages of infestations as well as the average trapped beetles were low. It was clearly revealed from the data that there was a significant positive correlation (r = 0.705) between percentages of infestations and average trapped beetles. The damage due to rhinoceros beetle was found in all ages of palms. The high infestation of Rhinoceros beetle infestations was found all over the South, Middle and North Andaman, it ranged from 0.5 to 41.32%. Almost half the palms (41.32%) in Govind Nagar of Havelock Island have the infestations of Rhinoceros beetle. Scale insect infestations were low as compared to rhinoceros beetle. High infestation of scale insect was seen in Andaman Plantations (Meethakhadi) of South Andaman (9.46%). The most serious disease of coconut is Bud rot caused by *Phytophthora palmivora*. This disease leads to palm

death and/or yield reduction by premature nut fall. Another important disease prevailing in Andaman is stem bleeding. Dark reddish-brown liquid from growth cracks and wounds on the stem trickling down are observed in stem bleeding palms. The bud rot and stem bleeding ranged from 0.20 to 31.25 % and 0.04 to 9.6%, respectively. Highest bud rot infestation was found in V. K. Pur of Little Andaman (31.25%) and stem bleeding was found in Krishna Nagar (9.6%) of Havelock Island.

**(a)**

**(b)**

**(c)**

**(d)**

Plate 13. Major insect pests and diseases of coconut in Andaman. **a)** Coconut Palm attacked by Rhinoceros beetle **b)** Trapped Rhinoceros beetles **c)** Coconut Palm attacked by Bud Rot **d)** Coconut Palm attacked by Stem Bleeding.

# Division of Animal Science



# Improvement of Nicobari Fowl for Meat and Egg

*A.Kundu, Arun Kumar De, Jai Sunder, M. S. Kundu, S. Jeyakumar and S. K. Verma*

## Comparative performance of Nicobari and Vanaraja fowls under intensive system of management

A study was conducted to evaluate the growth performance, feed consumption, feed conversion ratio and performance index (PI) of Vanaraja (Van) fowl (T1) and three varieties of Nicobari fowl viz. Brown (Brn) (T2), White (Wht) (T3) and Black (Blk) (T4). A total of thirty eight birds comprising of 10 Vanaraja, 9 each in Brown and White and 10 Black Nicobari fowls were reared from day old to 4th week of age (brooding stage) providing standard feeding and management. The data were analyzed as a randomized complete block design by SAS (1990) software (SAS Inst. Inc., Cary, NC).

The comparative body weight of Vanaraja and three varieties of Nicobari fowl are presented in Table 1. The results revealed significantly ($p<0.05$) higher body weight of Vanaraja compared to all the varieties of Nicobari fowl in all the ages of measurements (Table 1). Among the three varieties of Nicobari fowl, the body weights of T2, T3 and T4 did not differ significantly at 0 day as well as 1st week of age but at 2nd week of age a significantly higher ($p<0.05$) body weight was observed in T4 as compared to T2 and T3 (Table 1).

**Table 1. Comparative Body weight (g) of Vanaraja and Nicobari fowls**

| Age (Wks) | Body weight (g) | | | |
|---|---|---|---|---|
| | Van (T1) | Brn (T2) | Wht (T3) | Blk (T4) |
| 0 | 33.5$^{a}$ | 30.0$^{b}$ | 26.5$^{b}$ | 29.0$^{b}$ |
| 1 | 63.5$^{a}$ | 49.44$^{b}$ | 48.89$^{b}$ | 52.0$^{b}$ |
| 2 | 141.5$^{a}$ | 83.33$^{c}$ | 83.33$^{c}$ | 107.5$^{b}$ |
| 3 | 255.0$^{a}$ | 131.11$^{c}$ | 172.78$^{b}$ | 192.0$^{b}$ |
| 4 | 308.5$^{a}$ | 155.44$^{c}$ | 187.78$^{c}$ | 223.0$^{b}$ |

Means with different superscripts in the same row differ significantly ($p<0.05$)

The average feed intake from 0-4th week of age was highest in Vanaraja (27.33 g) followed by White Nicobari (24.50 g), Black Nicobari (23.99 g) and Brown Nicobari (23.34 g). The best FCR (weekly) was observed in White (3.00) followed by Black (3.02), Vanaraja (3.58) and Brown (3.80) during 1st week of age. But during 2nd, 3rd and 4th week of age the best FCR was recorded in Vanaraja (2.05, 2.02 and 5.02 respectively). The overall FCR from 0 day to 4th week of age was best in Vanaraja followed by Black Nicobari, White Nicobari and Brown Nicobari. The highest average weight gain (g) was observed in Vanaraja (68.75) and the lowest was in Brown Nicobari (31.36). Performance Index (PI) indicated the superiority of Vanaraja (Avg. 28.32) over Nicobari birds (Avg. 7.51, 14.19 and 17.36 for Brown Nicobari, White Nicobari and Black Nicobari respectively). The objective scoring index was constructed based on the traits studied in respect of Vanaraja, Brown, White and Black Nicobari fowls. The scoring index also revealed the superiority of Vanaraja (35) followed by Black (42), White (63) and brown (69).

## Adaptability studies of Vanaraja and Nicobari fowls based on hematological traits

Six adult male and female in each of Vanaraja, Brown Nicobari, White Nicobari and Black Nicobari reared under intensive deep litter system of management were studied for hematological traits in relation to adaptability characteristics using the Cell Counter MS9-5V-Melet Schloesing laboratories. The traits studied were 1. Leucocytes: WBC (103/µl), Lym%, Mon%, Heter%, Eosin%, Baso% (Table

2); 2. Erythrocytes: RBC (106/µl), Mean Corpuscular Volume (MCV) fl, HCT%, Mean Corpuscular Hemoglobin (MCH) pg, MCHC g/dl, HGB g/dl, RDW-SD fl, RDW-CV%, (RBC Dispersion width-Coefficient of variation of MCV), µRBC%, MRBC% (Table 3); 3.Thrombocytes: PLT 103 /µl, MPV fl (Mean Platelet Volume), Pct%, Mod fl, Medn fl, PDW (Platelet dispersion width), µPLT%, MPLT% (Table 4). Two factorial (breed and sex) analyses were done. The hematological traits differed significantly ($p<0.01$) among the cock and hen as well as between strains or breed. Female showed lower erythrocyte value than males. Males showed higher leukocyte count than female except heterophils. H:L count revealed that Vanaraja and Brown Nicobari females were more stress prone under deep litter system. Platelets were lower in female than male. Subjective scoring index based on all blood parameters revealed lowest score in White Nicobari males (71 score) indicating their better adaptability physiologically followed by Brown male (73 score). The respective score for male and female of Black Nicobari were 84 and 91. All the females of Brown Nicobari, White Nicobari and Vanaraja scored more than 100 indicating their less adaptability as compared to their male counterpart (Table 5).

**Table 2. Hematological traits of three varieties of Nicobari fowl and Vanaraja (Leucocytes)**

| Traits | Brown Nicobari | | Black Nicobari | | White Nicobari | | Vanaraja | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| WBC10 3/µl | 132.04 | 163.13 | 132.70 | 163.24 | 149.03 | 163.53 | 148.90 | 158.22 |
| Lyph% | 33.88 | 53.45 | 35.97 | 52.97 | 42.53 | 51.93 | 46.77 | 56.20 |
| Mono% | 10.52 | 10.72 | 10.52 | 10.48 | 10.88 | 10.95 | 10.52 | 10.30 |
| Heter% | 38.85 | 23.25 | 38.25 | 23.40 | 31.95 | 24.28 | 28.33 | 21.03 |
| Eosino% | 2.7 | 0.27 | 1.63 | 0.33 | 0.80 | 0.12 | 1.22 | 0.53 |
| Baso% | 3.02 | 4.12 | 3.12 | 4.15 | 3.78 | 3.97 | 3.82 | 4.15 |

**Table 3. Hematological traits of three varieties of Nicobari fowl and Vanaraja (Erythrocytes)**

| Traits | Br M | BrF | Bl M | Bl F | W M | W F | VaM | Va F |
|---|---|---|---|---|---|---|---|---|
| RBCX10 6/µl | 1.98 | 1.38 | 2.14 | 1.50 | 1.61 | 1.46 | 1.59 | 1.60 |
| MCV fl | 98.48 | 92.5 | 96.92 | 94.12 | 97.3 | 90.05 | 95.15 | 93.25 |
| HCT% | 19.38 | 12.67 | 20.7 | 14.07 | 15.67 | 13.12 | 15.03 | 14.83 |
| MCH pg | 77.12 | 68.43 | 72.75 | 70.63 | 76.13 | 57.07 | 73.85 | 65.72 |
| MCHC g/dl | 78.23 | 73.75 | 74.95 | 74.93 | 78.22 | 65.98 | 77.60 | 70.43 |
| HGB g/dl | 15.03 | 9.28 | 15.47 | 10.55 | 12.23 | 8.35 | 11.67 | 10.50 |
| RDW-SD fl | 30.87 | 30.70 | 29.7 | 30.38 | 30.97 | 30.33 | 29.95 | 29.75 |
| RDW-CV % | 8.52 | 9.03 | 8.33 | 8.78 | 8.67 | 9.17 | 8.57 | 8.68 |
| µRBC% | 0.57 | 0.42 | 0.52 | 0.53 | 0.58 | 0.30 | 0.45 | 0.35 |
| MRBC % | 97.07 | 93.33 | 98.10 | 96.38 | 96.93 | 87.62 | 97.08 | 95.63 |

**Table 4. Comparative evaluation of Hematological traits of three varieties of Nicobari fowl and Vanaraja (Thrombocytes)**

| Traits | Brown Nicobari | | Black Nicobari | | White Nicobari | | Vanaraja | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| PLT 10 3/µl | 17.33 | 10.50 | 12.50 | 11.0 | 11.67 | 8.0 | 10.33 | 8.5 |
| MPV fl | 3.38 | 3.40 | 3.28 | 3.28 | 3.6 | 3.78 | 3.77 | 4.02 |
| MOD fl | 1.97 | 1.87 | 2.03 | 2.15 | 1.98 | 1.90 | 1.78 | 1.83 |
| Medn fl | 2.15 | 1.93 | 2.15 | 2.35 | 2.03 | 1.98 | 2.00 | 1.93 |
| PDW | 5.45 | 4.85 | 4.23 | 5.22 | 5.27 | 4.57 | 5.50 | 4.68 |
| µPLT % | 52.02 | 56.88 | 59.77 | 54.05 | 53.40 | 52.80 | 49.07 | 48.27 |



**Table 5. Subjective Scoring Index for hematological parameters**

| Traits/ Index | Brown Nicobari | | Black Nicobari | | White Nicobari | | Vanaraja | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| Erythrocyte | 23** | 60 | 34 | 48 | 26 | 71 | 41 | 53 |
| Leucocytes | 29 | 24 | 28 | 23 | 25 | 22** | 26 | 25 |
| Thrombocytes | 21 | 29 | 22 | 20** | 20** | 32 | 29 | 35 |
| Over all | 73 | 113 | 84 | 91 | 71** | 125 | 96 | 113 |

**Lowest score = best

On the basis of the study on hematological parameters, it is concluded that White Nicobari male was observed the best in respect of adaptability trait followed by Brown Nicobari male, Black Nicobari male, Black Nicobari female and Vanaraja male. The Vanaraja female and Brown Nicobari female were observed equal in terms of adaptability. White Nicobari Female was found least adaptable under hot and humid climate of A&N Islands. In general males were found more adaptable than female.

## Comparative Performance Evaluation of Different Crosses of Vanaraja and Nicobari Fowls

The Vanaraja fowl was crossed with three varieties of Nicobari fowl viz. Brown, Black and White and the body weight of direct and reciprocal crosses produced were compared and presented in Table 6.

The different hatches of pure Nicobari and Vanaraja used for this experiment were selected on the basis of body weight. As no significant differences among hatches were observed, the data from all hatches were pooled over for analysis. Among the pure birds, the body weight of Vanaraja was found significantly better ($p<0.05$) than all the Nicobari varieties at all the weeks of observations. Among the F-1 crosses, the White Nicobari X Vanaraja cross excelled in body weight at 2nd, 3rd and 4th week of age over all the other crosses studied. At 4 month of age the F-1 cross of White Nicobari x Vanaraja gained 43.33% less body weight than the Vanaraja parent (female), while it gained 20.61% more body weight than the White Nicobari parent (Male) whereas in its reciprocal cross 45.97% less body weight gain than Vanaraja parent (Male) and 15.0 % more body weight gain than White Nicobari parent (Female) were observed.

**Table 6. Comparative body wt. (in g) of pure and crosses of Vanaraja and Nicobari fowls**

| | Body wt. (in g) of pure and crosses of Vanaraja and Nicobari fowls | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | V x WN | WN x V | V x Bl N | Bl N x V | V x Br N | Br N x V | Vanaraja | Brown Nicobari | White Nicobari | Black Nicobari |
| 0 Day | $35.89^{b}$ | $35.46^{b}$ | $38.75^{a}$ | $39.55^{a}$ | $33.00^{c}$ | $30.00^{c}$ | $33.50^{b}$ | $30.00^{c}$ | $29.44^{c}$ | $29.00^{c}$ |
| 1st week | $48.52^{d}$ | $48.64^{d}$ | $56.25^{c}$ | $69.93^{a}$ | $52.14^{cd}$ | $47.50^{d}$ | $63.50^{b}$ | $49.44^{d}$ | $48.89^{d}$ | $52.00^{cd}$ |
| 2nd week | $73.70^{cd}$ | $89.44^{bc}$ | $83.18^{cd}$ | $85.36^{cd}$ | $75.00^{cd}$ | $64.06^{d}$ | $127.50^{a}$ | $83.33^{cd}$ | $83.33^{cd}$ | $107.50^{b}$ |
| 3rd week | $103.13^{f}$ | $125.48^{de}$ | $167.31^{c}$ | $172.04^{c}$ | $110.00^{ef}$ | $97.11^{f}$ | $255.00^{a}$ | $131.11^{d}$ | $167.36^{c}$ | $192.00^{b}$ |
| 1st month | $155.24^{e}$ | $194.84^{d}$ | $221.48^{cd}$ | $217.88^{cd}$ | $143.33^{e}$ | $133.42^{e}$ | $423.87^{a}$ | $201.42^{d}$ | $233.33^{c}$ | $291.00^{b}$ |
| 2nd month | $601.27^{e}$ | $764.03^{d}$ | $524.14^{e}$ | $509.41^{e}$ | $521.67^{e}$ | $398.87^{f}$ | $1620.00^{a}$ | $832.50^{cd}$ | $883.33^{c}$ | $995.50^{b}$ |
| 3rd month | $1376.60^{c}$ | $1511.77^{b}$ | $1055.86^{de}$ | $1029.76^{ef}$ | $937.31^{f}$ | $752.03^{g}$ | $2195.50^{a}$ | $1268.54^{c}$ | $1147.44^{d}$ | $1360.00^{c}$ |
| 4th month | $1833.70^{bc}$ | $1923.10^{b}$ | $1420.80^{de}$ | $1517.30^{de}$ | $1341.30^{e}$ | $1083.90^{f}$ | $3394.00^{a}$ | $1612.50^{cde}$ | $1594.40^{cde}$ | $1705.00^{bcd}$ |

Means with different superscripts in the same row differ significantly ($p<0.05$)

# Productivity Enhancement of Pigs under Island Ecosystem

*M.S. Kundu, A. Kundu, Jai Sunder, S. Jeyakumar and S.K. Verma*

## Effect of supplementation of zinc on growth performance of piglets

An experiment was conducted on 10 piglets to study the effect of supplementation of zinc on growth performance of weaned piglets. The piglets were divided into supplemented (n=5) and unsupplemented (n=5) groups. Supplemented group was kept on milk feeding schedule along with 80ppm zinc supplementation by drenching. However the unsupplemented group was fed only on mother's milk till the weaning. The average daily weight gains (ADWG) were recorded for both the supplemented and unsupplemented groups. The results revealed that, the ADWG was significantly higher ($p<0.05$) in supplemented group than unsupplemented group at 30$^{th}$ day. In other days of measurement numerical higher body weights though not significant were observed. The overall ADWG were also significantly higher in supplemented groups. It may be inferred that the supplementation of Zinc at the rate of 80 ppm along with milk helps in improvement of daily body weight gain (Table 7).

**Table 7. Effect of supplementation of zinc on average daily weight gain (g) of piglets**

| Age (days) | Body weight gain (g) | |
|---|---|---|
| | Control Unsupplemented | Treatment Supplemented |
| 15 | 286.66 ± 2.72 | 295.00 ± 6.31 |
| 30 | 283.33$^{a}$ ± 1.92 | 300.00$^{b}$ ± 2.72 |
| 45 | 300.00 ± 4.71 | 381.73 ± 128.12 |
| 60 | 333.33 ± 6.09 | 395.00 ± 46.70 |
| 75 | 253.33 ± 80.14 | 383.33± 35.54 |
| 90 | 336.66 ± 1.92 | 370.00 ± 38.54 |
| Overall | 298.88$^{a}$ ± 10.05 | 365.00$^{b}$ ± 2.46 |

Means with different superscripts in the same row differ significantly ($p<0.05$)

## Effect of supplementation of zinc on post weaning growth performances of piglets

An experiment was conducted to see the effect of Zinc supplementation on post weaning growth performances of piglets. A total number of 10 piglets at the age of weaning were divided into two groups. The supplemented group (n=5) was fed with 80 ppm Zinc along with normal farm diet whereas the unsupplemented (n=5) groups were fed only with the normal farm diet. The experiment continued for three months. The results (Table 8) revealed that the supplemented group showed significant increase in body weight gain from 60$^{th}$ day onwards than the unsupplemented group. Supplementation of 80 ppm Zinc in the diet of weaned piglets showed a body weight gain of 5.98 Kg in the treated group over the un- supplemented group. The cost of 5.98 kg live weight was calculated to be Rs 897.00 and supplementation cost of Zinc ($ZnSo_4$. $5H_2O$) was Rs 50.00 only. Net profit of Rs 847.00 was recorded for the group of 5 piglets with Rs 169.40 per piglet during the period.

## Effect of floor space for nursing Sows on growth performances of piglets from birth to weaning

An experiment was conducted to see the effect of floor space on the performances of growth of the piglets. For this purpose two types of floor space were given to the nursing sows. One group of sows having 60 sq ft and another group were given 30 sq ft floor space for nursing sows. The body weight growth recorded at 56$^{th}$ day was 68.26 ± 3.69 and 106.769 ± 3.56 g per day respectively for the group 30$^{th}$ sq ft and 60$^{th}$ sq ft groups. It was observed that 60 sq ft

floor space helped to increase the weaning body weight of piglets significantly ($p<0.05$) compared to the 30 sq ft floor space.Total gain in body weight for giving extra space to the nurshing sows was recorded to be 5.19 Kg for 5 sows, the cost of which was calculated to be Rs 778.00 for the group as per the prevailing market rate. However the weaning body weight of 1.03 Kg extra per piglet over the control group is helpful in subsequent growth in for the piglets.

**Table 8. Effect of Supplementation of zinc on post weaning growth performances of piglets**

| Age of the piglets | Control (Kg) | Treatment (Kg) |
|---|---|---|
| 57th -day | 07.28 ± 0.23 | 07.10 ± 0.25 |
| 72nd days | 11.58 ± 0.27 | 11.53 ± 0.30 |
| 87th days | 15.83 ± 0.26 | 16.03 ± 0.31 |
| 102nd days | 20.33 ± 0.32 | 22.75 ± 0.83 |
| 117th days | 25.33 [a] ± 0.36 | 28.68 [b] ± 0.65 |
| 132nd days | 29.13 [a] ± 1.14 | 34.43 [b] ± 0.43 |
| 147th days | 34.18 [a] ± 1.13 | 39.98 [b] ± 0.48 |
| Total Gain (90days) | 26.90[a] ± 0.91 | 32.88[b] ± 5.10 |

Means with different superscripts in the same row differ significantly ($p<0.05$)

## Study the Feasibility and Convergence on Subsistence Pig Rearing to Commercial Pig Farming Inclusive of its Process

*M. S. Kundu, A. Kundu, S. Jeyakumar, Subhash Chand, S.K. Zamir Ahmed and Shiv Kumar*

### Studies on feeding practice of Nicobari pig and importance of rations based on local feedstuffs

The locally available feed resources viz. Nicobari Alu, Pandanus, Colocasia and Bread fruit are used to feed the pigs. Most of the feed materials are used for human consumption and the left over are fed to the pigs. The feed materials are high in starch as well as so the energy content and low in protein content. These are not sufficient to meet the nutrient requirement of the pigs. Specially minerals especially the calcium is in low level resulting in low stature of the pigs. The available data suggests that the feed can supply only 11- 14 g of Ca / day as against the requirement of 40 g per day. It has been observed that the protein and minerals are limiting in the feeds currently used by the farmers. Forages could be the possible solution to meet the energy requirement of the pigs as forages contain fairly good amount of CP (160-270g/Kg DM). However due to bulking property, the voluntary intake was limited when supplied fresh but when presented in dry and ground form voluntary intake was double. In order to improve feed quality, the protein and mineral need to be supplemented. Awareness training programme on "Scientific pig rearing & conservation of indigenous pig germplasm" was organized at Car Nicobar on 4-7th July 2010. All together 175 change agents participated in the training programme (Plate 1).


Plate1: Scientist imparting training to the tribals.

# Dietary Supplementation of Micronutrient to Improve the Productivity of Pig

*M. S. Kundu, S. Jeyakumar, Jai Sunder, A. Kundu, S. K. Verma and A. K. De*

## Analysis of micronutrients in the locally available feed staffs for pig feeding

Four energy rich concentrate feeds viz. Mustard cake, Copra cake, Wheat Bran and, Gram and nine fodder samples viz. Napier, Guinea grass, Para grass, Subabul, Dinanath, Nicobari Alu, Pandanus, Bred fruits and Colocasia were analyzed for Zinc (Zn) and copper (Cu) content. The average Zn and Cu content of theses samples were 40.89 ± 0.98 and 8.14 ± 0.11 µg/ kg for concentrate feed; whereas 31.46 ± 0.91 and 5.51 ± 0.11 µg/kg for fodder samples respectively. The Zn and Cu content both in feed and fodder samples varied from 48.25 to 16.23 µg/kg and found to be below the critical level. Hence extra supplementation is required to get the optimum result. Similarly in case of copper the content is also below the critical level than the requirement. Therefore the supplementation is required (Table 9).

**Table 9. Zinc and Copper content of locally available energy rich concentrates and fodder**

| Energy rich feed ingredients | Zinc conc. (ppm) | Copper conc. (ppm) |
|---|---|---|
| Mustard cake | 46.25 | 7.01 |
| Copra cake | 37.89 | 8.04 |
| Wheat Bran | 48.25 | 9.24 |
| Gram Chuni | 31.18 | 8.26 |
| **Average** | **40.89 ± 0.98** | **8.14 ± 0.11** |
| Fodder | | |
| Napier | 25.12 | 6.65 |
| Guinea grass | 26.23 | 5.21 |
| Para grass | 23.12 | 9.45 |
| Subabul | 29.25 | 5.23 |
| Dinanath | 26.23 | 6.23 |
| Nicobari Alu | 72.23 | 6.45 |
| Pandanus | 38.25 | 2.35 |
| Bred fruits | 26.45 | 3.45 |
| Colocasia | 16.23 | 4.56 |
| **Average** | **31.46 ± 0.91** | **5.51 ± 0.11** |

# Potential of *Morinda citrifolia* Fruit as Feed for Livestock and Poultry

*Jai Sunder, D.R. Singh, S.K. Verma, A.Kundu and R. C. Srivastava*

## Evaluation of *Morinda citrifolia* as feed in Japanese quail

*Morinda citrifolia* fruits were collected, cut into small pieces and sun dried. The dried *Morinda citrifolia* fruits were grounded to make it in the form of feed granules (Plate 2). The experimental ration was prepared as per the BIS standard (Table 10). A total of 100 day old Japanese quails were randomly divided into two groups (50 in each) providing one group with experimental feed containing *Morinda citrifolia* fruit granules and the other one without *M. citrifolia* fruit granules as control. The experimental

feed was fed to Japanese quail while one group was kept as control. The observations *viz*. body weight, mortality and feed intake were recorded and feed conversion ratio (FCR) was calculated. No medication, mineral and vitamin supplement were given during the experimental period. The birds were reared under normal housing and management condition.

**Table 10: Composition of experimental and control feed**

| Ingredients | CP % | Experiment feed (kg) | Control feed (kg) |
|---|---|---|---|
| Maize | 9.2 | 15 | 20 |
| Wheat | 10 | 15 | 20 |
| Morinda fruit | 6.3 | 15 | 0 |
| Rice bran | 12 | 15 | 20 |
| Ground nut cake | 41 | 25 | 25 |
| Fish meal | 43 | 15 | 15 |
| **Total** | | **100** | **100** |
| CP % | | 22.23 | 22.94 |
| CF % | | 6.25 | 6.35 |
| ME (Kcal) | | 2501.45 | 2621 |

Plate 2: Preparation of *M. citrifolia* dried fruit granules

The result revealed that body weight of the *Morinda* fed group was higher than the control group at different days of observation (Table 11). The body weight at 2nd, 3rd and 5th week of age was significantly ($p<0.05$) higher in the morinda fed group compared to the control group. The replacement of maize, wheat and rice bran @ 5% each with *Morinda* fruit showed better performance in the treatment group. The mortality was high (7%) in both the group during the first four days of age, but no mortality was observed after the 2nd week in any group. The feed conversion ratio of morinda fed group was found better than the control group at the end of 5th week of age. Best FCR was recorded at the 3rd week of age when the quails are in growing phase. The findings of the present study indicated that the feeding of *M. citrifolia* fruit can replace rice bran, wheat and maize combined up to 15% level.

**Table 11: Effect of feeding Morinda citrifolia on Body weight (g) at different week interval**

| Age (week) | Body weight | | FCR | |
|---|---|---|---|---|
| | Control | Treatment | Control | Treatment |
| 0 | 7.25±0.12 | 7.29±0.11 | | |
| 1 | 19.30±0.73 | 18.28±0.66 | 4.72 ± 0.27 | 4.64 ± 0.57 |
| 2 | 37.42±2.02$^{b}$ | 43.17±0.97$^{a}$ | 7.24 ± 0.24$^{b}$ | 6.4 ± 0.17$^{a}$ |
| 3 | 71.88±1.42$^{b}$ | 77.09±1.41$^{a}$ | 6.68 ± 0.12$^{b}$ | 4.32 ± 0.17$^{a}$ |
| 4 | 94.25±2.03 | 98.77±2.14 | 6.72 ± 0.33$^{b}$ | 4.49 ± 0.14$^{a}$ |
| 5 | 111.0±3.36$^{b}$ | 121.12±2.74$^{a}$ | 7.41 ± 0.29 | 6.39 ± 0.18 |
| 6 | 125.75 ± 3.50 | 135.05 ± 4.118 | | |

Means with different superscripts in the same row differ significantly (P< 0.05)

# Development of Therapeutics & Supplements by Using Indigenous Herbs and Beneficial Microorganisms for Livestock Health and Production

*Jai Sunder, S. Jeyakumar, M.S. Kundu, S.K. Verma, A. Kundu and R.C. Srivastava*

## Survey & documentation of ITKs in Animal health & production

A survey was conducted in different villages of South Andaman and North Andaman to collect the information on the indigenous technical knowledge (ITK) and medicinal plants used for animal health and production. The information on the important ITKs and the medicinal plants are listed in Table 12. The information on the ITKs used by the different religion and communities varied from place to place. The use of ITKs is diminishing due to lack of interest of youth in the animal husbandry practices and loss of knowledge on the ITKs. The use of medicinal plants in the Andaman villages were found less as the farmers are dependant on the veterinary health care of the AH&VS. However, some of the farmers still practice the traditional way of treatment and few of the important plants are listed below:

**Table 12: ITKs practiced by livestock owners of Andaman Villages**

| Purpose | Methods | Species |
|---|---|---|
| Increase body weight/health | 1. Mix maize with feed<br>2. Deskin the dhaman snake or oriental ratsnake (*Ptyas mucosus*), boil it, remove the bones, add jeera (cumin) and raw turmeric, boil again and given to cattle | Goat, poultry, cattle |
| Increase milk production | 1. Feed one coconut daily with feed<br>2. Boil kanta bhaji (*Azeretum conizoies*)and give to cattle<br>3. Feed bhringraj(*Eclipta alba*) leaf<br>4. Dry the *Mimosa pudica* plant and feed to cattle | Cattle |
| Mouth ulcer | 1. Mix the salt with mustard oil, rub the affected surface with banana stem slowly | Cattle, goat |



| | | |
|---|---|---|
| Fever | 1. Mix Brandy in rice.<br>2. Mix chilly powder or mustard oil in Feed<br>3. Mix rice with diesel overnight fed to poultry<br>4. Feed onion to poultry<br>5. Mix rice with *Bombay chilli* (Capsicum spp) and given to poultry<br>6. Mix paracetamol with rice and given to poultry<br>7. Mix country liquor with wheat kept it for overnight and feed to poultry in empty stomach. | Poultry |
| Fever in goat | 1. Prepare paste of papaya root and given to goat and apply the paste over the body surface from head to tail for three days | goat |
| Wound Healing | 1. Make a paste of turmeric in coconut oil and apply over the wound area twice a day. Wound healing occurs within two days.<br>2. Make paste of turmeric, naphthalene and neem oil and apply over the wound | Poultry and cattle |
| De-worming | 1. Feed fish called *Channa spp* (snake head, *kala machchi*) (black fish) to cattle for a week. It kills all the intestinal worm and animal become healthy within 2 weeks.<br>2. Collect human urine in bottle, keep it for 10 days in dung and give to cattle for two days<br>3. Mix *Cissus quadrangularis* turmeric, chilli and given to poultry | Cattle<br><br>Poultry |
| Retention of Placenta | 1. Boil whole paddy (dhan) in water and given to cattle<br>2. Boil Bottle gourd (louki) in water and mix in feed<br>3. Give raw bamboo leaves directly to cattle<br>After 12-24 hrs of feeding of any one of the above, the placenta sheds off.<br>4. Feed *Brassica* spp. leaves ( wild raddish) | cattle |
| Diarrhoea | 1. Feed directly the inner most white portion of banana flower to the animal once in a day for 2-3 days<br>2. Feed inner white portion of the banana stem<br>3. Feed banana flower<br>4. Mix *Piper nigrum* flower, fire wood smoke ash, turmeric, salt and *Acorus* fruit and give one bolus to goat in the morning and if required in the evening<br>5. Feed *Centella asiatica* (*medak bhaji),* phylanthus leaf and neem leaf<br>6. Mix garlic and turmeric in feed and given to poultry | Goat, Cattle<br><br>Goat<br><br><br><br>Poultry |
| Stomach pain | 1. Mix raw turmeric and neem leaf and feed | Cattle, goat |
| Mastitis | 1. Boil tamarind leaves and give hot fomentation over the affected udder<br>2. Mix raw fruit of *Datura stramonium* and leaf and apply over the affected udder | Cattle |
| Eruption in tongue/ulcer | 1. Mix turmeric, salt and turmeric and rub over affected area | Cattle |
| Foot infection in ducks | 1. Keep the ducks in dry place for 2-3 days | Duck |
| General weakness | 1. Prepare paste of *Cissus quadrangularis* ( feed leaf and stem to animals) | Cattle, goat |

## Isolation, identification and characterization of beneficial microbes

A total of 20 *Lactobacillus spp*. have been isolated from various sources such as goat intestinal swab, poultry intestine and oral mucosa (Table 13). The biochemical characterization of the lactic acid bacteria showed positive growth at 45$^0$C by *Lactobacillus jensenii, Lactobacillus salivarius* and *Streptococcus salivarius*. All the species showed negative reaction with catalase test (Table 14). The

*in-vitro* dual culture assay of Lactic acid bacteria showed antibacterial inhibitory activity against *Salmonella spp*. and *E. coli*. The metabolite of the lactic acid bacteria has been prepared for *in-vitro* antibacterial activity assay by disc diffusion method.

**Table 13: Isolation of Lactic acid bacteria from different sources**

| Samples collected | Organism identified |
|---|---|
| Curd | *Lactobacillus jensenii, Lactobacillus casei* |
| Dough | *Lactobacillus casei, Yeast, Streptococcus* |
| Vegetables | *L. brevis, L. cellobiosus* |
| Goat vaginal swab | *L. salivarius, Streptococcus* |
| Cow vaginal swab | *Streptococcus* |
| Chicken intestine | *Lactobacillus jensenii, L. brevis* |

**Table 14: Biochemical characteristics of Lactic acid bacteria**

| S.No | Name of the organism | Gram's staining | Growth at 45°C | Catalase | Arabinose | Maltose | Mannitol | Raffinose | Salicin | Sorbitol |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Lactobacillus jensenii* | + | + | – | – | + | – | + | – | + |
| 2 | *Lactobacillus salivarius* | + | + | – | – | + | + | + | – | + |
| 3 | *Lactobacillus casei* | + | – | – | – | + | + | – | + | + |
| 4 | *Lactobacillus brevis* | + | – | – | + | – | + | + | – | – |
| 5 | *Streptococcus salivarius* | + | + | – | + | + | – | + | + | – |
| 6 | *Lactobacillus cellobiosus* | + | – | – | + | + | + | + | + | – |

# Characterization of Livestock Production Sub System and Assessment of Critical Nutritional Gap in Bay Islands

***S.K. Verma, M.S. Kundu, Subhash Chand, Jai Sunder, I. Jai Sankar and Abhay Singh***

Out of 572 Islands, islets and rocks in Andaman Nicobar group of Islands only 36 inhabited islands have 1.74 and 9.79 lakh livestock and poultry population respectively as per 18th livestock census, 2007. Out of 36 inhabited islands livestock are available only at 23 islands and rest 13 islands have only human activity. The main animal species reared by the farmers are cattle, buffalo, goat, pig and poultry.

## Characterization of Livestock Population

According to 17th livestock census, 2003 there was a population of 1.95 lakh of livestock and 9.31 lakh of poultry (Table 15). During 18th livestock census 2007, livestock population was reduced by 10.9 % while poultry population was increased by 5.1 %. In 2003 Goat population was 64,126 (32.86 %) followed by 62,632 cattle (32.09 %); 52,201 pigs (26.75 %) and 16,211 buffaloes (8.31 % %). Crossbred cattle population was less (6.56 %) as compared to Indigenous cattle (25.53 %). Likewise crossbred pig population was also less (1.59 %) than indigenous



pig population (25.16 %). According to 18th livestock census, 2007 cattle and buffalo population was reduced while goat and pig population was increased which clearly indicates the increasing interest of farmers in small livestock farming as compared to large animal farming.

**Table 15: Status of livestock population in A&N Islands**

| Livestock Species | Number (17th Livestock census, 2003) | % of Total Livestock | Number (18th Livestock census, 2007) | % of Total Livestock |
|---|---|---|---|---|
| Crossbred Cattle | 12801 | 6.56 | NA | NA |
| Ind. Cattle | 49831 | 25.53 | NA | NA |
| Total Cattle | 62632 | 32.09 | 49364 | 28.39 |
| Buffalo | 16211 | 8.31 | 10091 | 5.80 |
| Goat | 64126 | 32.86 | 66721 | 38.37 |
| Crossbred Pig | 3096 | 1.59 | NA | NA |
| Ind. Pig | 49105 | 25.16 | NA | NA |
| Total Pig | 52201 | 26.75 | 47730 | 27.45 |
| Total Livestock | 195170 | NA | 173906 | NA |
| Total Poultry | 930878 | NA | 978565 | NA |

It is evident from table that proportion of cattle in total livestock population reduced by 3.7%, while buffalo population reduced by 2.51%. However, the goat and pig population increased by 5.49% and 0.70%. The increase in pig population is significant because there was huge loss of pig population during tsunami. Due to Tsunami about 25% cultivable paddy land was inundated by sea water which resulted in less availability of paddy straw for livestock. Due to insufficient feeds and fodder now farmers are moving towards small ruminant production or non ruminant production.

### Island wise fodder and feed requirement for different livestock species

Island wise fodder and feed requirement was also worked out. Requirement of green fodder was 1.37 lakh t/annum while requirement of dry fodder was 0.66 lakh t/annum. Requirement of concentrates for livestock was 1.23 lakh t/annum (Table 16).

**Table 16: Island wise feed and fodder requirement of livestock in A&N islands**

| S.No. | Island | GF Req. (t/annum) | DF Req. (t/annum) | Conc. Req. (t/annum) |
|---|---|---|---|---|
| 1 | East Island | 1.22 | 0 | 0.41 |
| 2 | North Andaman Island | 36855.51 | 19847.605 | 26096.04 |
| 3 | Smith Island | 367.92 | 196.005 | 271.20 |
| 4 | Middle Andaman Island | 30358.15 | 16250.165 | 20948.81 |
| 5 | Long Island | 861.40 | 428.875 | 525.60 |
| 6 | Baratang Island | 5583.04 | 3024.025 | 3397.06 |
| 7 | South Andaman Island (Rural) | 35630.57 | 17747.395 | 30436.62 |
| 8 | South Andaman Island (Urban) | 3957.33 | 1499.785 | 2090.36 |
| 9 | Viper Island | 26.28 | 17.52 | 14.60 |
| 10 | Havelock Island | 2792.62 | 1396.855 | 1710.76 |
| 11 | Neil Island | 2848.46 | 1274.945 | 1521.69 |
| 12 | Rutland | 455.89 | 254.04 | 240.54 |
| 13 | Little Andaman Island | 6509.78 | 2661.945 | 4288.75 |
| 14 | Nicobar Island | 6552.12 | 123.005 | 23076.03 |
| 15 | Chowra Island | 253.68 | 0 | 1914.79 |
| 16 | Terresa Island | 392.01 | 8.03 | 2510.47 |

| | | | | |
|---|---|---|---|---|
| 17 | Bombooka Island | 22.27 | 6.935 | 100.01 |
| 18 | Katchal Island | 237.62 | 41.975 | 856.29 |
| 19 | Nancowry Island | 441.65 | 201.48 | 905.57 |
| 20 | Kamorta Island | 231.41 | 70.445 | 279.23 |
| 21 | Little Nicobar Island | 5.84 | 0 | 52.20 |
| 22 | Kondul | 4.75 | 0 | 38.33 |
| 23 | Great Nicobar Island | 2316.66 | 1327.87 | 1815.51 |
| | **Total** | **136706** | **66379** | **123095** |

It can be seen that large animals reared were maximum at North Andaman Island followed by South Andaman Island (Rural) and Middle Andaman Islands. In Nicobar Group of Islands ruminants were available mainly at Car Nicobar Island and Campbell Bay.

## Availability of dry matter during different months

On the basis of field survey, estimation was made regarding availability of dry matter to the livestock during different months. It was observed that maximum availability of dry matter was during the months of August and September when some jungle grasses were available to the animals. From October onward availability of dry matter was reduced till March. February and March were the most crucial months when animals were getting very little to feed as no grasses were available in the jungle and farmers' stock of paddy straw was also exhausted by this time. From April onward availability of dry matter was improving slightly due to pre monsoon showers. But none of the month was such when animals were able to fill up their belly well. Most of the animals were underfed which was reflected in their production status. Average dry matter availability through out the year was only 40 % with a range of 25 - 55 % (Fig 1).

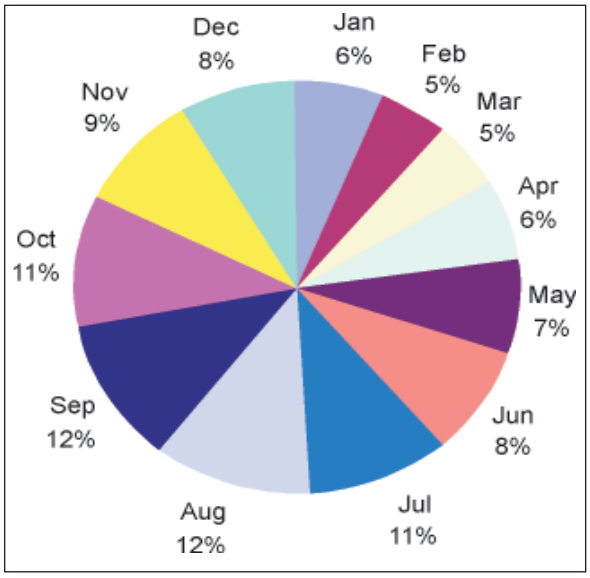



Fig 1: Availability of dry matter to the livestock during different months

## Assessment of nutritional gap in different livestock species

Requirement and availability of green fodder, dry fodder and concentrate for different livestock species were estimated. The results revealed that the deficit of green fodder was 59.6% while that of dry fodder was 42.1%. The most deficits were the concentrate feed (97.19%) as there is almost negligible production of grain and oilseed crops for livestock feeding. (Table 17)

**Table 17: Estimated requirement, availability and deficit of Green, dry fodder and concentrate**

| Feed/ fodder | Requirement (t/annum) | Availability (t/annum) | Deficit (t/annum) |
|---|---|---|---|
| Green Fodder | 136706 | 600 (Culti. Fodder) 54682 (Grazing) | 81424 (59.56 %) |
| Dry Fodder | 66379 | 38425 (Paddy straw) | 27954 (42.11 %) |
| Concentrate | 123095 (30691 for poultry alone) | 3461 (Bran/ husk/ Oilseed cake) | 119634 (97.19 %) |



# Feasibility Evaluation of Growing Fodder during Pre Paddy and Post Paddy Period under Rain fed Conditions

*S.K. Verma, R.C. Srivastava, T. Subramani and B.K. Nanda*

Green and dry fodder shortage is very acute in Andaman and Nicobar group of Islands as very little area is under cultivable fodder. Due to shortage of feeds and fodder the productivity of the cattle and buffalo is very poor in these Islands. Out of the total geographical area, cultivable area is very limited which mainly comes under plantation crops on the hilly slops and about 8000 ha area is paddy land. Therefore it was presumed to utilize the existing cultivable land judiciously to produce fodder during the period when no crop is there in the fields or to utilize the land under coconut and arecanut gardens and nearer to fish ponds. Hybrid napier cuttings and rooted slips were transplanted under the coconut and arecanut plantations and on the bank of fish pond. The fodder grass was established well and producing biomass even during dry period. Besides this, Hybrid napier fodder was transplanted on the ridges and terrace risers of vegetable block. The grass has been established well and due to its thick grass canopy, the risers were stabilized very soon and the soil erosion was checked.

As the cultivable land is meager therefore concept of growing pre paddy and post paddy fodder was exercised. In the year a trial was conducted to study the production potential of different fodder crops as pre paddy fodder. Four crops were sown on 3rd March 2010 at Bloomsdale Farm in five replications and harvested on 6th May 2010 after 65 DAS. Cowpea produced maximum biomass (31.38 t/ ha) followed by Ricebean (20.19 t/ha), Maize (9.26 t/ha) and Coix (4.94 t/ha). It can be concluded that fodder crops can be taken as pre and post paddy crops successfully to augment the fodder supply to the livestock (Table 18).

**Table 18: Yield of different fodder crops during pre paddy season**

| Crops | Yield (t/ ha) | | | | | Average Pdn (t/ha) |
|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | R5 | |
| Maize | 9.69 | 9.63 | 9.69 | 7.69 | 9.63 | 9.26±0.39$^{c}$ |
| Coix | 2.5 | 9.38 | 5.63 | 5.00 | 2.19 | 4.94±1.29 $^{c}$ |
| Cowpea | 34.38 | 34.06 | 28.13 | 30.63 | 29.69 | 31.38±1.22 $^{a}$ |
| Ricebean | 30.63 | 16.88 | 23.44 | 7.81 | 22.19 | 20.19±3.79 $^{b}$ |

The average figures bearing different superscripts in the same column differ significantly ($p<0.01$)

# Enhancement and sustainable Dairy Cattle and Buffalo production in Bay Islands

*S. Jeyakumar, A. Kundu, M.S. Kundu, Jai Sunder, T. Sujatha, S.K. Verma, Subhash Chand, M. Balakrishnan and R.C. Srivastava*

## Productive and reproductive performance of dairy cows and buffalo

Lactation performance of cross bred cows (n=6) reared at institute farm showed lactation length of 351.17±43.36 days with lactation yield of 1857.74±272.21 litre with a wet average of 5.5±0.7litre. The peak yield of 8.88±0.95 litre was reached at 27.17±4.33 days. No significant sex difference in birth weight (in kg) of calves was observed. The average birth weight of male was (n=13, 20.88±1.28 kg,) and that of female was (n=8, 20.45±1.08). Jersey calves numerically weighed more than HF cross. The average age at first calving in cross bred cows was 42.67±1.23 with inter-calving

period of 17.00±1.34 months. Productive performance of buffalo (n=1) showed the lactation length of 246 days with a lactation yield of 450.4 litre. The peak yield of 3.6 lit reached 11 days. The average Fat and SNF percentage of milk estimated by Gerber sulphuric acid method at ANIIDCO were. 4.1, 8.10 for cow and 8.58, 9.66 for buffalo respectively. Studies on Lactation curve to identify and improve feeding and management in cross bred cows showed fluctuation and improvement in lactation yield between four and eighth month (which could be due to better availability of fodder during monsoon period) but no significant fluctuation in lactation yield in buffalo throughout the lactation period. There was significant enhancement in overall milk production and revenue generation during the period of study from 2006 to 2010.

### Upgradation of desi buffaloes with Murrah germplasm through AI technology

A primiparous desi buffalo with a history of post partum anestrum was successfully treated using CIDR technology (CIDR+PG+PMSG) and animal was brought into cyclicity. Fixed time Artificial Insemination using Murrah germplasm resulted in pregnancy and successful birth of first upgraded Murrah female calf in the institute farm on 24$^{th}$ November 2010. The birth weight of calf was 31.0 kg. The dam yielded 460.75 lit in 128 days with an average daily milk yield of 3.6 lit. The peak yield of 3.6 lit reached at 11 days

### Effect of *Morinda citrifolia* on antioxidant activity in calves

To assess the antioxidant effect of *Morinda citrifolia*, whole fruit in mash form was fed to 4-6 months old four crossbred calves @100g/calf /day. Blood samples (whole blood in EDTA and for serum) were collected from jugular vein to assess antioxidant and free radical scavenging activity. The results showed that Morinda feeding exerted antioxidant properties by gradually increasing the Super oxide Dismutase (IU/mg protein) (SOD) from 0.74±0.12 in treated group against control of 0.90±0.11 at the zero week to 1.97±0.12 against control level of 0.89±0.09 at 4$^{th}$ week and catalase levels ((IU/mg protein) in blood from 0.11.41±0.46 in treated group against control of 13.08±0.73 at the Zero week to 18.58±0.29 against control level of 13.42±0.90 at 4$^{th}$ week significantly ($p<0.01$).This would reduce stress and enhances antioxidant defense mechanism for better calf-hood health management.

### Effect of external application of *M. citrifolia* on Hump sore in cattle

As a pilot study an adult cow affected with Humpsore was topically applied with fruit pulp of *Morinda citrifolia* on the lesion for ten days. Preliminary observation showed that the plant exerted house fly repellent activity and healing effect on the humpsore wound. (Plate 3 a, b & c)

**(a)** **(b)** **(c)**

Plate 3: a) Humpsore lesion in a cow b) application of Morinda and c) healing effect of Morinda after 10 days of application.

## Probiotic mineral supplementation to improve lactation performance in cows

Minerals and probiotics are the critical nutrients that influence the productivity and their daily requirement is essential in lactating cows. The present study was carried out to evaluate the efficacy of commercially available probiotic mineral mixture on lactation performance of crossbred cows. Healthy, normally calved, 12 crossbred cows under standard management condition and in early to mid lactation from Institute Cattle Farm were selected for the study. The cows were divided into two groups as supplemented (treated group, n=6) and unsupplemented cows (control group, n=6). The cows in treatment group were fed with 50g of probiotic mineral supplement available in market, containing Calcium-14.0%, Phosphorous-7.0%, Magnesium-3.0%, Sodium-7.0%, Potassium-2%, Cobult-30 ppm, Copper-500 ppm, Iron-4000 ppm, Iodine-150 ppm, Manganese-1000 ppm, Zinc-3000 ppm, Selenium-30 ppm, Vitamin A-5,00,000 IU/Kg, Vitamin D3-1,00,000 IU/Kg, VitaminE-1000 IU/Kg and probiotic microbes such as Lactobacillus acidophilus, L. sporogenes, Bacillus subtilis and Saccharomyces cerevisiae) for a period of 30 days. Cows in both the groups were observed for daily milk production and the milk yield characteristics. The traits of the supplemented group were compared by't' test among themselves i.e., prior to, during and after supplementation. The average daily milk yield (lit) of a cow was significantly ($P \leq 0.01$) highest (4.67±0.05) during supplementation than before (3.70±0.05) and after (4.17±0.04) supplementation. Similarly, the average daily milk yield (in lit) of individual cow was significantly ($P \leq 0.01$) higher in supplemented group (4.86±0.03) than unsupplemented (control) group (3.25±0.04). It is suggested that use of probiotic microbes along with mineral mixture enhances the milk production of lactating cows by improving the absorption and/or bioavailability.

**Vermicompost production & harvest**

Plate 4: Harvest of vermicompost from all the three tanks, separation of compost and worms, good quality compost and packing of compost for despatch.

A total of 4.3 tonnes of vermicompost was produced from two tanks during the first cycle and revenue of Rs. 34,400 was generated by sale of compost @ Rs. 7.00 per kg. The analysis of vermicompost at NRM lab revealed that the N, P and K content was 1.5, 0.7 and 0.86 per cent respectively.

## Biochemical and genetic diversity analysis of enteric/vaginal micro flora of cattle

A total of 40 bacterial isolates were obtained from the rectal and vaginal swab of cattle. The biochemical tests revealed that most of the bacteria belonged to *Klebisella sp, Cedeca sp, Serratia sp salmonella sp Enterbacter sp, Yersinia sp* and *Escherichia sp.* The Antibiogram test showed sensitivity to Tetracycline (85 %), gentamicin (62%), Co-trimoxazole (60%), chloramphenical (55%), Ciprofloxacin (45%), Cefuroxime (35%), Ceftriaxone (25%), Ampicillin (10%). The 16s rDNA of all the isolates were amplified with primers PA and PH. Gel electrophoresis of undigested PCR products of all the isolates produced a single band of about 1500 bp. 22 and 20 restriction patterns were obtained after digestion of the amplified 16s r DNA fragment with *HaeIII and* Hinf1 respectively. A high similarity index of around 80% was obtained from the two restriction endonucleases (*Hae* III and *Hinf* I) by performing a similarity analysis based on composite ARDRA profile.

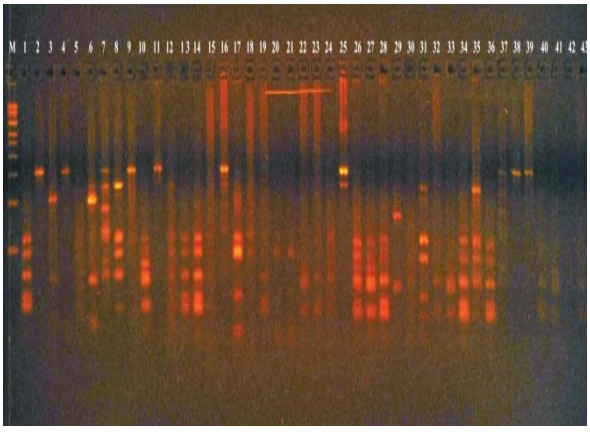


Plate 5: Photograph of restriction digestion analysis of 16s rDNA fragment of bacterial isolates with *Hae11, M= marker (1.5 kb) s. no. 1-43 (bacterial isolates)*

## Success story: Plantation based model dairy farming under island ecosystem

A private entrepreneur Shri Sundaramurthy, R/o Kodiyaghat (near Chidiyatapu) is practicing plantation (coconut) based agriculture in 7.85 hectare. He was interested in integrating dairy in the plantation and he had few desi cows with a total production of 2-3 lit/day which was used for his household consumption. The farmer approached Animal Science Division, CARI for technical guidance to start a dairy farm in his plantation area. The farmer was given 7 days practical training on scientific dairy farming and a scientific team from CARI visited his farm area to examine and suggested to develop infrastructure facilities viz. development of water resource (water harvesting pond and storage tank), fodder cultivation as an intercrop in the coconut plantation area and construction of a dairy cattle shed for 20 cows with required facilities and proper drainage with recycling system for farm waste. He was given a project proposal for 10 cows and the same was sanctioned by State Bank of India. The farmer got an amount of Rs. 8.0 lakhs as a loan to start his farm. As per the technical guidance and knowledge gained through training, the farmer constructed a dairy house with a capacity for 20 adult cows (Tail – to – Tail system) with a separate calf shed, milk collection and feed storage room. A pond was created to harvest and utilize water for farm and agricultural. Green fodder is being

Plate 6: Plantation based dairy farm



harvested regularly and chaffed with manual chaff cutter before feeding. Through bank loan he purchased 16 cross bred cows and got insured. He is maintaining the cows properly as per the technical guidance provided time to time. Now he is having herd strength of 37 dairy cattle including calves and bull. Presently 5 cross bred cows are in milking stage with overall farm production of 40-45 lit/day with an average of 7-8 lit/day/cow. He sells milk directly to households @ Rs.30-35/lit and he is getting a regular income of Rs.1350-1500 per day with a net profit of Rs. 800/day on milk after deducting the expenditure incurred on feed and labour. In addition to milk, farmer is getting manure and he is efficiently utilizing the waste output from the shed. The liquid waste is directly utilized for banana and vegetable cultivation through proper drainage system. The solid manure is being regularly collected from the farm and converted into farmyard manure and utilized for horticulture crops, fodder and coconut plantation. The intervention by CARI and farmer's effort has resulted in establishment of a successful model plantation based dairy farm suitable for the island ecosystem.

## Productivity Enhancement of Goats in Bay Islands

***S. Jeyakumar, Jai Sunder, M.S. Kundu, A.Kundu, S. K. Verma, M. Balakrishnan, Subhash Chand, Zamir Ahmed and R.C. Srivastava***

### Augmentation of production through controlled breeding programme in goats

Controlled breeding technology is of good practical interest to planned breeding and fixed time Artificial Insemination which would accelerate kidding system to improve the livelihood of the local farmers and meet out the local demand for chevon. The progestagen in association with PMSG (pregnant mare serum gonadotrophin) was employed in controlling estrus in goats. As a pilot experiment six Andaman Local goats of 1- 4 years weighing 15-20 kg were taken for the study in the farmer's field. The does were inserted with an indigenously developed intravaginal sponge obtained from Central Institute for Research on Goats (CIRG-ICAR). The cylindrical shaped sponges with a diameter of 25mm (impregnated with 300mg of natural progesterone) tied with one foot long thread were inserted into vagina of goat using glass speculum and plastic plunger, and tested for their retention for 12 days. At the time of insertion, 1ml of injection containing 2.5mg of estradiol -17 beta was administered subcutaneously. The intravaginal sponges were removed 12 days after insertion. One ml of Pregnant Mare's Serum Gonadotropin (PMSG) was injected intramuscularly at the time of withdrawal of the sponge. The does were observed for onset of estrus daily in the morning and evening. The does in estrus were bred by Artificial Insemination using Boer goat frozen semen obtained from Kerala Livestock Development Board. The sponge retention rate, estrus response and conception rate were 66.66, 100.00 and 75.00 per cent respectively. It is suggested that intra vaginal sponges can be successfully employed for controlled breeding in goats and further study is in progress (Plate 7 a to l).

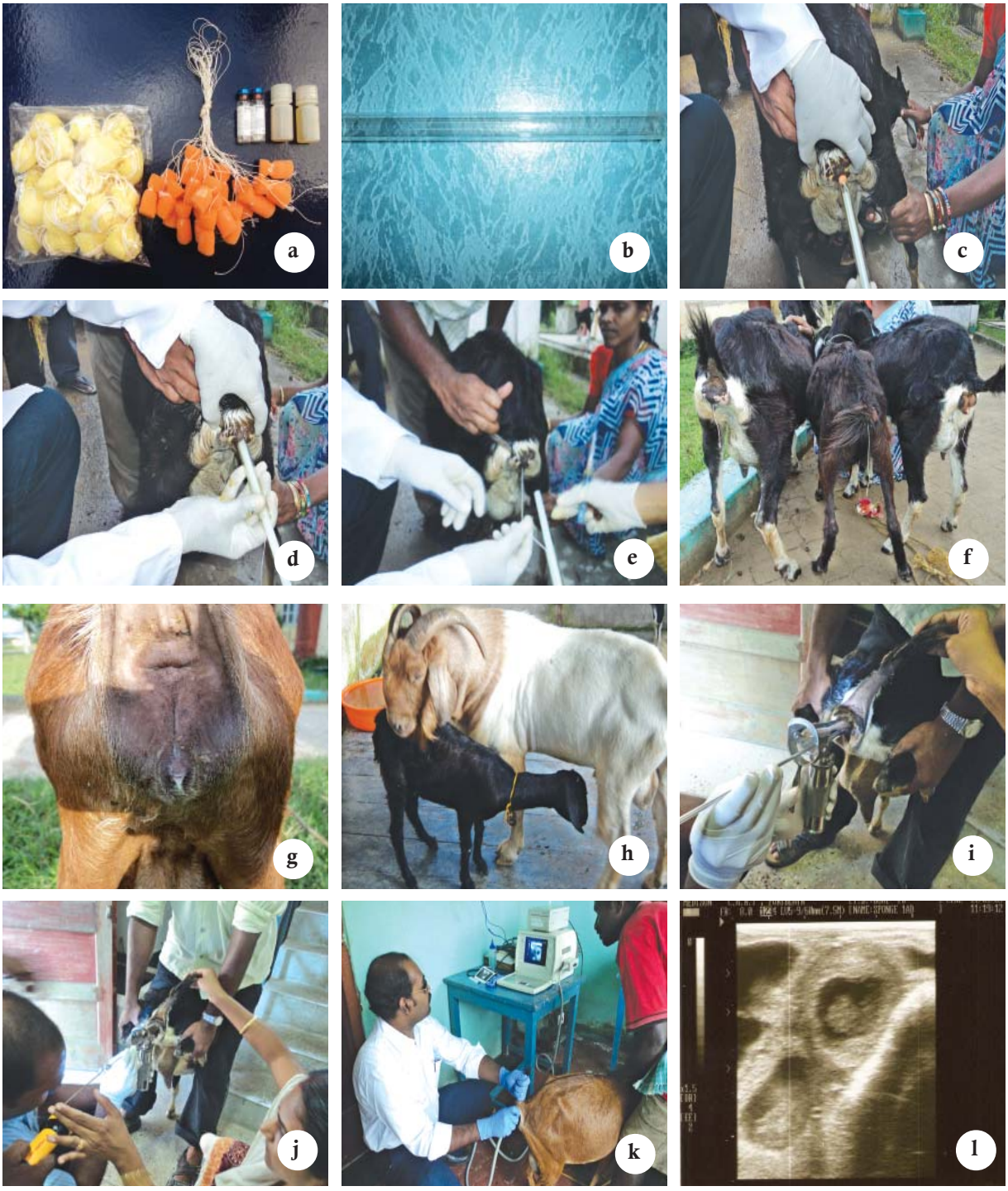



Plate 7: Controlled breeding technology in goat at field : a-Intravaginal sponge, b-glass speculum, c-insertion of speculum, d-insertion of sponge using plunger, e-retention of sponge in vagina, f-sponge in situ in 3 goats, g-expression of heat with mucus discharge after removal of sponge, h- detection of standing heat using teaser buck, i-checking of os cervix opening, j-AI using Boer frozen semen, k-pregnancy diagnosis using ultrasound scanning , l- Ultrasonogram showing developing foetus

## Antioxidant property of *Morinda citrifolia* in kids

Crushed fruit of *Morinda citrifolia* was fed to 4 kids @ 40g per day orally over a period of five weeks and were compared with 4 control kids. *Morinda citrifolia* feeding significantly (P<0.01) increased the antioxidant superoxide dismutase levels (IU/mg protein) in serum of treated kids (1.86±0.14) than control (0.93±0.13). The present study suggests that this medicinal plant have moderate to potent antioxidant and/or free radical scavenging activity.

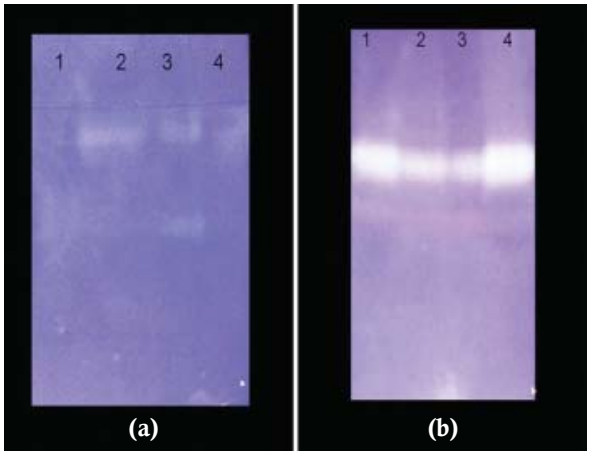



Plate 8: Showing Super oxide dismutase (SOD) expression absent in control (a) and present (thick white band) *Morinda* fed kids (b).

## Water bath based ultrasonography: a new alternative diagnostic procedure developed for testicular sonography in bucks

Six adult male goats were examined to study the sonographic appearance of normal testes and epididymides using a water bath-based ultrasound scanning technique. The ultrasonographic examinations were done using a 5 – 9 $MH_z$ / 60 mm (7.5 $MH_z$) linear – array transducer and a B-mode scanner. The ultrasonographic examination was performed in goats after standardizing the procedure on six testes collectedfrom slaughter house. The testicular parenchyma appeared homogenous with a coarse medium echo-pattern. The mediastinum testis located centrally in the testes was a linear structure with greater echogenicity than the testicular parenchyma when viewed in the longitudinal plane and nearly circular echogenic "spot" in the midline of the testis when viewed horizontally. The testicular tunics and skin were evident as a distinct hyperechogenic line encircling the testicular parenchyma. The head and tail of the epididymis were easily identified in all the testes, but the epididymal body and ductus deferens were difficult to identify consistently. The tail of the epididymis was distinct and easily identified on the distal end of the testis with sonolucent tubules and appeared sonographically as a 'peaked cap' upon the testicular parenchyma. The vascular pampiniform plexus was easily identified on the proximal end of the testis. Intertesticular septum appeared between two testes as a hyperechoic line. The scrotal septum was seen in lateral sonogram as a highly echogenic thick band between the testes. In conclusion, ultrasonography using a water bath based approach permits a non-invasive easy and simple method for evaluation of the scrotum and testis in male goats and proves to be a valuable diagnostic tool for evaluating physiopathologic conditions of goat testis during breeding soundness or clinical examination.

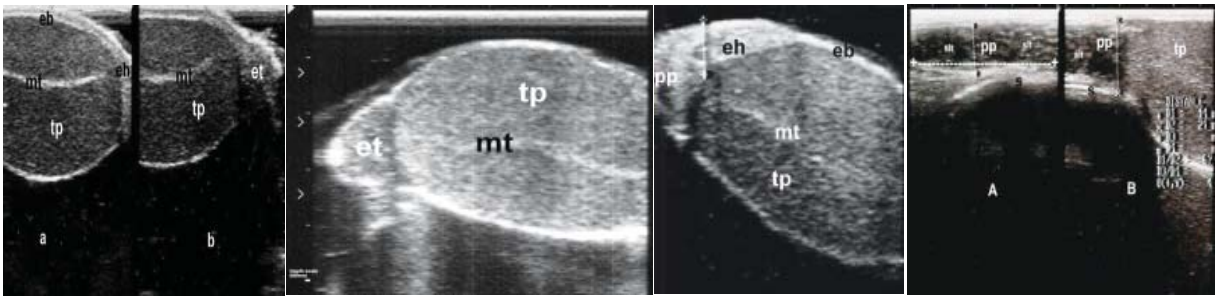



Plate 9: Sonographic characteristics of goat testis (tp-testicular parenchyma, mt-mediastinum testis, et-epididymal tail, eh-epididymal head, eb-body of epididymis, pp-pampiniform plexus)

### Development of database system for goat husbandry

The animal genetic resources available throughout the world are in a dramatic state of decline through natural or manmade interventions. To store and retrieve various information, an efficient data management system is required. In general goat production systems require a continuous set of data recorded over a period of time. Through relational database management system, computers can offer a quick means of data management. Keeping this in view, a database management system has been developed to record data on productive performance, reproductive performance, health & disease status and overall performance of goats.

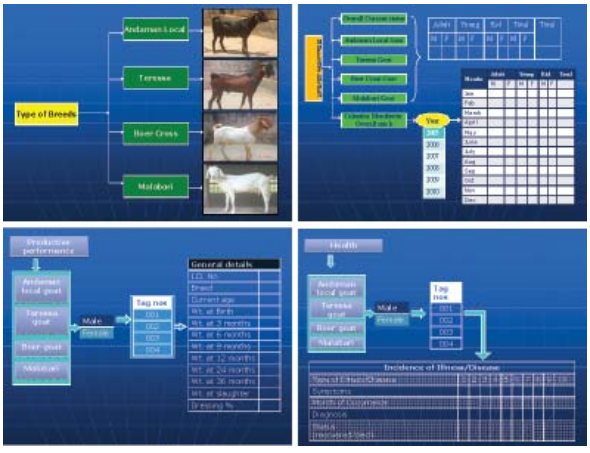




Plate 10: Front page of goat husbandry database management system and design of data base indicating menu, sub menu and drop-down menu for data entry and retrieval.

## Augmentation of Production in Cattle and Buffaloes through Reproductive Health Management Techniques

*S. Jeyakumar, Jai Sunder, M.S. Kundu, S.K. Verma, A.K. De, A. Kundu, Ajmer Singh, S.K. Zamir Ahmed and Director, Deptt. of AHVS*

### Studies on infertility and reproductive disorders among dairy cattle

A total number of four infertility camps were conducted both under farm and field conditions at different locations of South Andaman. In the camps 76 cattle were examined. Out of total no. of cattle examined, 35% were in different stages of pregnancy. The incidence of various causes of infertility was observed to be post partum anoestrum (35%), repeat breeding syndrome (10.55%), and post pubertal anoestrum in heifers (1.3%) and underdeveloped genitalia in heifers (3.9%). Reproductive disorders viz., endometritis and cystic ovary was 5.3%. All the cattle were

Plate 11: Infertility camp organized jointly by CARI and Dept. of AHVS at New Bimbliton village of South Andaman

physically examined for their health status and blood samples from each animal was collected at 10 days interval to rule out infectious and non-infectious causes of infertility. As a preliminary therapeutic approach all the cattle were dewormed, deticked and farmers were supplied with mineral mixture supplementation to improve the general health status of infertile animals. In cattle various reproductive disorders viz., Retained foetal membrane (7.69%), post partum metritis (2.88%), abortion (3.84%), total uterine prolapse (0.96%), ovarian abnormality (0.96%), dystocia (1.92), repeat breeding syndrome (2.88%) and post partum anestrum (4.80%) were observed in the organized farm for the period of 2003-2010. Among the problems retained foetal membrane was found to be the highest which could be due to nutritional and other predisposing factors viz. abortion and dystocia.

## Molecular Characterization of Indigenous Pigs of Bay Island by Microsatellite Markers

*Arun Kumar De, S. Jeyakumar, M. S. Kundu, Jai Sunder, A. Kundu and S. K. Verma*

### Collection of biological samples from indigenous pig breeds of Andaman & Nicobar Islands and Isolation of DNA

The total Pre-tsunami and Post-tsunami pig population of Andaman and Nicobar islands are 52,201 and 13,755 respectively (DAH&VS, A&N Admn). The majority of the pig population belongs to indigenous type. Three different indigenous genetic groups of pigs are indigenous desi pig, Nicobari pig and Andaman wild pig.

Andaman wild pig | Nicobari Pig | Indigenous desi pig

Plate 12. Indigenous pig germplasm of Andaman & Nicobar Islands

Blood samples of indigenous desi pig of Andaman (n=20), Andaman wild pig maintained at Mini Zoo, Haddoo (n=1) and Nicobari pig maintained by tribes of Car Nicobar (n=25) were collected for molecular characterization. DNA was isolated from blood samples of native pig breeds of Andaman and Nicobar Islands by standard method of phenol-chloroform extraction followed by alcohol precipitation. DNA was also isolated from hair follicles of native pig breeds. The quality of isolated DNA was checked by running the DNA samples in 1.5% agarose gel electrophoresis (Plate-13) and by measuring the ratio of absorbance (Plate-14) at 260 and 280 nm (A260/A280). In all the cases the A260/A280 ratio was in between 1.8 to 1.9 indicating that the quality of isolated DNA was good. Isolated DNA samples were quantified based on the following formula: Quantity of DNA (µg/ml) = (OD260 x 50 X dilution factor).

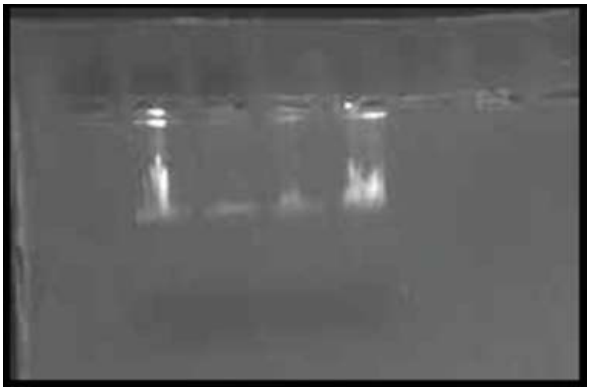


Plate 13. Agarose Gel Electrophoresis of Genomic DNA

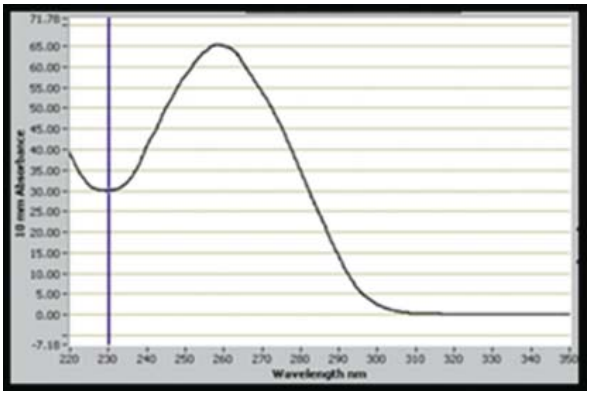
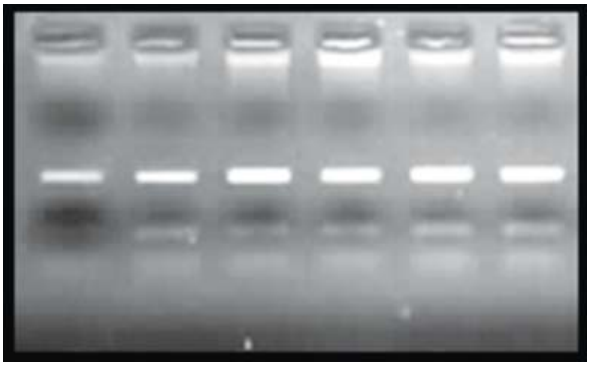


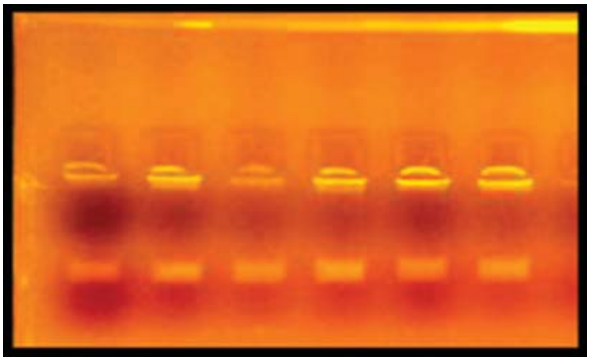

Plate 14. A260/A280=65.003/35.009=1.85

## Standardization of PCR protocol for amplification of microsatellite loci

PCR protocol was standardized for 17 sets of FAO recommended microsatellite primers. Each 25 µl reaction consisted of DNA (100 ng), primers (50 ng each), dNTPs (50 nM each), 2.5 µl of 10 X buffer and Taq DNA polymerase (0.75 unit). The PCR products were analyzed through denaturating Poly Acrylamide Gel Electrophoresis (PAGE). PAGE results were analyzed by software 'PopGene'. The observed numbers of alleles, PCR product size range, observed heterozygosity, polymorphism information content (PIC) at different microsatellite loci in nondescript pig of Andaman are presented in Table 19.



S0218



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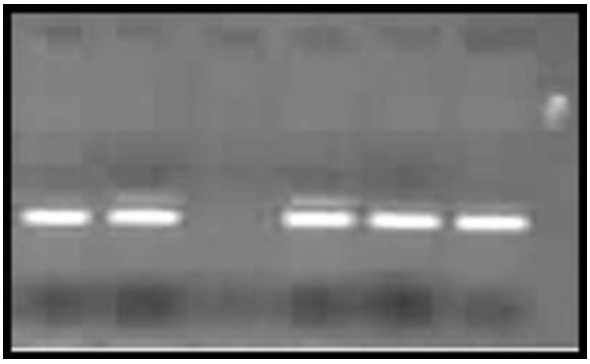
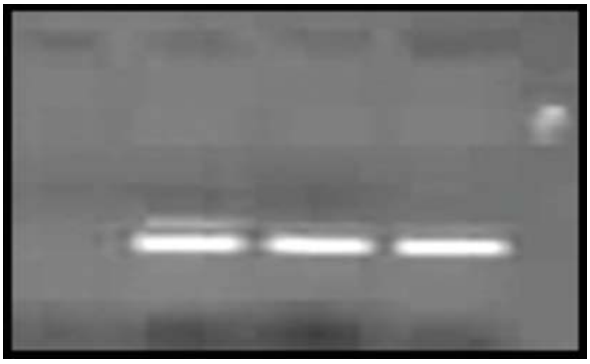


S0090

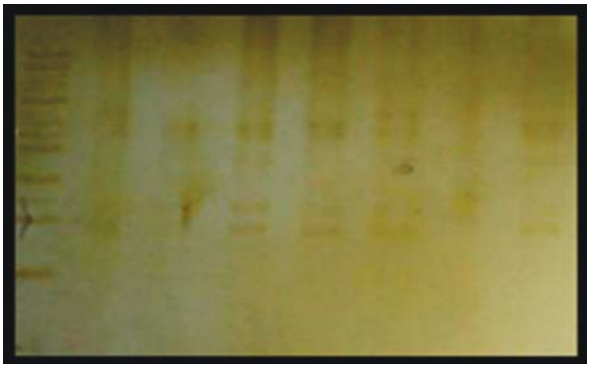


IGF1

Plate 15. Agarose gel electrophoresis of PCR amplicons of various microsatellite loci of nondescript pig of Andaman

**Table 19. Observed numbers of alleles, PCR product size range, observed heterozygosity, polymorphism information content (PIC) at different microsatellite loci of indigenous desi pig**

| MicrosatelliteLocus | Observed no. of alleles | SizeRange (bp) | Observed heterozygosity | PIC |
|---|---|---|---|---|
| S0218 | 4 | 144-656 | 0.76 | 0.84 |
| IGF1 | 2 | 254-643 | 0.84 | 0.74 |
| S0335 | 2 | 218-242 | 0.52 | 0.78 |
| SW951 | 2 | 132-182 | 0.64 | 0.70 |
| S0225 | 5 | 178-194 | 0.60 | 0.80 |
| CGA | 8 | 266–30 | 0.48 | 0.81 |
| S0005 | 11 | 221–257 | 0.60 | 0.82 |
| S0226 | 6 | 185–205 | 0.64 | 0.75 |
| S0227 | 7 | 231–253 | 0.64 | 0.85 |
| SW122 | 7 | 110–124 | 0.84 | 0.86 |
| SW911 | 5 | 157–175 | 0.76 | 0.75 |



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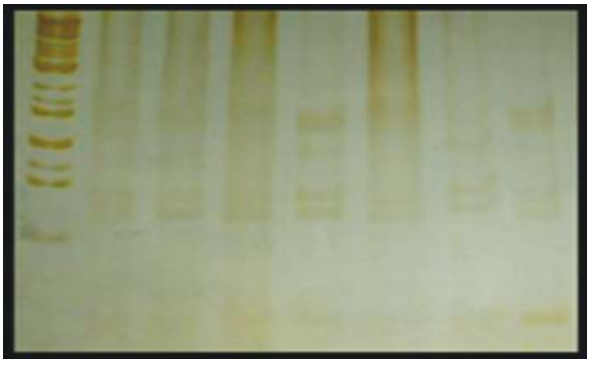
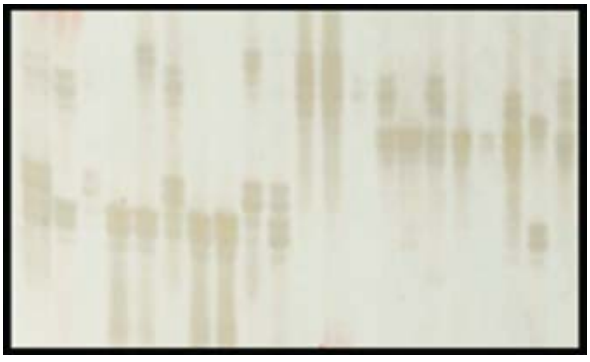


IGF1

S0335



S0225

Plate 16. Microsatellite analysis of indigenous desi pig of Andaman showing number of alleles under PAGE

## Phenotypic characterization of Andaman wild pig

With the official permission of the Department of Environment and forest, A& N Administration, phenotypic characterization of Andaman wild pig available in the Mini Zoo was carried out. General appearance of the pig was very short with compact body and was very active, alert and a fast runner. Blood and hair follicles were also collected for haematological analysis and molecular characterization. The data on phenotypic characteristics (in inches) are given in Table 20.

**Table 20. Phenotypic characteristics of Andaman Wild Pig**

| Parameters (in inches) | Andaman wild pig (n=1) |
|---|---|
| Sex | Male |
| Castrated/Uncastrated | Uncastrated |
| Ear length | 3 |
| Ear width | 3 |
| Snout width | 4 |
| Leg length | 9 |
| Hoof circum | 2.5 |
| Tail length | 4.0 |
| Abdomen width | 20.5 |
| Chest width | 21.5 |
| Body length | 23 |
| Neck width | 15.5 |
| Testis length | 2.5 |
| Testis width | 2.0 |
| Body weight based on chest girth | 16 kg |

## Enhancement and Sustainable Dairy Farming through Reproductive Health Care

*Kuntola Roy and S. Jeyakumar*

A survey was conducted to know the dairy herd composition, housing, feeding, health care and milk marketing at Indira Nagar village of South Andaman. All the constraints faced by the farmers were identified with open ended questionnaire and grouped under two categories as health/management constraint and policy related constraints. Ranking of the constraints were done based on the frequency of responses expressed by respondents for each constraint. Infertility camp was conducted regularly to find out and reduce the incidence of reproductive problems in cows.

### Dairy farming practices in South Andaman

It was observed that the entire household (100.0%) reared dairy cows in semi-intensive system and 100.0% of the cattle sheds were of temporary type mostly made up of locally available wooden materials with katcha floor. Regarding the system of feeding, majority (90.0%) of the farmers practiced semi-stall feeding and allowed their animals for grazing for a period of 6-8 hours. Very few farmers (5.0%) allowed their animals for scavenging on locally available grasses and leaves. A higher percentage (90.0%) of farmers offered readymade concentrate feed @ 1.5-2.0 kg per day per milch cow and pregnant animals. It was observed that pond was the major source of drinking water for the animal. The average holding size was 4.5 animals per family. Herd composition of different category of animals is presented in Fig 1. Among the cows 59.09% was in milk and 40.91% was dry animals to maintain a steady production status throughout the year. The highest quantity of milk was sold to vendors (42.0% in morning and 22.0% in evening) and the dairy farmers keep 17.0% of total milk for daily home consumption.

### Constraints analysis

The constraint analysis revealed that the major constraint faced by the farmers was anoestrus and repeat breeding (94.0%) followed by prolonged inter calving period (90.0%) and high tick infestation (50.0%). Besides, majority of the respondents i.e. 96.0% had the constraints of shortage of green fodder followed by inadequate selling price for milk (90.0%), poor marketing facility for milk sale (80.0%) and non

availability of concentrates (60.0%). Small number of respondents i.e. 30.0% and 20.0% reported scarcity of water in dry season and lack of proper scientific knowledge as constraints for profitable dairy farming.

## Incidence of infertility and parasitic problems of dairy cows

The study revealed that among the cows, the incidence of post partum anoestrus, repeat breeding and cystic ovary was found to be 33.3%, 12.8% and 2.60% respectively which were identified as the main cause of infertility and reproductive disorders. Among the heifers, the incidence of post pubertal anoestrus was observed to be very high (90.9%), followed by repeat breeding (4.5%). The incidence of helminthic infection was found to be 13.8% on coprological examination. The cows were treated periodically with deworming drugs (Albendazole oral suspension) regularly which reduced incidence rate. The incidence of tick infestation was found to be very high (100.0%) which might be a main predisposing factor for poor health and reproductive performance. The tick infestation was effectively controlled by deticking treatment comprising topical application of Deltamethrin/ Cyprimethrin (Butox/Tikkil®) and injection of Ivermectin (Hitek®).

Plate 17: Infertility investigation at field

## Technological Intervention

### Infertility management and controlled breeding

Animal with no clinical signs of infertility were given mineral (Agrimin®), vitamin A $D_3E$ (VETADE®) supplementtation and Sodium Acid Phosphate (Urimin®) to correct nutritional deficiency followed by herbal preparation (Aloes Compound®) to induce cyclicity. Due to this intervention 19.0% anoestrus heifers exhibited the signs of oestrus and resulted in pregnancy rate of 9.5%. Based on the reproductive status of the animals three different protocols such as single/ double injection of PGF2α (n=4), CIDR insert (11) and GNRH - PGF2α – GnRH (Ov-synch) (n=7) were adopted to treat the infertility problem in selected dairy animals. Following the treatment, highest pregnancy rate of 81.9% was observed in CIDR insert protocol followed by Ov-synch protocol (28.6%) and PGF2α injection protocol (25.0%).

### Promotion of fodder cultivation

Survey revealed that a few farmers were cultivating fodders particularly in the pond embankment. To ascertain the year round availability of green fodder, farmers were encouraged to cultivate fodder in their


Plate 18: Fodder cultivation in waste land and as intercrop in the Arecanut plantation area by dairy farmers at Indiranagar

waste land especially in the arecanut/coconut plantation area. To start the fodder cultivation initially cuttings of Paragrass and the rooted slips of Hybrid Napier strain 6 were provided. After the introduction of green fodders it was observed that 32.0% and 28.0% of the farmers cultivated Paragrass and Napier strain 6 respectively which significantly reduced green fodder shortage problem during rainy and dry season resulted in increase of milk production.

### Formation of Dairy Co-operative Society

A Dairy Co-operative Society named "Indira Nagar Dairy Co-operative Society Limited" was formed successfully (Regn. No. 1127 dated 22nd February, 2010) with 15 initial members. The society functions with the objective to undertake activities necessary for clean and quality milk productions, adoption of scientific dairy farming/technological interventions to enhance milk production and for proper post harvest processing and marketing.

### Capacity building of dairy farmers

For the first time a mobile milking machine (two can two cluster systems) was introduced to train and demonstrate the farmers to produce safe, clean and unadulterated wholesome milk for the consumers and also a training programme was conducted for 17 dairy farmers in collaboration with Milk Plant, ANIIDCO on "Post harvest processing of milk & preparation of traditional dairy products".

Plate 19: Members of the dairy coop society

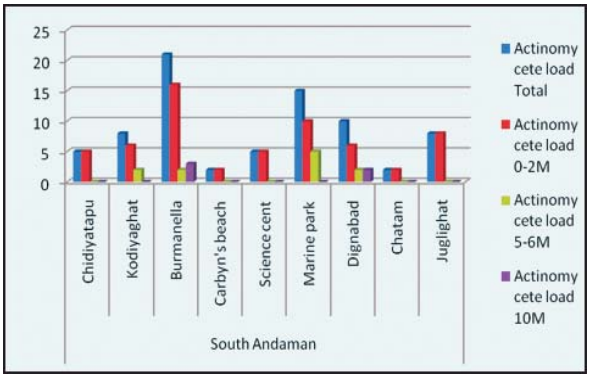

Plate 20: Training to Dairy farmers

## Isolation, Identification and Characterization of Marine Actinomycetes

*Sumitha Gopalakrishnan and Jai Sunder*

In the present study survey was conducted in North, Middle and South Andaman coasts and samples viz. water and seabed sediments were collected. A total of 142 bacterial isolates were identified from the various stations of each zone at sea depth of 0-2 m, 5-6 m and 10 m.

It was found that number of isolates were more in 0-2 m depth, where anthropogenic activities are more. The isolates from shore region showed more salt



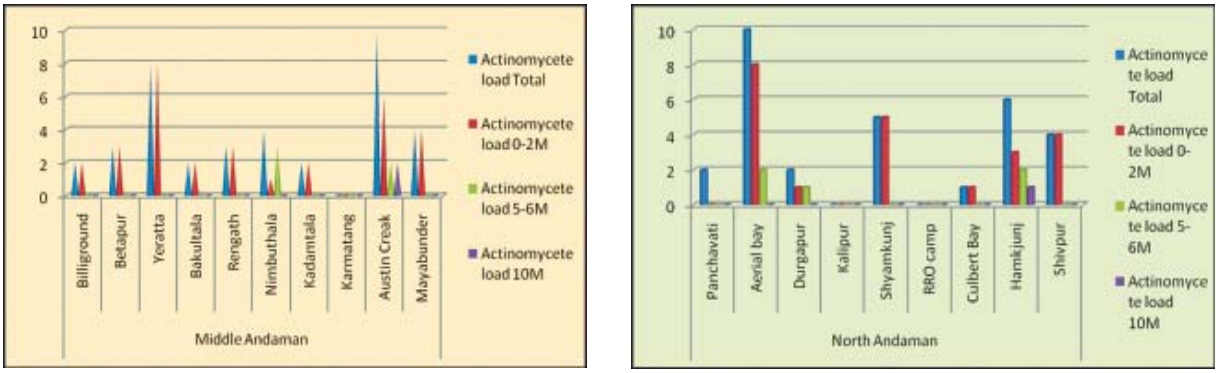



Fig 2: Load of Actinomycetes isolated from various station

tolerance than 5 m and 10 m depth. The isolates showed growth in pure sea water as well as 0% saline water. Only 13 isolates did not show growth at 0% salinity while 53 isolates showed good growth at 100% salinity.

According to the morphological characters like soluble pigment production, reverse side pigmentation, spore chain morphology,microscopic observation of aerial and substrate mycelium, Carbohydrate utilization the isolates were identified upto species level. Most of the isolates belongs to *Streptomyces* sps (70%) followed by *Micromonospora* sps (20%) *Streptoverticillium* sps., *Nocardia* sps (10%).

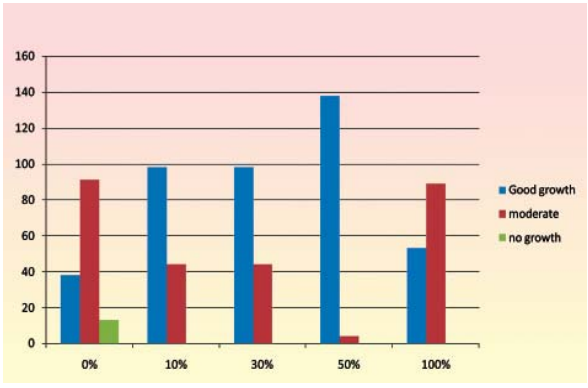



Fig 3: Salt tolerance showed by different isolates

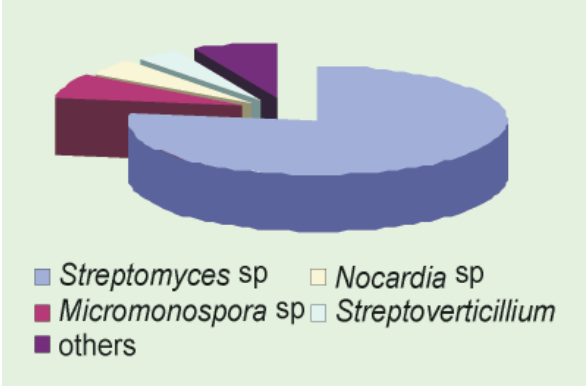



Fig 4 : Species wise distribution of Marine Actinobacteria

# Division of Fisheries Science



# Temporal and Spatial Variability of Water Quality Parameters and Mineral Profile of Waters of Andaman and their Impact on Shellfishes and Finfishes

*Kamal Sarma, S. Dam Roy, Grinson George, Benny Varghese and S. Murugesan*

The project objective is to study the variability of water quality parameters in Andaman coastal region and their implication on aquatic organisms. A comparative study was conducted on oyster (Crassostrea rivularis) living in polluted (Phoenix jetty) and unpolluted water bodies (North Wandoor). This study indicated that average length, weight and meat yield of the oyster collected from North Wandoor sample were significantly (P<0.05) higher compared to Phoenix jetty sample (Table 1). Different water quality parameters revealed that chemical oxygen demand (COD) and phosphate were higher in Phoenix jetty compared to North Wandoor. Samples for mineral profiles from water, soil and oyster have been prepared and estimation using Atomic Absorption Spectrophotometer is underway.

**Table1. Length, weight meat yield of Crossastrea rivularis collected from two locations**

| Site of collection | Total weight(g) | Length(cm) | Width(cm) | Meat weight (g) | Meat yield(%) |
|---|---|---|---|---|---|
| North Wandoor | 175.04±11.14[a] | 10±0.42[a] | 7.91±0.22[a] | 12.87±0.62[a] | 7.69±0.45[a] |
| Phoenix jetty | 87.68±7.90[b] | 8.38±0.32[b] | 6.83±0.28[b] | 4.74±0.40[b] | 5.68±0.31[b] |

*Each column with different superscript differ significantly at 5%level.*

Salinity tolerance limits of freshwater fishes are of ecological significance in assessing distribution of fish and their impact on ecosystems. It is an important environmental factor, which influences growth performance of many fish. To assess the effect of salinity on freshwater fishes and to find out suitable species for aquaculture purpose for low saline brackishwater areas, an acute toxicity study for a period of 96 h and a chronic toxicity test for a period of 90 days were conducted. 100% mortality was recorded for 3.4 cm fry of *Clarias batrachus* at 14 ‰ salinity and for 14.5 cm fingerling, the salinity was 15 ppt. $LC_{50}$ of 96 h of fry and fingerling was calculated following standard protocol and the values were 11.80 and 12.52 ‰ respectively. Based on these results, two sub lethal concentrations *viz.* 4 and 8 ‰ was selected and fishes were exposed for a period of three months. Results of the experiments indicated that growth of *C. batrachus* was best at 0 ‰ (0.13-0.35 ‰) salinity followed by 4 ‰ (4.1-4.44‰) and 8 ‰ (8.13-8.23 ‰) and their percentage weight gain was 62.7%, 57.8% and 54.4% respectively. Survival rate after 90 days culture period was 96.7%, 93.3 % and 83.3% respectively. Biochemical constituents and enzymes are being used as potential biomarkers for variety of organisms. These parameters are highly sensitive and conserved between species and less variable. Hence, to study the impact of salinity on organism level gross parameters like glucose, glycogen, ascorbic acid and enzymes like Acetyl choline esterase (AChE), Alkaline phosphatise activity (ALP), adenosine triphosphosphtase (ATP) and Lactate dehydrogenase (LDH) were used for the present study. In the present study, at the end of the 90 days culture period different biochemical parameters were estimated. Glucose level was significantly (P<0.05) varied in blood and brain of *C. batrachus*. Elevated levels of plasma glucose may reflect stress response and/or increased energy demand at 4‰ salinity. Glycogen level was significantly reduced in liver tissues (P<0.05) when exposed to higher salinity (Fig.1) which might be due to higher catabolism of glycogen to give rise to energy purpose. Reduction of liver glycogen was 45.8% and 56.2% at 4‰ and 8‰ salinity respectively. In the study, ascorbic acid reduced significantly in liver,

kidney, brain and muscle of *C. batrachus* (Fig 2). As in most cases vitamin C (Ascorbate) is rapidly depleted in fish exposed to sub lethal concentration of several stressors of both inorganic and organic substances as a defensive reaction of fish to combat stress. Hence, in the present study, fish might have rapidly utilized ascorbic acid for detoxification process or might have been used up for preventing peroxidation of important cells. The depletion of ascorbic acid was highest in brain and that was 35.6% and 46.2% corresponding to 4‰ at 8‰ salinity respectively.

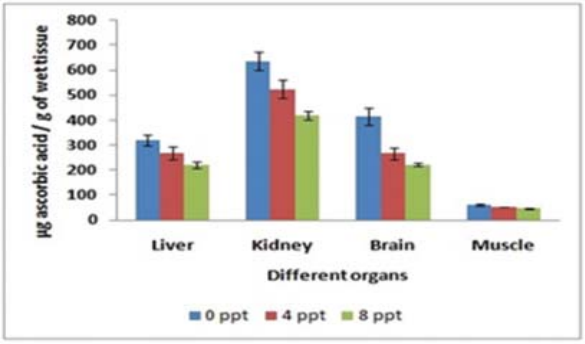



**Fig.1 Variations in ascorbic acid level in after 90 days of salinity exposure**

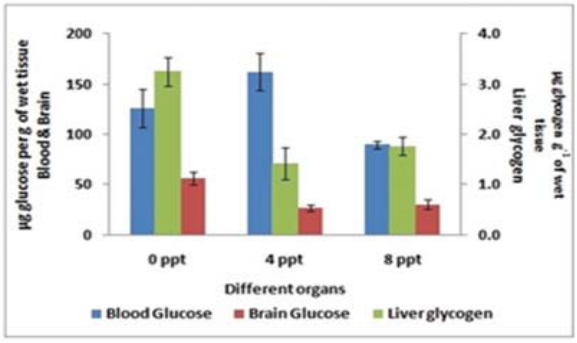



**Fig.2 Variations in the glucose and glycogen level after 90 days of salinity exposure**

Data pertaining to enzymatic activities in *Clarias batrachus* at the end of 90 days culture period are illustrated in Table 2 which showes that all the four enzymes were significantly affected upon salinity exposure. Data corresponding to brain AChE activity indicated that it was progressively decreasing with increase in salinity. A total of 39.3% and 54.45% inhibition of AChE was recorded at 4‰ and 8‰ respectively. Acetylcholine esterase (AChE) is one of the most widely used enzymes as a biomarker for environmental pollution. Reduction of AChE enzyme activity indicates interference in energy metabolism of the nervous system and might cause behavioral alteration. Similarly ATP and ALP activity in liver and LDH activity in muscle were also significantly reduced in *C. batrachus* which might be due to salinity induced stress.

**Table 2. Different enzyme activities of *C. batrachus* at the end of 90 days of sub lethal salinity exposure**

| Parameters | Organs | Salinity | | |
|---|---|---|---|---|
| | | 0 ‰ | 4 ‰ | 8 ‰ |
| AChE activity[1] | Brain | 0.168 ± 0.03[a] | 0.102 ± 0.02[ab] | 0.076 ± 0.0[b] |
| ALP activity[2] | Muscle | 2.900±0.37 | 2.005±0.68 | 1.467±0.54 |
| | Liver | 16.773±1.32[a] | 10.876±0.75 [b] | 5.737±0.96[c] |
| ATP activity[3] | Muscle | 1.358 ± 0.18[a] | 0.766 ± 0.07[b] | 0.665 ± 0.17[b] |
| | Liver | 1.958 ± 0.41[a] | 0.868 ± 0.07[b] | 0.783 ± 0.13[b] |
| LDH activity[4] | Muscle | 160.724±14.73[a] | 106.948±21.69[b] | 146.448 ± 7.36[b] |
| | Liver | 42.762 ± 6.13 | 39.728 ± 6.72 | 38.580 ± 1.37 |

*Each column with different superscript differ significantly at 5%*

*[1]n moles of paranitrophenol released/ mg protein/ minute at 37[0]C*

*[2] Δ 0.01 OD/mg protein /minute at 25[0]C*

*[3]µg of phosphorus released /mg protein/minute at 37[0]C*

*[4] µmoles of acetyl choline hydrolyzed /mg protein/minute at 37[0]C*

From the present investigations it can be summarized that the increasing salinity has a negative impact on biochemical composition in *C. batrachus*. The *C. batrachus* is a hardy variety and can tolerate extreme environmental conditions like higher salinity. However, the impact of salinity might be very severe for weaker fishes especially at juvenile stages. Hence, impact of sea water intrusion into freshwater areas can have devastative effect on *C. batrachus*.

## Broodstock Development and Breeding of Damsels

***Grinson George, S. Dam Roy and Kamal Sarma***

Broodstock development and breeding of two species of damsels namely, *Amphiprion percula* and *Premnas biaculeatus* were standardized under this project. Rotifers and copepods are important live feed form the marine ornamental fishes (Plate 1&2). It is imperative to identify the level of algal feed required for maintaining the quality of copepods and rotifers. Several characteristics of rotifers, including their nutritional quality, body size and motility make them as one of the best feed for the active fish larvae. The rotifer, *Brachionus plicatilis* has been most widely used as essential food source in raising marine fish, shrimp and crab larvae. *Brachionus plicatilis* is a euryhaline species in the Family *Brachionidae*, and is possibly the only commercially important rotifer, being used in Andaman as food for fish larvae. Studies conducted at Marine Research Laboratory indicated that *Nanochloropsis oculata* is a better algal feed to rotifer than *Chlorella marina.* In outdoor mass culture, cell density of the stock culture of *Nanochloropsis oculata* was 2.58x$10^6$ $ml^{-1}$. For maintaining the rotifers, @20-30 rotifers/ml in a 500 l tank, 10 litre of algae with a cell density of 2-5 x$10^6$ $ml^{-1}$ is recommended.

Copepod nauplii is also an ideal feed for ornamental fish larvae. Copepods are comparatively smaller (60-120 µm) than rotifers (150-200µm). Hence, copepod nauplii are equally suited for feeding all ornamental fish larvae with small gape size. The calanoid copepod, *Acartia spinicauda* is widely distributed and available in plenty in the mangrove creeks and protected bays. The copepods were fed with *Chaetoceros calcitrans*, *Nanochloropsis oculata, Iscochrysis galpana* in the ratio of 4:2:1 at a cell density of 1 x$10^6$ $ml^{-1}$, 2-5 x$10^6$ $ml^{-1}$ and 1 x$10^6$ $ml^{-1}$ respectively. The average daily production of copepod nauplii was 10-15 nauplii/ml.

A training programme on marine ornamental fish breeding was conducted for 30 unemployed youth in collaboration with the Out Reach Centre, Diglipur. Based on the breeding experiments on two major marine ornamental fish species, it has been estimated

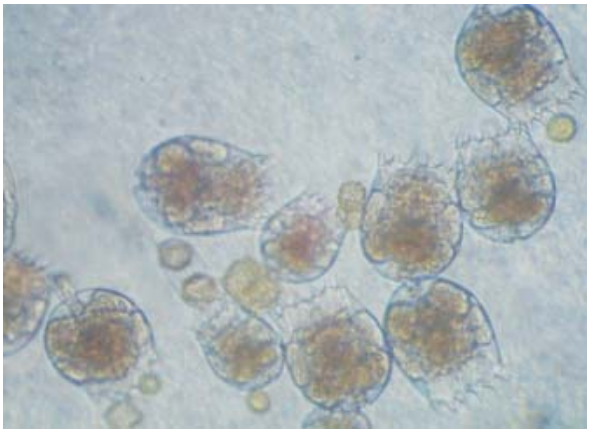


Plate 1 : Mass culture of rotifers

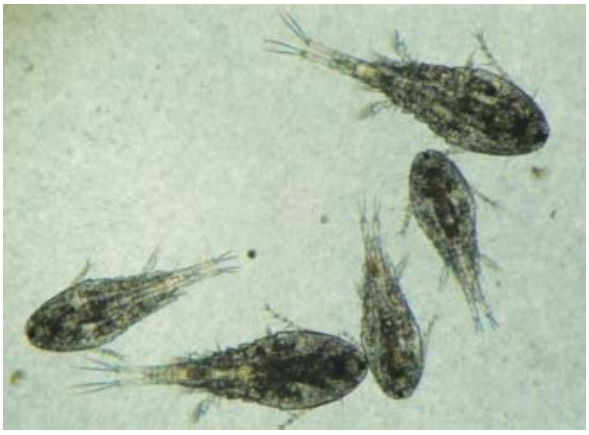


Plate 2 : Mass culture of copepods

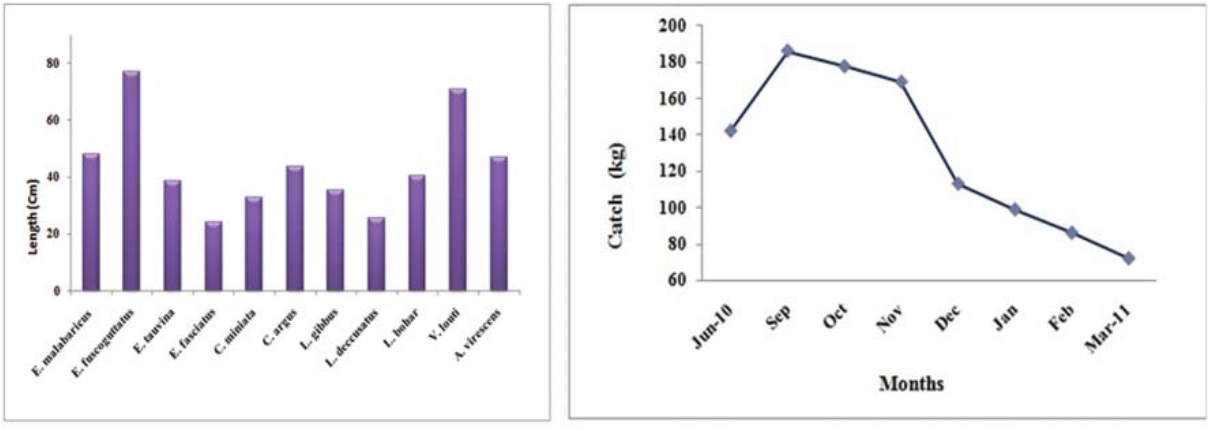
that through captive breeding of marine ornamental fishes in a smaller scale at an area of 0.1 ha with an investment of Rs.1.5 lakh as operational expenditure, an entrepreneur can market about 5000 seeds per year and earn up to Rs. 2 lakhs per annum. It is hoped that ornamental fish breeding will be a potential livelihood alternative for the coastal fishers in the islands.

## Distribution, Abundance and Stock Assessment of Groupers and Snappers in Andaman Waters

***R. Kiruba Sankar and S. Dam Roy, Kamal Sarma, Grinson George and P. Krishnan***

The fishes of family Serranidae (Groupers) and Lutjanidae (Snappers) are an important resource along the Andaman coast. The most common genera landed in Groupers are *Epinephelus*, *Cephalopholis*, *Variola*, *Plectropomus* and in Snappers are *Lutjanus*, *Aprion*, *Aphareus*, and *Pristipomoides.* Data on Weekly landings were collected from Wandoor, Guptapara, Junglighat and Dignabad landing centers. A view of the Guptapara landing centre and a hawl of snappers is shown in Plate 3**.**

Length (cm), weight (g), catch (kg) and effort in terms of number of boats were recorded on weekly intervals from the above landing centers. The average length of various groupers and snappers are presented in Fig 3. *Epinephelus malabaricus* and *Aprion virescens* landings were the most frequent species landed from different landing centres. From the observations it was found that average length of *E. malabaricus* and *A. virescens* was 47.9 cm and 47.0 cm respectively. Catch per unit effort (CPUE) was estimated considering nine landing days per month by cluster sampling. A fishing boat with overall length (OAL) of 32 ft, one of the commonly operated boats in Andaman, with 3-4 days of fishing and 3-4 crew members constituted one unit of effort for the analysis. The average annual CPUE for groupers and snappers was found to be 131 kg/boat. April-May is a closed season for fishing in Andaman. The landing pattern was inconsistent during July and August 2010 due to inclement weather and hence this period was also not considered for the analysis. The study showed that the CPUE peaked in the month of September 2010 and decreased thereafter. The present study will be continued to have a comprehensive data base on landing pattern and catch effort analysis to have a better understanding about grouper and snapper fishery in Andaman.




**(a)** **(b)**

Fig 3. Average length (a) and CPUE of Groupers and Snappers (b)

Plate 3. A view of Guptapara fish landing centre and a haul of Snappers

Gut content analysis was done by occurrence method for *Epinephelus malabaricus* and *Aprion virescens,* the landings of which were consistent throughout the season. The study indicated that teloests constituted the most preferred prey of *Epinephelus malabaricus* (n=35) with the occurrence frequency of 81% followed by sepia (75%), polychaetes (68.75%) and crustaceans (50%). In case of *Aprion virescens,* crustaceans and copepod constituted the most preferred prey with the occurrence frequency of 93.75% and 75% respectively. Comprehensive stock assessment using FiSAT program and studies on reproductive biology and maturity stages are under progress.

## Characterization of the Role of Associated Bacteria in the Bioactivity of Marine Sponges from Andaman

***P. Krishnan, Kamal Sarma, S. Murugesan and Jai Sunder***

**Project Co-ordinator: R.C. Srivastava**

Marine sponges assume great significance for bioprospecting owing to their bioactivity and their established association with the bacteria. The antimicrobial activity of the host vis-à-vis the associated bacteria was characterized for five sponges *viz., Monanchora arbuscula, Crella cyathophora, Carteriospongia foliascens, Plakortis* sp and *Oceanapia sagittaria* collected from Pongi Baalu.

In case of *Oceanapia* sp, *Monanchora* sp and *Carteriospongia* sp, the bioactivity of the sponge is predominantly due to host metabolites, while in *Crella cyathophora* and *Plakortis* sp the associated bacteria have higher inhibitory bioactivity than their hosts (Fig.4). The associates from *Crella cyathophora* were found to have inhibitory activity against a wide range of pathogens.

The methanol extracts of *Monanchora* sp and *Carteriospongia* sp were franctionated by column chromatography and their bioactivity when tested against *Klebsiella pneumonia* showed synergestic and antagonistic properties of different fractions (Fig.5) indicating that the cumulative inhibitory activity of the extracts of marine sponges is only indicative and there could be specific fractions with greater antimicrobial property.

Similar characterization of the antimicrobial assay of host vis-à-vis the associated bacteria was carried out for eight other sponges collected from Pongi Baalu viz., *Mycale* sp., *Psamochella* sp., *Pseudoceratina purpurea, Gelliodes fibulatus, Axinella acanthelloides,*

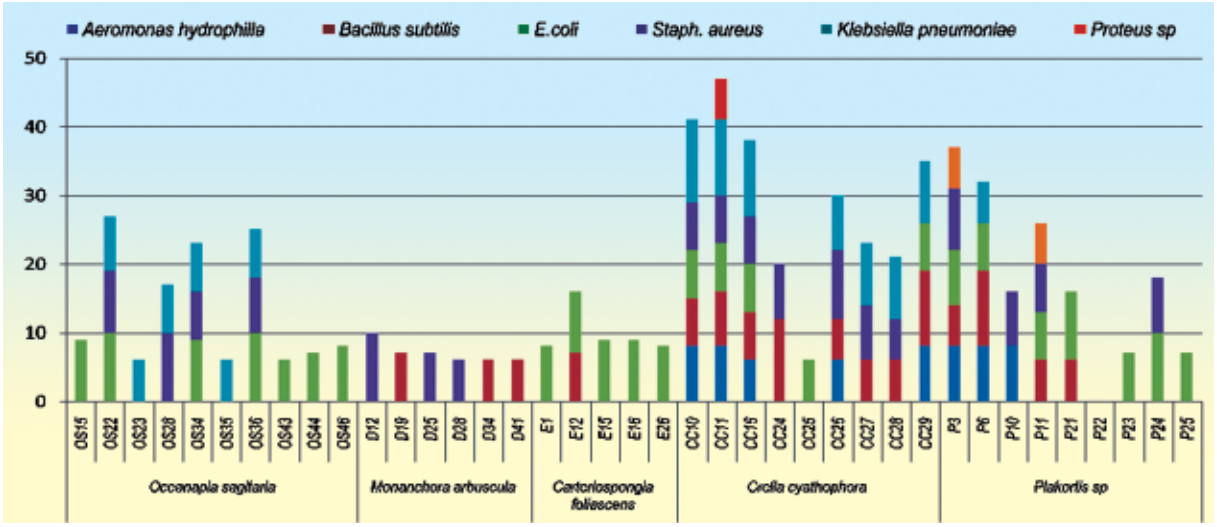



Fig. 4. Inhibitory efficiency of the marine sponges associated bacteria against selected pathogens

*Stylissa carteri, Iotrochota baculifera and Lamellodysidea herbacea*. The bacteria associated with these sponges were identified based on their morphological, physiological and biochemical properties and were found to be the members of *Micrococcus* sp., *Staphylococcus* sp., *Streptococcus* sp., *Lactococcus* sp., *Enterococcus* sp., *Leuconostoc* sp., *Pedicoccus* sp., *Aerococcus* sp., *Lactobacillus* sp., *Kurthia* sp., *Arthrobacter* sp., *Bacillus* sp., *Alcaligenes* sp.,, *Pseudomonas* sp., *Klebsiella* sp.,, *Shigella* sp., *Salmonella* sp., *Escherichia* sp., *Aeromonas* sp., *Chromobacterium* sp., *Neisseria* sp., *Vibrio* sp., *Corynebacterium* sp., *Veillonella* sp., *Citrobacter* sp and other enteric genera. The study revealed that only in case of *Pseudoceratina purpurea,* the bioactivity was predominantly due to host metabolites, while in all others the associated bacteria displayed higher inhibitory bioactivity than their hosts. There was significant ($P<0.05$) difference in the nature of inhibitory activity of the antibiotics produced by the isolates. The gram positive bacteria

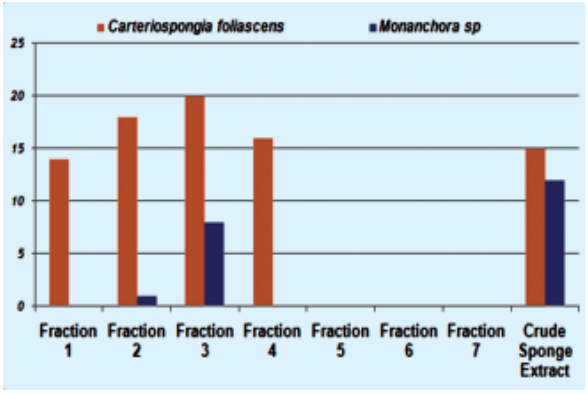


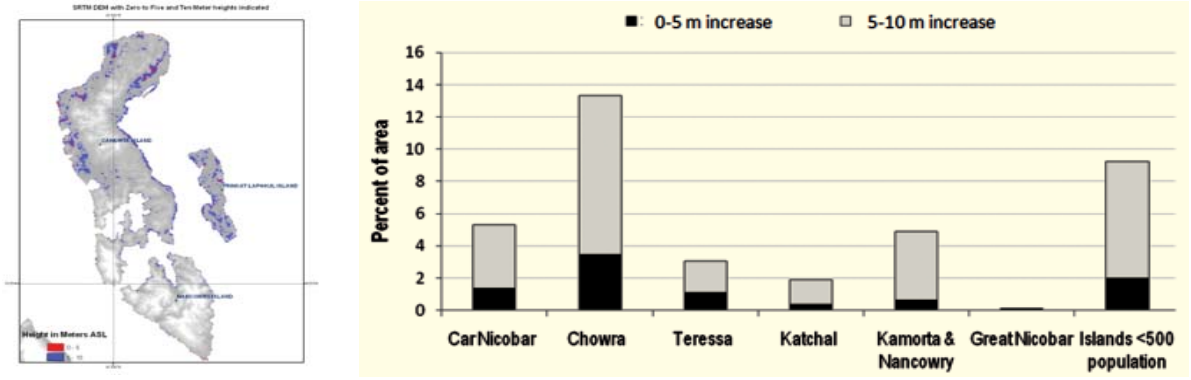

Fig. 5. Inhibitory efficiency of different fractions of methanol extracts of selected marine sponges against *Klebsiella pneumonia*

associated with sponge elicit more antimicrobial activity than the gram negative bacteria and activity was more pronounced (56%) against gram positive bacteria. The molecular characterization of the sponge associated bacteria with significant inhibitory property is underway.

# Assessment of Threats due to Climate Change in Nicobar Group of Islands and Development of Adaptation Strategies

*P. Krishnan, S. Dam Roy, S.K. Ambast, A. Velmurugan, S. Jeyakumar, Subhash Chand, S.K. Zamir Ahmed and Grinson George*

Nicobar Islands constitute the most vulnerable region in our country to climate associated eventualities due to their geographical isolation, flat topography and limited physical size rendering coastal retreat impossible. These islands lie in the most severe seismic zone (zone V) and hence the adaptation strategies need to be evolved not only for the gradual sea level rise but also for storm surges, tsunamis and flooding due to land subduction. An increase in sea level due to global climate change produces greater waves and flooding leading to higher erosion and amplified impact of storm.The estimation of extent of area likely to be affected with increase in sea level, as estimated using Shuttle Radar Topography Mission (SRTM) digital elevation maps (DEM) shows that the loss of land would be maximum (13.34%) in Chowra where over 13% of island will be inundated with a 0-10m high surge (Fig. 6).




(a) (b)

Fig.6. SRTM DEMs showing area affected by sea level rise in Kamorta and Nan Cowry (a) and estimated area affected (%) in Nicobar group of islands (b)

The projected changes in mean temperature and precipitation for Nicobar region assessed based on the recent GCMs using the MAGICC/SCENGEN software indicate that the rainfall pattern is all set to change significantly ($P<0.05$) during different seasons and the pattern of change in Nicobar would be different from that in Andaman (Plate 4 and Fig.7.). However, the mean temperature is expected to follow similar pattern in both the group of islands.

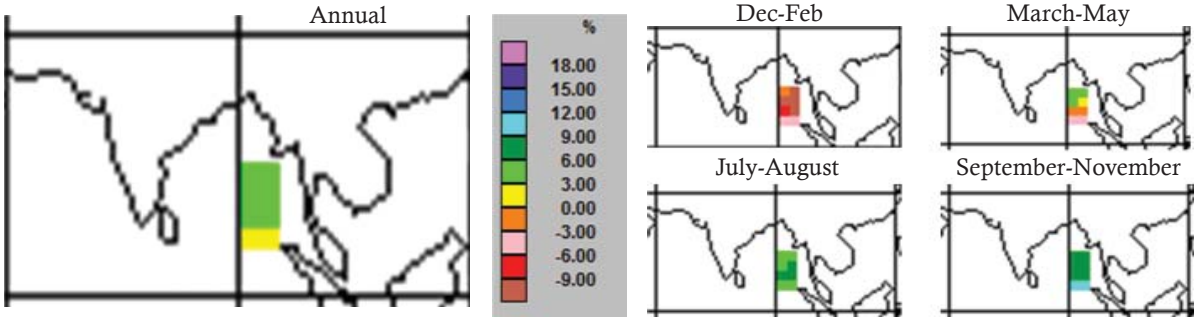



Plate 4. Projected change in rainfall (%) in Andaman and Nicobar under A1BAIM scenario for projected year 2025 by MAGICC/SCENGEN software

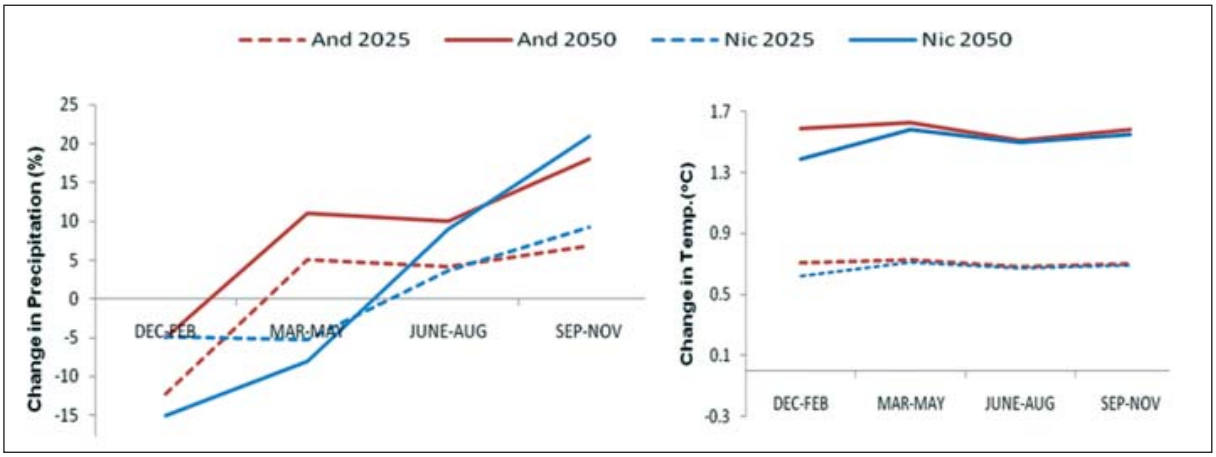



Fig. 7. Change in temperature (oC) and precipitation (%) in Andaman and Nicobar districts during 2025 and 2050 as projected by MAGICC/SCENGEN software

The intensity of cyclones in a region has a direct correlation with the sea surface temperature (SST). For the satellite derived sea surface temperature (SST) data, the SST maps from the NASA JPL-PODAAC site with 4.63 km spatial resolution covering the area surrounding the A&N Islands were accessed and processed using ERDAS-IMAGINE and ARC-GIS software. The increase in SST (0.75-1.25°C) during April to July 2010 resulted in mass bleaching of corals in Nicobar district and its long term impact is yet to be assessed.

The local tribes derive their livelihood from agriculture and allied sectors though they operate mostly at subsistence level. Field surveys were conducted in Car Nicobar, Nan Cowry, Kamorta and Campbell Bay and soil samples collected across each of the islands for analyzing their nutrient status. The soils of Nicobar group of islands are fine to medium in texture, slightly acidic in nature (pH 4.47-7.17), having low soluble salts (EC 0.01-0.9 dS/m). The soil fertility of these islands shows that these soils are generally medium in available N (4.47-7.19 kg/ha) and low in available K (115-194 kg/ha), which implies that climate change-induced increase in rain fall or seawater ingression would lead to erosion, leaching of salts and salination of coastal lands thus rendering the soil unproductive for agriculture. The coastal plains and hill slopes of Nicobar group of islands are highly vulnerable to such events. The southeast coast of the Great Nicobar Island is particularly vulnerable to sea level rise and associated sea surges, which would affect the marine lives in general and giant leather back turtle in particular. The fisheries in Nicobar Islands is entirely capture-based. Though 14% of the active fishers and fishing crafts of the UT are in the Nicobar group of Islands, they contribute just 2% of the total catch. The poor catch, in spite of availability of reasonably good infrastructure for harvest and post-harvest in the islands, could be attributed to lack of motivation among the local tribes to expand their fishing operation and the inherent fear among them to explore new fishing grounds in deeper waters.

Though the contribution of islands to global climate change is insignificant, they bear the maximum brunt of climate associated disasters which calls for an adaptation-centric, pro-development climate policy for the islands against the conventional approach of responding to climate change as an environmental problem. Preparation of detailed island-specific vulnerability maps and adaptation strategies are underway.



# Potential Fishing Zone Validation in Andaman Sea

*Grinson George, S. Dam Roy and Kamal Sarma*

Application of remote sensing technologies to examine the ocean features is becoming extremely important for marine fisheries. With an objective to bridge the wide gap between the estimated and harvested potential, Potential Fishing Zone (PFZ) forecasts are used. PFZ advisories are generated by INCOIS, Hyderabad based on Indian Remote Sensing Satellite P4 Ocean Colour Monitor (IRS P4 OCM) derived chlorophyll data and National Oceanographic Aerospace Administration Advanced Very High Resolution Radiometer (NOAA AVHRR) derived Sea Surface Temperature (SST). The major fish landing centers of Andaman and Nicobar islands were visited periodically and field level data with respect to conventional fishing grounds, crafts and gears employed, baits used and major landings were collected. The advisories were disseminated to fishermen residing near the PFZs and representatives of fishermen co-operative societies in the major landing centres through Digital Display Boards (DDBs), mobile, hand-outs, agro-advisory bulletins and All India Radio.

A total of 59 forecasts were received (Andaman-39; Nicobar-20) during 2010-2011. 22 PFZ forecasts from Andaman district were validated while only 3 of the 20 received PFZ forecasts from Nicobar district could be validated due to geographical isolation and difficulties in accessing the PFZs with the small fishing vessels. On an average, 35.5% of the received forecasts were validated during 2010-2011 in Andaman and Nicobar Islands (ANI). Simultaneous validation experiments ($n$=19) synchronizing with PFZ forecasts was carried out within and outside PFZs, employing different fishing crafts viz., gillnetters, trawlers and longliners around Andaman Sea. Results from the validation programme revealed that fishing in the PFZs increased the catch by 37±1.8%, 34±1.24% and 30±1.36% from the above mentioned crafts respectively. The catch per unit effort (CPUE) of the dominant species harvested by trawlers and long liners during validation experiments in PFZs were calculated following standard methods (Table 3).

**Table 3. Mean CPUE for the major landings in Andaman**

| No | Species | Mean CPUE | |
|---|---|---|---|
| | | PFZ | Non-PFZ |
| 1 | Scombrids | 83.45 | 31.12 |
| 2 | Carangids | 55.36 | 19.65 |
| 3 | Leiognathids | 48.82 | 21.67 |
| 4 | Sphyraenids | 45.62 | 11.43 |
| 5 | Upenids | 34.81 | 23.21 |
| 6 | Nemipterids | 19.63 | 39.9 |
| 7 | Carcharahinids | 215.6 | 182.3 |
| 8 | Istiophorids | 167 | 0 |
| 9 | Thunnids | 51.19 | 32.09 |

Since gillnetters use species-specific gear (gillnet with mesh size 21-27 mm for sardine), we considered only the landings by trawlers and longliners. Significant increase in the catch of scombrids, thunnids and carangids were observed in the PFZs as compared to non-PFZs. Comparatively low catches of nemipterids were observed in the PFZs when compared to the non-PFZs. Landings from longliners composed mainly of carcharhinids, oceanic thunnids and istiophorids, which showed significant increase ($P<0.05$) when operated in PFZs.

Depth of PFZs is one of the key factors controlling the probability of fishing vessels harvesting available food resources at different trophic levels. It was evident during validation experiments that PFZ advisories were relevant for even deep sea fishes caught with long liners, which indicated the operation of the trophic link. Gut content analysis of major fishes from PFZ and non-PFZ areas were conducted to see the trophic variations (Table 4).

**Table 4. Gut content and morphometric details of major fish species caught at PFZs**

| Landing centre | Species | Major gut contents | Mean length (cm) | Mean weight (g) |
|---|---|---|---|---|
| Dignabad | *Epinepheleus* spp | Sepia, Sqilla, Squids, juvenile fish | 47.5 | 3796.0 |
| | *Lutjanus* spp | Squids, Portunid crabs, juvenile fish | 32.6 | 881.0 |
| | *Rastrelliger* spp | *Calanus* spp, *Coscinodiscus* spp | 27.0 | 212.0 |
| | Sardinella spp | Algal mass, detritus | 15.0 | 0.4 |
| | *Sphyaena* spp | Crustaceans, anchovies | 26.2 | 36.0 |
| Junglighat | *Epinepheleus* spp | Squids, sepia, juvenile fish, crustaceans | 51.0 | 4656.0 |
| | *Lutjanus* spp | Sepia, portunid crabs, shrimps | 37.8 | 953.3 |
| | *Rastrelliger* spp | *Calanus* spp, crustacean larvae | 23.4 | 198.0 |
| | Sardinella spp | *Thalassiothrix* spp, green algae | 21.0 | 19.0 |
| | *Sphyaena* spp | Crustaceans, juvenile fish | 17.2 | 41.0 |
| Aerial Bay | *Sardinella* spp | Algal mass, detritus | 15.0 | 31.0 |
| | *Rastrelliger* spp | *Calanus* spp, cycloid scales | 18.1 | 191.0 |

Periodic interactions were held with fisher-folk in order to ensure effective reach of PFZs. During 2010-11, a total of 18 small and 2 massive campaigns were conducted across the Islands which elevated the number of users of PFZ forecasts. PFZ advisories have proved to be a potent tool in harvesting the under-exploited fishery resources with a significant increase (34%) in CPUE of fishing vessels in the A&N Islands.

## Development of Mangrove Based Agro Aqua Farming for Restoration of Mangrove Ecosystem and Livelihood through Community Farming in Andaman Islands

***P. Krishnan, S. Dam Roy, Alok Saxena and Grinson George***

**Project Co-ordinator: R.C. Srivastava**

Mangroves are significant ecosystems in the islands, which contribute to the natural productivity and also act as a bio-shield against natural disasters. The present study is an initiative for understanding of the mangrove ecosystem as a livelihood source for the coastal dwellers against the conventional perception of cutting the mangroves for wood and converting the wetlands to arable lands.

A demonstration farm has been set up at the brackishwater farm complex, Sippighat adjacent to the mangrove creek. The model has two ponds with provision for water exchange as per tide level and a mangrove nursery bordering the ponds. Due to the alteration in the land topography, the bundhs breached on three different occasions and subsequently they were strengthened and turfed with saline resistant grass to avoid further damage. The ponds are stocked with wild collected mullet seeds and hatchery produced tiger shrimp seeds under polyculture system. Horticultural plants like bottle gourd, bitter gourd, asparagus, cucumber, snake gourd and fruits like banana, papaya, guava, sapota and mosambi have been raised on the bundhs. A duck shed has been constructed on the bundh with a provision to wash off the duck waste directly into the ponds. Ten ducks are being reared in the model farm and fed with low cost material so as to be economical for the farmers to adopt. A mangrove nursery was constructed bordering the ponds where the propagules of *Rhizophora* spp and *Bruguiera* spp are maintained (Plate 5).

A study was conducted to investigate the transfer of

energy across the trophic tiers in a mangrove ecosystem by comparing the productivity between the mangrove-based aquaculture pond and an artificial pond. The primary, secondary and tertiary production in the study sites were estimated following standard protocols. The mean primary and secondary productivity in the Sippighat mangrove area was found to be 38.275 ±7.17 mg c/$m^3$/h and 0.018025 mg c/$m^3$/h respectively which were significantly ($P<0.05$) higher than that in the non-mangrove area. Secondary productivity is approximately the average abundance of zooplankton in the area converted into carbon biomass. The mean tertiary productivity of 0.001325 mg c/$m^3$/h was observed during the sampling period. A training programme on the "Issues involved in developing a mangrove-based brackishwater farm in Andaman" and a Farm School on "Mangrove-based brackishwater aquaculture" was conducted in collaboration with KVK, Sippighat in the model farm wherein 30 farmers including 12 women were trained on developing a mangrove-based integrated farming system.

Permission has been obtained from relevant regulatory agencies for constructing ponds adjacent to the mangroves without making any masonry structures. Totally three villages were extensively surveyed for establishing field demonstration units and two sites - one in Wandoor (Indiranagar) and another in Guptapara were selected for development of mangrove based agro-aqua farming.

Plate 5. A view of the model farm showing the fish culture pond, duck shed, mangrove nursey and different components of integration

Works for pond construction were initiated at Guptapara and Indira Nagar, South Andaman, which however, could not be completed due to inclement weather. Efforts have been initiated to complete the construction of demonstration ponds in farmers' fields and create awareness to the local communities on the prospects of mangrove-based aquaculture in the Islands.

# Optical Characterization of Coral Reef Diversity

*P. Krishnan and Grinson George*

The project envisages to conduct periodic surveys in Andaman reefs to monitor their health status with special reference to the changing environmental conditions and develop spectral signatures of different coral forms using underwater radiometer. During the study period, the reefs in Andaman underwent mass bleaching, the worst ever recorded in the region. The sea surface temperature (SST) during 2010 was higher than the average SST of each of the last three decades during January to October. During April to July, the increase was higher (0.75-1.25°C) than the rest of the months ( Fig. 8 & Plate 6), which resulted in mass bleaching of corals, which hitherto have been dead.

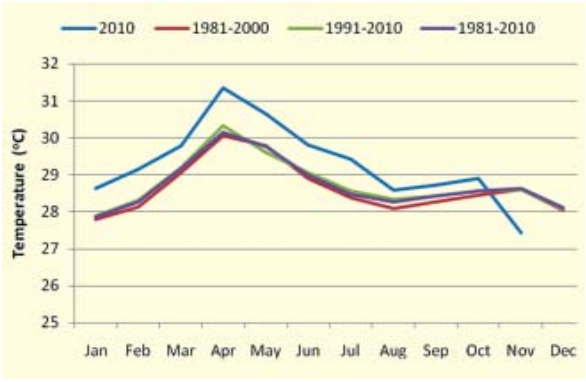



Fig. 8. Comparison of SST in 2010 with historical SST data.

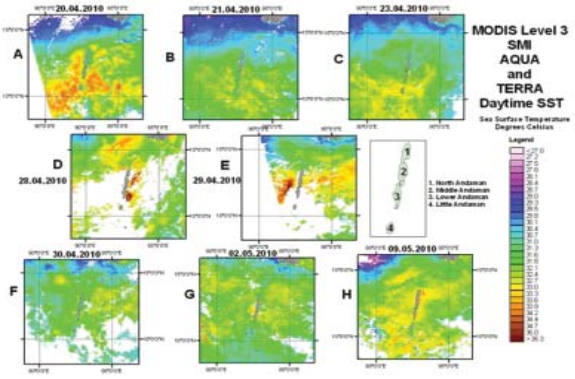



Plate 6. SST Map showing gradual increase in SST from 20 Apr 2010 to 09 May 2010

Periodic surveys were conducted in North Bay, Chidiyatapu, Mahatma Gandhi Marine National Park, Wandoor and Rani Jhansi Marine National Park, Havelock. The extent of bleaching ranged from 37 to 70% in various sites. The bleaching of corals started in the first week of May 2010. It was found that the percentage of fully bleached corals was maximum at Havelock Island (Wall) (69.49%), followed by South Button Island (67.28%), Nicolson Island (56.45%), Red Skin Island (43.39%), North Bay (41.65%) and Chidiyatapu (36.54%). It was observed that the branching corals (*Acropora* sp) were the worst affected due to bleaching. The predominant species were *A. formosa, A. nobilis, A. robusta, A. breuggemanni, A. grandis*). In South Button, vast beds of *Acropora spp.* recorded almost 100% bleaching. In one of the dive spots in Havelock, the encrusting corals, *Diplostrea heliopora*

Branching coral (*Acropora* spp)

Plate coral *(Echinopora lamellose)*

Massive coral *(Porites solida)*

Plate 7. Bleached corals as observed during May 2010

were extensively bleached. Even massive corals *(Porites sp*) were found to have fully bleached in some of the study sites, though the overall extent of their bleaching was less compared to fragile branching corals (Plate 7). The bleaching was not confined to the reef building corals but also observed among some of the reef communities like sea anemone and giant clam, which are also known to have symbiotic association with the *zooxanthellae*.

The surveys conducted in the subsequent months revealed that all the fully bleached branching corals were dead and were covered with filamentous algae (Plate 8). Development of filamentous algae indicates poor abundance of herbivorous fishes in these locations and consequently, the corals could no longer be serving as substrates for the fresh polyps.

Plate 8. Dead corals with the deposition of algae over the fully bleached corals

Among the different forms of corals, massive corals (Porites sp) showed resilience and those which were partially bleached have recovered. Some of the reef communities like sea anemone and giant clam, which had undergone bleaching, have fully recovered to pre-bleaching status, while the brittle stars and sea fans which got affected by elevated sea surface temperature have been damaged irrevocably.

The reefs are being monitored for their responses to the changes in environmental conditions and in the ensuing period works related to development of spectral signatures of corals of Andaman by deploying the underwater radiometer will be carried out.

## Cataloguing and Conservation of Marine Sponges of Andaman through DNA Barcoding

***P. Krishnan, Kamal Sarma, C. Raghunathan and N.V. Vinith Kumar***

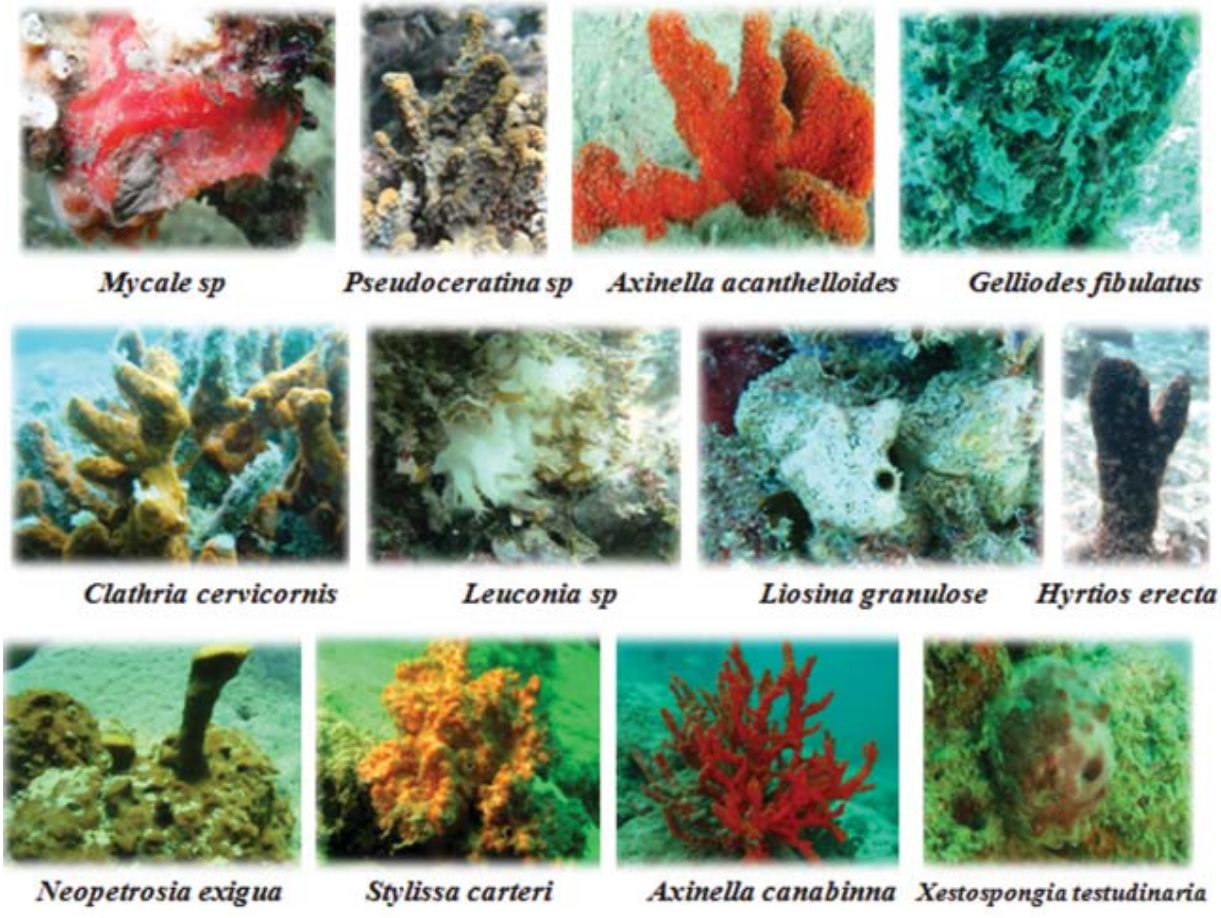
Sponges are among the most ancestral metazoans and may hold many clues to our understanding of the evolution of early animal and developmental processes. They assume significance owing to their multiple ecological roles and commercial importance to the pharmaceutical and biomaterials industry as producers of highly potent secondary metabolites useful for drug development.

Marine sponges are difficult to identify, often even by taxonomic experts, due to which many sponges discovered in large scale biodiversity surveys remain un-described. Globally over 8000 sponges have been described while from India only about 500 sponge species have been reported including 75 from Andaman, which perhaps could be more, in the light of the rich marine biodiversity of the Islands. The utilization of additional characters, such as informative signature DNA sequences, and the

establishment of a DNA sequence-aided taxonomic system might provide an opportunity to overcome these shortcomings and aid our future endeavours to strive for more comprehensive species discoveries. The barcoding exercise in general and that of sponges in particular, assumes significance from at least two important angles, namely (a) meeting the taxonomic challenges and (b) securing intellectual property rights (IPRs) for some of the country's important bioresources.

Fresh marine sponge specimens were collected from North Bay, Pongi Baalu and Havelock from a depth of up to 12 m using SCUBA (Self Contained Underwater Breathing Apparatus). All the three study sites are known for their rich biodiversity of corals, reef fishes and reef associated organisms. The whole sponge specimens, where ever possible, were collected and stored in ethyl alcohol as voucher specimens while a small tissue sample was separately preserved for DNA isolation. Altogether 51 such marine sponges have been collected, of which 27 have been described fully through conventional taxonomy with the assistance of ZSI regional station, Port Blair. The taxonomic particulars were collected as required under the global sponge barcoding project and a sample of which is shown in Plate 9.

The DNA isolation procedures have been standardized and genomic DNA of all the sponge specimens collected so far have been isolated and stored at -20°C in a deep freezer. The PCR amplification of the selected barcode regions from various sponge samples is being standardized. Efforts are underway to describe the un-identified sponge species and develop GIS-based resource maps and barcodes of the collected species.



| | | |
|---|---|---|
| Species Name | | *Xestospongia testudinaria* |
| Collection | Date | 10-10-2010 |
| | Location | North Bay, Port Blair, South Andaman |
| Preservation method | | EtOH |

| Morphological description | |
|---|---|
| Growth form | Barrel shaped sponge with large area basal attachment |
| Colour in EtOH | Off- white |
| Oscules | Present at the inner surface in groups; 0.5- 1 mm in diameter |
| Texture | Soft and breaks with little pressure |
| Surface ornamentation | Corrugated |
| Choanosomal skeleton | Dense network of short longitudinal multispicular tracts |
| Ectosomal skeleton | Lacks special ectosomal skeleton but has a tangential disorganised network of free spicules |
| Megascleres | Oxeas |
| Microscleres | Absent |

# Social Science Section




# An Economic Analysis of Floriculture and Vegetables Potential in Andaman and Nicobar Islands.

*Subhash Chand, D.R. Singh, R.C. Srivastava and Sharwan Singh*

During the year under report, price behavior, cost of cultivation and marketing of vegetables was studied. Data on prices of different vegetables, market channels involved, market margin etc. were collected from Port Blair, Bathu Basti and Goalghar markets from producers, sellers and consumers whereas cost of cultivation was worked out based on the primary data of South Andaman.

## Cost of cultivation

The analysis of primary data on cost of cultivation of vegetables showed that over all, operational cost was Rs 78100 /ha out of which labour charges were Rs 65100 (83.4 percent). The yield as well as gross income was found to be higher in case of cowpea cultivation (35 tons and Rs. 2.5 lakh/ha respectively) followed by French beans and Cauliflower (Table 1). Since labour cost was too high in these islands, the introduction of cheaper farm machinery and scientific package of practices may help reduce cost of cultivation.

**Table 1. Costs and Returns per ha. in cultivation of Vegetables in Andaman**

| Particular | Crop | | | | | Over all |
|---|---|---|---|---|---|---|
| | Coriander | French bean | Cowpea | Palak | Cauli -flower | |
| No of man days | 450 | 300 | 650 | 350 | 650 | 480 |
| Expenditure on Labour (Rs) | 58500 | 39000 | 84500 | 59000 | 84500 | 65100 |
| Expenditure on inputs (Rs.) | 14100 | 10100 | 14200 | 13500 | 13100 | 13000 |
| Operational cost (Rs.) | 72600 | 49100 | 98700 | 72500 | 97600 | 78100 |
| Variable cost (Rs) | 76230 | 51555 | 103635 | 76125 | 102480 | 82005 |
| Yield (Ton/ ha.) | 3.0 | 4.0 | 35.0 | 12.5 | 7.0 | 12.3 |
| Gross Income (Rs.) | 90000 | 160000 | 350000 | 125000 | 175000 | 180000 |
| **Returns over variable cost Rs.)** | **13770** | **108445** | **146365** | **48875** | **72520** | 77995 |

## Price spread and market margin

The price spread and market margin was worked out for major vegetables separately. For Cauliflower, marketing channels and expenditure incurred over various intermediaries are presented in table 2. There was a big gap between the price paid by the consumer and price received by producer in all three channels identified. More than 52 percent of consumer price was distributed among the different intermediaries of market system. These intermediaries have to be narrowed down and proper marketing mechanism has to be developed so that vegetables are provided to consumers at cheaper rates and at the same time farmers are paid remunerative prices as perceived by majority of farmers.

## Market efficiency

Measures of market efficiency were worked out and it was revealed that market efficiency was found to be 75% in channel III (producers to consumer) followed by channel II at 55% (producer to retailer to consumer) and channel I (producer to local vegetable collector to wholesaler to retailer to consumer) at 52%. This indicates that where ever less intermediaries are involved, the producer gets better price. (Table 3)

**Table 2. Market channels for Cauliflower**

| Particulars | Market Channels (Amount in Rs) | | |
|---|---|---|---|
| | I | II | III |
| Prices received by Farmer | 35 | 37 | 45 |
| Cost incurred by the local auctioneer | 6.00 | 6.00 | 6.00 |
| Margin | 5.00 | 4.00 | 10.94 |
| Price paid by the vegetables Collector / | 46.00 | 48.00 | 66.94 |
| Cost incurred by **Local Dealer** | 3.00 | | |
| Margin | 3.00 | | |
| Local dealer price | 52 | | |
| Cost incurred by the wholesaler | 5.00 | 6.00 | |
| Margin | 4.94 | 3.00 | |
| Wholesaler's price | 61.94 | 57.00 | |
| Cost incurred by the retailer | 3.00 | 3.00 | |
| Margin | 2.00 | 6.94 | |
| **Retailer's price / Price paid by consumer** | 66.94 | 66.94 | 66.94 |

**Table 3. Measures of efficiency of different market channels**

| Item | Market Channels | | |
|---|---|---|---|
| | I | II | III |
| Consumer's price (Rs/kg) | 66.94 | 66.94 | 66.94 |
| Farmer's price (Rs/kg) | 35 | 37 | 50.00 |
| Marketing cost + margin (Rs/kg) | 31.94 | 29.94 | 16.94 |
| Marketing expenditure as % of consumer's price | 47.77 | 44.73 | 25.31 |
| **Market efficiency** | **0.52** | **0.55** | **0.75** |

## Price trend of major vegetables sold in A & N Islands

The price data for three years were analyzed on monthly average basis for different vegetables from July 2008 to December 2010 and found that all the vegetable showed similar trend (Fig. 1). The slight deviation in the price trend of potato, onion, brinjal and cabbage during 2009-10 may be due to short supply of these vegetables and high price of onion and potato. The variation in the price followed the trend of local production and availability.

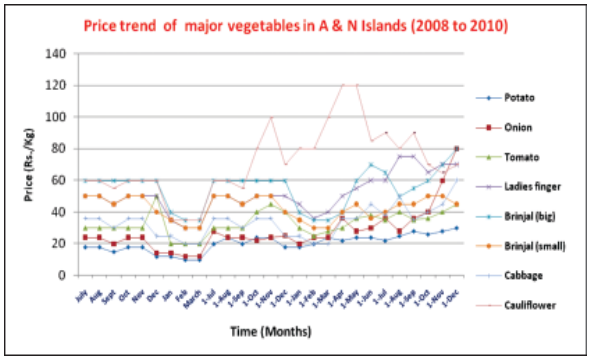



Fig.1: Price trend of major vegetables in A & N Islands (2008 to 2010)



# Economic Valuation of Mangroves in Andaman and Nicobar Islands

*Subhash Chand, S. Dam Roy, R.C. Srivastava and P. Krishnan*

To access socio economic status of the beneficiaries from mangroves area, 57 respondents were selected randomly for the detailed study. The data were collected on the aspects viz. use of mangroves, income of the beneficiaries, family size, education level, utilization pattern of mangroves, willingness to pay for conservation of mangroves etc. The secondary data were collected from the published reports of forest department, statistical abstracts and other published research reports from national and international literature.

The findings indicated that majority of the mangrove users were resource poor and dependent upon mangrove resources to a greater extent. The income varied from Rs 5000 to Rs 10000/- per annum with the average family size of about 4 persons.

## Mangrove status in India

The data collected from secondary sources on the extent of mangroves indicated that total area in all the eight coastal states of India was 482700 ha (2008). West Bengal (Sundarbans) occupied the maximum area (212300ha) followed by Gujrat (99100ha), A & N Islands (99600ha), and rest by Orissa, Maharashtra, Tamil Nadu and Karnataka. The total value of benefits derived from the mangroves were found to be Rs. 10069 crores. The degradation of mangrove areas was on the rise, may be due to human interference. Similar trend was observed in case of mangroves of A & N Islands. Here, mangrove expanse has declined from 96600 ha in 1997 to 63700 ha in 2005 and may be going down further given population pressure and dependency on mangroves. Only sincere efforts to conserve the mangroves can reverse the trend.

### Benefits of mangroves

To assess the benefits of mangroves in terms of perception by different stakeholders, a scoring technique was used. The scores were assigned based on the importance from 0 to 3 scale (Table 4) and benefits were categorized as Income (I), Employment (E) and Other Benefits (B).

**Table 4: Benefits of Mangroves as perceived by different stakeholders**

| Type of benefit | Output | Fisherman | | | Local People | | | Tourism | | | Res. & Edu. | | | Govt. | | | Total Score | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | E | B | I | E | B | I | E | B | I | E | B | I | E | B | I | E | B |
| **Direct** | Fuel | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 3 |
| | Fodder | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| | Medicine | 1 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 4 |
| | Genetic res. | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 2 | 2 | 2 | 4 | 5 | 5 |
| | Apiculture | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Wild life res | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 |
| | Fish res. | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 2 |
| | Recreation | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 5 |
| | Tourism | 1 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 6 | 2 | 5 |
| | Education and research | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | 0 | 0 | 1 | 1 | 1 | 1 |
| **Indirect** | Support to fisheries | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 4 |
| | Support to habitats & Species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 4 |
| | Shoreline protection | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| | Sediment & accretion | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 4 |
| | Other function | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 2 |
| **Non Use** | Other none use value | 2 | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 5 | 3 | 6 |
| **Total** | | **9** | **7** | **13** | **17** | **9** | **9** | **6** | **7** | **13** | **6** | **3** | **7** | **4** | **3** | **9** | **42** | **29** | **51** |

I = Income, E= Employment, B= Other Benefits

It is evident from table 4 that fishermen perceived 50 percent income and 58 percent employment generation benefits from mangroves. Local people, tourism and other stake holders also exhibited the same trend. The benefits in terms of sea sore protection, wild life shelter and other non-use values etc were in the range of 33 to 55 percent as perceived by different categories of stakeholders.

The findings indicated that 'other benefits' of mangroves were more as compared to income generation and employment opportunities. Hence, valuation process should take into account the 'other benefits' assessment by using the surrogate measures and shadow pricing.

## Market and Export Potential Analysis of Marine Fishery Resources in Andaman and Nicobar Islands

***Subhash Chand, R.C. Srivastava, P. Krishnan, S. Dam Roy, Kamal Sarma and M. Balakrishnan***

Andaman and Nicobar has coast line of 1962 km which is one fourth of total coast line of India. However, with the declaration of 200 miles of Exclusive Economic Zone (EEZ), these islands encompass about 0.6 million Sq. Km which is about 30 percent of EEZ of India. The projected fisheries potential of Andaman & Nicobar Islands, as per the revised estimate of Fishy Survey of India (John *et.al.*, 2005, Fish Survey India. No. 28, pp.38) is 1.48 lakh tonnes. Therefore, these Islands have rich and unexploited fishery resources. At present only 32335 tones (2008-09) of fishes are annually harvested from Andaman waters. The fish potential and other infrastructure available in Andaman and Nicobar Islands is given in Fig. 2.

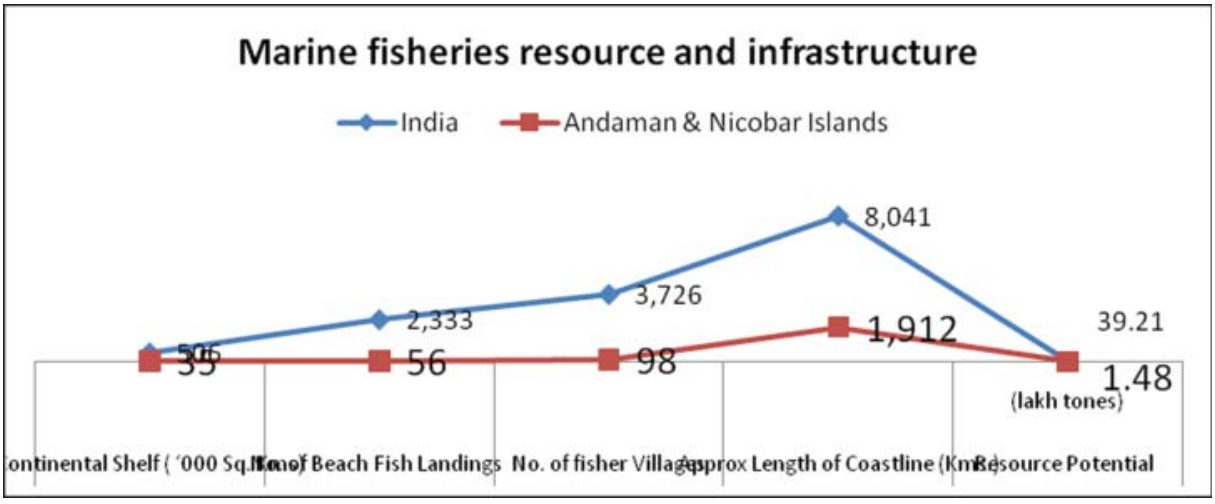


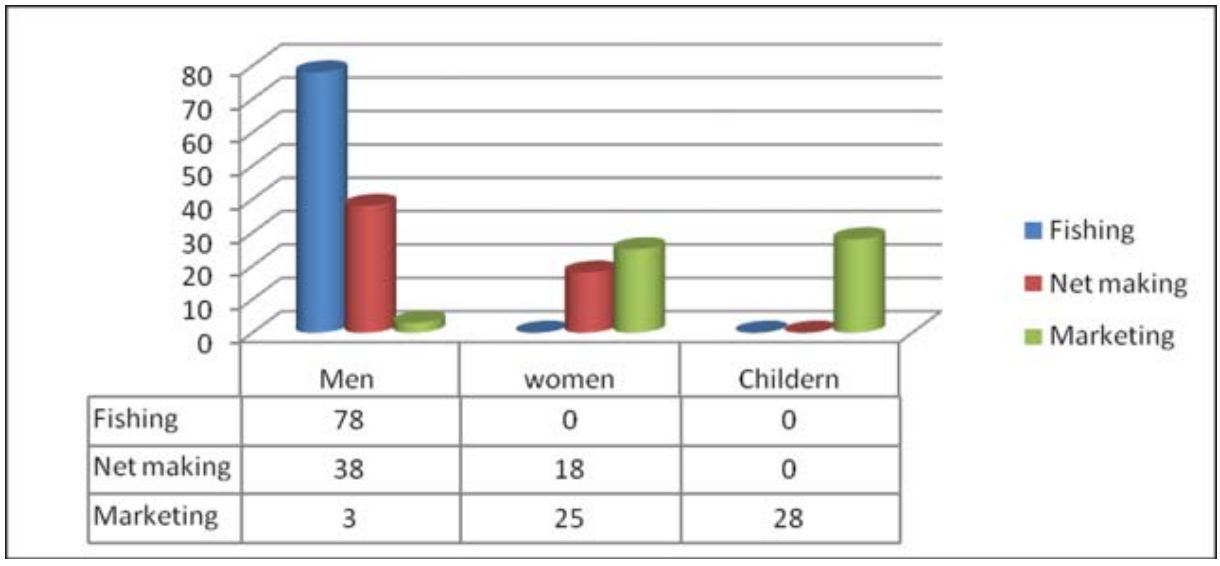

Fig 2: Marine Fisheries resources and Infrastructure

In view of the above, socio economic status of fishermen in these islands and market mechanisms of marine fishery resources were studied.

### Classification of respondents and their socio economics status

The data were collected from 78 fishermen - respondents on socio economic aspects. It was found that average family size varied from 5 to 7 persons in the family. The occupational distribution of the respondents indicated that fishermen families were engaged in fishing and allied activities like net making and marketing of fish (Fig. 3). The average family income varied from Rs. 15000 to Rs. 35000

per annum. This low income level resulted in poor education level and poor health status. Average family income varied from Rs. 15000 to Rs. 35000 per annum. This low income level resulted in poor education level and poor health status.




| | Men | women | Childern |
|---|---|---|---|
| Fishing | 78 | 0 | 0 |
| Net making | 38 | 18 | 0 |
| Marketing | 3 | 25 | 28 |

Fig. 3. Occupational distribution of the respondents Price trend of major fishes

The data on different fish species sold in Port Blair market collected from consumer and fisherman on daily, weekly, monthly basis and analyzed (Fig. 4). It was revealed that during 2009 -10 the prices of different fish species varied from Rs.240 to below Rs 50 per kg. However, fishes like prawn, Surmai, Kokari and Koral receive higher price whereas fishes like Shankar, topi, tilapia and bangdi etc. were sold and cheaper price. There was no significant correlation ($R^2$=0.2) between the prices of different species.

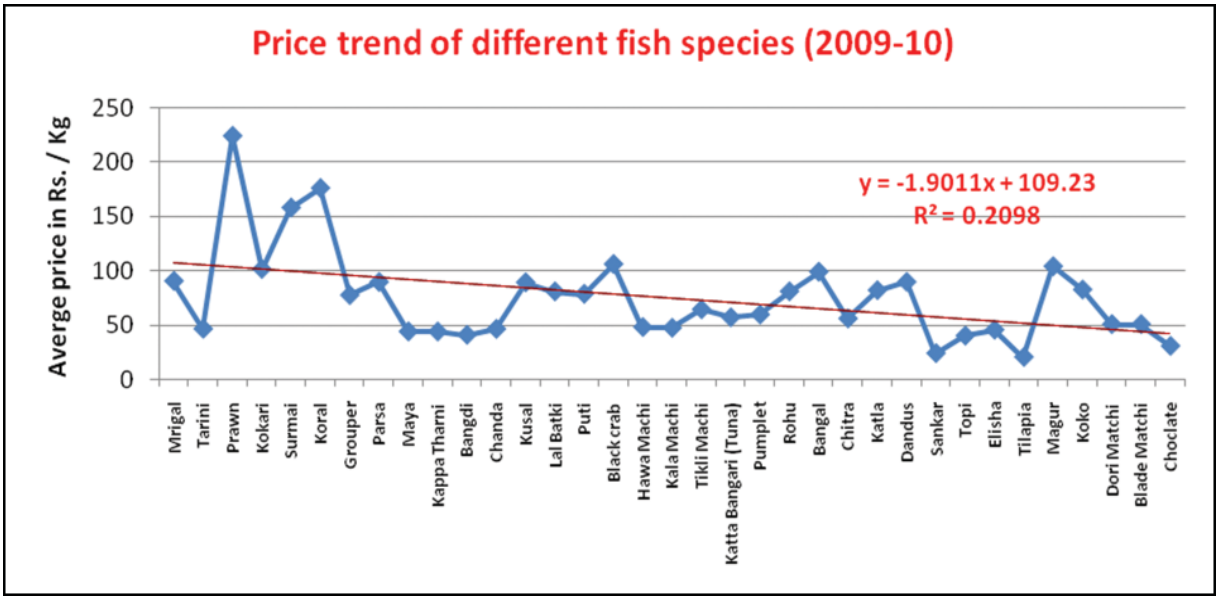



Fig. 4: Average price of different fish species in A & N Islands

# Development of Artificial Neural Networks (ANN) Based Forecasting Model for Studying Varieties Diversity, Yield and Production in Prominent Rice Cultivars of Bay Islands

*M. Balakrishnan, N. Ravisankar, Subhash Chand, R.C. Srivastava, S.K. Zamir Ahmed and Krishna Kumar*

Reliable forecasting of the crop yields is very important for better planning and decision making. The study was initiated to investigate the ability of neural network for yield prediction of rice in Andaman and Nicobar Islands. The yield data from experimentations conducted during 1980 to 2002 were subjected to ANN approach for developing a meaningful yield prediction model for five varieties of rice viz. C14-8, Quing Livan No.1, Taichung, Sen Yu and Jaya under island conditions. The information on parameters like varietal spectrum, weather parameters , yield components, soil charactrestics, abiotic and biotic stressors etc were collected from the the records of the Institute and used for 'training data set'. The results obtained from the study showed that the ANN model could be applied well to prediction modeling.

## Forecast using ANN Model

The production forecast performance of ANN models are presented in Fig.5 and 6. ANN model 1 shows that yield of C14-8 could be predicted up to 95 % accuracy as evident from the value of $\chi 2$ (0.90) against table value (21.67) at 5% level of significance.

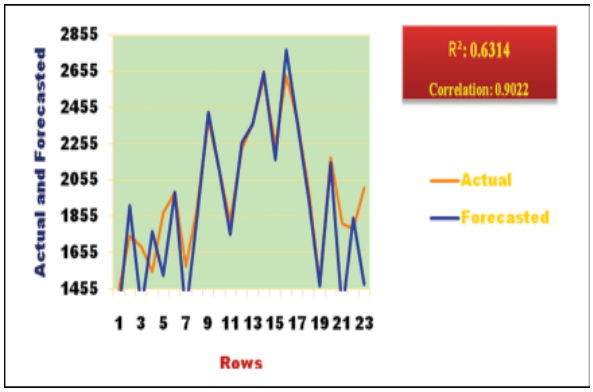



Fig. 5: Actual and estimated rice yield of bay Islands using C14-8 (south Andaman)

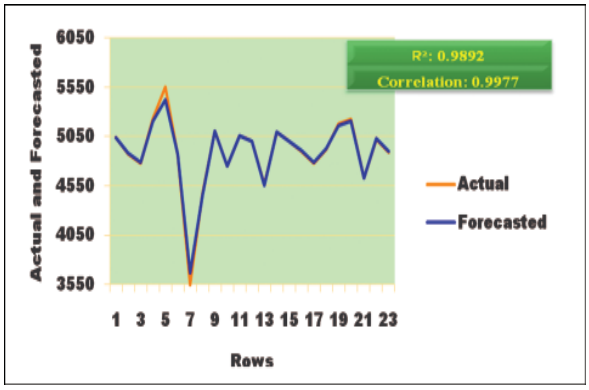



Fig.6: Actual and estimated rice yield of bay Islands (Middle Andaman)

ANN model 2 shows that there was no significant difference in the yield of Jaya as evident from the value of $\chi^2$ (0.92) against table value (20.090) at 5% level of significance.

It is also observed during the study that there is no need to discard the abnormal data record since it helped in contributing knowledge during training of ANN and leads to its better performance. The forecast outputs trace the actual production very well for all levels of rice yields in those years which were used in the experiment. So, it can be inferred that the ANN has high potential for the application in crop yield forecast.

# Establishment of Sub- Distributed Information Centre (DBT)

*M. Balakrishnan*

This Bioinformatics centre was established to develop databases on biodiversity of Andaman & Nicobar Islands, which would provide information to taxonomists, ecologists, biodiversity management specialists, policy makers, planners and related entrepreneurs. The aim was also to store, manage, and exchange electronically the published scientific information in standard format. This centre has been serving as an active site for bioinformatics research and development in this remote union territory. It provides computational support and training to students and scientist and offers traineeships and studentships to deserving bioinformatics students. The following soft wares and tools have been developed during the year.

## I. Tools for Aloevera chemical constituent systems

*Aloevera* extracts have antibacterial and antifungal activities useful in treatment of minor skin infections and wounds as well as inhibit the growth of fungi that cause *tinea*. This software is prepared using VB.net and MS SQL. The System developed under VB.net consists of a Loading Screen at the beginning. When the user press the enter button, the loading bar starts running. After loading, the page takes you to the Home page which is built with a Menu bar. One can search by 'chemical', 'taxonomy', 'etymology' and 'practices'. The File menu consists of Open a file and Close the file or exit the entire program. "Search By chemical" tab, we gave the user to select chemical properties like enthrone, enzymes and organic compounds. Under "Practices tab", one can select the type of practices to know about the methodology of practices. "Us" tab, takes the user to CARI Website and contact us. The user can also select the same from the check box in the Homepage.



## II. Database Development.

Databases like 'Coconut Information System', 'Arecanut Information System' and 'Mango EST Sequesnce Information' have been developed and are being maintained.

**1. Web based Coconut disease resistance and salinity tolerant Information System**

An extensive survey was conducted in both Andaman as well as Nicobar group of islands to get

primary data about the information on coconut plants and to collect the germplasm. In this survey, all details regarding such as common name, scientific name, it family, genera, habitat, date of collection, characteristics, flowering time, its availability, type of disease, effect of salinity and tolerance to coconut plant for which it is being used were collected. In addition to that, secondary data were also collected from Botanical Survey of India, Port Blair. With all these, Information System was created using ASP.net and Adobe Macromedia Dream weaver software. This information system can be accessed through CARI website.


**2. Web based Mango EST Information system of Andaman and Nicobar Islands Mango EST**

The Mango ESTs are small pieces of DNA sequence that are generated by sequencing either one or both ends of an expressed gene. They contain enough information to permit the design of precise probe for DNA micro arrays that can be used to determine the gene expression involved in hereditary diseases.


ESTs also have a number of practical advantages. They greatly reduce the time required to locate a gene. This Information Systems has 137 EST Sequences, protein name, its functions, EST name and length. This would be useful for those engaged in scientific exploration, compilation and subsequent documentation of mangoe Expressed Sequence tags (EST) available in Andaman and Nicobar Islands. This information system can be accessed through CARI website

**3. Database for Arecanut of Andaman and Nicobar Islands**

The arecanut palm is the source of common chewing nut, popularly known as betel nut or *supari*. Six varieties cultivated mainly in Andaman are: Mangala, Sumangala, Subamangala, Mohitnagar, Srimangala and Samruthi. The database contained common name, scientific name, soil type, season, planting, sowing, harvest, manuring, irrigations, yield and disease management etc. This information system provides sharable frame work with metadata, quality evolution procedures and their standardization. The entire database is organized in object oriented relational database using MS-Access as backend and the interface for the database was developed with ASP.NET. Web forms are contained in the files with an ASPX extension. These files typically contain static (X)HTML markup, as well as markup defining server-side Web Controls and User Controls where the developers place all the required static and dynamic content for the web page. With all these information, an offline database has been prepared for Windows.

# Identifying Livelihood Options and Training Needs Compatible to Self Help Groups to Fructify these Options

*S.K. Zamir Ahmed, Subhash Chand, M. Balakrishnan and R.C. Srivastava*

The status of the Self Help Groups (SHGs) showed an overall credit linkage of 31.60 percent in Andaman & Nicobar Islands. Out of 120 credit linked women SHGs promoted by six leading Self Help Group Promoting Agencies (SHGPA) representing all the three districts taken for the study inferred that the strength of the group was in the tune of 10.48. The average corpus money of 1.26 lakhs was available with the group which was enough to start any agricultural and allied enterprise as a self employment venture. The findings on the expenditure pattern on saving together accounted for 71 percent on social capital i.e. health, education and household (Fig.7). Beside, seven training needs for livelihood options were preferred by the respondents wherein the Goat farming was the first choice followed by vegetable cultivation, floriculture, poultry farming, piggery, handicraft and mushroom cultivation being their last choice. But the constraints faced in practicing self employment venture were non availability of the critical inputs to the stakeholders in time (35.8%) followed by low level of attitude towards agriculture sector than non agriculture sector (26.7%), lack of scientific know how & do how (16.7%), more risk involvement (12.5%) and no assured market (8.3%).

Thus, it was inferred that the Self Help Groups contributes to take a major share and possess high degree of multifarious skills, therefore, training woman in the interested avocations was essential to convert them in to an active force accompanied with proper environment for its application ushering empowerment and decent livelihood. Quality and effective training programmes accompanied with proper environment for its application will definitely contribute towards their development in knowledge, favourable attitude and finally will lead to adoption. For up scaling SHGs of A & N Islands, A & N Administration has taken cue from this project and introduced cluster approach in the villages of South Andaman with livelihood options identified in association with leading NGOs and NABARD.

(n=120)

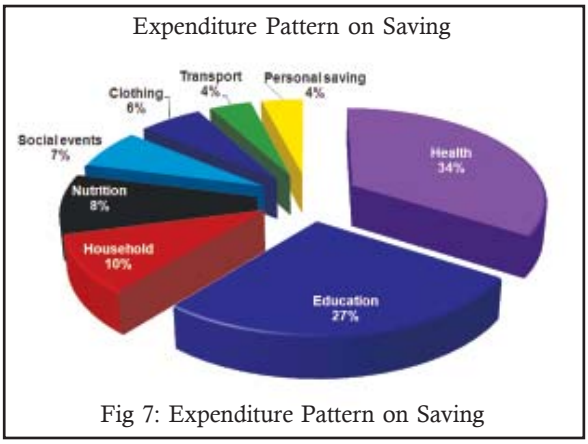



Fig 7: Expenditure Pattern on Saving

# Establishment of Out Reach Centre at Diglipur, North & Middle Andaman District

*R.C. Srivastava and S.K. Zamir Ahmed*

The Out Reach Centre of the Institute supported by NABARD established at Diglipur to cater to the needs of the stakeholders of North & Middle Andaman District has taken up need based technological intervention in the field of agriculture and allied through training, technological demonstration, exposure visit and other extension activities . In addition to this, marketing behaviour of perishable commodities was also studied.

## Human Resource Development

Twenty one field level training programmes for the stakeholders were conducted in agricultural and allied fields wherein a total of 552 farmers got trained and 1669 trainee days were utilized. The over all participation of trainees was in the tune of 79% males and 21% females. Besides this, six customized programme on the subject viz. Vermi-compost, Carp seed production and nursery management, Quail farming, Protected cultivation of vegetable crops, Goat farming and Marine ornamental fish breeding were also conducted wherein a total of 175 youths were trained to build in confidence and capacity for taking up entrepreneurial activity for self employment.

## Kharif Technological Demonstration

A total of fifty three demonstrations i.e. sixteen (6.30 ha) under System of Rice Intensification (SRI) and thirty seven (13.30 ha) under non SRI were conducted covering an area of 19.60 ha. Under SRI, var. US 312 gave the mean yield of 5.86 t/ha. against local check Jaya (3.86 t/ha) showing 52 percent increase in yield followed by var. VNR-2355 plus.

**Table 5. Kharif Technological Demonstration under SRI**

| Variety | No. of Demo. | Area (in ha.) | Yield (t/ha) | | | Check yield t/ha. | % yield gain |
|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Mean | | |
| VNR-2355 Plus | 06 | 2.60 | 3.72 | 6.63 | 5.74 | 3.70 | 55.13 |
| US-312 | 10 | 3.70 | 4.12 | 7.58 | 5.86 | 3.86 | 51.89 |

**Table 6. Kharif Technological Demonstration under Non-SRI**

| Variety | No. of Demo. | Area (in ha.) | Yield (t/ha) | | | Check yield t/ha. | % yield gain |
|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Mean | | |
| CARI-5* | 02 | 0.60 | 2.5 | 2.8 | 2.65 | 2.20 | 20.45 |
| GAYATRI | 03 | 0.60 | 4.65 | 5.13 | 4.84 | 3.80 | 27.37 |
| VARSHA | 04 | 0.60 | 3.03 | 4.83 | 3.81 | 3.30 | 15.45 |
| RANJEET | 01 | 0.10 | - | 3.88 | 3.88 | 3.00 | 29.33 |
| VNR 2355 Plus | 10 | 4.20 | 2.90 | 5.11 | 4.24 | 3.60 | 17.78 |
| US-312 | 17 | 7.20 | 2.42 | 5.33 | 3.78 | 3.35 | 12.83 |

**Saline Tolerant*


Under non SRI, var. Gayatri gave the yield of 4.84 t/ha followed by VNR 2355 Plus (4.24 t/ha), Ranjeet (3.88 t/ha), Varsha (3.81 t/ha) and US-312 (3.78 t/ha) respectively (Table 5 & 6). Here, the percentage increase in yield was 29% in var. Ranjeet followed by Gayatri (27%), VNR 2355 Plus (18%), Varsha (15.45%) and US312 (13%) respectively.

### Rabi Technological Demonstration

During Rabi season, 63 demonstrations in farmers field with seven crops were conducted wherein Chilli var. Flame hot gave a yield of 7.03 t/ha against the local check Fair Bomb (6.43 t/ha). Cauliflower var. White Marble gave 24.5 t/ha against the local check Karuna (23.6 t/ha). Cabbage var. Rare Ball gave 25.36 t/ha against the local check Blue Bandies (23.66 t/ha). Okra var. US-7136 gave 4.10 t/ha against the local check Arun (3.67 t/ha). Tomato var. Laxmi (NP-5005) gave 10.00 t/ha against the local check Karan (5.55 t/ha), Green garm var. Jhad Kalai gave 0.56 t/ha and Blackgram var. Tel Kalai gave 0.65 t/ha against the local check (0.57 t/ha) and in potato var. Kufri Surya gave an yield of 3.7 t/ha. The potential yield could not be realized due to heavy down pour and stagnation of water in the field during the productive stage.

### Exposure visit

One hundred and twelve farmers representing from Diglipur to Baratang attended Kisan Mela on the theme "Self Reliant Village - Answer to Climate Change" from 2nd to 3rd February, 2011 at CARI, Port Blair. During the period, they attended Kisan Gosti, Kullah Manch, Farmers quiz and training at CARI. The major achievement was felicitation of four farmers who had taken up technological demonstrations with the support of the host Institute in the field of vermin-composting, SRI cultivation, Use of Bio-control in vegetables and cultivation of high yielding variety CARI-5 in problem soil. The farmers also got their field problems addressed by the team of diversified group of the scientists.

### Field Visits by the Scientist/Experts

Eight hundred and twenty one visits were made for the purpose of selection of farmers, monitoring of the crops demonstrated and to impart advisory services.

### Farmers visit to ORC

Eighty seven farmers from neighboring cluster of villages visited ORC with the purpose to refer the technical bulletins and to have discussion on the ongoing activities and training programmes. In addition, fourteen telephonic advisories on pest and disease management were made available to the farmers by the scientists of host institute.

### Marketing behavior of perishable commodities at Diglipur

Data were collected from two un-regulated markets through interview method and personal observation with the help of key informants from Subhash Gram and Aerial Bay at weekly intervals on the product

available and sold to the commoners during the period. Pulses (black gram, green gram and *Jai Bangla*) totaling to 1280.4 t were exported from Port Blair to Chennai, thereafter processed and brought back to be sold to the target clientele due to absence of any Dal mill. Approximately 30 t of Groupers (all varieties) were exported to Port Blair @ Rs. 60 to 85/-kg. Essential items like onion (186 t) followed by potatoes (160 t) were imported to Diglipur per annum for the consumers besides tomato (27 t) and poultry (10 t). A total of 97 t of major vegetables were exported from Diglipur to nearby islands per annum. Almost all types of vegetables produced from nine clusters of villages are exported to other islands.

Marine fishes like Elish were sold at an average price of Rs. 350/-, fresh water fish Magur @ Rs. 130, Burma rice (black & white) and Jeera rice were sold @ Rs. 60 to 70 and the other rice varieties like Ponni local, Jaganath, Bhavani, C14-8 and Jaya were sold @ Rs. 11 to 16/-. Mutton was the choice of the people and was sold @ Rs. 300/- per kg on Sunday market whereas Pork was sold in the range of Rs. 100 to 200 per kg.

## Potential and Prospects of Campbell Bay Being Production Hub to Meet Requirements of PDS (Rice) and Perishable Foods of Nicobar District

***Ajmer Singh, S K Zamir Ahmed, S K Verma and R C Srivastava***

The project aims at assessing the scope and level of local production to meet the requirements of perishable foods of Nicobar group of islands.

The study becomes all the more important as there are little livelihood options except agriculture in Great Nicobar group of islands. Whatever agriculture development took place during the post settlement period, has been undone by Tsunami and the situation is likely to aggravate after rehabilitation work is over and subsidized ration is stopped. Analyzing socio-economic parameters, yield gaps, identification of technological interventions and their economic analysis (ex-ante) will be the core of the study.

The project started only in Sept. 2010 and during preliminary survey, it was found that average family size of respondents was 4.41. The monthly income of the families was Rs 16060 out of which maximum contribution was from govt. service (Rs 6284) followed by agriculture (Rs 4744), private jobs (Rs 2214), pensions (Rs 1378) and business/ self employment (Rs 1180).

The requirements for the population of 8679 (Campbell Bay) and 39949 (Great Nicobar) of cereals works out to be at 1410 and 6492, pulses at 90 and 413, vegetables at 513 and 2362 and that of milk at 593 and 2730 t/ year.

Currently, farmers are cultivating four major cropping systems viz. Field crops (Rice, Maize and Jowar), Pulses (Moong and Urd), Vegetables (Mainly leafy and green vegetables) and Plantation crops (Coconut, Arecanut, Mango, Papaya and Spices). Out of total 979.2 ha, 63.5 ha lost in the sea during Tsunami and 303.3 ha are under submergence during high tides which needs reclamation and crop planning. It is revealed during the survey that the



average operational holding per farm was 2.9 ha. Out of 613.1 ha available for cultivation, only 35.7 ha were under field crops and 211.2 ha were under plantation crops. Rests were lying unattended and needs huge investment to initiate agriculture in that land. The plantation crops were found to be profitable followed by poultry so the inhabitants are not akin to replace plantations with food crops.

Milk production was found to be economical and feasible as fodder (Green grass) was available in plenty throughout the year. Livestock economy of the Campbell Bay farmers was very weak. Animals worth Rs 15841 only were kept per family. The highest contribution was from Desi cattle followed by sheep & goat, then by poultry in terms of present value of livestock kept by the farmers.

Regarding inputs availability and their usage, subjective rating was obtained from the respondents (Inputs availability rating: 0 – unavailable, 10- available in plenty). Out of 100 farmers selected for the study, 60 opined that the inputs availability was not satisfactory in case of most of the critical inputs. Availability in time and quality was satisfactory only in case of machinery and manures. Labour availability and its cost was the concern of all the farmers.

## Consumption of food commodities

The per family consumption expenditure per month was Rs 3961 out of which maximum payments were made towards milk consumption followed by vegetables, meat & fish. The expenditure on rice and wheat was the least (Rs 222 and Rs 184 respectively) as these were supplied through PDS (Table 7).

**Table 7. Consumption Pattern of Farmers in Campbell Bay**

| Food | Qty(Kg/per family/month) | Cost (Rs) |
|---|---|---|
| Wheat | 17.39 | 184 |
| Rice | 25.12 | 223 |
| Pulses | 3.87 | 369 |
| Vegetables | 72.31 | 869 |
| fish | 10.10 | 445 |
| Egg | 38.04 | 149 |
| Meat/ chicken | 4.60 | 614 |
| Milk/ curd | 39.58 | 908 |
| Fruits | 11.24 | 264 |
| Ghee/ butter | 2.74 | 111 |
| Paneer | 1.63 | 10 |
| **Total** | | **3961** |

Given the average productivity per hectare ie 5.0 tons for rice, 0.7 tons for pulses and 7.0 tons for vegetables, sufficient quantities of food crops can be harvested from the available arable land in Campbell Bay which can feed whole of Nicobar group of islands and thereby we could save much on front of public exchequer.

To initiate agriculture sector, reclamation of land which got degraded due to submergence in the sea is the first priority followed by connectivity where as for livestock sector, establishment of Gaushala and vacation of encroached grazing land should be the priority as reported by the respondents.

# Krishi Vigyan Kendra - South Andaman

The KVK of CARI has conducted mandated programes of conducting training, technological demonstrations through FLD & OFT to cater to the needs of the stakeholders of the South Andaman. The details of the activities are manifested below.

## Training

Fifty three training programmes for the benefit of practicing farmers, rural youths and extension functionaries in agriculture and allied disciplines were conducted wherein 1247 beneficiaries (774 Male and 473 Female) participated as detailed below:

**Table 8 : Training programmes**

| Thematic Area | No. | No. of Participants | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| **(A) Practicing Farmers/ Farm women** | | | | |
| Crop production | 6 | 102 | 28 | 130 |
| Horticulture | 5 | 54 | 66 | 120 |
| Livestock Production and Management | 4 | 61 | 32 | 93 |
| Agrl. Engineering | 5 | 69 | 37 | 106 |
| Fisheries | 7 | 160 | 64 | 224 |
| **(B) Rural Youth** | | | | |
| Crop production | 3 | 29 | 36 | 65 |
| Horticulture | 3 | 37 | 33 | 70 |
| Livestock Production and Management | 6 | 58 | 98 | 156 |
| Agrl. Engineering | 4 | 77 | 09 | 86 |
| Fisheries | 3 | 50 | 15 | 65 |
| **(C) Extension Personnel** | | | | |
| Crop production | 1 | 09 | 05 | 14 |
| Horticulture | 3 | 29 | 34 | 63 |
| Livestock Production and Management | 1 | 21 | 04 | 25 |
| Agrl. Engineering | 1 | 12 | 08 | 20 |
| Fisheries | 1 | 06 | 04 | 10 |
| **GRAND TOTAL** | **53** | **774** | **473** | **1247** |

**Front Line Demonstrations (FLD)**

- On popularization of hybrid rice (Var.Coraknath 509) was conducted in five farmers field *viz.,* Guptapara, Memyo, Manjery villages of South Andaman in an area of 0.4 ha each . The result indicated that Var.Coraknath 509 gave an average yield of 5.25 t/ha which was 32.24 percentage higher over control (Jaya).
- Groundnut Var. ICGS 76 was demonstrated in three farmers field at Burmanallah, village of Port Blair and Guptapara, Namunagar villages of Ferrar Gunj block in an area of 0.4 ha each. Farmers have taken up sowing in upland and lowland areas. Due to high rainfall the crop performance in upland areas was better.
- On Sweet potato Var.CARI SP-I and CARI-SP-II were taken up in South Andaman villages like Calicut, Muccapahad, Burma Nallah in an area of 1.0 ha.Var. CARI-SP-I performed better and gave an yield of 21.3 t/ha, followed by CARI-SP-II (19.02 t/ha) over the local check Bidhan Jagnath (12.4 t/ha.)
- Seven Front Line Demonstration on bhendi var. Arka anamika and Prabhani kranti were taken

up in the Muccapahad, Burma Nallah, Manglutan villages in South Andaman in an area of 1.0 ha. The Var. Arka Anamika performed better and gave a yield of 5.3 t/ha, followed by Prabhani Kranti ( 5.1 t/ha)

- One demonstration on pig farming was conducted with four piglets wherein the pigs attained an average body weight of 78 kg per animal over the local check of 60 kg per animal.
- Five demonstrations on Backyard poultry farming was conducted with 10 nos. of Nicorock poultry birds. The birds recorded higher egg production of 145 eggs per year over the local check of 80 eggs.
- Three demonstrations on fodder cultivation on Hybrid Napier was conducted in 3.0 ha of area. The green fodder recorded yield of 150 t/ ha/ year over the yield of local check ( 80 t/ ha/ year.)
- One demonstration on Brackish water Shrimp Farming was conducted with culture of *P. monodon* (tiger prawn) in Brackish water pond area of 0.4 ha. *P. monodon* seeds (3000 nos./ ha). Due to heavy rain mass mortality of prawn occurred and only 25 Kg prawn was harvested.
- Five demonstrations on Integrated Fish Farming were conducted wherein fish fingerlings of Indian Major Carps and Grass Carp were provided to the farmers along with inputs like lime and feed. Culture with proper pond management technique showed healthy growth of Catla 780 g (Av.) followed by Rohu 550 g (Av.), Mrigal 300 g (Av.) and Grass Carp 960 g (Av.).
- On popularization of coconut dehusker was conducted by evaluating the performance of two units of paddle operated and three units of hand

Hybrid rice (Coraknath 509)


YVM resistant Bhendi (Arka anamika)


Fodder cultivation on Hybrid Napier


Fish sampling under FLD

operated coconut dehuskers among the coconut growers of South Andaman. It was found that the dehusking rate for paddle operated, hand operated and manual dehusker was 122, 79 and 172 nuts/hour respectively. Paddle operated coconut dehusker was safe and widely accepted whereas hand operated coconut dehusker was women friendly. The manual method of coconut dehusking by sabal was risky and used by skilled persons. Bending stress was observed when dehusking was carried out by manual method for a longer period.

### On Farm Trials (OFT)

- OFT on Evaluation of high yielding long duration paddy varieties during Kharif (wet) season was conducted in randomized block design with seven replications. Variety Gayatri registered significantly higher grain yield of 4039 kg/ha followed by Varsha (3674 kg/ha) whereas Var. C 14-8 gave the lowest grain yield of 2264 kg/ha .
- OFT on System of Rice Intensification was conducted during wet (Kharif) season at Ferrar Gunj block. The trial was laid out in randomized block design with seven replications at Maymeo and Shoalbay villages of South Andaman with short duration paddy variety (MLT-10) . Higher grain yield (4585 kg/ha) was recorded with SRI planting followed by recommended practice of 20 x 15 cm. SRI method of planting led to 10.32 % and 24.28 % higher grain yield than other planting method of recommended practices and farmer's method respectively.
- Evaluation of suitable local chilli varities (Marshial, Suraj mirchi and Bombay mirchi) under plantation (Coconut and Arecanut) crops revealed that Variety Marhsial gave 5.07 t/ha with the BC ratio of 1:4.8 followed by Suraj mirchi 4.8 t/ ha with the B C ratio of 1:4.5 and Bombay Mirchi ( 3.9 t/ha) with BC ratio of 1:4.9 respectively.
- Evaluation of Disease resistant Bitter gourd on sloppy land revealed that Var. Pusa Do Mausami performed better and was tolerant to Mosaic and gave a record yield of 13.1 t/ha with the BC ratio of 1:3.9, followed by CO-1 (11.8 t/ha) with the BC ratio of 1: 3.5 over the farmers variety Bold (8.1t/ha) with BC ratio of 1: 2.7.
- On growth performance of carps revealed that the treatment with proper stocking ratio, feeding and water quality management gave better growth yield in 10 months culture (163 Kg) against the farmers' practice without any management (58.0 Kg).
- On evaluation of improved poultry strain under backyard poultry production system with local desi bird, Vanaraja, Nicobari and Vanaraja cross revealed the increase in body weight in Vanaraja (2267.19±27.10) followed by Vanaraja cross (1263.43±16.71) at 20th week old birds.
- On performance and operation of paddy transplanter showed that the total time taken for transplanting by transplanter was reduced by 95% but the numbers of missing plants by mechanical transplanting increased from 0 to 6 when compared with manual transplanting method.

High yielding long duration paddy

System of Rice Intensification (MLT-10)

Suraj mirchi under coconut plantation

Improved poultry strains under Backyard

Growth performance of IMC

Paddy transplanter

## Extension activities:

**Table 9 : Extension activities**

| Nature of Extension Activity | No. of activities | Farmers | | | Extension Officials | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | M | F | T | M | F | T | M | F | T |
| Field Days | 05 | 49 | 63 | 112 | - | - | - | 49 | 63 | 112 |
| Kisan Mela | 01 | - | - | 1920 | - | - | - | - | - | 1920 |
| Kisan Gosti | 02 | 27 | 59 | 86 | - | - | - | 27 | 59 | 86 |
| Exhibition | 04 | Many | | | | | | | | |
| Film Show | 22 | Many | | | | | | | | |
| Method Demonstrations | 12 | 127 | 139 | 266 | - | - | - | 127 | 139 | 266 |
| Farmers Seminar | 03 | 97 | 62 | 159 | - | - | - | 97 | 62 | 159 |
| Group meetings | 13 | 39 | 26 | 65 | - | - | - | 39 | 26 | 65 |
| Lectures delivered as resource persons | 27 | 259 | 291 | 550 | - | - | - | 259 | 291 | 550 |
| Newspaper coverage | 15 | Published in Daily Telegram, News Paper, P. Blair | | | | | | | | |
| Radio talks | 06 | Broadcasted in All India Radio, Port Blair | | | | | | | | |
| TV talks | 01 | Telecasted in Doordarshan, Port Blair | | | | | | | | |
| Extension Literature | 07 | 276 | 118 | 394 | - | - | - | 276 | 118 | 394 |
| Advisory Services | 26 | 33 | 28 | 61 | - | - | - | 33 | 28 | 61 |
| Scientific visit to farmers field | 216 | 323 | 278 | 601 | - | - | - | 323 | 278 | 601 |
| Farmers visit to KVK | 156 | 546 | 95 | 641 | - | - | - | 546 | 95 | 641 |
| Diagnostic visits | 58 | 24 | 48 | 72 | - | - | - | 24 | 48 | 72 |
| Self Help Group Conveners meetings | 03 | - | 27 | 27 | - | - | - | - | 27 | 27 |

## Linkages & collaboration with other departments:

KVK has developed effective linkages with the development departments of A & N Administration and other organization. Summary of linkages and collaboration is given in Table 10.

**Table 10: Summary of linkages and collaboration**

| Name of organization | Nature of linkage |
|---|---|
| Department of Agriculture, A & N Administration | Training , supply of seedlings and field visits |
| Department of AH & VS, A & N Administration | Training , Inputs distribution and field visits |
| Department of Fisheries, A & N Administration | Training , seed production and fingerling distribution , kisan gosti. |
| A & N Cooperative Bank, | SHG Promotion & financial assistance and small entrepreneurship development |
| NABARD, Port Blair | Formation of Projects, SHGs & farmers club |
| NFDB, Hyderabad | Training to the farmers and extension workers |
| ATMA | Demonstration of pro ven technologies through FLDs and construction of poly house for demonstration |
| Coconut Development Board | Training and field advisory services. |
| CIPMC, Port Blair | IPM Management |
| NCUI, Port Blair | Training and field advisory |
| SACON, Coimbatore | Training to the students |
| NGOs [Hope foundation, APRAJITA, WBVHAI] | Training |
| Media (Press, DDK and AIR) | Coverage, publicity and broadcasting of activities/ demonstrations. |

Pot mixture preparation

Preparation of plant extracts

Practical training on medication

Integrated Fish Farming

## Krishi Vigyan Kendra, Nicobar

This KVK was sanctioned on 20th May, 2010 for Nicobar District by ICAR, New Delhi. The foundation stone was laid on 13th September, 2010 by Dr. S. Ayyappan, Secretary, Department of Agriculture, Research and Education (DARE), Ministry of Agriculture, GOI and Director General, ICAR, New Delhi at Arong village in presence of dignitaries viz. Shri Vivek Rae, Chief Secretary, A&N Admn., Dr. H.P. Singh, DDG (Horticulture), Dr. K.D. Kokate, DDG (Agril. Extension), ICAR, Dr. R. C. Srivastava, Director, CARI, Dr. A.K. Singh, ZPD, Zone-II, Kolkata, Dr. S.K. Zamir Ahmed, Senior Scientist & Administrative Head, KVK, Nicobar, Shri. Aberdeen Blair ,Chairman, Tribal Council and large gathering of Development Department officials, Village Captains and farmers representing 15 villages of Car Nicobar.

The location of Krishi Vigyan Kendra is in Nicobar District which is tribal area having majority of the area under coconut plantation and agri-horticulture based cropping system practiced in traditional way. The KVK aims to transfer agriculture and allied technologies through training, conducting front line demonstration and on farm trials for its adoption by the stakeholders. During the period the following activities were performed.

- Rapid Rural Appraisal at Campbell Bay to assess technological backstopping and training needs of the stakeholders.
- Exposure visit of farmers representing Nicobar Islands to Kisan Mela at CARI, Port Blair from 2nd-3rd February, 2011.
- Participation in Kisan Mela at Car Nicobar and Scientist Farmers Interaction under Coconut Mission from 21st - 23rd February, 2011.
- Induction training for newly recruited SMS & PA of Krishi Vigyan Kendra, Nicobar from 5th to 30th March, 2011.
- Visit of SMS / PA to Car Nicobar for familiarization with socio-economic conditions of tribal and interaction with officials of development departments and tribal council was done from 9th to 14th March, 2011.
- Exposure to TIECON - 2011 at CARI, Port Blair from 23rd to 26th March, 2011

Dr. S. Ayyappan, Secretary DARE & DG, ICAR alongwith other dignitaries at Arong for the inauguration.

Director, CARI briefs Dr. S. Ayyappan, Secretary DARE & DG, ICAR about the proposed Techno Park at Arong.

KVK staff interacting with Captain of the Village

Director CARI along with EO, AC Nicobar & Admin. Head at Arong Site.



## TECHNOLOGIES ASSESSED AND TRANSFERRED

- Pond based integrated farming system (IFS) in 14 farmers fields of South Andaman, Little Andaman and Neil Island
- Crop diversification through broad bed and furrow (BBF) based farming system in 12 farmers in the low lying areas of South Andaman and Little Andaman Island
- Micro-irrigation *viz.,* drip and sprinkler system in 12 farmer's fields in South Andaman, Little Andaman, Neil and Havelock Island
- Crop diversification and intensification through land shaping and water management activities viz. broad bed and furrow system, paddy-fish system, three-tier farming system and farm pond based farming system transferred to the farmers of degraded land and water areas in Chouldari, Shoal Bay, Dashrathpur and Deshbandhugram clusters
- Groundnut cultivation as intercrop in coconut plantation in hilly lands for seed purpose during wet season and table purpose during dry season
- Biomass fired copra dryer
- Mini dal mill to the farmers of Diglipur in North Andaman Islands
- Bacterial wilt resistant line of Brinjal, CARI-B1
- Non-chemical based IPM technology such as the use of pheromone traps and biopesticides to the farmers for pest management in vegetable crops
- Production of breeder seed of rice (568 kg), green gram (12 kg), Black gram (8 kg) and sesame (0.5 kg) was produced
- Sustainable Pig Production Technology – from Production to Consumer level
- Potential fishing zone advisory-based fishing for improving net income of fishers

# INFORMATION ON OTHER SECTIONS

### *Library*

Library of the institute acts as a centre for literature and information related to the mandate of the institute. It has the facilities for on and off line information retrieval, networking, automation computers , extensive collection of resource material in agriculture and allied fields, special collection of island related books and publication along with reprographic facility which has given it a prime importance in these islands. The current holdings of the library consists of 5627 books, 5616

miscellaneous publications, 2455 bound volumes of journals and 9565 loose issues of journals. A total of 21 Foreign and 81 Indian journals were subscribed and 183 books added during the year. Gratis publications such as Annual Report, Newsletter and Research Bulletin received from India and Foreign Institutes as exchange relationship is also maintained which serves to fulfill the need of the scientists/ research workers of CARI as well as of other local research and educational institute. It also has the completed series of CAB, AGRICOLA, AGRIS, CD-ROM databases for retrieving the information through off line for the use of the scientists.

### Prioritization, Monitoring and Evaluation Cell

Prioritization, Monitoring and Evaluation Cell (PME Cell) serves as a vital link between the Institute, Council (ICAR), Government, Semi-Government, NGOs, other R & D organization and A & N Administration in addition to providing information on various research, development, extension and human resource development activities to these agencies. The cell has co-ordinated the conduct of the Institute Research Committee meeting (IRC) from 17th, 18th, 19th, 20th and 28th August, 2010 wherein a total of fifty six ongoing projects, sixteen new projects and twenty eight external funded totaling to hundred were presented followed by feedback

wherein the house opined that the conduct of IRC in a participatory mode was very helpful as every scientists could get enough time and opportunity to present their research finding. Results' Frame Work Document (RFD) of Institute for the period from January to March, 2011 was also complied and send to ICAR HQ.

Beside compilation of institute reports, it also facilitates publishing of research articles, technical bulletins, folders, books, newsletter, farmer's data base, proceedings of the workshop, symposium and seminars and coordinates to showcase the activities and achievement of the institute both at Island and National level. Presently the cell has a repository of 52 RPFs of the Institute funded project along with the Annual Report, bulletins, folders, books and other related publication for ready reference.



## Computer Cell / ARIS Cell

The Agricultural Research Information System (ARIS) envisages providing online interconnectivity between the different research institutes, National Centres and SAU's.

### Activities Undertaken

- Installed and trained SAS software to all the Scientists and Technical Officers.
- R-governance office automation software was implemented for KVK, Sippighat and Nicobar.
- Providing Internet and e-mail connectivity to all Scientists, Officers of CARI & KVK.
- Maintenance of VSAT of 512 Kbps for browsing and downloading information.
- Web page creation, updation and maintenance.
- Computer upkeep, purchase of computers, softwares, cartridges and its maintenance.
- Data compilation and statistical analysis.
- Providing visual aids for different programmes.
- Maintenance of networking, DAMA VSAT.
- Individual email Ids for KVK, Nicobar staff created in Mail Server.
- PERMISNET - Personal Management Information System Network- (Monthly and quarterly updating of personal records of all the staff of CARI has been carried out through online).
- Intelligent Reporting System – Quarterly updating of data and uploading.
- Procurement and installation of personal computers and other accessories of the Institute.
- Downloading the circulars and other information from ICAR website.

### Website Updated

- Institute bilingual website is updated regularly.
- Updating of the CARI website (http://cari.res.in) was done regularly by publishing the latest Institute progress in terms of research, technologies developed, tender notifications, recruitment notifications and other information.

### Database developed / Updated

- Cartridge maintenance.
- Intelligent Reporting System updated.
- PERMISnet biodata of staff updated.
- R-Governance modification and updated.
- Playbill preparation in R-governance.
- Issued individual User Ids for the new entrants of CARI and KVK's.

### Training Conducted

- On Data analysis using SAS of the NAIP consortium Strengthening Statistical Computing for NARS funded by NAIP organized by CCPI, DWM, Bhubaneshwar at CARI , Port Blair from 1st – 7th March 2011.
- On R-governance in two batches i.e. from 3rd to 8th April 2010 for 14 administrative staff , and on 9th April 2010 for Scientists and Technical Officers wherein 25 participated .

## Estate Section

The estate, workshop and instrumentation centre takes up works related to infrastructure development of the institute to support its research activities. It also takes up repairs and maintenance of residential and non-residential buildings of the Institute. The power supply plays an important role for laboratory research works. A 320 KVA Generator set is kept as stand by for restoration of power supply during power cuts and exigency. The water supply system to residential & non-residential buildings is operated by the section which also ensures water supply during dry spells through pumping from wells, ponds, reservoirs to residential, non-residential, experimental blocks, livestock and plantation crops.

### Infrastructure Development

An amount of Rs 51.18 lakhs under plan and non-plan has been spent for development of new infrastructures, repairs and maintenance of the residential and non residential buildings. A poultry and duck shed at Sippighat farm were constructed

as part of mangrove based farming system. Five old poly houses and the tissue culture room in Central laboratory building were put under research activity after its renovation. The Committee room, Conference Hall and the Computer cell were decorated internally to the national standards with all facilities. The lawn near the Guest House was decorated by installing decorative light luminar and laying outdoor tiles on the approaches around the lawn area. The entrance and zero point were made attractive to the staff member and outsiders by providing fountains. The old library building and the scooter shed were modified for construction of stall for display of poster and charts etc. during the International Conference "TIECON – 2011". This year 20 nos. of stall for displaying exhibits were constructed including a big pandal and a stage for the Island Kisan Mela – 2011. The section also acts as the liasioning agency for the works executed by CPWD, Port Blair and electricity department of A & N Administration.

### Workshop

Re-scheduling of school trips, arrangement and management of vehicles during major events of the Institute was done. The works related to routine and major repairs of Staff car, Jeep and staff/school bus were also completed in stipulated time.

### Instrumentation Cell

Repairs and maintenance of scientific equipments and providing uninterrupted power supply during important meetings and functions of the Institute was done.

### RTI, ITMU, Rajbhasha Implementation Cell (RIRIC)

CARI bagged the prestigious Rajarshi Purushottam Das Tandon Award of ICAR, for use of Hindi in official work. CARI was also adjudged as Best Institute to Implement Rajbhasha in an effective manner by Rajbhasha Sansthan, New Delhi. In addition the Director of the Institute was nominated as Chairman, TOLIC by Department of Official Language, Ministry of Home Affairs, Government of India, New Delhi and under his chairmanship the sixty sixth half yearly meeting of Town Official Language Implementation Committee was held on 15th December 2010 which was attended by 35 member offices situated in Port Blair.

During the period a total of nine applications were received under RTI which were addressed well in time. No appeal was received against the reply provided by CPIO.

Participated and showcased technologies developed by CARI scientists for fisheries sector in Entrepreneurs Meet organised by Zonal Technology Management Business Planning and Development Unit, NAIP Component - I on 18th June 2010 at NIRJAFT, Kolkata and Innovations and Industry Meet on Fisheries organized by Zonal Technology Management Business Planning and Development Unit, South Zone and CIFT, Kochi on 8th September 2010 at Vishakhapattanam.

Hindi Chetna Maas was celebrated w.e.f. 13th September 2010 to 12th October 2010 wherein six

competitions were organised in which both Hindi and Non Hindi speaking officials participated with great enthusiasm. As a part of Hindi Chetna Maas, Hindi workshop was organised on 29th September 2010 on the topic "Hindi Ke Vikas Me Ahindi Bhashiyon Ka Yogdan" in collaboration with Swatantrata Sangram Senani Vanshaj Samiti, Port Blair. Besides this a Vaigyanik Sangoshthi was also organised on 6th October 2010 in collaboration with CMS Vatavaran Chennai. During the concluding function Mrs. Shibani Sen Gupta was awarded a cash of Rs. 800/- for using Rajbhasha in day to day official works.

## Registration of the germplasm

Hindi workshop organised at CARI, Port Blair

- National Identity has been allotted to a germplasm of Annona glabra as IC No.-547015 by NBPGR, New Delhi.
- A total of 24 potential bacterial and fungal cultures have been deposited in culture collection centre at National Bureau of Agriculturally Important Microorganisms, Mau, U.P

## Post Graduate Students Cell

PG Cell has been established to facilitate the post graduate research work undertaken at CARI in collaboration with the other research Institutes. During the last year a total of 23 students registered for undertaking M.Sc dissertation and 8 students for summer training at CARI. To provide the comforting environment to the students, hostel facilities for boys and girls students have been created with cots, mattress etc. The registration fee has been marginally increased to Rs. 1500 per students.

A MoU has been established with the PRIST University, Thanjavur, Tamil Nadu for undertaking Ph.D. research work at CARI with the following features viz:

1. PRIST University will recognize the faculty of CARI as research supervisors/guides as per the university norms so as to enable the research scholars, technical officers and scientists to register for M.Sc./M.Tech./M.Phil./PhD with PRIST University and pursue research at CARI.
2. PRIST will accord priority in admission with 50% concession to the wards of CARI Staff for pursuing UG and PG programmes.

The scientists of CARI have been recognized as research supervisor by the PRIST University. During this year a total of 30 students have applied for Ph.D registration. Based on the written examination and the personal interview, finally 25 students have been recommended by the University to undergo Ph.D registration. For smooth functioning of the PG cell, the In charge PG cell has been nominated as Co-ordinator PG cell and two Co-Coordinators have been nominated to look after the activities of PRIST University and Bharathidasan University.

## Students guided by Scientists for dissertation

| Name of the student | Degree/ Courses | Duration (Months) | Title of the project work | College/ University |
|---|---|---|---|---|
| **Dr. Jai Sunder** | | | | |
| Sakthi Vel R. | M.Sc. (Biotech) | $4^{1/2}$ | Biochemical and genetic diversity analysis of gut microbes of cattle and goat | St. Joseph College, Mahabalipuram, Tamil Nadu |
| G. Prakash | M.Sc. (Biotech) | 4 | Isolation, identification and characterization of enteric microflora of cattle and goat | NGM College, Pollachi, Tamil Nadu |
| S.Gayathri | B.tech ( Biotech) | 4 | Isolation, identification and characterization of lactic acid bacteria for its antibacterial activity | Kalasalingam University, Krishnakoil, Tamil Nadu |
| K.Jinsha | M.Sc. (Biotech) | 4 | Isolation, identification and characterization of aflatoxin producing *Aspergillus* spp and its pathogenecity in ducklings | Kannur University, Kannur, Tamil Nadu |
| Miranda Das | M.Sc. (Biotech) | 2 | *In-vitro* antibacterial activity of *Morinda citrifolia* extracts | Madras University, Chennai, Tamil Nadu |
| **Dr. Krishna Kumar** | | | | |
| Suresh Babu | M.Phil | 5 | Isolation and characterization of stress tolerant, antagonistic and plant growth promoting bacteria from active volcano of Barren island soils | Bharthidasan University, Trichy, Tamil Nadu |
| **Dr. M. Balakrishnan** | | | | |
| A. Aruna | M.Sc. Bioinformatics | 3 | Determination of helix stability and hydrophobicity in folding mechanism of chitinase protein in the plant "*Brassica Juncea*" | Rama Krishna College of Arts and Science for Women, Coimbatore, Tamil Nadu |
| J. Sangeetha | M.Sc. Bioinformatics | 3 | In-silico structural and functional analysis of selected protein conserved domains in marine sponges (*Ircinia Strobilina*) | Rama Krishna College of Arts and Science for Women, Coimbatore, Tamil Nadu |
| **Dr. M. Sankaran** | | | | |
| P.Chandrasekhar | M.Sc. (Biotech) | 4 | Genetic diversity analysis in Arecanut (*Areca catechu L.*) by using RAPD and ISSR DNA markers | Bharthidasan University, Trichy, Tamil Nadu |
| S. Rajaperumal | M.Sc. (Biotech) | 4 | Genetic diversity analysis in *Amorphophallus* sp. by using RAPD and ISSR DNA markers | Bharthidasan University, Trichy, Tamil Nadu |
| S. Suresh | M.Sc. (Biotech) | 4 | Genetic diversity analysis in *Dioscorea* sp. by using RAPD and ISSR DNA markers | Bharthidasan University, Trichy, Tamil Nadu |
| N.Pandiyaraj | M.Sc. (Biotech) | 4 | Genetic diversity analysis in coconut by using SSR and ISSR DNA markers | Bharthidasan University, Trichy, Tamil Nadu |
| V. Anbananthan | M.Sc. (Biotech) | 4 | Assessing the molecular diversity in coconut by using RAPD markers | St. Joseph College, Mahabalipuram, Tamil Nadu |



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|---|---|---|---|---|
| **Dr. D.R.Singh** | | | | |
| T.K.Fathima Faseela | M.Sc. (Biotech) | 4 | Genetic diversity analysis of Taro (*colocasia esculenta*(L)Schott) collection from A & N islands Using RAPD and ISSR DNA markers | Kannur University, Kannur, Tamil Nadu |
| Bhushan V. Mahure | M.Sc. (Biotech) | 4 | Molecular characterization of superior clones of Noni (*Morinda citrifolia*) from Andaman Islands using RAPD and ISSR DNA markers | Bharthidasan University, Trichy, Tamil Nadu |
| **Dr. Kirubasankar** | | | | |
| S. Rajesh | M.Sc. (Marine Science) | 6 | Length weight relationship and catch effort analysis of commercially important perches of Andaman | Bharthidasan University, Trichy, Tamil Nadu |
| **Dr. Shrawan Singh** | | | | |
| R.Balaji | M.Sc. (Biotech) | 4 | Combined studies on Molecular, Biochemical and morphological markers for diversity analysis of *Capsicum annum* L. | NGM College, Pollachi, Tamil Nadu |

**Students guided by Scientists for summer training**

| Name of the student | Degree/ Courses | Duration (Months) | Title of the project work | College/ University |
|---|---|---|---|---|
| **Dr. Jai Sunder** | | | | |
| Sonam Murthy | B.tech (Biotech) | 1 | Molecular biology techniques | SRM university, katankulathur, Tamil Nadu |
| Ajeetha Bibi | M.Sc. (Biotech) | 1 | Isolation, identification and characterization of pathogenic microorganism from poultry | Bharathidasan University, Trichy, Tamil Nadu |
| **Dr. S. Jeyakumar** | | | | |
| A. Anantharaj | M.Sc. Biochemistry | 1 | Immunomodulatory and antioxidant properties of *Morinda citrifolia* in calves | Bharathidasan University, Trichy, Tamil Nadu |
| M.M.Sathya | M.Sc. Genomics | 1 | Antioxidant and blood chemical properties of *Morinda citrifolia* feeding in goat | Madurai Kamraj University, Madurai, Tamil Nadu |
| **Dr. Arun De** | | | | |
| V. Shajeeda Banu | M.Sc. Biotechnology | 1 | Molecular characterization of indigenous goats of A & N Islands using microsatellite markers. | Vels University, Pallavaram, Tamil Nadu |
| P.R.Versha | M.Sc. Biochemistry | 1 | Molecular characterization of Teresa goat of A & N Islands using microsatellite markers. | Bharathidasan University, Trichy, Tamil Nadu |
| V. Sudha Devi | B.Sc. Biotechnology | 1 | Molecular characterization of Teresa goat of A & N Islands using microsatellite markers. | Acharya Bangalore B-School, Bangalore, Karnataka |

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|---|---|---|---|---|
| **Dr. Krishna Kumar** | | | | |
| Sneha Sawhney | B.Sc. Biotechnology | 1 | Morphological and molecular characterization of *Trichoderma* isolated from Middle and North Andaman | Capital College, Bangalore, Karnataka |
| **Dr. M. Sankaran** | | | | |
| S. Arun Kumar | M.Sc. (Biotech) | 3 | Molecular biology techniques | SRM University, Katankulathur, Tamil Nadu |

## Celebration of Independence and Republic Day

Independence Day and Republic Day were celebrated in the institute with joviality and fervour. Dr. R.C.Srivastava, Director, CARI hoisted the National flag, thereafter; he appreciated the hard work and dedication of all the staff members in accomplishing new heights in the research, development and extension activities. Just after the flag hoisting ceremony, prizes were distributed to the winners of Annual Sports of the Institute. Various functions like quiz, drawing competition for children's and fun games for ladies were arranged in the forenoon. In the evening children's of CARI family presented a colourful cultural programme.

During the Republic day celebration Director CARI, unfurled the National flag at CARI. During his address he appreciated the staff members for their valuable contribution towards the research and development of the institute in the last one year. On the eve, he awarded the best staff for their extraordinary contribution and devotion to their duties. Just after the flag unfurling ceremony variety programmes were conducted by the staff and children.

## Games and Sports

The annual sport of this institute was held on 8th April 2010. Like every year all the staff members of the different houses participated in large numbers. Various indoor, outdoor, and athletic events were conducted for the staff, their family members and children. The house championship was won by Kurien House, while Bose house, Menon house and Bhabha house stood 2nd 3rd and 4th respectively. Shri A. Babuswamy of the Kurien house was declared as the Best Athlete for the year 2010-2011. The prize distribution of the annual sports was held during the Independence Day celebration. Our Institute also participated in the Annual sports organised by the Central Government Employee Welfare Coordination Committee (CGEWCC). For the sixth year in succession our institute won maximum prizes in all the indoor, outdoor, and athletic events and stood first amongst all the other Central Govt. Institution in the A & N Islands. The facilities for indoor sports like TT, multi gym have been developed for staff and family members. All the instruments are in good working condition and a logbook has been maintained for its proper use.

## CARIEWA

During the period the following activities were conducted

- Holding of farewell of transferred / superannuating staff members and Welcoming new staff members joining CARI and KVK's.
- Yoga programme of two months duration was organized for staff and their family members.
- CARI Best Worker Award 2010 was given to 08(eight) staff members of the Institute.
- Theatre workshop on "Aberdeen Ki Ladai by the the children of the staff directed by Shri. Phalguni Gangopadhyay Ex-Librarian" was staged during ITF 2011 and won cash award.

# AWARDS AND RECOGNITION

| Scientist | Award / Recognition | Awarding Agency/ Organization Society |
|---|---|---|
| Veena Kumari, Prashant Mohanraj, R.C.Srivastava, S.K. Verma | Dr. Rajendra Prasad Puruskar Award for Technical Books in Hindi | ICAR New Delhi on 16th July, 2010 in the Field of Agriculture and Allied Sciences on the book entitled "Andaman Nicobar Dweep Samooh Ki Titliyan. |
| D.R.Singh | Best Oral & Poster Presentation Award | World Noni Congress 2010, Chennai from 1st - 3rd October, 2010. |
| Ajanta Birah | Certificate of Appreciation | CMS Vatavaran and Society for Andaman and Nicobar Ecology on 4th October, 2010. |
| S.K. Verma | Best Paper Presentation Award | Rajbhasha Sansthan, New Delhi from 27th - 29th October, 2010 at Dalhousie, Himachal Pradesh. |
| D.R.Singh, Ajanta Birah, S. Jeyakumar, M. Balakrishnan, M.Sankaran, S.K.Zamir Ahmed, P.Krishnan, Krishna Kumar, Jai Sunder, A.Kundu, M.S.Kundu, N.Ravisankar, Kamal Sarma, Subhash Chand, Ajmer Singh | Recognition as Ph.D guide | PRIST University, Thanjavur, Tamil Nadu on 25th January, 2011. |
| Krishna Kumar | SPPS Meritorious Award-2011 | In recognition of his contribution in plant pathology by Society of Plant Protection Sciences, New Delhi on 17th February, 2011. |
| Ajanta Birah | 1st Best Poster Award | International Conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable development and climate change held at CARI, Port Blair from 23rd – 26th March, 2011. |
| P.K.Singh , Krishna Kumar, Ajanta Birah, R.K. Gautam and Naresh Kumar | 3rd Best Poster Award | International Conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable development and climate change held at CARI, Port Blair from 23rd – 26th March, 2011. |
| Kamal Sarma & P. Krishnan | 2nd Best Poster Award | International Conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable development and climate change held at CARI, Port Blair from 23rd – 26th March, 2011. |



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|---|---|---|
| N. Ravisankar, A. Velmurugan, T. Subramani, S.K. Ambast and R.C. Srivastava | Best Poster Presentation Award | International Conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable develop ment and climate change held at CARI, Port Blair from 23rd – 26th March, 2011. |
| S.K. Ambast | Fellow | Indian Society of Coastal Agricultural Research, 2010. |
| P. Krishnan | Dr. Karunasagar Best PG Thesis (PhD -Indian Category) Award | Professional Fisheries Graduates Forum, Mumbai. |
| P. Krishnan | Best Young Scientist Award - 2010 | Hiralal Chaudhari Foundation, CIFE for the outstanding works done in documenting biodiversity and efforts for conservation of bio-resources of Andaman. |
| Fisheries Science Division | Best Stall Award | Island Kisan Mela from 2nd-3rd February, 2011. |

# ON GOING RESEARCH PROJECTS 2010-11

## External Funded

| Project Title | Principal Investigator | Budget (lakhs) | Date of Start/ Completion | |
|---|---|---|---|---|
| **NBAIM - ICAR** | | | | |
| Application of micro-organisms in agriculture and allied sectors- microbial diversity and identification | Dr. Krishna Kumar | 34.85 | 2006 | 2012 |
| **NMPB, New Delhi** | | | | |
| Technological innovations for commercial exploitation of *Morinda citrifolia* as livelihood option for island farmers | Dr. D.R. Singh | 246.00 | 2008 | 2011 |
| **MoWR, New Delhi** | | | | |
| Farmers participatory action research programme-phase I | Dr. R.C. Srivastava / Dr. S.K. Ambast | 24.00 | 2008 | 2010 |
| **NAIP, World Bank -GEF, ICAR, New Delhi** | | | | |
| Strategies for sustainable management of degraded coastal, land and water for enhancing livelihood security of farming communities | Dr. S.K. Ambast | 206.00 | 2009 | 2013 |
| **Space Application Centre, ISRO, Ahmedabad** | | | | |
| Energy and mass exchange in vegetative systems | Dr. S.K. Ambast / Dr. A. Velmurugan | 12.00 | 2010 | 2012 |
| **ICAR, New Delhi** | | | | |
| All India network project on rodent control. | Dr. Ajanta Birah | 8.31 | 2009 | 2012 |
| ICAR mega seed project | Dr. P. K. Singh | 39.72 | 2007 | 2012 |
| National net work project on underutilized fruits | Dr. D.R. Singh | 18.82 | 2008 | 2011 |
| National initiative on climate resilient agriculture | Dr. Nagesh Ram | 31.35 | 2011 | 2013 |
| **DBT – New Delhi** | | | | |
| Development of Mangrove-based fin/shellfish culture for livelihood restoration through employment generation in Andaman | Dr. P. Krishnan | 36.00 | 2008 | 2011 |
| Cataloguing and conservation of marine sponges of Andaman through DNA barcoding | Dr. P. Krishnan | 33.82 | 2010 | 2013 |
| Establishment of sub distributed information system | Dr. M. Balakrishnan | 86.00 | 2005 | 2012 |
| **Coconut Development Board** | | | | |
| Production of disease-free elite planting material for improving the productivity of Coconut in Bay Islands | Dr. Krishna Kumar | 18.29 | 2010 | 2013 |
| Monitoring and surveillance of infestation of pest and disease of coconut in Andaman and Nicobar Islands | Dr. Ajanta Birah | 7.01 | 2010 | 2012 |

| | | | | |
|---|---|---|---|---|
| **SAC, Ahmadabad** | | | | |
| Optical characterization of coral reef diversity | Dr. P. Krishnan | 10.55 | 2010 | 2013 |
| **WNRF, Chennai** | | | | |
| Collection, conservation, characterization and identification of superior clones of *Morinda citrifolia* | Dr. D.R. Singh | 9.54 | 2008 | 2011 |
| **INCOIS, Hyderabad** | | | | |
| Potential fishing validation in Andaman sea | Mr. Grinson George | 37.00 | 2008 | 2012 |
| **NOVOD** | | | | |
| Germplasm collection, evaluation and identification of high yielding genotypes of Jatropha and Karanj and their multiplication in Bay Islands | Mr. I.Jaisankar | 20.00 | 2008 | 2011 |
| **A & N Administration** | | | | |
| Development and efficient utilization of water resources in the micro watershed of sona nala | Dr. R.C. Srivastava | 69.00 | 2011 | 2013 |
| **Department of Science and Technology( Women Scientist Scheme)** | | | | |
| Enhancement and sustainable dairy farming through reproductive health care | Dr. Kuntola Roy / Dr. S. Jeyakumar | 13.68 | 2009 | 2012 |
| Isolation, Identification and characterization of Marine Actinomycetes from Andaman Coasts | Mrs. Sumitha Gopalakrishnan / Dr. Jai Sunder | 8.50 | 2009 | 2012 |
| **NABARD, Port Blair** | | | | |
| Establishment of Out Reach Centre at Diglipur, North & Middle Andaman district | Dr. R.C. Srivastava/ Dr. S.K. Zamir Ahmed | 79.696 | 2009 | 2013 |
| **PDFSR, Modipuram (ICAR)** | | | | |
| AICRP on integrated farming system | Dr. R.C. Srivastava/ Dr. N. Ravisankar | 85.06 | 2010 | 2012 |
| **Ministry of Water Resources** | | | | |
| Farmers participatory action research programme - II$^{nd}$ Phase | Dr. T. Subramani | 50.00 | 2011 | 2012 |
| **CSS-NHM** | | | | |
| Centrally sponsored scheme for integrated development of Spices | Mr. I. Jaisankar | 13.00 | 2004 | Continued |
| **MoES, New Delhi** | | | | |
| Integrated agromet advisory services | Dr. R.C. Srivastava / Dr. S.K. Ambast | 60.00 | 2007 | 2012 |

## Institute Funded

| Project Title | Principal Investigator |
|---|---|
| **Natural Resource Management** | |
| Development on fresh and brackish water based integrated farming system (IFS) in Bay Islands | Dr. R. C. Srivastava |
| Development of the design criteria for gravity fed drip irrigation system and its evaluation for plantation crop | |
| Planning, augmentation and efficient utilization of water resources in *Kajunallah* watershed | Dr. S.K. Ambast |
| Dynamics of salt-water-nutrient in Broad Bed and Furrow system | |
| Improved crop planning for minimizing production losses in low lying areas during dry season | Dr. N. Ravisankar |
| Effect of vermicompost on nutrient dynamics and yield of vegetable crop | Dr. A. Velmurugan |
| Effect of nutrient levels and irrigation on areca nut yield and soil fertility | |
| Assessing the impact of pesticide use on soil and water resources in intensive vegetable growing areas of Andaman Islands | Dr. T.P. Swarnam |
| Application of organic amendments for managing the acid soils of Andaman | |
| Water and nutrient management in capsicum through drip system under protected cultivation | Dr. T. Subramani |
| Post harvest management of rice and pulses in the Islands | Dr. Sachidananda Swain |
| Post harvest management and value addition of spices in the Island | |
| **Horticulture & Forestry** | |
| Improvement of Coconut | Dr. M. Sankaran |
| AICRP on Tuber crops | |
| Standardization of agro technique for organic black pepper cultivation in A&N Islands | Mr. I.Jaisankar |
| Identification, evaluation and development of Silvipastoral system for Bay Island condition | |
| All India Coordinated Research Project (Vegetables crops) | Dr. Shrawan Singh |
| Standardization of technologies for protected cultivation of vegetables crops in Andaman & Nicobar Islands | |
| Collection, conservation, evaluation and utilization of indigenous vegetables from Andaman & Nicobar Islands | |
| Physiochemical and molecular characterization of multiple and single season flowering genotypes of mango | Mr. Dipak Nayak |
| Standardization of technologies for production of quality flowers under Island ecosystem | |
| **Field Crops** | |
| Standardization of production and protection technology of tropical mushrooms. | Dr. Krishna Kumar |
| Development of eco-friendly IPM modules for okra and cucurbits in Andaman | Dr. Ajanta Birah |
| Genetic improvement of long duration rice for Andaman and Nicobar Islands | Dr. P.K. Singh |
| Molecular tagging of biotic stress resistance in rice (*Oryza sativa*) | Dr. Naresh Kumar |
| Development of biotic stress resistant lines in brinjal (*Solanum melongena* L.) | |
| **Animal Science** | |
| Improvement of Nicobari Fowl for meat and egg | Dr. A. Kundu |



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|---|---|
| Potential of *Morinda citrifolia* fruit as feed for livestock and poultry | Dr. Jai Sunder |
| Development of therapeutics & supplements by using indigenous herbs and beneficial microorganisms for livestock health and production | |
| Characterization of livestock production sub system and assessment of critical nutritional gap in Bay Islands | Dr. S. K. Verma |
| Determination of carrying capacity ofIslands and its potential for organic farming | |
| Feasibility evaluation of growing fodder during pre paddy and post paddy period under rainfed conditions | |
| Productivity enhancement of goats in Bay Islands | Dr. S. Jeyakumar |
| Augmentation of production in cattle and buffaloes through reproductive health management techniques | |
| Molecular characterization of indigenous pigs of Bay Island by microsatellite markers | Dr. Arun Kumar De |
| **Fisheries Science** | |
| Brood stock development and breeding of damsel fishes | Mr. Grinson George |
| Temporal and spatial variability o f water quality parameters and mineral profile of waters of Andaman and their impacton shell fishes and fin fishes | Dr. Kamal Sarma |
| Evaluation of pond lining for pisciculture in saline acidic soils of Andaman | |
| Stock assessment of grouper and snapper | Dr. S. Dam Roy |
| Characterization of the role of associated bacteria in the bioactivity of marine sponges from Andaman | Dr. P. Krishnan |
| Assessment of threats due to climate change in Nicobar group of Islands and development of adaptation strategies | |
| **Social Science Section** | |
| An Economic Analysis of floriculture and vegetable potential in Andaman and Nicobar Islands | Dr. Subhash Chand |
| Economic valuation of mangroves in Andaman and Nicobar Islands | |
| Market and export potential analysis of marine fishery resources in Andaman and Nicobar Islands | |
| Potential and prospects of Campbell bay being production hub to meet requirements of PDS (rice) and perishable foods of Nicobar | Dr. Ajmer Singh |
| Demand and supply analysis of livestock products in Andamans | |
| Impact assessment of technological interventions in Andaman | Dr. S.K. Zamir Ahmed |
| Development of database on biodiversity of horticultural crops in Andaman & Nicobar Islands | Dr. M.Balakrishnan |
| Development of interactive digital database on reef biodiversity in Andaman & Nicobar Islands | |

# PUBLICATION

## Research Article


Ahmad. I, Someshwar Bhagat, T. V. R. S. Sharma, Krishna Kumar, P. Simhachalam and R. C. Srivastava (2010). ISSR and RAPD marker based DNA fingerprinting and diversity assessment of *Annona* spp. in South Andaman. *Indian J. of Horticulture*, 67(2): 147-151.

Ajanta Birah and R. C. Srivastava (2010). Growth-inhibitory effect of plant extracts against tobacco caterpillar (*Spodoptera litura*) in Bay Islands. *Indian J. of Entomology.* 72 (2): 112-115.

Ajanta Birah, D. R. Singh and R. C. Srivastava (2010). Growth-inhibitory effect of *Morinda citrifolia* against tobacco caterpillar (*Spodoptera litura*). *Insect Environment*, 16 (1): 15-17.

Ajanta Birah, Krishna Kumar, Someshwar Bhagat, P. K. Singh and R. C. Srivastava (2010). Evaluation of Pest Management Modules against Okra Shoot and Fruit Borer *Earias vittella* (Fabricius) in Andaman. *Annals of Plant Protection Sciences*, 18(1):53-55.

Ajanta Birah, Someshwar Bhagat, A. K. Tripathi and R. C. Srivastava (2010). Impact of pest management modules against pollu beetle, *Longitarsus nigripennis* M. in Black pepper in Bay Islands. *Indian Journal of Entomology,* 72 (1): 41-44.

Ajanta Birah, T.V.R.S. Sharma, Shrawan Singh and R. C. Srivastava (2010). Effect of aqueous leaf extract of cloves (*Syzygium aromaticum*) on growth and development of tobacco caterpillar (*Spodoptera litura*). *Indian Journal of Agricultural Sciences*, 80(6): 534-537.

Akshey, Y.S., Malakar, D., De A.K., Jena M.K., Pawar S.S., Dutta, R. and Sahu, S. (2011). Effect of roscovitine treated donor cells and different activation methods on development of handmade cloned goat (*Capra hircus*) embryos. *Theriogenology*, 75: 1516–1524.

Akshey, Y.S., Malakar, D., De, A. K., Sahu, S., Garg, S., Pawar, S.S. and Dutta, R. (2010). Selection of developmentally competent oocytes using brilliant cresyl blue stain to promote blastocyst development after somatic cell nuclear transfer in goat. *Indian Journal of Dairy Science*, 63(3): 247-52.

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Akshey, Y.S., Malakar, D., De, A.K., Jena, M.K., Garg, S., Pawar, S.S and Mukesh, M. (2010). Hand-Made Cloned goat (*Capra hircus*) Embryos- A Comparison of Different Donor Cells and Culture Systems. *Cellular Reprogramming* (Formerly "Cloning and Stem Cells"), 12 (5):581-588.

Ambast, S.K., Srivastava, R.C., T. Subramani, Subash Chand and N. Ravisankar(2010). Design of drop spillway in undulated terraian for rainwater management in Kajunallah watershed of Andaman & Nicobar Islands. *Journal of Indian Society of Coastal Agricultural Research*, 28(2): 51-55.

A. Venkatesh, N C Choudhuri, A. Kundu and R.P. Medhi(2010). Introduction and evaluation of the performance of Japanese Quail- A new component of Home gardens in South Andaman. *Indian Journal of Agro-forestry*, 12(01):35-39.

Balakrishnan, M., R.Elanchezhian, R.C Srivastava and Mayank Pokhriyal (2010). Database for Medicinal Resources of Andaman and Nicobar Islands. *Journal of Medicinal and Aromatic plant Sciences*, 32(1):53-57.

Bobban Subhadra and Grinson George (2011). Algal biorefinery based industry: an approach to address fuel and food insecurity for a carbon-smart world. *Journal of the Science of Food and Agriculture*, 91: 2–13.



Bohra, A., A. Dubey, R. K. Saxena, R. P. Varma, K. N. Poornima, Naresh Kumar, A. D. Farmer, S. Gudipati, H. D. Upadhyaya, R. Gothalwal, S. Ramesh, D. Singh, K. Saxena, P. B. Kavi Kishor, N. K. Singh, C. D. Town, G. D. May, D. R. Cook and R. K. Varshney (2011). Analysis of BAC-end sequences (BESs) and development of BES-SSR markers for genetic mapping and hybrid purity assessment in pigeonpea (*Cajanus spp*.). *BMC Plant Biology*, 11:56.

Choudhuri, N.C., Paul G., Kundu, A., Kundu, M.S., Chatterjee, R.N and Chand, S. (2010). Training impact on poultry farmers of South Andaman Islands and comparative performance evaluation of pure and cross breeds of Nicobari fowl. *Livestock Research for Rural Development,* 23(02):155.

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De, A.K. and Malakar D. (2011). A simple method of production of interspecies embryos between sheep and goat. *The Indian Journal of Animal Sciences*, 81 (3): 254–256.

De, A.K., Malaka, D., Akshey, Y.S., Jena, M.K., Garg, S., Dutta, R. and Sahu, S. (2011). *In vitro* development of goat (*Capra hircus*) embryos following cysteamine supplementation of the *in vitro* maturation and *in vitro* culture media. *Small Ruminant Research*, 96: 185-190.

Garg, S., Malakar, D., Dutta, R., Jena, M.K., De, A.K., Kumar, D. and Sahu, S. (2010) Rhythmic beating of heart muscle generated from goat embryonic stem cells. *Reproduction, Fertility and Development*, 23(1): 249-249.

Gautam, R. K., A. K. Nayak, D. K. Sharma, Ali Qadar, P. Dey and Gurbachan Singh (2010) Morphological and chemical fingerprinting of sweet basil (*Ocimum basilicum* L.) genotypes grown in sodic soil. *Agrochimica*, 54 (5): 289-302.

Gautam, R. K., M. S. Chauhan, B. Panesar, A. K. Nayak, D. K. Sharma, A. Qadar and Gurbachan Singh (2011). Stress tolerance and heritability in dill (*Anethum graveolens* L.) lines from central and western India under contrasting soil sodicity environments. *Indian Journal of Agricultural Sciences*, 81(4): 353-358.

Islam, M.T., P. C. Sharma, R. K. Gautam, D. Singh, S. Singh, B. Panesar and S. Ali (2011). Salt tolerance in parental lines of rice hybrids through physiological attributes and molecular markers. *International Journal of Experimental Agriculture*, 2 (1): 1-7.

Jaisankar, I., V.Damodaran, D.R. Singh and R.Sudha (2010). Effect of time of pruning and peeling on the bark yield of (Cinnamon verum J.pres) in Andaman and Nicobar Islands. *Journal of Spices and Aromatic Crops*, 19 (1&2): 50-52.

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In addition to above 120 papers were presented in the Conference/ Symposium/ Workshop

# PEER RECOGNITION TO DIRECTOR, DR. R.C. SRIVASTAVA

## Award

Under the esteem leadership of Dr.R.C.Srivastava, Director, Central Agricultural Research Institute, Port Blair has been awarded **"Sardar Patel Best Institute Award"** by Indian Council of Agricultural Research for the year 2009, in recognition of work done by Institute in the last five years. In addition to this, the Institute has also bagged three more ICAR Awards this year: **Dr. Rajendra Prasad Award** for best technical book ***'Andaman Nicobar Ki Titaliyan'*** in Hindi; Rajarshi **Purushottam Das Tandon Award** for use of Hindi in official work and **Jagjivan Ram Puraskar** to Island farmer Mr. Manindra Mistry of Deshbandhu Gram, Diglipur for diversified Agriculture based on CARI technologies. Institute has also been awarded **Best Institute Award for implementation of Official Language** by Rajbhasha Sansthan, New Delhi.

● Elected fellow of National Academy of Agriculture Science, New Delhi



## Peer Recognition

- Adhyaksh, Town Official Language Implementation Committee
- Member, Programme Advisory & Monitoring Committee (PAMC) - Research Programme on Sea water Intrustion & Farming under WAR for Water Programme.
- Member, Executive Committee of Andaman & Nicobar Science & Technology Council
- Chairman, National Mission on Strategic Knowledge for Climate Change, Dept. Science & Technology, A&N Islands, Port Blair. Member, UT Coordination Committee, A&N Administration, Port Blair
- Member, Society of Science Centre, A&N Islands, Port Blair
- Member, State Level Environment Council, A&N Islands, Port Blair
- Member, Executive Committee of SOC, Andaman Nature Club, Port Blair
- Member, State Board for Wildlife , A&N Islands, Port Blair
- Member, Andaman & Nicobar Science & Technology Council, A&N Islands, Port Blair
- Member, State Level Sanction Committee for Rashtriya Krishi Vikas Yojana, A&N Islands
- Member, State Seed Sub-Committee for Agricultural & Horticultural crops, A&N Islands, Port Blair
- Member, State Level Watershed Development Committee under Watershed development Project for rainfed areas in A&N Islands.

- Member, Governing Council of Andaman & Nicobar Coconut Mission
- Member, Governing Council of High Value Agriculture Development Agency for the UT of A&N Islands
- Member UT level Task Force Committee for A&N Islands
- Member, Agriculture Technology Management Agency Governing Body of A&N Islands.
- Member, Steering Committee of the UT Level for documentation of traditional knowledge of Ethno Medicine
- Member, Scientific Advisory Committee at UT Level, A&N Administration
- Member, Governing Body of A&N Medicinal Plants Board
- Chairman, Working Group of A&N Medicinal Plants Board

## Participation in important meeting, symposium and workshop

- Assessment Committee Meeting at ASRB, KAB, New Delhi from 12th -13th April 2010.
- Interface meeting of Directors/PCs Crops Science & Horticulture Division at Directorate of Weed Science Research, Jabalpur from 17th - 18th May 2010.
- National Conference on Horticultural Biodiversity for Livelihood Economic Development and Health Care, Bangalore from 29th -30th May 2010.
- International Seminar on Mango Biodiversity for Livelihood at CISH, Lucknow from 25th - 28th June 2010.
- Workshop of NAIP consortium on Developing, commissioning operating& managing and online system for NET-ARS-PRELIM Exam. at ASRB, New Delhi on 1st July 2010.
- Workshop on Disposal on appeal under RTI held at ISTM, New Delhi on 12th July 2010.
- Director's Conference held at NASC Complex, New Delhi on 15th July 2010.
- ICAR Award ceremony, NASC Complex, New Delhi on 16th July 2010
- IMC Meeting of Directorate of Water Management, Bhubaneswar on 4th August 2010.
- Foundation stone laying ceremony of KVK at Car Nicobar on 13th September 2010.
- XX Regional committee meeting zone –II held at CARI, Port Blair on 14th September 2010.
- World Noni Congress and Steering Committee meeting of NMPB Project at Chennai on 1st October 2010.
- National Seminar on Issues in Land Resource Management – Land Degradation on Climate Changes and Land Use Diversification at NBSSLUP, Nagpur from 8th-10th October 2010.
- International Conference on Coconut Biodiversity for Prosperity held at CPCRI, Kasaragod from 26th -28th October 2010.
- 9th National Symposium of Indian Society of Coastal Agricultural Research at Goa from 28th -29th October 2010.
- Interactive meeting with Hon'ble DG and Horticulture Industry meet at IIHR, Bangalore from 9th -11th November 2010.
- Interface meeting of NRM- Crop Science-Hort.Division at NASC Complex, New Delhi from 23rd -24th November 2010.
- Brain Storming Session on Second Grass Revolution: Strategies for Agricultural transformation in Eastern India held at ICAR Research Complex for Eastern Region, Patna from 11th -12th December 2010.
- National KVK Conference at MPUAT, Udaipur from 22nd -23rd December 2010.
- Meeting of Coastal and Island Agricultural agencies to work out suitable management strategies at ICAR, New Delhi on 14th January 2011.



- X Agricultural Science Congress on Soil, Plant & Animal Health for Enhanced and Sustained Agricultural Productivity at NBFGRI, Lucknow from 10th -12th February 2011.
- Directors-Vice Chancellors Interface meeting at ICAR, New Delhi from 23rd -24th February 2011.
- RAC Interface meeting at ICAR, New Delhi on 9th March 2011.

## Management & Guidance of Research, Development and Extension (RDE)

**Research:**

During the Institute Research Committee meeting (IRC) meeting held from 17th, 18th, 19th, 20th and 28th August, 2010 a total of fifty six ongoing projects, sixteen new projects and twenty eight external funded totaling to hundred were reviewed.

Summary of the Institute funded and sponsored projects for the period:

| | | |
|---|---|---|
| a) | Number of institute funded research projects continuing | **52** |
| b) | Number of institute funded research projects concluded | **20** |
| c) | Number of new institute funded research projects initiated | **16** |
| d) | Number of externally funded projects continuing | **28** |

**Organizing Workshops/Seminars/Conferences**

- National Workshop-cum Training on Sequence Alignment & Phylogentic Analysis from 9th to 11th June, 2010
- Brain Storming Session on Livestock and Poultry Production Policies for Andaman & Nicobar Islands from 20th to 21st June, 2010
- XX Regional Committee Meeting from 14th - 15th September, 2010
- Seminar on Weather, Climate and Farmers on 29th November, 2010
- International Conference on Tropical Island Ecosystem : Issues Related to livelihood, sustainable development and climate change from 23rd to 26th March, 2011

# PARTICIPATION OF SCIENTISTS IN CONFERENCES / SEMINARS/ SYMPOSIA / MEETINGS

| Scientist | Programme | Venue | Date/Duration |
|---|---|---|---|
| R.K.Gautam, Pankaj Kumar Singh, Krishna Kumar | 45th Rice research group meeting | AAU, Anand, Gujarat | 3rd - 6th April, 10 |
| R.K.Gautam | Inception Workshop of IRRI-STRASA project | NASC, New Delhi | 5th - 6th April, 11 |
| Nagesh Ram | Zonal Workshop of KVK, Zone-II | RAU, Patna | 7th - 9th April, 10 |
| S. K. Verma | The Right to Information Act, 2005 | Bangalore (Camp: Bhubaneswar) | 12th -14th April, 10 |
| S.K. Zamir Ahmed | KVK Interface Meeting | ICAR | 26th April, 10 |
| S.K. Zamir Ahmed | Scientific Advisory Committee meeting of KVK | CARI, Port Blair | 21st - 22nd May, 10 |
| Shubash Chand, I. Jai Shankar, S.K. Zamir Ahmed, A. Velmurugan, T.P. Swarnam, T. Subramani | National Conference on Horticultural biodiversity for livelihood, economic development and healthcare | UAS, Bangalore | 29th - 31st May, 10 |
| Krishna Kumar, Naresh Kumar, T. Subramani, Sachidananda Swain | Training on Sequence alignment and Phylogenetic analysis | SUB-DIC, CARI, Port Blair | 9th -11th June, 10 |
| S. K. Verma | Entrepreneurs meet organised by Zonal Technology Management | NIRJAFT, Kolkata | 18th June, 10 |
| M. Balakrishnan | National Workshop on SAS software installation | DWM, Bhubaneswar | 18th -19th June,10 |
| All Scientist | Brainstorming session on livestock and poultry development policy for A & N Islands | CARI, Port Blair | 20th - 21st June, 10 |
| Subhash Chand | International training on Food Policy and Technology Forecasting (Social Sciences) | IFPRI, Washington DC. USA | 21st June - 22nd Sept., 10 |
| M. Balakrishnan, S. K. Zamir Ahmed | Workhsop on Developing, Commissioning, Operating and Managing online system | ASRB, ICAR | 1st July, 10 |
| Nagesh Ram | NICRA workshop on Possible interactions in vulnerable districts on climate resilient technology | CRIDA | 1st July, 2010 |
| S.K. Zamir Ahmed | ATIC Interface-2010 | NASC, New Delhi | 3rd July, 10 |
| Pankaj Kumar Singh | Review meeting of ICAR Seed Project: seed production of agricultural crops | Pusa, New Delhi | 19th -20th July, 10 |
| S.K. Ambast | Consortia's Advisory Committee (CAC) meeting | BCKV campus Kalyani | 21st July, 10 |

| | | | |
|---|---|---|---|
| S.K. Ambast | CIC and CMU meeting of the NAIP project on Strategies for Sustainable Management of Degraded Coastal Land and Water for Enhancing Livelihood Security of Farming Community | RRS CSSRI, Canning Town | 22nd July, 10 |
| Krishna Kumar | Annual Review Meeting of ICAR Network Project on AMAAS | NBAIM, UP | 17th -18th Aug., 10 |
| A. Velmurugan | Annual work plan review meeting cum workshop of ISRO-GBP project | SAC, Ahmedabad | 19th - 20th Aug., 10 |
| Sachidananda Swain | Novel food processing, Co-product utilization and quality assurance | CIPHET, Ludhiana | 1st - 21st Sept., 10 |
| S. K. Verma | Industry Meet on Fisheries organised by Zonal Technology Management centre & CIFT, Kochhi | Vishakhapattanam | 8th Sept., 10 |
| N. Ravisankar | Implementation of FASAL (Forecasting Agricultural Output using Space, Agro meteorology and Land based observations) | AMD, IMD, Pune | 15th - 16th Sept., 10 |
| All Scientists | Vaigyanik Sangosthi, CMS Vatavaran, Chennai and CARI, Port Blair | CARI, Port Blair | 6th Oct., 10 |
| A. Velmurugan | Project review meeting of Nutrient Management | DST, Port Blair | 11th -12th Oct., 10 |
| M. Balakrishnan | National Consultative meet on Bioinformatics in Horticulture | Bioinformatics Centre,IISR, Calicut, Kerala | 11th -12th Oct., 10 |
| S.K. Zamir Ahmed | Panel discussion on confronter climate change towards carbon neutral Indian cities | CARI, Port Blair | 16th Oct., 10 |
| T.P. Swarnam | Group meeting on solving the pulses crisis through crop diversification | Agricultural Research Station, Durgapura, Jaipur | 25th –26th Oct., 10 |
| Krishna Kumar | International Conference on Coconut Biodiversity for prosperity | CPCRI, Kerala | 25th -28th Oct., 10 |
| S. K. Verma | Workshop on Rajbhasha organised by Rajbhasha Sansthan, New Delhi | Dalhousie, Himachal Pradesh | 27th - 29th Oct.,10 |
| S.K. Ambast | 9th National Symposium of Indian Society of Coastal Agricultural Research | B.S.Konkan Krishi Vidhyapeeth at Goa | 27th -30th Oct., 10 |
| M. Balakrishnan | Interactive meeting on Information and Communication Technology in ICAR | NASC, Complex, NewDelhi. | 3rd - 4th Nov. , 10 |
| R.K.Gautam | International Rice Congress | Hanoi, Vietnam | 9th -11th Nov. , 10 |

| | | | |
|---|---|---|---|
| S. K. Verma | ZTMC meeting cum workshop | NIRJAFT, Kolkata | 28th - 29th Jan., 11 |
| M. Balakrishnan | XXI All India BTISnet Coordinators Meeting organized by DBT, Ministry of Science and Technology | Pondicherry University, Pondicherry | 3rd - 4th Feb., 11 |
| S. Jeyakumar | International conference on Frontiers in Reproductive Biotechnology and 21st Annual Meeting of The Indian Society for the study of Reproduction and Fertility | NDRI | 9th -11th Feb., 11 |
| Krishna Kumar, Ajanta Birah, R.K.Gautam, Pankaj Kumar Singh, K. Deva Kumar, Naresh Kumar A. Velmurugan, T.P. Swarnam, S.K. Zamir Ahmed | 9th National Symposium on Crop Health Management for Sustainable Agri-horticultural Cropping System | CARI, Port Blair | 17th -19th Feb., 11 |
| R.C. Srivastava & Nagesh Ram | Workshop on budget allocation for NICRA project | ZPD, Kolkata | 21st – 22nd Feb., 11 |
| S.K. Ambast | Annual Review Workshop of NAIP projects under component 3 | NBFGR | 1st - 2nd March, 11 |
| Krishna Kumar | 3rd Technical Review Meeting of NMPB Project on *Morinda citrifolia* | CARI, Port Blair | 27th March, 2011 |
| All Scientists | Training programme on Data Analysis using SAS of the NAIP consortium Strengthening statistical Computing for NARS | CARI, Port Blair | 1st -7th March, 11 |
| Dr. Jai Sunder | RAC Interaction meeting | NASC Complex | 8th - 9th March, 11 |
| A. Kundu, M. S. Kundu | National workshop cum Training on Protein –Protein Interaction | CARI, Port Blair | 9th -11th March, 11 |
| S.K. Zamir Ahmed | Sensitization of Result-Frame Work Document | NASC, New Delhi. | 11th - 14th March, 11 |
| All Scientists | International Conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable development and climate change | CARI, Port Blair | 23rd -26th March, 11 |



# HUMAN RESOURCE DEVELOPMENT OF STAKEHOLDERS

| Title | Period | Participants (No.) | Type of Participants | Venue | Conducted by |
|---|---|---|---|---|---|
| **Training to stakeholders** | | | | | |
| Scientific Block Cultivation of Drumstick & Agathi | 6th - 8th May, 10 | 20 | Farmers | Diglipur | ORC,CARI, NABARD & KVK |
| Pig Farming | 6th - 8th May, 10 | 23 | Farmers | Diglipur | ORC,CARI, NABARD & KVK |
| Fish Nursery Management | 6th - 8th May, 10 | 35 | Farmers | Diglipur | ORC,CARI & NABARD |
| Scientific PoP of HYV of Rice | 15th - 17th June, 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD |
| Backyard Poultry Farming | 15th -17th June, 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD & KVK |
| Integrated Fish Farming System | 15th - 17th June, 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD & KVK |
| Plant Propagation Techniques of Fruit crops | 15th-17th June, 10 | 30 | Farmers | Diglipur | ORC,CARI NABARD & KVK |
| Pest Disease & Weed Management in Rice | 12th - 14th July, 10 | 31 | Farmers | Diglipur | ORC, CARI & NABARD |
| Cat Fish Culture & Induced Breeding of IMC | 12th - 14th July, 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD &FSD |
| Quality seed production technology for paddy | 19th July, 10 | 26 | Farmers | KVK, CARI | KVK, CARI |
| Technological Options for Livelihood Security in Degraded Land and Water in Andaman and Nicobar Islands | 2nd - 4th Aug., 10 | 40 | Farmers | KVK, Sippighat | NAIP |
| Post harvest processing of milk & preparation of traditional dairy products | 2nd - 3rd Aug., 10 | 17 | Dairy farmers | CARI | CARI & ANIIDCO |
| Disease management in protected cultivation | 26th Aug., 10 | 30 | Farmers | ATIC-CARI, Port Blair | CARI |
| Integrated Plant nutrient management for paddy | 31st Aug. - 2nd Sept., 10 | 30 | Farmers | Ferrargunj | NRM & KVK |
| Soil and Water conservation measures | 3rd - 6th Sept., 10 | 25 | Extension functionaries | KVK, Port Blair | NRM & KVK |
| IDM on spice cultivation | 18th Dec., 10 | 30 | Farmers | KVK, CARI | KVK, CARI |

| | | | | | |
|---|---|---|---|---|---|
| Role of PPV & FR in crop diversity conservation | 27th Dec., 10 | 100 | Farmers | Diglipur | PPV & FR, New Delhi |
| Pest, Disease Management of Vegetable & Cole crops | 27th - 29th Dec., 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD & FCD |
| PoP for HYV Pulses & Oil Seeds. | 27th - 29th Dec., 10 | 30 | Farmers | Diglipur | ORC,CARI, NABARD & FCD |
| Maintenance and Operation of Power Tiller | 28th - 30th Dec., 10 | 30 | Farmers | KVK, Port Blair | NRM & KVK |
| Balance Fertilizer application in Plantation crops | 1st - 3rd Feb., 11 | 23 | Farmers | CARI | ORC,CARI, NABARD & KVK |
| Nutrition kitchen gardening | 1st - 3rd Feb., 11 | 21 | Farmers | CARI | ORC,CARI NABARD & KVK |
| Multi-tier cropping system | 1st - 3rd Feb., 11 | 22 | Farmers | CARI | ORC,CARI, NABARD & KVK |
| Composite fish culture with IMC | 1st -3rd Feb., 11 | 21 | Farmers | CARI | ORC,CARI, NABARD |
| Non-traditional vegetable production | 1st - 3rd Feb., 11 | 23 | Farmers | CARI | ORC,CARI, NABARD & KVK |
| Land and Agricultural Development | 5th - 6th Feb., 11 | 30 | Farmers | Baratang | ORC,CARI, NABARD & WBVHAI |
| Farming system options for degraded coastal land and water | 7th - 9th Feb., 11 | 50 | Farmers | ORC, Diglipur | NAIP |
| Integrated disease management for Andaman & Nicobar Islands | 10th Feb., 11 | 25 | Farmers | KVK, CARI | KVK, CARI |
| Management of livestock component | 10th - 12th Feb., 11 | 73 | Farmers | Dashrathpur | NAIP |
| Training-cum-demonstration of Bio-mass fired Copra Drier | 22nd - 23th Feb., 11 | 17 | Farmers | Subash Gram | ORC,CARI, NABARD & NRM |
| Pre and post harvest management for Mango | 22nd- 23th Feb., 11 | 20 | Farmers | Subash Gram | ORC,CARI NABARD & H & F |
| Quality seed production | 26th March, 11 | 27 | Extension workers | KVK, CARI | KVK, CARI |
| Package and practices of fodder cultivation | 29th - 30th April, 10 | 25 | Farmers | Lal Pahar | ASD & KVK |
| Turkey & Guinea fowl farming | 30th June - 3rd July, 10 | 25 | Farmers | Port Mort | ASD & KVK |
| Broiler and Quail farming | 30th Sept. - 4th Oct., 10 | 25 | Farmers | Makka Pahad | ASD & KVK |



| Customized Training | | | | | |
|---|---|---|---|---|---|
| Vermicomposting | 24th - 27th May, 10 | 30 | Rural youth | CARI | ORC, CARI, NABARD, & NRM |
| Carp seed production and nursery management | 23rd -26th June,10 | 30 | Rural youth | CARI | ORC, CARI, NABARD, & FSD |
| Quail farming | 21st - 24th July, 10 | 30 | Rural youth | CARI | ORC, CARI, NABARD, & ASD |
| Protected Cultivation Vegetable Crops | 24th - 27th Aug., 10 | 25 | Rural youth | CARI | ORC,CARI NABARD & H& F |
| Goat farming | 29th Oct. - 1st Nov. 10 | 25 | Rural youth | CARI | ORC, CARI NABARD & ASD |
| Livelihood Options in Agriculture and Allied Fields | 11th to 15th Nov., 2010 | 7 | Rural youth & Progressive farmers | CARI | CARI & CCD |
| Marine Ornamental Fish Breeding | 19th - 22nd Nov., 10 | 30 | Rural youth | CARI | ORC,CARI NABARD & FSD |
| Induction training for newly recruited SMS and PA of KVK, Nicobar. | 5th -14th March, 11 | 06 | SMS & PA | CARI | SSS & KVK |
| Data analysis using SAS | 1st - 7th March, 11 | 57 | Scientists, Technical officers of CARI & SMS of KVK | CARI | DWM, Bhubaneswar& Bioinformatics Centre, CARI |

## EXTENSION ACTIVITIES

Organization of Kisan Mela / Workshops/ Meeting

| Kisan Mela | | | | | |
|---|---|---|---|---|---|
| Kisan Mela on theme : Self reliance village Climate change | 2nd - 3rd Feb., 11 | 2042 | Farmers, PRI's, SHG's & Students | CARI, Port Blair | CARI |
| Kisan Mela at Nicobar | 21st - 23rd Feb., 11 | 520 | Farmers,Tribal Council, Development Dept. | Car Nicobar | DC, Car Nicobar & Dept. of Agriculture |
| **Workshop/ Seminar** | | | | | |
| Seminar on Sequence Alignment and Phylogenetic Analysis | 9th - 11th June, 10 | 27 | Scientists, Professors, Technicals, Research Scholars & Students | CARI | Bioinformatics Centre, CARI |
| Roving seminar on Weather, Climate and Farmers | 29th Nov., 10 | 121 | Farmers, NGO's, Department officials and CARI Scientists | CARI, Port Blair | IMD, Pune |

| | | | | | |
|---|---|---|---|---|---|
| Groundwater Management and Rainwater Harvesting | 15th Dec., 10 | 30 | Officers of line departments, NGO members | CARI, Port Blair | NRM & CGWAER, Kolkata |
| User-interaction workshop on PFZ validation | 4th Feb., 11 | 2 | Fishermen | INCOIS, Hyderabad | INCOIS, Hyderabad |
| 9th National Symposium on Crop Health Management for Sustainable Agri-Horticultural Cropping System | 17th - 19th Feb., 11 | 90 | Directors/ Professors/ Scientists/ Students | CARI, Port Blair | SPPS, New Delhi |
| Seminar on Protein Protein Interaction | 9th - 11th March, 11 | 30 | Scientists, Professors, Technicals, Research Scholars & Students | CARI | Bioinformatics Centre, CARI |
| International conference on Tropical Island Ecosystems: Issues related to livelihood, sustainable development and climate change | 23rd-26th March,11 | 260 | Scientists, Professors, Technicals, Research Scholars & Students | CARI, Port Blair | CARI, Port Blair |

| **Other Extension activities** | | | | | |
|---|---|---|---|---|---|
| Livestock health and infertility camp | 10th March, 11 | 25 | Farmers | New Bimblitan | ASD & Dept. of AH&VS |
| Exposure visit of farmers to on station IFS experiments | 2nd - 3rd Feb., 11 | 400 | Farmers | CARI, Port Blair | AICRP-IFS |
| Awareness campaign for popularization of weather forecast based Agromet advisories | 2nd -3rd Feb., 11 | 500 | Farmers | CARI, Port Blair | IMD, Pune |
| Training cum awareness on conservation and management of genetic wealth of A & N Islands | 27th - 29th Dec., 10 | 100 | Farmers | Diglipur, (North Andaman) | PPV&FRA, Pusa, New Delhi |
| Farm School on AIR on PoP of HYV of Rice | 15th April-15th July, 10 | ---- | Stakeholders of A & N Islands | Port Blair | Prasaar Bharti & CARI |

## Radio Talks

| Title | Date of Broadcast | Expert |
|---|---|---|
| **धान में चूहों से होने वाले नुक्सान व प्रबंधन** | 4th April, 10 | Ajanta Birah |
| Nariyal ke naye bhagan kee tayari | 5th April, 2010 | L.B.Singh |
| **बैंगन के रोग व उनका प्रबंधन** | 12th April, 10 | Krishna Kumar |
| SRI Technique seh dhan ki kheti, Sr. Scientist (Agril. Extn.) | 29th April,10 | S.K. Zamir Ahmed |
| Pahari Jameen main krishi: Kuch sujhav | 11th May, 10 | S.K. Ambast |
| Integrated nutrient management for rice | 20th May, 10 | A. Velmurugan |
| Murgipalan me prakash Babasthya | 21st May, 10 | A. Kundu |
| Pashuon mein thaneilla | 28th May,10 | Jai Sunder |
| Dhan ki unat kaashat Par Krishi Paatshala ke liye Aalekh- Dhan me rog prabhandhan | 10th June, 10 | Krishna Kumar |
| **धान की प्रमुख समस्याएं व उनका प्रबंधन** | 17th June, 10 | Ajanta Birah |
| Dhan ki unnat kast par krishi pathshala ke lia aalekh dhan ki katai | 1st July, 2010 | N. Bommayasamy |
| Dhan ki kheti ke liye unnat Krishi yantro ki upayog | 2nd July, 2010 | B. K. Nanda |
| Dhan ka uchit Bandaran | 8th July, 10 | S.K. Zamir Ahmed |
| **पक्षियों से होने वाले नुक्सान व उनका प्रबंधन** | 12th Dec., 10 | Ajanta Birah |
| Tarbuj avam kharbuj me rog Prabandhan | 20th Dec., 10 | Krishna Kumar |
| Asasthya murgion ki pahachan | 21st Dec., 10 | A. Kundu |
| Sukar Palan Me Ahar babastha O prabandan | 27th Dec., 10 | M. S. Kundu |
| Pashuon mein prathamic upchar-kuch sujao | 29th Dec., 10 | S. Jeyakumar |
| Krishi Vigyan Kendra Ki Gatividhyan | 30th Dec., 10 | Nagesh Ram |
| Sambhavit matsya kshetr va mausam ka poorvanuman | 14th Jan.,11 | Grinson George |
| Prospects of fish culture in Sea water | 19th Jan.,11 | Kamal Sarma |
| Jaiphal (Nut meg) Mein Falan ke Samayasa | 20th Jan.,11 | L.B.Singh |
| Backyard Poultry farming | 21st Jan.,11 | N.C. Choudhuri |
| Dweep mein Ganne ki kethi | 10th Feb., 11 | N. Ravisankar |
| Scientific paddy cultivation | 22th April, 6th May, 3rd June & 15th July, 10 | N. Ravisankar |

## Doordarshan Interview

| Title | Date of Broadcast | Expert |
|---|---|---|
| Earthworm multiplication techniques | 3rd April,10 | N. Ravisankar |
| Techniques of wet bed method of rice nursery | 15th June, 10 | N. Ravisankar |
| Land preparation for the paddy cultivation | 15th June, 2010 | B. K. Nanda |
| Bakri Palan and Krithrim prajanan | 8th Dec., 10 | S. Jeyakumar |
| Samudriya Rangeen Matsyom ka Prajanan | 9th Dec., 10 | Grinson George |
| Sambhavit matsya kshetr ka poorvanuman | 10th Dec., 10 | Grinson George |
| Nimn Gunwtta wale kshetron ke liye krishi taknekiyan | 2nd Feb., 11 | S.K. Ambast |



# ROUND UP OF INSTITUTE ACTIVITIES

| Sl. No. | Events | Date |
|---|---|---|
| 1. | Farm School on AIR on PoP of Rice | 15th April, 2010 |
| 2. | RAC meeting | 14th to 16th May, 2010 |
| 3. | Exhibition of Mango diversity | 29th to 31st May, 2010 |
| 4. | National Workshop-cum Training on Sequence Alignment & Phylogentic Analysis | 9th to 11th June, 2010 |
| 5. | Brain storming on Livestock and Poultry Production Policies for Andaman & Nicobar Islands | 20th to 21st June, 2010 |
| 6. | Exposure visit of Nicobari Tribes by ACANI | 19th July, 2010 |
| 7. | Director and Team visit to Nicobar Island | 9th August, 2010 |
| 8. | IRC meeting | 17th to 20th August, 2010 |
| 9. | IVth PMC of ORC meeting | 27th August, 2010 |
| 10. | IRC- 2010 (External funded project) | 28th August, 2010 |
| 11. | KVK Nicobar foundation stone laying ceremony at Arong & field visit to Auchung | 13th September, 2010 |
| 12. | Inauguration of Marine hill laboratory by Hon'ble DG, ICAR, New Delhi | 13th September, 2010 |
| 13. | XX Regional Committee Meeting | 14th to 15th September, 2010 |
| 14. | KVK interface meeting between ICAR, State Agricultural Universities and State Agricultural Departments. | 16th September, 2010 |
| 15. | Hindi Chetna Month | 14th September to 12th October, 2010 |
| 16. | Exposure visit of GTTs working in different schools | 27th October, 2010 |
| 17. | Exposure visit of Tribal Farmers by ACANI | 9th November, 2010 |
| 18. | Roving Seminar on Weather, Climate and Farmers | 29th November, 2010 |
| 19. | IMC Meeting | 7th December, 2010 |
| 20. | Ground water management and rain water harvesting | 15th December, 2010 |
| 21. | RAC meeting | 17th to 19th January, 2011 |
| 22. | Island Kisan Mela | 2nd to 3rd February, 2011 |
| 23. | Visit of Director and his team to Baratang | 5th to 6th February, 2011 |
| 24. | Visit of ISTM officials | 18th February, 2011 |
| 25. | Visit of farmers on State Level Seminar-cum-Farmers Meet | 25th February, 2011 |
| 26. | Training on Data analysis by using SAS software | 1st to 7th March, 2011 |
| 27. | International Conference on Tropical Island Ecosystem : Issues Related to livelihood, sustainable development and climate change | 23rd to 26th March, 2011 |

## LINKAGES AND COLLABORATION

- Directorate of Cropping System Research (PDCSR), Modipuram
- Space Application Centre, ISRO, Ahmedabad
- Central Soil Salinity Research Institute, Karnal
- Andaman and Nicobar Administration
- Ministry of Water resources, New Delhi
- Ministry of Earth Sciences, New Delhi
- International Rice Resaerch Insttiute, Manila, Philippines
- Regional Plant Quarantine Station, Chennai
- National Research Centre for Mushroom, Solan
- Coconut Development Board, Kochi, Kerala
- National Bureau of Agriculturally Important Microorganisms, Mau, U. P
- Indian Agricultural Research Institute, New Delhi
- Directorate of Rice Research, Hyderabad
- Indian Institute of Pulses Research, Kanpur
- Directorate of Oil Seed Research, Hyderabad
- Indian Institute of Vegetable Research, Varanasi
- Dr. .P. D. K. V., Akola, Maharastra and CARI, Port Blair
- CIPMC, Port Blair, Ministry of Agriculture, GOI
- PRIST University, Thanjavur for guideship of Doctoral students.
- CDRI, Lucknow.
- WNRF, Chennai.
- NMPB, New Delhi.
- Directorate of Arecanut and Spices Development, Calicut.
- CTCRI, Thiruvanathapuram.
- CPCRI, Kasaragod.
- IIHR, Bangalore.
- Directorate of Agriculture, A & N Islands.
- NOVOD, Gurgaon.
- TANUVAS, Chennai
- BSI, Port Blair.
- Coconut Mission, Car Nicobar.
- NHRDF, Nasik.
- Directorate of Onion and Garlic
- Annamalai University, Chidambaram, Tamilnadu
- Bharadhidasan University, Trichy, Tamil Nadu
- Space Applications Centre, Ahmedabad
- Indian National Centre for Ocean Information Services, Hyderabad
- National Remote Sensing Centre, Hyderabad
- Regional Remote Sensing Centre (ISRO), Nagpur
- DBT, New Delhi.
- National Institute of Oceanography(CSIR), Goa
- DST, New Delhi
- RMRC, ICMR, Port Blair
- IVRI, NDRI, PDADMAS, CSWRI, IGFRI, PDP, CARI, Izatnagar.
- DAHVS, A&N Administration.
- KLDB
- Tribal Council, Car Nicobar
- West Bengal Voluntary Health Association of India, Port Blair
- NABARD, Port Blair
- ATMA, Port Blair



# DISTINGUISHED DIGNITARIES

- Dr. Damodar Rout, Ministry of Agriculture, Crop, Fisheries and Animal Resource Development, Govt. of Orissa on 16th September, 2010
- Shri Pradha Sarathi, Ministry of Animal Husbandry Dairy & Fisheries, Govt. of Andhra Pradesh on 16th September, 2010
- Shri.N.Raghuveera Reddy, Ministry of Agriculture, Govt. Andhra Pradesh on on 16th September, 2010
- Shri. Narendra Nath, Ministry of Agriculture, West Bengal on 16th September, 2010.
- Lt. Governor, Lt. Gen (Retd). Bhopinder Singh, on 16th September, 2010
- Dr. S. Ayyappan, Secy DARE & DG, ICAR, New Delhi on 16th September, 2010
- Shri. Rajiv Mehrishi, Secretary, ICAR, New Delhi on 16th September, 2010
- Dr. H.P.Singh, DDG (H), ICAR, New Delhi on 13th September, 2010
- Dr. K. D. Kokate, DDG (AE), ICAR, New Delhi ICAR on 13th September, 2010
- Dr. K.M.L. Pathak, DDG(AS), ICAR, New Delhi ICAR, New Delhi on 13th September, 2010
- Dr. Arvind Kumar, DDG (Edn.), ICAR, New Delhi on 16th September, 2010
- Dr. M.M.Pandey, DDG (Engg), ICAR, New Delhi on 16th September, 2010
- Dr. Swapan Datta, DDG(CS), ICAR, New Delhi on 16th September, 2010
- Dr. A.K.Singh, DDG (NRM), ICAR, New Delhi on 16th September, 2010
- Dr. A.K.Das, VC, UBKV on 16th September, 2010
- Dr. D. P. Rae, VC, OUAT on 16th September, 2010
- Dr. P. Raghava Reddy, VC, ANGARU on 16th September, 2010
- Dr. S. D. Shikhamany, VC, AP (Hort.) on 16th September, 2010
- Prof. S.K.Sanyal, VC, BCKVV, West Bengal on 16th September, 2010
- Dr. C.S. Chakraborty, VC, WBUAFS, West Bengal on 16th September, 2010
- Dr. S. Bhargav, GB Member on 16th September, 2010
- Mr. P. L. Behera, NABARD, Mumbai on 5th May, 2010
- Dr. A.P. Samadar, PC, NAIP, New Delhi on 15th September, 2010
- Dr. Ravindra Kumar (ADG Coord.), ICAR, New Delhi on 15th September, 2010
- Shri. C. Vasudevappa, Senior Executive Director, NFDB on 16th September, 2010
- Dr. L. Kumar, Visiting Professor, Pondicherry University on 14th October, 2010
- M Sailabdeen, Faculty Member, SIE, Port Blair on 27th October, 2010
- Shri. G. Sajan, ASD, Doordarshan on 4th November, 2010
- Shri. Pitamber, Deputy Secy (AS), ICAR HQ on 4th November, 2010
- Dr. J.P.Dhaka, Principal Scientist (Agri. Econ.), NDRI, Karnal, Haryana on 4th December, 2010
- Dr. K. Vijayakumaran, Director General, Fishery Survey of India, Mumbai on 6th January, 2011
- Dr. B.S. Mahapatra, Director, CRIJAF, Barrackpore, Kolkata on 10th January, 2011
- Prof. S. Kannaiyan, Ex VC TNAU, Ex. Chairman NBA on 21st January, 2011

- Prof. P Murugesan, Chancellor, PRIST University, Thanjavur on 21st January, 2011
- Dr. A. K. Khan, Principal Scientist, ICAR Research Complex for Eastern Region, Patna on 27th January, 2011
- Dr. Atul Kumar Srivastava, Professor and Head (Agri. Engg.) on 28th January, 2011
- Dr.. R.J.Rabindra, Director, NBAH, ICAR, Bangalore on 16th February, 2011
- Dr. Vishwas Nath, Division of Extn., IARI, New Delhi on 16th February, 2011
- Prof. M.L.Chathagri, Entomologist, BCKV, West Bengal on 16th February, 2011
- Dr. P Ananda Kumar, Director, NRC on Plant Biotech, New Delhi on 17th February, 2011
- Prof. Mohammad M. Anwar, Director, NRC on Seed Spices, Tabiji, Ajmer, Rajasthan on 17th February, 2011
- Shri. Takashi Kume, Research Institute for Humanity and Nature, Kyoto, Japan on 22nd March 2011



# PERSONNEL

## Director

Dr. R.C. Srivastava

## Head / Incharge Divisions / Section

| | |
|---|---|
| Head, Division of Natural Resource Management | Dr. S.K. Ambast |
| Head Division of Horticulture & Forestry | Dr. D.R. Singh |
| Head, Division of Field Crops | Dr. R.K. Gautam |
| Head i/c Division of Animal Science | Dr. A. Kundu |
| Head i/c Division of Fisheries | Dr. Kamal Sarma |
| Incharge, Social Science Section | Dr. Ajmer Singh |
| Administrative Officer | Mr. Abhishek Srivastava |
| Senior Administrative Officer i/c (w.e.f. 06.03.2011) | Er. S.L.Paik |
| Finance & Accounts Officer | Shri Joseph George |
| Incharge, Prioritization, Monitoring & Evaluation Cell | Dr. S.K. Zamir Ahmed |
| Incharge, Computer Cell | Dr. M. Balakrishnan |
| Incharge, Library | Dr. A. Kundu |
| Incharge, Central Instrumentation Facility | Dr. Jai Sunder |
| Incharge, Legal Cell | Dr. S.K.Zamir Ahmed |
| Incharge, Garacharma Farm | Dr. K.K. Singh |
| Incharge, Sippigaht Farm | Mr. I. Jaisankar |
| Incharge, Bloomsdale Farm | Dr. P.K. Singh |
| Estate Officer, Estate Section | Er. S.L.Paik |
| Incharge, Guest House | Dr. V.B. Pandey |
| Security Officer | Sh. N.K. Pushp |
| Controlling Officer, Krishi Vigyan Kendra | Dr. Subhash Chand |
| Co-ordinator, Bio-Informatics Centre | Dr. M. Balakrishnan |
| Incharge, RIRIC | Dr. S.K. Verma |
| Incharge, PG Cell | Dr. Jai Sunder |
| Administrative Head, KVK Andaman | Dr. Nagesh Ram |
| Administrative Head, KVK Nicobar | Dr. S.K. Zamir Ahmed |

## List of Scientific Staff

### Division of Natural Resource Management

Dr. S.K. Ambast, Head

Dr. N. Ravisankar, Senior Scientist (Agronomy)

Dr. A. Velumurugan, Senior Scientist (Soil Science: CF & M)

Dr. T.P. Swarnam, Senior Scientist (Agronomy) w.e.f. 28.02.11

Mr. B.L. Meena, Scientist (Soil Science) on Study leave.

Mr. T. Subramani, Scientist (Agronomy)

Dr. Sachchidanand Swain, Scientist (ASPE)

### Division of Field Crops

Dr. R.K. Gautam, Head

Dr. Krishna Kumar, Senior Scientist (Plant Pathology)

Dr. Ajanta Birha, Senior Scientist (Agri. Entomology)

Dr. Pankaj Kumar Singh, Senior Scientist (Plant Breeding)

Dr. K. Deva Kumar, Senior Scientist (Biotechnology-Plant Science)

Dr. Awnindra Kumar Singh, Senior Scientist (Plant Breeding)

Mr. Israr Ahmed, Scientist (Biotechnology)

Dr. Naresh Kumar, Scientist (Plant Breeding)

### Division of Horticulture & Forestry

Dr. D.R. Singh, Pr. Scientist & Head

Dr. M. Sankaran, Senior Scientist (Horticulture)

Dr. V. Bhaskaran, Senior Scientist (Horticulture)

Ms R. Sudha, Scientist (Horticulture)

Shri I. Jaisankar, Scientist (Forestry)

Dr. Shrawan Singh, Scientist (Vegetables)

Mr. Dipak Nayak, Scientist (Fruit Science)

### Division of Fisheries Science

Dr. S. Dam Roy, Head (till June, 2010)

Dr. Kamal Sarma, Senior Scientist (Fish & Fisheries) & i/c Head from July onwards

Dr. P. Krishnan, Scientist (Fish & Fishery)

Shri. Grinson George, Scientist (Fish & Fishery Science)

Mr. R. Kiruba Sankar, Scientist (Fish & Fishery Science)

### Division of Animal Science

Dr. A. Kundu, Principal Scientist (Livestock Production & Management) & i/c Head

Dr. Madhu Sudan Kundu, Sr. Scientist (Animal Nutrition)

Dr. S. Jeyakumar, Scientist Sr. Scale (Animal Reproduction)

Dr. Jai Sunder, Scientist Sr. Scale (Veterinary Microbiology)

Dr. S.K. Verma, Scientist Sr. Scale (Animal Nutrition)

Dr. T. Sujatha, Scientist (Poultry Science) on study leave

Dr. Arun Kumar De, Scientist (Animal Biotechnology)

### Social Science Section

Dr. Ajmer Singh, Senior Scientist (Agricultural Economics) & i/c Head

Dr. Subhash Chand, Sr. Scientist, (Agriculture Economics)

Dr. S.K. Zamir Ahmed, Sr. Scientist (Agriculture Extension)

Dr. M. Balakrishnan, Scientist Sr. Scale (Computer Applications)

### Krishi Vigyan Kendras

Dr. Subhash Chand, Controlling Officer

### KVK, South Andaman

Dr. Nagesh Ram, Subject Matter Specialist (Fisheries) & Administrative Head

Shri. L.B. Singh, Subject Matter Specialist (Horticulture)

Dr. Abhay Kr. Singh, Subject Matter Specialist (Animal Science) on study leave

Mr. Bijaya Kr. Nanda, Subject Matter Specialist (Agri. Engineering)

Mr. N.C. Choudhuri, T-6 (Animal Science)

### KVK, Nicobar

Dr. S.K. Zamir Ahmed, Sr. Scientist & Administrative Head

Shri Sanjay Kr. Jha, T-6 Subject Matter Specialist (Plant Protection)

Shri Sanjay Kumar Pandey, T-6 Subject Matter Specialist (Agronomy)

Dr. Zachariah George, T-6 Subject Matter Specialist (Animal Science)

Shri Chandrika Ram, T-6 Subject Matter Specialist (Agri. Engineering)

Dr. Viveka Nand Singh, T-6 Subject Matter Specialist (Horticulture)



# COMMITTEES OF THE INSTITUTE

## Research Advisory Committee from June 2010

| | | |
|---|---|---|
| Dr. K. Pradhan | - | Chairman |
| Dr. S. Edison | - | Member |
| Dr. R. P. Tewari | - | Member |
| Dr. Shyam Singh | - | Member |
| Dr. Umesh Srivastava | - | Member |
| Dr. Y. Basavaraju | - | Member |
| Dr. R.C. Srivastava, Director | - | Member |
| Smt. Uma Bharti | - | Non Official Member |
| Shri Mohammed Azimuddin | - | Non Official Member |
| Dr. Jai Sunder | - | Member Secretary |

## IJSC Members

| | | |
|---|---|---|
| Dr. R.C. Srivastava, Director | - | Chairman |
| Dr. A. Kundu, | - | Official Member |
| Dr. Krishna Kumar | - | Member |
| Dr. Subhash Chand | - | Member |
| Finance & Accounts Officer | - | Member |
| Estate Officer | - | Member |
| Shri K. Naryanan | - | Staff Side Member |
| Shri Harishankar Prasad | - | Member |
| Shri Prasanta Kumar Das | - | Member |
| Shri B. Mahadevaiah | - | Member |
| Shri K. Ali | - | Member |
| Sr. Administrative Officer i/c | - | Member Secretary |

## Institute Management Committee

| | | |
|---|---|---|
| Dr. R.C. Srivastava | - | Chairman |
| Dr. R.V. Nair | | Member |
| Dr. D.P. Singh | - | Member |
| Dr. Akella Vani | - | Member |
| Dr. A. Gopalakrishnan | - | Member |
| ADG (H-II) | - | Member |
| Finance & Accounts Officer | - | Member |
| Finance & Accounts Officer, (CRIJAF, Barrackpore) | - | Member |
| Smt. Uma Bharti | - | Member |
| Shri Mohammed Azimuddin | - | Member |
| SAO i/c | - | Member Secretary |

## Official Language Implementation Committee

| | | |
|---|---|---|
| Dr. R.C. Srivastava, Director | - | Chairman |
| Dr. N. Ravisankar | - | Member |
| Dr. Jai Sunder | - | Member |
| Dr. S.K. Zamir Ahmed | - | Member |
| Dr. M. Balakrishnan | - | Member |
| Shri Abhishek Srivastava | - | Member |
| Shri Joseph George | - | Member |
| Shri P. Gangopadhyay | - | Member |
| Shri A.K. Tripathi | - | Member |
| Shri S.K. Verma | - | Member Secretary |

## Purchase Advisory Committee

| | | |
|---|---|---|
| Dr. Jai Sunder | - | Chairman |
| Finance & Accounts Officer | - | Member |
| Dr. N. Ravisankar | - | Member |
| Dr. P. Krishnan | - | Member |
| Dr. S. Jeyakumar | - | Member |
| Sr. Administrative Officer i/c | - | Member Secretary |

## Works Committee

| | | |
|---|---|---|
| Dr. A. Kundu | - | Chairman |
| Sr. Administrative Officer i/c | - | Member |
| Finance & Accounts Officer | - | Member |
| Estate Officer | - | Member Secretary |

## Condemnation Committee

| | | |
|---|---|---|
| Dr. Jai Sunder | - | Chairman |
| Sr. Administrative Officer i/c | - | Member |
| Finance & Accounts Officer | - | Member |

| | | |
|---|---|---|
| Asstt. Administrative Officer (Store) | - | Member Secretary |

**Price Fixation Committee**

| | | |
|---|---|---|
| Dr. A. Kundu | - | Chairman |
| Dr. Kamal Sarma | - | Member |
| Dr. M. Shankaran | - | Member |
| Finance & Accounts Officer | - | Member |
| Sr. Administrative Officer i/c | - | Member |
| Farm Manager, Sipighat Farm | - | Member Secretary |



# NEW ENTRANTS / TRANSER / PROMOTION / RETIREMENTS

## New Entrants

- Dr. Raj Kumar Gautam, Head of Division, Field Crops joined on 30th August, 2010
- Dr. K. Deva Kumar, Senior Scientist joined on 30th August,2010
- Dr. V. Baskaran, Senior Scientist joined on 30th August, 2010
- Shri Sanjay Kumar Jha, T-6 (SMS), joined on 17th September, 2010
- Dr. Awnindra Kumar Singh, Senior Scientist joined on 14th February, 2011
- Shri Sanjay Kumar Pandey, T-6 (SMS), joined on 18th February, 2011
- Shri Amit Srivastava, T-6, joined on 18th February, 2011
- Shri Ajay Kumar Pandey, T-4, joined on 19th February, 2011
- Dr. Zachariah George, T-6 (SMS), joined on 22nd February, 2011
- Er. Chandrika Ram, T-6 (SMS), joined on 28th February, 2011
- Dr. Sanat Kumar, T-4, joined on 28th February, 2011
- Shri Ashish Singh Yadav, T-3, joined on 1st March, 2011
- Smt. Poonam, Lower Division Clerk, joined on 1st March, 2011
- Smt. C. Siji, Lower Division Clerk, joined on 1st March, 2011
- Dr. Viveka Nand Singh, T-6 (SMS), joined on 7th March, 2011
- Shri P. Kakesh Rao, Lower Division Clerk joined on 7th March, 2011
- Miss. Harapriya Nayak, T-6 (SMS), joined on 9th March, 2011
- Miss. Nutan Kumari Yadav, T-1, joined on 19th March, 2011

## Transfer

- Dr.S. Dam Roy, Head of Division transferred on 22nd June, 2010 at CIFE, Mumbai
- Dr. C.S. Chaturvedi, Sr. Scientist transferred on 13th August 2010 at CIFE, Mumbai
- Dr. Someshwar Bhagat, Scientist transferred on 29th December, 2010 at NCIPM, New Delhi
- Shri M. Krishnan, A.A.O transferred on 5th February at NRC for Banana, Tiruchirapalli
- Shri Abhishek Srivastava, A.O transferred on 5th March, 2011 at CSSRI, Karnal

## Promotion

- Shri Bipul Chandra Roy, T-3 got promoted to T-4 on 13th September, 2006
- Shri S. Murugesan, T-5 got promoted to T-6 on 4th January, 2009
- Shri Arul Selvam, T-5 got promoted to T-6 on 1st November, 2009
- Shri Anjan Sengupta, T-4 got promoted to T-5 on 3rd February, 2010
- Shri N.K.D. Pillai, T-4 got promoted to T-5 on 3rd February, 2010
- Shri Theophil Gidh, T-3 got promoted to T-4 on 15th March, 2010
- Shri R.C. Das, T-3 got promoted to T-4 on 20th April, 2010
- Shri H.N. Mukherjee, T-5 got promoted to T-6 on 20th April, 2010
- Shri K. Narayanan, T-2 got promoted to T-3 on 21st April, 2010
- Smt. Ashima Saha, Sr. Clerk got promoted to Assistant on 31st December, 2010
- Shri P.K. Roy, Sr. Clerk got promoted to Assistant on 31st December, 2010
- Shri D. Mohan Rao, Sr. Clerk got promoted to Assistant on 31st December, 2010

- Shri S.P. Narayan, Jr. Clerk got promoted to Sr. Clerk on 31st December, 2010
- Shri S.K. Biswas, Sr. Clerk got promoted to Assistant on 31st December, 2010
- Shri Karapaya, Sr. Clerk got promoted to Assistant on 31st January, 2011
- Shri Praksh Mondal, Jr. Clerk got promoted to Sr. Clerk on 31st January, 2011
- Shri P.K. Das, Jr. Clerk got promoted to Sr. Clerk on 31st January, 2011
- Shri M.S.R.C Murthy, H.S.W got promoted to Jr. Clerk on 31st January, 2011
- Smt. P. Janaki, Supdt-cum-Accountant got promoted to Asstt. Administrative Officer on 7th March, 2011

### Retirement

- Shri R. Kondaiah, T-4, Driver retired on 30th June, 2009
- Shri Ratia Kullu retired on 30th June, 2010
- Shri K. Jayaprakash retired on 31st December, 2010
- Shri K.D. Murthy on 31st January, 2011
- Shri Phalguni Gangopadhayay, T-6 retired on 28th February, 2011
- Shri Dominic Ekka retired on 31st March, 2011

## Weather Parameters (2010-11) at CARI, Port Blair (110.36'.35" N, 92.42'.54" E)

| Month & Year | Rainfall (mm) | Rainy days | Maximum T (°C) | Minimum T (°C) | RH (%) | Wind speed (KMPH) | Solar radiation (W/m²) |
|---|---|---|---|---|---|---|---|
| April ' 10 | 47.0 | 3 | 34.5 | 24.6 | 84 | 3.6 | 152 |
| May ' 10 | 208.3 | 8 | 34.8 | 25.8 | 88 | 3.8 | 102 |
| June ' 10 | 434.6 | 11 | 32.1 | 25.5 | 90 | 4.3 | 87 |
| July ' 10 | 454.8 | 13 | 31.4 | 24.9 | 92 | 5.2 | 85 |
| Aug ' 10 | 156.2 | 6 | 30.7 | 25.1 | 92 | 3.9 | 75 |
| Sept ' 10 | 50.4 | 3 | 31.3 | 24.9 | 93 | 3.1 | 86 |
| Oct ' 10 | 295.4 | 15 | 31.0 | 24.8 | 92 | 3.6 | 80 |
| Nov ' 10 | 257.8 | 12 | 31.5 | 24.6 | 91 | 2.9 | 73 |
| Dec ' 10 | 72.6 | 5 | 30.5 | 23.4 | 89 | 3.8 | 70 |
| Jan ' 11 | 123.4 | 6 | 29.3 | 22.4 | 89 | 2.5 | 72 |
| Feb ' 11 | 279.0 | 4 | 29.8 | 22.6 | 89 | 2.6 | 93 |
| Mar ' 11 | 532.8 | 13 | 29.6 | 21.5 | 90 | 2.5 | 85 |

**Rainfall during 2010-11**