NBPGR

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National Bureau of Plant Genetic Resources
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CONTENTS

ACRONYMS

AFLP	Amplified Fragment Length Polymorphism
AICRP	All India Coordinated Research Project
ARIS	Agricultural Research Information System
AVRDC	Asian Vegetable Research and Development Center
BARC	Bhabha Atomic Research Center
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CMS	Cytoplasmic Male Sterility
CPGR	Commission on Plant Genetic Resources
CSCNRVC	Central Sub-Committee on Crop Standards, Notification and Release of Varieties of Agricultural Crops
CSIR	Council of Scientific and Industrial Research
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DFID	Departmental Fund for International Development
DPPQ&S	Department of Plant Protection, Quarantine & Storage
DRDO	Defense Research and Development Organization
EC	Exotic Collection
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
GHU	Germplasm Handling Unit (of NBPGR)
GPA	Global Plan of Action
IARC	International Agricultural Research Center
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IFPGR	International Fund for Plant Genetic Resources
INIBAP	International Network for the Improvement of Banana and Plantain
INPGRS	Indian National Plant Genetic Resources System
IPGRI	International Plant Genetic Resources Institute
IC	Indigenous Collection
ISPGR	Indian Society of Plant Genetic Resources
ITK	Indigenous Traditional Knowledge
IUPGR	International Undertaking on Plant Genetic Resources
LTS	Long Term Storage
MTA	Material Transfer Agreement
MTS	Medium Term Storage
NAAS	National Academy of Agricultural Sciences
NAGS	National Active Germplasm Sites
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NBPGR	National Bureau of Plant Genetic Resources
NGO	Non-Governmental Organization
NHCP	National Herbarium of Cultivated Plants
NRC	National Research Center
PEQN	Post-Entry Quarantine Nursery
PGRFA	Plant Genetic Resources for Food and Agriculture
SAU	State Agricultural University
STMS	Sequence Tagged Microsatellite Site
TRIPS	Trade Related Intellectual Property Rights

PREFACE

The National Bureau of Plant Genetic Resources (NBPGR) is a nodal organization for management of Plant Genetic Resources (PGRs) in India. Established by the Indian Council of Agricultural Research (ICAR) in 1976 with its headquarters in New Delhi, it has a network of 11 regional stations located in different agroclimatic zones of the country and one experimental farm at Issapur, New Delhi. Since its establishment, NBPGR has responded very dynamically to the needs, challenges and opportunities of PGRs and redefined its mandate, plans and programmes accordingly.

The significant achievements of various PGR activities during 2004 namely exploration and collection of germplasm of crop plants and their wild relatives, introduction of exotic germplasm for specific traits in a pest-free state, characterization and evaluation for identification of promising accessions, regeneration/ maintenance of germplasm, *ex-situ* conservation of germplasm in national genebank, tissue culture and cryopreservation, accessioning and data documentation, and DNA Fingerprinting of promising genotypes and released varieties are given in the report under different chapters. Germplasm evaluation in collaboration with Project Coordinators/ Project Directorates/ crop based institutes of ICAR and emphasis on germplasm utilization and pre-breeding deserve special mention.

NBPGR held regular meetings of its Institute Management Committee (IMC), Research Advisory Committee (RAC), Staff Research Council (SRC), Germplasm Advisory Committee (GAC) and Institute Joint Staff Council (IJSC), which led to the development of a more cohesive, and clear-cut target oriented programmes. Besides several training programmes, NBPGR also organized a National Conference on Transgenics in Indian Agriculture from 9-10 March 2004.

It is a pleasure to place on record my sincere thanks and gratitude to Dr Mangala Rai, Secretary, Department of Agricultural Research and Education & Director General, Indian Council of Agricultural Research, and to Dr G Kalloo, Deputy Director General (Crop Sciences & Horticulture), ICAR for their continued guidance and support in executing the mandate of NBPGR. I thankfully acknowledge the contributions of scientists, technicians and other staff of NBPGR in meeting our mandate objectives.

I take this opportunity to make a special mention of the efforts of Drs Arjun Lal, (Mrs) Neeta Singh and KC Bhatt in compiling and editing the report meticulously.

BS Dhillon

New Delhi
23 July 2005

BS Dhillon
Director

EXECUTIVE SUMMARY

PLANT EXPLORATION AND COLLECTION OF GERMPLASM

NBPGR and various cooperators undertook a total of 115 explorations across the country under NATP-PB project and collected 7,623 accessions of various agri-horticultural crops and their wild relatives. Out of these, the Headquarters, New Delhi through 12 explorations, collected 691 accessions. A total of 185 accessions comprising cereals (7), millets (12), pulses (25), oilseeds (11), vegetables (54), horticultural crops (10), fibre crops (10), spices (14), medicinal plants (9), ornamentals (1), dye yielding plants (2), miscellaneous (1) and wild relatives (29) were collected from Konkan and western region of Maharashtra by Regional Station, Akola; and Bhowali station collected 458 collections from Uttaranchal. During three explorations, Base Center, Cuttack collected 384 accs. comprising cultivated rice, vegetable crops, turmeric, jute, allied fibres, M&AP and wild relatives of crop plants; 1524 accessions comprising paddy, pearlmillet, minor millets, niger, *Pongamia* sp., tuber crops, pulses, ginger, turmeric, grapes, medicinal and aromatic plants and their wild relatives were collected during 13 explorations by Hyderabad station; 277 collections comprising cereals (5), millets (59), oilseeds (1), fruits (96), medicinal and aromatic plants (62), multipurpose tree (62), dye yielding (1) and wild relatives (3) were made during five explorations by Jodhpur station; 277 collections comprising cereals (5), millets (59), oilseeds (1), fruits (96), medicinal and aromatic plants (62), multipurpose trees (62), dye yielding (1) and wild relatives (3) were made during six explorations by Ranchi station; 1,327 accessions of various crop plants and their wild relatives were collected during eleven explorations from NEH region by Shillong station; 618 accessions during nine explorations by Shimla station; 252 collections were made from different areas of Kashmir, Jammu and Ladakh (J&K) by Srinagar station and 1037 collections were made from Kerala, Karnataka, Goa, Tamil Nadu, Andhra Pradesh, A&N islands by Thrissur station. Vegetatively propagated planting material was established near the collection sites (at the NBPGR regional stations or identified NAGS in the region) while orthodox seeds were stored in MTS or LTS in national genebank.

Special exploration missions were undertaken in Sunderban delta, Chhattisgarh (for the collection of M&A P), cold desert tract of Himachal Pradesh, Jammu & Kashmir (for collection of minor fruits), southern Rajasthan (for the collection of minor fruits and *Jatropha*), western Maharashtra (for the collection of dye yielding plants), Arunachal Pradesh, Sikkim, Nagaland, Mizoram and Meghalaya (for collection of M&AP, orchids etc.).

Some important collections made included rare and endangered plants like *Crocus sativus*, *Gloriosa superba*, *Taxus baccata*, *Solanum khasianum*, *Saussurea lappa*, *Swertia chirayita*, *Dactylorhiza hatageria*, *Picrorrhiza kurroa*, *Rheum australe*, *Rauvolfia serpentina*, *Hedychium coronarium*, *Abelmoschus moschatus* ssp. *tuberosus*, *Nephelium ramboutan-ake* (edible rambutan-like fruits, superior to true rambutan with an average fruit weight of 50 g/fruit and with better shelf-life of 5 days), *Garcinia wightii* (wild mangosteen with sour aril, can be used as a rootstock for

mangosteen), cucumber (small white salad landrace of cucumber, cultivated commercially).

A total of 904 herbarium specimens and samples were added to the National Herbarium of Cultivated Plants.

EXCHANGE OF GERMPLASM

During the period under report 28,437 accessions (78,571 samples) were imported from 51countries and these included germplasm (14,173 accessions) as well as trial material (14,264 entries; 64,398 samples) of different agricultural and horticultural crops. Requirement for germplasm from abroad was met by arranging material from different sources from India and 132 samples were sent to nine countries. Based on requests received from research workers in the country, 13,008 samples of diverse crops were supplied to users for crop improvement programs in the country. Trait specific germplasm introduced in various crops is highlighted here under.

Oryza sativa: EC539103-10, EC546740 from Philippines for BPH resistance; EC 539111-118 for bacterial blight resistance; EC539131-38 for blast resistance; var MR 219, MR 220 (EC548000-001) from Malaysia for multiple disease resistance; var. Boliviar (EC550177) for resistance to blast and narrow brown leaf spot (*Cercospora janseana*), from USA. var. Saber from USA for resistance to blast *(Pyricularia grisea*) and sheath blight (*Rhizoctonia solani*), brown leaf spot (*Cercospora janseana*), leaf smut (*Entyloma oryzae*) and panicle blight.

Triticum aestivum: var. Bigsky (EC538958), EC550180 and EC550181 from USA for resistance to stem rust; var. Outlook (EC541189) from USA for resistance to wheat aphid (*Diuraphis noxia*) due to presence of resistance gene Dn4, stem rust (*Puccinia graminis*) and moderately resistant to stagonospora blotch (*Stagonospora nodurum*); var. Deloris EC552125 from USA for resistance to dwarf bunt (*Tilletia controversa*); var OK 101 (EC5438493) from USA for resistance to wheat soil borne mosaic virus; var. Caledonia (EC550175) and var. Richland (EC 550176) from USA for resistance to loose smut (*Ustilago tritci*), *Wheat spindle streak mosaic virus* and soil borne *Wheat mosaic virus.*

Zea mays: EC 546871 from Indonesia for downey mildew resistance.

Hordeum vulgare: EC 538157 from USA for resistance to stripe rust, *Barley yellow dwarf virus*, leaf rust, powdery mildew, net blotch and scald; var. UC 969 (EC538158), var. UC 960 (EC538159), var. UC 937 (EC538160) from USA for resistance to *Barley yellow dwarf virus*, leaf rust, net blotch and scald.

Panicum miliaceum: EC 552153 from USA for resistance to Russian wheat aphid (*Diuraphis noxia*), head rot associated with stem maggot (*Meromyza* sp.) and European corn borer (*Ostrinia nubilalis).*

Glycine max: var. Washita (EC537946) and EC538829 from USA for resistance to root knot nematodes (*Meloidogyne incognita);* var. Catoosa (EC537947) from USA for resistance to soybean cyst nematode (*Heterodera glycines*) and root knot nematode (*Meloidogyne incognita);* EC538800 from USA for rust resistance; EC539008 from USA for resistance to phytophthora rot (*Phytophthora sojae*) and races 3 and 14 of soybean cyst nematode .

Cicer arietinum: EC 539009 from Spain for resistance to Ascochyta blight (*Ascochyta rabie*).

Cicer echinospermum (EC539329 and EC541555-556) Fusarium wilt resistance; *Cicer bijugum* (EC541549-50) for resistance to leaf miner, bruchids and ascochyta blight. *Cicer judaicum* (EC541557-558) for resistance to leaf miner, bruchids and ascochyta blight and EC 541561-62 for resistance to bruchids and cyst nematode; *Cicer pinnatifidum* (EC541559) for Fusarium wilt resistance - all species from ICARDA, Syria.

Phaseolus vulgaris: EC537955 from Canada for resistance to *Bean common mosaic virus* and Fusarium wilt (*Fusarium oxysporum);* Var. Orca (EC538843) from USA for resistance to *Bean common mosaic virus*, Curly Top Virus (CTV), root rot complex caused by *Fusarium solani, Rhizoctonia solani* and *Pythium* sp.; var. Emgopa 201-OURO (EC541908) from Brazil for resistance to *Bean common mosaic virus* and angular leaf spot (*Phaeoidariopsis griseola*); EC 540793-794 from CIAT, Columbia for resistance to angular leaf spot, caused by *Phaeoisariopsis griseola* and anthracnose (*Colletotrichum lindemuthianum*).

Pisum sativum: var. Accord .EC 538177 resistant to fusarium wilt race 1, 2 and 5; var. Barok. (EC 538178) resistant to fusarium wilt race 1, 2 and 5; var. Bridger. (EC 538179) resistant to Common Pea Mosaic Virus and Common Wilt Virus; var. Duke EC 538180 for resistance to Fusarium race-1, powdery mildew all from USA.

Carthamus tinctorius: EC548822 for resistance to Alternaria, Pseudomonas bacterial blight and head rot; EC548825-29 for resistance to verticillium wilt; EC548830-46 for resistance to phytophthora root rot; EC548847-48 for resistance to verticillium wilt, striped hull; EC548849 for resistace to thrips-all from USA.

Linum usitatissimum: EC 541217-223 for rust resistance; EC541218 and EC541226 for Fusarium wilt resistance - all from Russia.

Cucumis melo: Var. TGR 1551 EC 541901 from Spain for resistance to *Cucumber mosaic virus*; EC 539195-219 from USA for tolerance to *Cucumber mosaic virus* (CMV) and fusarium wilt.

Lycopersicon esculentum: EC538398-400 for resistance to bacterial wilt, *Tobacco mosaic virus*; EC 538415-416 for resistance to white fly transmitted gemini virus (WTG), bacterial wilt (BW), *Tobacco mosaic virus*, Fusarium wilt race 1 (F1); EC538429-431 for fruit worm resistance; EC 538432-435 and EC538432-435 for resistance to bacterial wilt, TMV, leaf blight and fusarium wilt; EC542063. for resistance to tomato spotted wilt virus- all from AVRDC, Taiwan.

Capsicum sp.: EC 538331-32 for resistance to anthracnose, tolerant to aphids; EC 538333-34 and EC538351 for resistance to bacterial wilt, bacterial black spot and potato virus Y; EC 538335-339 tolerant to fruit and shoot borer, resistant to bacterial wilt and leaf hoppers-all from AVRDC, Taiwan.

Solanum melongena: EC550890 from Philippines for having tolerance to fruit and shoot borer, resistant to bacterial diseases.

Besides, promising genotypes for abiotic stress tolerance were introduced in rice (EC 39139-44 for iron toxicity, EC541909-916 for submergence tolerance, EC541917-928 for salinity tolerance, EC541929-939 for zinc deficiency tolerance; EC546319-340 for phosphorus deficiency tolerance); in wheat (EC538236-56 for salinity tolerance; EC548493 for acidic soils); in maize (EC 552705-08 for acidic soil tolerance), in barley (EC 540807 for

drought tolerance); in *Panicum miliaceum* (EC 552154 for lodging tolerance); in soybean (EC 37946 for lodging tolerance, EC 538805, EC538811-12 for drought tolerance; EC538823-30 for drought and heat tolerance); in pea (EC548807-13 for stiff stem, lodging resistance); in tomato (EC538417-20 for heat tolerance) and in cotton (EC541867-76 for upland cultivation and resistance to adverse conditions).

QUARANTINE OF GERMPLASM

At New Delhi, a total of 28,668 accessions (78,772 samples) comprising 28,536 exotic accessions (78,640 samples, including 64,398 samples of international nurseries trial/ breeding material) of various crops and 132 accessions under export were processed for quarantine clearance. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 4,798 samples were found infested/infected contaminated with various pests *viz.*, insects/ mites -4,257 samples including 219 samples with hidden infestation; nematodes- 242; fungi/ bacteria- 122; and viruses- 177. Of the 4,798-infested/ infected/-contaminated samples, 4,756 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip, ethyl alcohol wash and mechanical cleaning. Forty-two samples of soybean from USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. Twenty-one Phytosanitary Certificates were issued for consignments meant for export. A total of 2,395 samples collected indigenously were processed for pest-free conservation. Of the 279 infested/ infected samples, 217 were salvaged and 2,676 samples were released for pest-free conservation. Six-thousand-five-hundred-and ninety-eight samples of transgenic crops *viz.*, paddy and wheat, were processed for quarantine clearance. Based on the field studies on virus spread, the seed standards for certification against *Soybean mosaic virus* (SMV) of soybean and *Black-eye cowpea mosaic virus* (BlCMV) of cowpea is concluded as 0.5%. Diagnostic kits against both SMV and BlCMV were prepared and can be efficiently utilized for quality control of seeds.

At Hyderabad, a total of 19,500 samples (11,474 import and 8,026 export samples) were processed for quarantine clearance and 150 phytosanitary certificates were issued. Several pathogens of quarantine importance were intercepted. A total of 2,472 import samples was found infested/ infected with pests/ pathogens of which 2,360 samples could be salvaged but 76 samples, infected with quarantine pathogens could not be salvaged and were detained. A total of 36 samples were rejected as they were infected with pathogens. In exports, 184 samples were rejected due to the association of quarantine pests/ pathogens. Quarantine service was extended to more than 30 organizations in South India.

CHARACTERIZATION, EVALUATION AND MULTIPLICATION OF GERMPLASM

Germplasm (introduced and indigenous) was grown in augmented block design with appropriate checks for characterization/ evaluation for identification of promising genotypes for various traits or grown for regeneration and seed increase. Collaborative evaluation of 23 crops was also initiated involving NBPGR stations and National Active Germplasm Sites (NAGS).

At the Experimental Farm, Issapur and

Headquarters, New Delhi, 9,375 accessions of different agri-horticultural crops, *viz*., cereals (6,625), legumes (635), oilseeds (496), vegetables (695), forages (230), under-utilized crops (392) and medicinal and aromatic plants (302) were grown for characterization, evaluation, multiplication and maintenance. Besides, a total of 4,105 accessions of various crops comprising cereals (2,265), pulses (701), oilseeds (250), vegetables (664), under-utilized crops (80) medicinal and aromatic plants (145) were grown for regeneration and seed increase. One-hundred-and-thirty accessions of perennial horticultural crops were also maintained in the field genebank. Promising accessions for various agro-morphological characters were identified. Germplasm evaluation of crops namely rapeseed mustard (760), sunflower (250), *Perilla* (44), walnut (29), pulses (541), wheat (81) and barley (49) for quality attributes also resulted in identification of promising accessions. Phytochemical studies of various medicinal and aromatic plants (M&AP) were also undertaken. Multi-location evaluation of chickpea resulted in identification of promising entries for biotic and abiotic stresses. Collaborative evaluation of 23 crops was also undertaken. Annual reports on germplasm evaluation for 2000, 2001, *kharif* (2003) and horticultural crops (2003-04) were compiled and distributed to concerned PCs/ PDs. Two germplasm field days were organized to promote interaction with plant breeders/ user scientists.

At Akola, a total of 8,989 accessions comprising NATP (1,023), pre-NATP (7,794), AVT (22) and multi-location (150) accessions were grown during *kharif* and *rabi*, A total of 1,033 accessions comprising millets (251), pulses (248) and oilseeds (534) were conserved in the National Genebank. A total of 1,969 samples were supplied to various indentors.

At Bhowali, a total of 731 accessions were grown for regeneration, characterization and maintenance, 1,189 accs. deposited in National genebank for LTS and 108 accs. supplied to user scientists. Elite planting material of *Allium tuberosum, A. schoenoprasum, Artemisia annua,* rose geranium, lavender, lemon grass, rosemary, kiwi, and *Cryptomeria japonica* were distributed to the farmers in Uttaranchal for their popularisation.

At Cuttack, a total of 1,862 accs. comprising cultivated rice (1,190), turmeric (132), mungbean (40) and sesame (500) were grown for preliminary characterization and seed multiplication.

At Hyderabad, 1,976 accessions of different agri- horticultural crops comprising of brinjal, chillies, blackgram, finger millet, maize, sorghum, tomato and other agri-horticultural crops and wild species were sown/ maintained for evaluation/ rejuvenation/ multiplication. A total of 1,979 samples of different agri-horticultural crops were added to the MTS facility during 2004 making a total of 51,959 germplasm samples as on 31.12.2004. The multiplied accessions of exotic germplasm comprising paddy (274), wheat (114), sorghum (46), and pearlmillet (97) were sent to the National Gene Bank (NGB), New Delhi for long-term conservation. Three germplasm awareness days for sunflower, pigeonpea, groundnut and a short-term training programme on 'Intellectual Property Rights and PGR Management' were organized.

At Jodhpur, observation were recorded on 1,219 accessions sown during Rabi, 2003; and 2,768 accessions sown in *kharif* 2004 and 606 accessions in *rabi* 2004. Data were also

recorded in Aonla, *Capparis decidua*, jamun, mulberry, *Salvadora* sp., *Aloe barbadensis*, *Andrographis paniculata*, *Jatropha curcas* and jojoba. A total 5,982 accessions were processed and kept in the MTS facility and 2,317 accessions deposited in genebank. Seed samples (1,677) were supplied to various indentors.

At Shillong, a total of 2,493 accessions were characterized and the promising genotypes for various attributes identified.

At Shimla, a total of 2,665 accessions of various agri-horticultural crops were characterized and multiplied for conservation and 359 accessions were sent for medium term storage as voucher specimens, 804 accessions for long-term storage and 55 accessions of wild fruits were sent for cryobank in the National Genebank. A total of 828 accessions of fruit crops, medicinal plants and ornamentals were conserved and maintained in field gene bank, 758 new germplasm accessions were added to the MTS maintained at Shimla and 958 were replaced by rejuvenation. Germplasm accessions comprising agricultural crops (1194) and horticultural crops (465) were supplied to various indenters.

At Thrissur, rice (196 accs. in *rabi* and 360 accs. in *kharif*), horsegram (197), lablab bean (19), bittergourd (15), taro (60), greater yam (194), jackfruit (72), turmeric (159), black pepper (20), Malabar tamarind (5), *Mucuna* (15), *Curcuma* (275), and *Trichosanthes* (19) were characterized and evaluated using appropriate checks, and promising accessions for important traits were identified. Tissue culture plants of cassava (43 accs.), black pepper (28) and ginger (198) were maintained *in vitro*. A total of 792 accessions were supplied to 15 user agencies. A total of 775 accessions (306 from explorations and 469 from regenerated/ multiplied germplasm) were deposited in National Genebank for LTS and 229 accs. for cryopreservation.

CONSERVATION OF GERMPLASM

A total of 31,935 germplasm accessions (orthodox seeds) of various crops and their wild relatives were received for long-term conservation in the National Genebank. These were processed following the genebank standards. Out of these 25,793 accessions were added to the base collection, raising the total germplasm holding to 2,87,028. A total of 7,281 accessions out of the 12,103 received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (2,733 accessions) and updating of passport data (2,909 accessions) were carried out. Longevity of castor, groundnut, pigeonpea, sponge gourd and cotton was found to be more when seeds were dried to ultra low moisture contents (1 to 3% moisture). Methods for breaking seed dormancy in *Kigelia pinnata, Chlorophytum borivillianum* and *Caturegehum spinosa* were established.

TISSUE CULTURE AND CRYOPRESERVATION OF GERMPLASM

A total of 1579 accessions belonging to fruit crops, bulbous and tuber crops, medicinal, aromatic and rare/ endangered plants, spices, plantation and new industrial crops, and others were conserved as *in vitro* cultures under culture room conditions and/ or at low temperature. The average subculture duration ranged from 4-24 months, depending on the species. Research emphasis was laid on standardizing *in vitro* slow growth and cryopreservation protocols in different species. Plantlet regeneration protocols were standardized in *Allium fistulosum* and

Curculigo orchioides. *In vitro* corms were induced in *Colocasia esculenta*. *In vitro* slow growth experiments yielded varying degree of success in alliums, *Bacopa monnieri, Colocasia esculenta, Curcuma longa, Elettaria cardamomum, Gentiana* and *Plumbago*. Cryopreservation experiments yielded encouraging results in *Allium chinense, Bacopa, Gentiana, Humulus lupulus* and *Musa*. Employing RAPD and ISSR markers, no differences were observed, between *in vitro*-conserved clones and their respective mother clones, in *Zingiber officinales,* and between R_0 plants and their respective mother plants, in *Colocasia esculenta*. A total of 61 accessions of *Musa* and one *Gladiolus* cultivar were supplied as *in vitro* cultures to various indentors. A total of 5,810 accessions of orthodox, intermediate and recalcitrant seed species were conserved in the cryobank. Pollen of 102 accessions of mango and dormant buds of 20 accessions of mulberry were successfully cryostored.

DNA FINGERPRINTING

A total of 778 crop varieties and elite landraces were analysed for DNA fingerprinting during the year. Microsatellite fingerprinting (STMS) was conducted in rice, wheat, pea, soybean and cotton while AFLP was used to fingerprint varieties of lentil and pigeon pea.

OTHER ACTIVITIES

- Meetings of the Institute Management Committee, Research Advisory Committee, Staff Research Council and the Institute Joint Staff Council were held timely to review the progress of work related to PGR activities and planning strategies to strengthen various activities and infrastructure to achieve the targets.
- The scientists, research associates, technical and administrative staff from headquarters and its regional stations participated in a number of seminars, conferences, workshops, trainings and summer institutes to exchange ideas and upgrade their skills. Three scientists participated in International symposia. Details of these participations are given under General Information.
- Several distinguished scientists, farmers, administrators, policy makers and students visited the National Genebank, DNA Fingerprinting labs, plant quarantine glasshouses, National Containment Facility (C4 level) and tissue culture labs at the Headquarters, New Delhi and field genebanks at Issapur, Akola, Bhowali, Cuttack, Hyderabad, Jodhpur, Ranchi, Shillong, Shimla, and Thrissur.
- NBPGR organized a National Conference on "Transgenics in Indian Agriculture" from 9-10 March, 2004 at NASC, Pusa campus New Delhi.
- The following training programmes were organized by NBPGR: on "Wild Relatives of Crop Plants" at New Delhi; on "Plant Varieties Protection and Farmers' Rights" (PVPFR) at Hyderabad; Fifth Orientation Course on "Biosafety Considerations for Evaluation of Transgenic Crops" at New Delhi; training programme on "Principles and Techniques of Seed Storage and Genebank Management" at New Delhi and a short-term training programme on 'Intellectual Property Rights and PGR Management' at Hyderabad.
- Field days were organized for *rabi* and *kharif* crops at the experimental farm, Issapur, New Delhi, Jodhpur, Hyderabad, Shimla, and Thrissur in which plant breeders from ICAR and SAUs participated

and selected germplasm accessions for crop improvement programmes.

- **REGISTRATION OF PLANT GERMPLASM AND FARMERS' VARIETIES:** Four meetings of the Plant Germplasm Registration Committee of ICAR were held under the Chairmanship of Dr G Kalloo, DDG (Horticulture and Crop Science), ICAR at NBPGR, New Delhi. A total of 247 proposals were received for germplasm registration and 121 germplasm lines were registered in the National Genebank.

Ph.D. Course in PGR - A New Initiative

The National Bureau of Plant Genetic Resources (NBPGR), in collaboration with the Post-Graduate School of the Indian Agricultural Research Institute (IARI) has developed and started Ph.D. degree programme in Plant Genetic Resources (PGR) from the academic session 2004-05. Limited seats are available to both Indian (3) and foreign (2) nationals. The candidates from India will be selected through a national level competitive examination conducted by the Post-Graduate School of IARI. The course is aimed to develop required skill and build-up confidence to carry on independent research on basic and applied aspects of PGR. For further details, please contact Director, NBPGR, New Delhi.

INTRODUCTION

The National Bureau of Plant Genetic Resources, commonly known as NBPGR was established by the Indian Council of Agricultural Research (ICAR) in 1976 with its main campus at New Delhi. Being the nodal organization in India it has been given the national mandate to plan, conduct, promote and coordinate all activities concerning plant exploration and collection and also for safe conservation and distribution of both indigenous and introduced genetic variability in crop plants and their wild relatives. The Bureau is also vested with the authority to issue Import Permit and Phytosanitary Certificate and conduct quarantine checks on all seed materials and plant propagules (including transgenic material) introduced from abroad or exported for research purposes.

Besides having a 40 ha experimental farm at Issapur village (about 45 km west of Delhi) the Bureau also has a network of 11 regional stations/base centres that provide access to representative agro-ecological situations in the country. It has strong linkages with leading crop-based Institutes, National Research Centers, All India Coordinated Crop Improvement Projects, State Agricultural Universities and other stake holders. NBPGR also works in close collaboration with several international institutes/organizations through memoranda/ workplans developed under bilateral/multilateral agreements. The Bureau not only provides genetic resources to on-going crop improvement programmes to sustain continued advances in agricultural productivity and stabilize production, but also conserves them safely to meet needs of future generations.

Organizational set-up

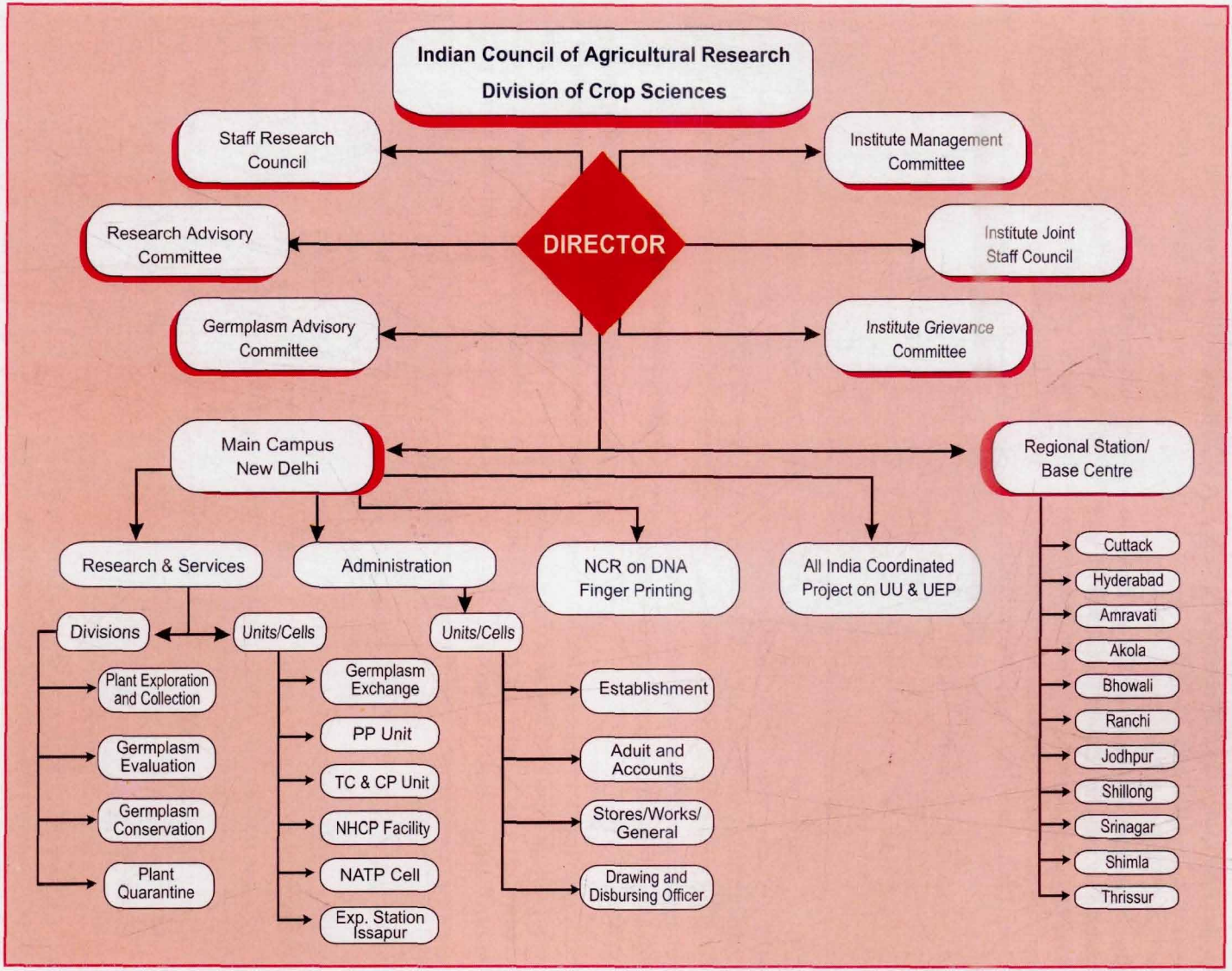
The Director, NBPGR is overall in-charge of administration, research management and coordination. The Institute Management Committee, Research Advisory Committee, Crop Advisory Committees and the Staff

MANDATE

To act as the nodal institute at national level for acquisition and management of indigenous and exotic plant genetic resources (PGR) for agriculture, and to carry out related research and human resource development for sustainable growth of agriculture.

Objectives :

- To plan, organize, conduct and coordinate exploration and collection of indigenous and exotic plant genetic resources.
- To undertake introduction, exchange and quarantine of plant genetic resources.
- To characterize, evaluate, document and conserve crop genetic resources and promote their use in collaboration with other national organizations.
- To develop information network on plant genetic resources.
- To conduct research, undertake teaching and training, develop guidelines and create public awareness on plant genetic resources.


Indian Council of Agricultural Research
Division of Crop Sciences
Staff Research Council
Institute Management Committee
Research Advisory Committee
DIRECTOR
Institute Joint Staff Council
Germplasm Advisory Committee
Institute Grievance Committee
Main Campus New Delhi
Regional Station/ Base Centre
Research & Services
Administration
NCR on DNA Finger Printing
All India Coordinated Project on UU & UEP
Divisions
Units/Cells
Units/Cells
Plant Exploration and Collection
Germplasm Evaluation
Germplasm Conservation
Plant Quarantine
Germplasm Exchange
PP Unit
TC & CP Unit
NHCP Facility
NATP Cell
Exp. Station Issapur
Establishment
Aduit and Accounts
Stores/Works/ General
Drawing and Disbursing Officer
Cuttack
Hyderabad
Amravati
Akola
Bhowali
Ranchi
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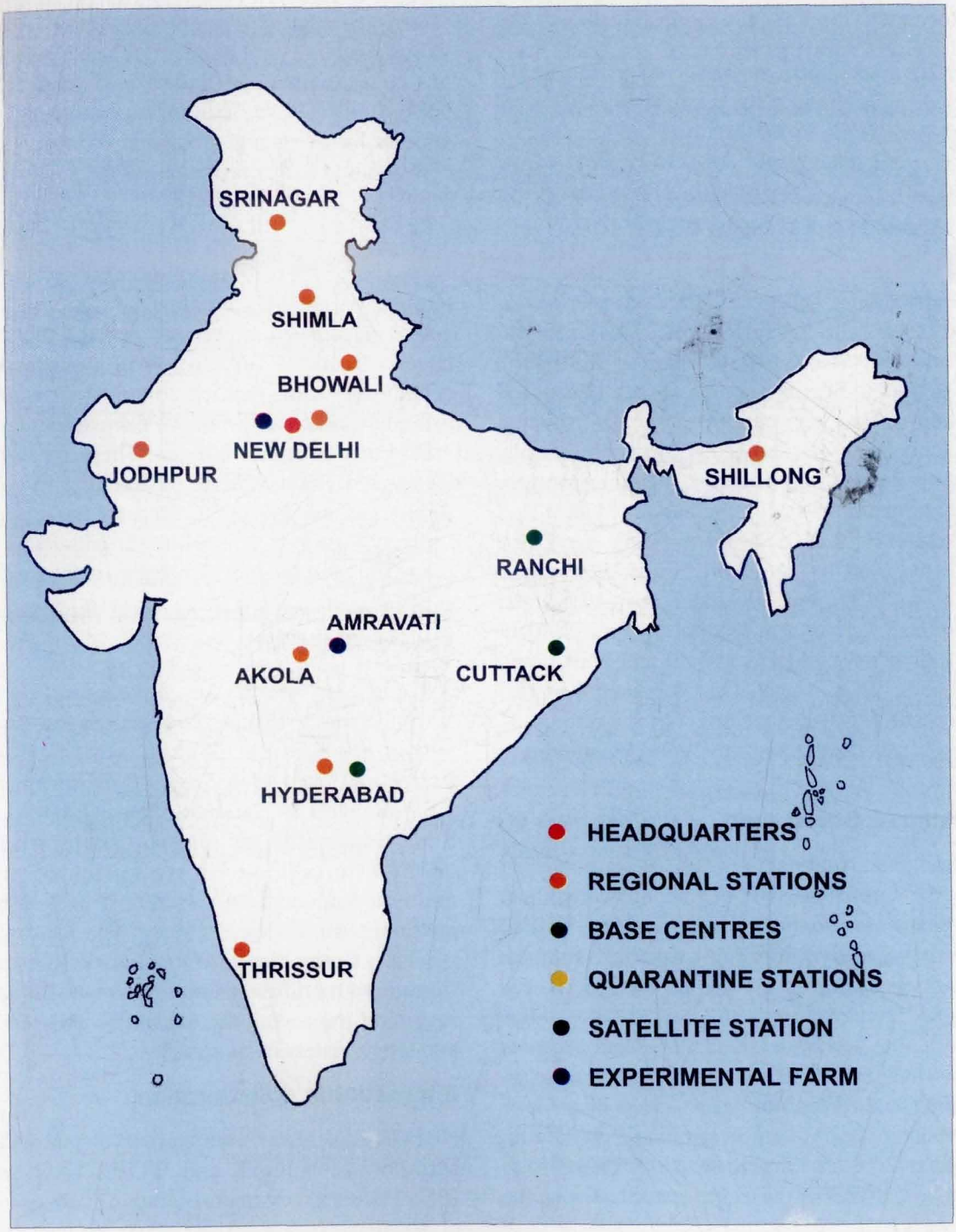
SRINAGAR
SHIMLA
BHOWALI
NEW DELHI
JODHPUR
SHILLONG
RANCHI
AMRAVATI
AKOLA
CUTTACK
HYDERABAD
THRISSUR
HEADQUARTERS
REGIONAL STATIONS
BASE CENTRES
QUARANTINE STATIONS
SATELLITE STATION
EXPERIMENTAL FARM

Research Council play important roles. The Bureau functions through its four main Divisions, namely i) Plant Exploration and Collection, ii) Plant Quarantine, iii) Germplasm Evaluation and iv) Germplasm Conservation. The Bureau has units of Germplasm Exchange, Tissue Culture and Cryopreservation (TC&CP), PGR and Policy Planning (PPU).

A principal scientist/senior scientist heads each Division/Unit. Other centralized services include units of Administration and Management, Purchase, Stores, Maintenance, Audit and Accounts, Security and Library. Regional Stations/Base Centres, headed by a principal scientist/senior scientist, are located at Shimla, Bhowali, Shillong, Jodhpur, Ranchi, Amravati, Hyderabad, Thrissur, Srinagar, Ranchi and Cuttack. It also houses NRC on DNA Fingerprinting, an All India Coordinated Research Project on Under-utilized Plants, National Agricultural Technology Project (Plant Biodiversity) and Household and Nutritional Food Security Project. The total sanctioned staff strength is 504 comprising 128 scientific, 127 technical, 78 administrative and 171 supporting staff.

National Genebank

The Indian National Genebank was established by the council at NBPGR to conserve national heritage of germplasm collections in the form of seeds, vegetative propagules, tissue/cell cultures, embryos, gametes etc. Based on experiences gained from working with a built-in cold storage vault obtained from UK in 1983, four modules (two units of 100 m^3 and two of 176 m^3 capacity) were installed for long-term storage of seeds of orthodox species kept in laminated aluminium foils at -20^{0}C after drying them to 5-7% moisture content. Stand-by diesel generator backs up the electricity supply. Vegetatively propagated clonal materials and recalcitrant seeds species are being maintained under field conditions backed up by tissue culture repositories. The Bureau has a strong programme on *in vitro* conservation and cryopreservation.

The new Genebank facility commissioned in 1997 has 13 modules, each with a storage capacity of 76,000 samples. One of these modules is used for medium term storage of active germplasm collections and the rest for base collections for long-term storage. Its cryopreservation facility contains six liquid nitrogen tanks (cryo-tanks), each containing 1000 litres of liquid nitrogen. These six cryo-tanks have a total capacity to store 0.25 million samples. Thus the new Genebank has a total capacity to store 1.25 million samples. This is one of the most modern Genebanks in the world.

Indian national plant genetic resources system (INPGRS)

NBPGR is gradually developing and strengthening the national plant genetic resources system by linking up the National Base Collection (kept under long-term storage at NBPGR) with 56 National Active Germplasm Sites responsible for different crops where germplasm collections are evaluated and multiplied under field conditions, backed by medium-term storage facilities. The Research Advisory Committee and Germplasm Advisory Committes for different crops advise the Bureau regarding improving the capability, efficiency and effectiveness of its services.

International collaboration

NBPGR implements workplans developed under MoU between ICAR and IPGRI. FAO and IPGRI also sponsor regional training courses on

conservation and utilization of genetic resources of local crops of agricultural importance in South Asia and adjoining regions to be conducted by NBPGR.

Besides working closely with IPGRI, NBPGR also collaborates actively with the International Agricultural Research Centers (IARCs) like ICRISAT, IRRI, ICARDA and CIMMYT. It exchanges plant germplasm with more than 80 countries and implements work plans developed under bilateral, regional and international agreements.

Training programmes and information services

The Bureau organizes advanced training programmes focusing on scientific procedures for collection, exchange, quarantine, biosafety, DNA Fingerprinting, evaluation, documentation and conservation linked to use of plant genetic resources. Major accomplishments of its staff are published in Annual Reports. NBPGR Newsletter is brought out quarterly. Crop Catalogues based on computerized data are also developed and published. Bureau's library at Headquarters specializes in information dealing with plant genetic resources and also subscribes to 50 foreign and 53 national journals.

Post-graduate teaching programme

Since academic session 1997, Bureau is undertaking teaching in plant genetic resources leading to M.Sc. degree linked with Post Graduate School, IARI, New Delhi. From the academic session 2004-2005, a Ph.D. degree programme in plant genetic resources has started in collaboration with the Post Graduate School, IARI, New Delhi.

Extension services for PGR awareness

Bureau organizes kisan diwas/field days for *rabi* and *kharif* crops and distributes seeds/planting material alongwith relevant literature on technical know-how for raising crops and management of PGR. Under the National Agricultural Technology Project- Plant Biodiversity (NATP-PB), special emphasis has been given to create PGR awareness among grass root level workers, tribal people, and farmers (particularly women) by organizing biodiversity fairs in villages. Students on educational tours from State Agricultural Universities are invited to visit the National Genebank, DNA Fingerprinting, tissue culture and quarantine labs, plant quarantine glass houses/ containment facilities at New Delhi.

1. DIVISION OF PLANT EXPLORATION AND COLLECTION

Summary: A total of 115 explorations were undertaken across the country under NATP-PB project and 7623 accessions of various agri-horticultural crops and their wild relatives were collected. Out of these, 691 accessions were made by the Headquarters, New Delhi through 12 explorations covering parts of Uttaranchal, Himachal Pradesh, Uttar Pradesh, Haryana, Punjab, Rajasthan, Jammu and Kashmir, Madhya Pradesh, and West Bengal including two special missions in Sundarban delta. A total of 904 herbarium specimens and samples were added to the National Herbarium of Cultivated Plants.

1.1 Exploration and Germplasm Collection

A total of 115 explorations were executed under the NATP project on Plant Biodiversity and 7,623 accessions of different agri-horticultural crops comprising 2,438 accessions of cultivated plants and 386 of wild species were collected The zone-wise details of the collected germplasm are given in table 1.

Table 1: Explorations undertaken and germplasm collected during 2004

Zone	Region	Number of Exploration undertaken	Accessions collected
1	Arid Region	7	259
2	South-West coastal region	33	1026
3	Humid/ moist tropical east coastal region	1	97
4	North- East hill region	21	2324
5	Central Himalayan region	7	269
6	North-West Himalayan and high altitude region	11	985
7	North- West plains	13	961
8	Sub-tropical humid region	4	559
9	Central Indian region	7	282
10	South -East costal region	11	861
	Total	**115**	**7623**

1.1.1 Explorations conducted by Headquarters: Fifteen multi-crop and crop specific explorations were undertaken by Headquarters in parts of UP, Uttaranchal, Chhatisgarh, Jammu and Kashmir, Rajasthan, Punjab, Haryana, Himachal Pradesh, Madhya Pradesh and West Bengal and a total of 963 accessions of different agri-horticultural crops were assembled. The details of crop diversity explored and germplasm collected during explorations are given in table 2.

The details of crop diversity collected during the explorations conducted by zone-VII are described hereunder.

Table 2: Details of crop diversity collected by Zone VII during 2004

Crop Group	Crops	Areas
Cereals (1331)	Rice (727), Maize (375), Barley (108), Wheat (120), Oat (1)	Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Mizoram, Rajasthan, Uttaranchal, West Bengal
Pseudo-cereals (296)	Amaranth (181), Chenopod (13), Buckwheat (96), *Perilla* (6)	Arunachal Pradesh, Assam, Goa, Jaharkhand, Karnataka, Maharastra, Rajasthan Tamilnadu, Uttranchal
Pulses (643)	Cowpea (116), Bengalgram (5), Horsegram (56), Ricebean (41), Greengram (34), Blackgram (136), Clusterbean (9), *Vigna* spp. (14), *Lathyrus* sp. (49), Lentil (69), Frenchbean (5), Gram (16), Pigeonpea (67), Bean (13), Miscellaneous (13)	Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Mizoram, Nagaland, Tamil Nadu, Uttaranchal, West Bengal
Millets and Minor millets (310)	Proso millet (10), Finger millet (119), Foxtail millet (18), Sorghum (97), Barnyard millet (5), *Panicum* sp. (5), Pearl millet (28), Little millet (17), Kodo millet (8), Miscellaneous (3)	Arunachal Pradesh, Assam, Jharkhand, Rajasthan, Uttaranchal
Vegetables (1976)	Water melon (60), Brinjal (289), *Dolichos lablab* (110), Ridge gourd (51), Bitter gourd (29), Bottle gourd (53), Snake gourd (12), *Colocasia* (37), Cucumber (61), Elephant foot yam (25), Ginger (7), Chili (239), Okra (61), Tomato (50), Frenchbean (143), Pumpkin (112), Chinese potato (26), Ash gourd (17), Field bean (6), Fababean (22), Spinach (25), Sponge gourd (28), Potato (13), Onion (32), Garlic (15), Sweet Potato (6), Coriander (35), Radish (19), Sembean (29), *Dioscorea* (5), Limabean (5), Pea (45), Methi (26), Rice bean (11), Rajmah (31), Cauliflower (5), Muskmelon (103), Satputia (6), *Solanum* sp. (12), *Cucumis hardwickii* (8), *Cucumis melo* (12), *Cucumis* sp. (6), Miscellaneous (32)	Assam, Goa, Gujarat, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Mizoram, Rajasthan, Tamil Nadu, Uttaranchal, Uttar Pradesh, West Bengal
Oilseeds (623)	Castor (92), Mustard (253), Niger (17), *Brassica rugosa* /Lai (11), Soybean (59), Sesame (59), Linseed (40), Toria (12), *Jatropha* (60), *Perilla* (14)	Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Mizoram, Nagaland, Tamilnadu, Uttranchal, Uttar Pradesh, West Bengal
Fruits/ horticultural crops (710)	Mango (35+338), Rambutan (25), Mangosteen (9), Ber (17), Peach (17), Pear (6), *Citrus* (11), Papaya (7), Walnut (35), Pomegranate (13), Apricot (17), *Prunus* sp (7), Custard apple (5), Miscellaneous (168)	Arunchal Pradesh, Assam, Himachal Pradesh, Kerala, Madhya Pradesh, Maharastra, Mizoram, Nagaland, Uttar Pradesh, West Bengal

M&AP, Spices and condiments (727)	Turmeric (108), Ginger (14), Black pepper (38), *Swertia* spp (11), *Potentilla* sp. (7), *Tinospora cordifolia* (12), Garlic (7), *Chlorophytum borivilianum* (40), *Saussurea lappa* (5), *Aloe barbadense* (11), *Acorus calamus* (16), *Asparagus* sp. (19), *Centella asiatica* (5), *Costus speciosus* (6), *Andrographis paniculata* (11), *Ocimum* sp. (13), *Mucuna pruriens* (10), Miscellaneous (394).	Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Mizoram, Orissa, Rajasthan, Uttaranchal, West Bengal
Agro-forestry Species (14)	Anola (5), Indian jujube (3), *Albizia lebbek, Albizia procera, Blepharis indica, Procumbens neurada, Bauhinia* sp., *Cassia sehmea* etc., one each	Haryana, Mizoram, Uttar Pradesh, West Bengal
Fiber crops (100)	Roselle (3), Cotton (66), Jute (5), Mesta (12), Kundrun (5), *Hibiscus* sp (5), Sanai (2), Kenaf (2)	Mizoram and West Bengal
Tuber crops (407)	Sweet potato (407)	Kerala
Ornamental plants (192)	Orchids (192)	Nagaland, Sikkim and West Bengal
Underutilized, and Other Crops (294)	*Prosopis cineraria* (49), sugarcane (17), *Sesbania* (21), *Diospyros* sp (15), *Exvatamia divavicata, Garcinia*, etc.	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Maharastra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal

Collection of Medicinal and aromatic plants from Chhattisgarh: A total of 62 accessions of medicinal and aromatic plants were collected from Bastar and Dantewara area of Chhatisgarh. The important species among these were *Acorus calamus*, *Aloe vera*, *Andrographis paniculata*, *Asparagus racemosus*, *Bixa orellana*, *Brayonia laciniosa*, *Ceasalpinia bonduc*, *Celastrus paniculatus*, *Chlorophytum* sp, *Cissus quadrangularis*, *Costus speciosus*, *Curcuma angustifolia*, *Mucuna* sp, *Nigella sativa*, *Operculina turpenthum*, *Plumbago zeylanica*, *Rauvolfia serpentina*, *Spilanthus acmella*, *Tinospora* sp, *Urginia indica*, etc.

Multi-crop collection from Sunderban, West Bengal: A total of 181 accessions of Cereals (30), Pseudocereals (10), Pulses (11), Oilseeds (4), Vegetables (67), Horticultural plants (11), Spices & condiments (2), medicinal and aromatic plants (14), Fibre (17), Others (15) were collected from Sunderban area specially from 24 Paraganas district of West Bengal.

Collection of *Sesbania grandiflora* from Haryana and UP: A total of 21 accession of Sesbania were collected from Yamuna Nagar and Faridabad in Haryana and Saharanpur, Muzaffarnagar, Baghpat, Aligarh, Ghaziabad, Bulandshahr and Mathura districts of Uttar Pradesh.

Collection of mango germplasm from UP: A total of 34 accessions of mango were collected from Sonti village of Baghpat district in Uttar Pradesh.

Collection of horticultural crops from Madhya Pradesh: A total of 39 accessions of various horticultural crops were collected from Guna, Raisen, Sagar, Hoshangabad, Betul, Panna areas of Madhya Pradesh. The important plant species collected were *Cordia myxa*, *Buchanania lanzan*, *Alangium salvifolium*, etc.

Collection of medicinal and aromatic plants from Himachal Pradesh: A total of 40 collections of various medicinal and aromatic plants such as *Acorus calamus*, *Andrographis paniculata*, *Arisaema*, *Asparagus adscendence*, *Bergenia ciliata*, *Celastrus paniculatus*, *Centella asiatica*, *Chlorophytum borivilianum*, *Coleus* spp., *Dactylorhiza hattagarri*, *Hedychium coronarium*, *Hyoscymus niger*, *Ocium kilimandscharicum*, *Picrorhiza kurroa*, *Potentilla fulgens*, *Rauvolfia serpentina*, *Rheum austerale*, *Saussurea costus*, were collected from Hamirpur, Chamba, Kangra, Mandi, Kullu, and Lahul districts of Himachal Pradesh.

Collection of minor fruit crops from cold desert tract of HP and J&K: A total of 30 accessions of various horticultural crops such as *Citrus grandis*, *Citrus aurantifolia*, *Crataegus oxyacantha*, *Diospyros melanoxylon*, *Elaeagnus baltisarsing*,, *E. bartisarsing*, *E. desosarsing*, *E. karposarsing*, *E. chapacha*, *Hippophae* sp, *Malus pumilus*, *Prunus armeniaca*, *Prunus cornuta*, *Prunus venusta*, *Pyrus* sp., *Ribes alpestre*, *Ribes glaciale*, *Ribes orientale*, *Rosa webbiana*, *Vitis* sp., *Ziziphus* sp. were collected from Una, Kangra, Kullu, Lahul-Spiti areas of Himachal Pradesh and Leh, Kargil, Pulwama and Udhampur areas of J & K.

Multi-crop collection from Rajasthan: A total of 122 accessions of different agri-horticultural crops comprising cereals, pseudocereals, millets, vegetables, pulses, oilseeds, fibres, horticultural crops, and medicinal and aromatic plants were collected from Rajsamand and Udaipur districts of Rajasthan.

Collection of citrus from foot hills of Himachal and Rajasthan: A total of 117 accessions of *Citrus* and other horticultural crops were collected from foothills of Himachal (Kangra) and parts of Rajasthan and Punjab.

Collection of minor fruits from Rajasthan: A total of 47 accessions of minor fruits comprising ber, *Cordia*, *Balanites*, *Salvadora*, *Diospyros*, and other economic plants from Jaipur, Pali, Sirohi, Udaipur, Dungarpur, Banswara, Chittorgarh, Ajmer districts of Rajasthan were collected.

Multi-crop collection through special mission in Sunderban : A total of 106 accessions comprising paddy, fibres, oilseeds, vegetables, pulses, medicinal and aromatic plants, wild relatives and other economic plants were collected from South 24 Pargana district and Sunderban areas in West Bengal.

Collection of M & AP from South Konkan region of Maharashtra and Goa: A total of 39 accessions of different medicinal and aromatic plants were collected from south Konkan region of Maharashtra and adjoining Goa. The important species collected were *Asparagus racemosus*, *Chlorophytum* sp, *Costus speciosus*, *Gloriosa superba*, *Gymnema sylvestre*, *Plumbago zeylanica*, *Rauvolfia serpentina*, *Tinospora sinensis*, etc.

Collection of Jatropha from Rajasthan: A total of 24 accessions comprising of *Jatropha* (23) and ber (1) were collected from Alwar, Rajasamand, Bhilwara, Chittorgarh, Kota, Tonk in Rajasthan and Neemach in MP.

Multi-crop and M&AP collection from cold desert tract of J&K and Himachal: A total of 154 accessions of crops (76) comprising hullless barley, vegetables, fruits, and M&AP (78) viz., *Aconitum* spp, *Ephedra gerardiana, Hippophae* spp, *Orchis latifolia, Origanum vulgare, Picrorhiza kurroa, Podophyllum hexandrum, Rheum australe, Thymus surphyllum, Valeriana jatamansi,* etc. were collected from Baramula, Kargil, Leh districts in J&K and Lahul district in Himachal Pradesh.

Collection of M&AP from Uttaranchal: A total of 71 accessions of different medicinal and aromatic plants comprising *Acorus calamus, Aloe barbadense, Asparagus adescendense, Bergenia ligulata, Centella asiatica, Hedychium spicatum, Hyoscyamus niger, Ocimum* spp, *Orchis latifolia, Rheum australe, Rubia cordifolia, Sassurea lappa, Spilanthes acmella, Tinospora cordifolia, Valeriana jatamansi, Withania somnifera,* etc from Almora, Bageshwar, Pithoragarh, Chamoli, Tehri and Uttarkashi districts of Uttaranchal.

Unique Collection

During above-mentioned explorations several rare, endangered and threatened medicinal and aromatic plants were collected from various difficult areas. The important species collected were *Crocus sativus, Dactyloriza hatageria, Gloriosa superba, Hedychium coronarium, Picrorrhiza kurroa, Rheum australe, Rauvolfia serpentina, Solanum khasianum, Saussurea lappa, Swertia chirayita, Taxus baccata,* etc.

1.2 National Herbarium of Cultivated Plants (NHCP)

A total of 904 herbarium specimens and samples were processed and added during the period under report. These included material collected during NATP and other explorations - *Cicer microphyllum, Fragaria vesca, Podophyllum hexandrum, Daphne papyracea, Rubia cordifolia* from Uttaranchal and Himachal Pradesh; variability in *Lawsonia inermis,* from Kerala; *Ocimum basilicum, Centella asiatica, Phyllanthus amarus, Piper longum from* Maharashtra and Jharkhand; *Cuscuta reflexa, Sesbania rostrata, Asparagus racemosus, Baliospermum montanum, Daucus carota* and *Nothosaerva brachiata* from northern plains. *Abroma augusta* from Bihar; *Ribes orientale, Stephania glabra* from Himachal Pradesh; *Atropa acuminata, Habenaria intermedia* from Jammu & Kasmir; *Piper hapnium* from Kerala; *Ceriops tagal, Hydnocarpus alpina, Paederia scanderns, Symphorema polyandrum* from Maharashtra; *Geodorum densiflorum* from Orissa; *Allium govanianum* from Uttranchal and others were added as local Delhi collections. *Ocimum kilimandscharicum, Stephania glabra, Byttneria herbacea, Cardiospermum halicacabum* from Jharkhand; *Rauvolfia serpentina, Gloriosa superba, Piper longum, Thunbergia laevis, Remusatia vivipara* from Maharashtra; *Desmodium gangeticum, Helicteres isora* from Goa; cultivated and wild species of *Solanum* from Chhattisgarh and Andhra Pradesh; *Luffa acutangula, Luffa cylindrica, Lagenaria siceraria, Solanum melongena, Mucuna prurita,* species of *Vigna* and *Sesbania* were collected from experimental fields at IARI, NBPGR and Issapur, Delhi. Seedless fruits of *Citrus aurantifolia,* from Faridabad, Haryana; fruit of *Juglans regia* from Jammu were also preserved and added to the NHCP. Exotic samples of *Brassica chinensis* and *Brassica pekinensis* were added from Thailand and Singapore. Aquatic species namely *Hydrilla verticillata* Gasp. and *Vallisneria spiralis* L.

(Hydrocharitaceae) , *Butomopsis lanceolat* Kunth. (Limnocharitaceae), *Najas minor* Allioni (Najadaceae) were the new taxa added as herbarium specimens. Identification of material was done and information provided for 24 species to students, researchers and farmers.

Research projects (Project Code: Title, Project Leader; Associates)

PGR/PGC – BUR – DEL – 01.00: Exploration for the Collection of Germplasm of Agri- Horticultural Crops, Biosystematics and Ethnobotanical Studies, and Maintenance of Herbarium (S S Malik, E Roshini Nayar, Anjula Pandey, K C Bhatt, N S Panwar, A K Singh, C S Raghav and Rajvir Singh)

PGR/PGC –BUR – DEL –01.01: Exploration for the Collection of Genetic Resources of Cultivated Crops and Their Wild Relatives (S S Malik, K C Bhatt, and Rajvir Singh)

PGR/PGC – BUR – DEL – 01.02: Exploration for Collection of Diversity in Medicinal and Aromatic Plants Diversity from Different Phyto-Geographical Regions (K C Bhatt, Ashok Kumar and C S Raghav)

PGR/PGC - BUR – DEL – 01.03: National Herbarium of Cultivated Plants (N H C P), Establishment, Maintenance, Build-Up and Taxononic Studies on Cultivated Crop Plants (E Roshini Nayar and Anjula Pandey)

PGR/PGC - BUR – DEL – 01.04: Collection, Conservation and Documentation of Wild/ Weedy Relatives of Crop Plants (WRCP) of India (Anjula Pandey, K C Bhatt, S S Malik, K S Negi, J C Rana, J Radhamani)

2. DIVISION OF GERMPLASM EVALUATION

Summary: During the year 9,375 accessions of different agri-horticultural crops, *viz*., cereals (6,625), legumes (635), oilseeds (496), vegetables (695), forages (230), under-utilized crops (392) and medicinal and aromatic plants (302) were grown for characterization, evaluation, multiplication and maintenance. Besides, a total of 4,105 accessions of various crops comprising cereals (2,265), pulses (701), oilseeds (250), vegetables (664), under-utilized crops (80) medicinal and aromatic plants (145) were grown for regeneration and seed increase. One hundred and thirty accessions of perennial horticultural crops were also maintained in the field genebank. Promising accessions for various agro-morphological characters were identified. Germplasm evaluation of crops namely rapeseed mustard (760), sunflower (250), *Perilla* (44), walnut (29), pulses (541), wheat (81) and barley (49) for quality attributes also resulted in identification of promising accessions. Phytochemical studies of various medicinal and aromatic plants (M&AP) were also undertaken. Multi-location evaluation of chickpea resulted in identification of promising entries for biotic and abiotic stresses. Collaborative evaluation of 23 crops has been undertaken. Annual reports on germplasm evaluation for 2000, 2001, *kharif* (2003) and horticultural crops (2003-04) were compiled and distributed to concerned PCs/PDs. Two germplasm field days were organized to promote interaction with plant breeders/ user scientists. A total of 10,268 seed samples were supplied to different institutes for use in crop improvement programmes.

2.1 Characterization and Preliminary Evaluation For Agro-Morphological Traits

A total of 9,375 accessions of agri-horticultural crops, *viz.* cereals (6,625), legumes (635), oilseeds (496), vegetables (695), forages (230), under-utilized crops (392) and medicinal and aromatic plants (302) were grown for characterization, preliminary evaluation, multiplication and maintenance. Besides, a total of 4,105 accessions of various crops, namely cereals (2,265) pulses (701), oilseeds (250), vegetables (664), under-utilized crops (80) and medicinal and aromatic plants (145) were grown for regeneration and seed increase only. One hundred and thirty accessions of perennial horticultural crops were also maintained in the field gene bank. List of germplasm sown and maintained in the field at NBPGR Experimental Station, Issapur and at NBPGR Headquarters during 2004 is presented in Table 1.

2.1.1 Identification of promising accessions: Based on characterization and preliminary evaluation data, promising accessions for various attributes, *viz.*, earliness, dwarf habit, pod length, pods per plant, seeds per pod and 100-seed weight etc. were identified (Table 2).

2.2 Germplasm Enhancement in Sesame and Mungbean

2.2.1 Sesame: Thirty enhanced progenies (F_6) of sesame were grown for further evaluation and selection of superior types. Fresh crosses were attempted between the superior enhanced progenies and exotic germplasm with non-shattering habit. Further, (F_3) progeny of sesame involving four *Sesamum* spp. were evaluated for selection and enhancement.

2.2.2 Mungbean: A total of 42 accessions of wild *Vigna* species in *mungo-radiata* complex were grown for evaluation and use in inter-specific hybridization. F_1 progenies of crosses between four green gram (*Vigna radiata*) varieties (CO-4, CO-5, CO-6, VBNGg-2) and four wild related species *V. radiata* var. *sublobata, V. radiata* var. *setulosa, V. mungo* var. *silvestris,* and *V. hainiana* were grown for evaluation.

Table 1: Germplasm evaluated/ maintained during 2004

Crop name	Botanical name	Accession (no.)	
		Characterization and evaluation	Regeneration/ maintenance
Wheat*	*Triticum aestivum*	2,370	-
	Triticum durum	1,007	-
Barley	*Hordeum vulgare*	1,169	-
Triticale*	*Triticale*	202	2,265
Wheat*	*Triticum aestivum*	641	-
Barley	*Hordeum vulgare*	361	-
Maize	*Zea mays*	867	-
Coix	*Coix lacryma-jobi*	8	
Cowpea	*Vigna unguiculata*	-	450
Urdbean	*Vigna mungo*	200	151
Pea	*Pisum sativum*	220	100
Lentil	*Lens culinaris*	215	-
Rapeseed	*Brassica* spp.	363	200
Sunflower	*Helianthus annuus*	105	50
Linseed	*Linum usitatissimum*	28	-
Brinjal	*Solanum melongena*	150	-
Tomato	*Lycopersicon esculentum*	175	
Garlic	*Allium sativum*	-	664
Palak	*Beta vulgaris*	65	-
Bottle gourd	*Lagenaria siceraria*	65	-
Radish	*Raphanus sativus*	20	-
Coriander	*Coriandrum sativum*	50	-
Ridge gourd	*Luffa acutangula*	65	-
Sponge gourd	*Luffa cylindrica*	65	-
Fenugreek	*Trigonella foenum-graecum*	40	-
Pearl millet	*Pennisetum typhoides*	230	-
Faba bean	*Vicia faba*	239	-
Sesbania	*Sesbania* spp.	81	80
Sunhemp	*Crotalaria juncea*	72	-
Vetiver	*Vetiveria zizanioides*	135	-
Aloe	*Aloe vera*	30	38
Giloe	*Tinospora cordifolia*	31	31
Sataver	*Asparagus racemosus*	22	20
Mucuna	*Mucuna pruriens*	40	6
Basil	*Ocimum basilicum*	34	20
Babchi	*Psoralea corylifolia*	10	30
Pomegranate	*Punica granatum*	-	49
Citrus	*Citrus* spp.	-	17
Guava	*Psidium* spp.	-	9
Mulberry	*Morus* spp.	-	4
Aonla	*Emblica officinalis*	-	4
Karonda	*Carissa* spp.	-	3
Lasora	*Cordia myxa*	-	1
Pear	*Pyrus* spp.	-	12
Plum	*Prunus* spp.	-	4
Bael	*Aegle marmelos*	-	10
Mango	*Mangifera indica*	-	3
Ber	*Zizíphus* spp.	-	11
Apple	*Malus* spp.	-	2
Almond	*Prunus* spp.	-	1

* International Nurseries

Table 2. Promising accession identified for different traits

Crop	Promising traits	Accession number
Pulses		
Pea	Early flowering	IC276596, IC276598 (≤ 55 days)
	Long pods	EC501259, IC342839 (> 8.8 cm)
	High pod number	IC267162, EC398602 (> 110)
	High 100-seed weight	IC342979, IC361877, IC356344 (>28 g)
Lentil	Early flowering	IC267089 (81 days)
	Tall plant type	IC267105 (47 cm)
Urdbean	Early flowering	PLU400 (46 days)
	High pods/ plant	PLU343 (60)
	High seeds/pod	PLU493 (6.5)
	High 100-seed weight (g)	IC73291 (4.3)
Oilseeds		
Toria	Long siliqua	IC268327, IC343122 (>5.0 cm)
	Early flowering	IC259457 (20 days)
Yellow sarson	Early maturity	IC395569 (125 days)
	Dwarf habit	IC395569, IC385779 (<85.0 cm)
	Long siliqua	IC385663, IC385664 (>5.0 cm)
Mustard	Dwarf habit	IC374358 (100.0 cm)
	Long siliqua	IC385781, IC385073 (> 5.0 cm)
Sunflower	Early maturity	EC512686 (119 days)
	High oil content	EC512696, EC512698 (>45%)
Vegetables		
Tomato	High number of primary branches	EC320571, EC338719 (>17)
	Higher fruits/ plant	EC318193, EC251613 (≥ 800)
	Higher fruit weight/ plant	EC141887, EC321425 (≤ 4.5kg)
Palak	Leaf length	IC274633, IC382255 (>38 cm)
	Leaf width	IC382255, IC381477 (≤ 15 cm)
Coriander	Days to 1st green leaf harvest	IC398776 (33 days)
Methi	Days to 1st green leaf harvest	IC336796 (26 days)
Sponge gourd	High primary branches	IC417970, IC284767 (>11)
	Fruit length	IC411904 (45.5 cm)
	Node no. at which 1st female flower appear	IC284767 (8)
Bottle gourd	Node no. at which 1st female flower appear	IC311135, IC331101 (>8 and ≤10)
	Vine length	IC385815 (10.11 m)
Ridge gourd	Node no.at which 1st female flower appear	IC424549 (12).
	High primary branches	IC417716 (12.9)
	Fruit length	NIC22409 (22.6 cm)
Brinjal	No. of primary branches	IC90965, IC127036 (15.5)
	Fruit length	IC332507, IC345744 (>19.5 cm)

2.3 Evaluation for Value Rich Traits

2.3.1 Oil content in different oil seed crops: A total of 1,078 accessions comprising *Brassica juncea* (329), *B. campestris* var. toria (114), *B. campestris* var. yellow sarson (117), *B. campestris* var. brown sarson (90), *B. napus* (42), *B. carinata* (13), *B. nigra* (9), *B. tournfoortii* (4), *Camelina sativa* (11), *Eruca sativa* (31), sunflower (250) and perilla (44) were analyzed for total oil content in the seed. Range of variation and mean value of oil percentage with promising accessions are given in Table-3. Some of the selected lines of niger (1), *Jatropha* (9) and safflower (60) were also studied for fatty acid profile.

2.3.2 Quality traits for walnut collections: Twenty-nine walnut collections maintained at the CITH, Mukteshwer were analyzed for oil, protein and fatty acid profile on kernel basis (Table 3 a). Collections with high oil and protein value (90.3 – 88.3%) were identified.

Table 3a: Quality traits of walnut collections

Traits	Range	Mean
Oil (%)	67.30 – 75.90	71.70
Protein (%)	13.90 – 18.64	16.80
Palmitic acid	4.90 – 7.50	6.00
Stearic acid	2.30 – 2.80	2.50
Oleic acid	13.90 -17.80	15.60
Linoleic acid	52.90 - 64.90	59.00

Table 3: Range, mean and promising accession for total oil content in *Brassica*, sunflower and *Perilla* seeds

Crops	Range (%)	Mean (%)	Promising accession
B. juncea	27.6 - 45.80	39.70	-
Toria	36.3 - 48.00	43.00	-
Yellow sarson	37.49 - 49.10	44.80	-
Brown sarson	34.5 - 47.70	41.90	IC241632 (47.67)
B. napus	33.5 - 48.80	42.80	EC400806 (48.83), IC241651 (47.77)
B. carinata	25.3 - 44.00	32.50	EC223405 (44.00)
B. nigra	26.3 – 42.92	31.00	SRB98 (42.92), IC381041 (35.41)
B. tournfortii	32.0 - 43.82	37.40	RVS04 (43.82), IC342758 (40.17)
Eruca sativa	28.8 - 38.31	34.30	IC397866 (38.31), IC113153 (37.73)
Camelina sativa	31.8 - 36.50	34.90	EC481678 (36.5)
Sunflower	24.0 - 51.00	38.68	EC512696, EC512698 (45)
Perilla	38.72 - 48.55	43.92	-

2.3.3 Protein content and amino acid profile of field crops: A total of 671 accessions of different crops were studied for protein content (Table 4). Seed protein in some selected arid legumes *viz.* kulthi (10 accs.), cowpea (10 accs.) and guar (5 accs.) were studied to establish their amino acid profile and to compare the amino acid profile of the registered wild horsegram (*Macrotyloma sargharwalensis*) accession (IC212722).

Table 4: Protein content and amino acid profile in field crops

Crop	Total accessions	Range (%)	Mean (%)
Chickpea	126	16.35 - 23.03	20.15
Pea	100	22.13 - 30.54	25.02
Cowpea	315	17.34 - 24.71	21.50
Wheat	81	10.41 - 19.81	15.40
Barley	49	9.89 - 16.14	13.02

2.4 Phytochemical Evaluation of Medicinal and Aromatic Plants

Eighteen accessions of *Ocimum* were analysed for their physico-chemical constants and aroma constituents using the gas chromatograph. The refractive index varied from 1.4610 to 1.5070, optical rotation from -2^0 03' to -14^0 58', acid value from 0.60 to 4.91 and specific gravity from 0.9405 to 0.9886. GC analysis showed the presence of three chemotypes (i) Methyl chavicol type (EC338785) (ii) Linalool type (EC174527, 73.63%). (iii) methyl chavicol and linalool type (EC388891, methyl chavicol-48.10%, linalool-37.50%).

A total of 126 samples of various aromatic plants were analyzed for essential oil content. Range and promising accession identified for essential oil content are given in Table 5.

A total of 90 samples of *Piper nigrum* were evaluated for their oleoresin content, which varied from 4.67% to 13.37%. The maximum oleoresin content was found in IC373770 (13.37%) followed by IC85396 (13.22%).

A total of 24 samples of tuberose flowers (8 replicates each of three double petalled cultivars of tuberose namely Pearl Double, Suvasini and Vaibhav) were analyzed for their concrete content, which varied from 0.0321% to 0.5830%. Cultivar Pearl Double gave maximum concrete content (0.0583%) followed by Suvasini (0.0328%) and Vaibhav (0.0321%).

2.5 Development of Calibration Curve in High Performance Thin Layer Chromatography (HPTLC)

A rapid and highly selective method for quantification of andrographolide, a lactone present in *Andrographis paniculata* was standardised using HPTLC. Andrographolide showed maximum absorption peak at 232 nm in the UV range. Using the linear calibration

Table 5: Chemical analysis of aromatic plants

Common Name	Botanical Name	Samples analyzed on dry wt. basis	Essential oil (%)	Promising Accessions (value)
Greater galangal	*Alpinia galanga*	6	0.28 - 0.84	IC349746 (0.84%), IC87883 (0.81%)
Lesser galangal	Alpinia *calcarata*	5	0.50 - 1.44	IC210421 (1.44%)
Palmarosa	*Cymbopogon martinii*	39	0.34 - 1.47	IW4490 (1.47%)
Coriander	*Coriandrum sativum*	40	0.10 - 0.34	IC321256, IC397838 (>0.33)
Ocimum	*Ocimum basilicum*	34	0.076 – 0.196	EC388890 (0.15%), IC110267 (0.15%), EC388893 (0.196%)

equation developed by this method, 30 accessions of *A. paniculata* were analyzed separately for andrographolide content in leaf, stem and capsules separately. Results indicated that the leaf contained maximum andrographolide content (1.14 – 2.60%), followed by stem (0.23 – 0.84%) and negligible in capsules (0.11 – 0.20%) at 105 days of harvest. Among the promising accessions, IC342134 contained maximum andrographolide content of 2.60%, followed by VS/HYS/2 (2.17%), IC111287 (2.11%) and IC342138 (2.05%). Andrographolide content declined with delay in harvest in all the *A. paniculata* accessions.

2.6 Documentation of Plant Genetic Resources

Germplasm characterization and preliminary evaluation data for 2000, 2001, kharif (2003) and horticultural crops (2003-04) were documented and distributed to PCs/ PDs. In addition, reports for the years 2000, 2001, 2002 and 2003 relating to characterization and evaluation data received from NATP partners were documented and distributed to NATP partners and PCs/PDs for effective utilization of germplasm.

Catalogues on strawberry, sorghum and *Sesbania* were published.

2.7 ARIS Activities

Accession numbers were allotted to sixty thousand collections along with passport data storage in the SQL server. Passport and genebank data were matched and the complete list was handed over to the Conservation Division for verification. The DUS database software was developed and demonstrated to the officials of ICAR, DAC, IARI and National Seed Project. The software will be used by all the DUS centers for data documentation as per the DUS guidelines. The test guidelines for DUS testing for 25 crops were converted in the form of a CD. All the common nine tables under the FAO project on "Establishment of Global Plan of Action for the National Information Sharing Mechanism of the PGR for Food and Agriculture" were completed. A common format of the Web Site of the Division of Crop Science and Horticulture (ICAR) was submitted to DDG (CS and H). Updating of all the employees database in the PERMISNET as per the requirement of ICAT was done.

2.8 Seed Supply

Utilization of germplasm of various crops by breeders and other scientists in the country for crop improvement programme is an important aspect in sustainability of crop production. During the period under report a total of 2,293 seed samples of various crop groups; cereals (110), legumes (998), oilseeds (336), vegetables (649), forage (25), under utilized crops (13) and medicinal and aromatic plants (162) were supplied to 115 research workers of ICAR Institutes, State Agricultural Universities and other research centers engaged in crop improvement programmes. Besides, 7,975 seed samples of exotic wheat (7,117), barley (827) and triticale (31) were also supplied to 48 indentors.

2.9 Germplasm Holdings in Medium Term Storage

A total of 16,486 accessions of various field crops comprising cereals (3,621), pulses (5,396), oilseeds (3,667), vegetables (2,428), under utilized crops (1,010), medicinal and aromatic plants (187), and millets and pearlmillet (177) were conserved in medium term storage during the period under report (Table 6).

Table 6: Active germplasm holdings in MTS

Crop group	Crop	Accessions
Cereals	Wheat	1,250
	Maize	1,100
	Barley	1,271
Pulses	Pea	650
	Cowpea	1,200
	Lentil	400
	Mungbean	645
	Urdbean	439
	Pigeonpea	500
	Chickpea	1,562
Oilseeds	Rapeseed-mustard	3,000
	Sunflower	95
	Sesame	550
	Crambe	22
Vegetable	Brinjal	850
	Tomato	700
	Bottle gourd	110
	Sponge gourd	135
	Ridge gourd	125
	Bitter gourd	5
	Pumpkin	6
	Radish	100
	Methi	250
	Palak	40
	Coriander	62
	Chinese Cabbage	45
Under utilized crops	Fababean	275
	Ricebean	103
	Amaranth	32
	Sesbania	400
	Crotalaria	200
Medicinal and aromatic plants	*Ocimum*	40
	Mucuna	50
	Poppy	53
	Psoralea	10
	Andrographis paniculata	15
	Periwinkle	10
	Ashwagandha	4
	Hyocymus	5
Millets	Pearlmillet	177

2.10 Germplasm Field Day

To promote germplasm utilization, two field days were organized for different *rabi* crops, oilseeds and pulse crops on 20th March and for wheat, barley and Triticale on 26th March, 2004. A large number of scientists from different Institutes/ SAUs participated in the field days and selected the material of their choice for utilization in crop improvement programmes.

Pea germplasm being evaluated by scientists on the field day at Issapur

2.11 Collaborative Germplasm Evaluation

Germplasm evaluation for qualitative traits and for agronomic performance has been taken up in collaboration with ICARs different Crop Based Institutes/ NRCs and AICRIPs. Collaborative germplasm evaluation has been taken up for 23 crops (Table 7).

Brassica germplasm being screened by scientists on the field day at Issapur

Table 7: Germplasm grown for collaborative evaluation

Crop	Accs. (no.)	Centers
Rice	100	PD, DRR, Hyderabad
Pearl millet	243	PC, Pearl millet, AR RAU, Mandor
Mungbean (Enhanced lines)	35	PC, IIPR, Kanpur
Urdbean	100	PC, IIPR, Kanpur
Pigeon pea	750	PC, IIPR, Kanpur
Cowpea	100	PC Arid Legumes, CAZRI, Jodhpur
Moth bean	200	PC Arid Legumes, CAZRI, Jodhpur
Cluster bean	100	PC Arid Legumes, CAZRI, Jodhpur
Castor	50	PD, DOR, Hyderabad
Brinjal	200	PC, IIVR, Varanasi
Bottle gourd	30	PC, IIVR, Varanasi
Sponge gourd	30	PC, IIVR, Varanasi
Mucuna	20	Director, NRC for M&AP, Anand,
Wheat	100	Director, DWR, Karnal
Barley	50	Director, DWR, Karnal
Field pea	50	PC, IIPR, Kanpur
Lentil	50	PC, IIPR, Kanpur
Rapeseed & Mustard	100	Director, NRC for RM, Bharatpur
Tomato	100	PC, IIVR, Varanasi
Garlic	50	Director, NRC for Onion & Garlic, Pune
Spinach	50	PC, IIVR, Varanasi
Methi	50	PC, NRC on Seed Spices, Ajmer
Coriander	50	PC, NRC on Seed Spices, Ajmer

2.12 Multi-location Evaluation of Germplasm

A special programme for multi-location evaluation of germplasm of major crops, namely, rice, wheat, chickpea and pigeonpea has been taken up in collaboration with crop based Institutes and AICRPs.

2.12.1 Rice germplasm evaluation: One thousand germplasm accessions of rice were sent during Kharif 2004 to twenty cooperative centres under DRR, Hyderabad for characterization and evaluation for agronomic traits and screening against diseases, insect pest and salinity. (Table 8)

2.12.2 Wheat germplasm evaluation: One thousand-and-five-hundred accessions of wheat were sent to nine locations in four zones for

Table 8: Evaluation of rice germplasm

Trait	Locations
Agronomic traits	DRR, Hyderabad; Coimbatore; CRRI, Cuttack; Raipur; Ludhiana; Pantnagar and Jorhat
Insect resistance	
Stem borer	DRR, Hyderabad and Ludhiana,
Brown plant hopper	DRR, Hyderabad and Maruteru
Gall midge	DRR, Hyderabad; Sambalpur; Ragolu; Jagityal; Moncompu and Hazaribag
Disease resistance	
Bacterial leaf blight	DRR, Hyderabad; Pantnagar; Maruteru and Hazaribag
Blast	DRR, Hyderabad; Hazaribag; Malan; Ponnampet and Nellore
Rice Tungro	Coimbatore; CRRI, Cuttack and Thrissur
Abiotic stress	
Salinity	Karnal

evaluation of agronomic traits and screening against biotic stresses (Table 9).

2.12.3 Chickpea evaluation: A total of 125 accessions of chickpea were sent during rabi 2003-04 for evaluation against biotic/abiotic stresses (wilt, root rot, collar rot, pod borer and rainfed/drought situation) at various locations. The data received for wilt from 7 locations (Gulberga, Bangalore, Rahuri, Ludhiana, Hisar, Sehore and Kanpur) indicated that only 10 accessions *viz.*, IC268937, IC268967, IC268972, IC269110, IC269135, IC269262, IC299299, IC269308 and IC269352 showed less severity of wilt. IC269125 showed minimum disease incidence (7.58%) followed by IC269299 and IC268937 showing 11.19 and 11.99% incidence respectively.

Screening for root rot at 5 locations (Ludhiana, Hisar, Coimbatore, Sehore and Durgapura) showed that the infection was minimum IC269299 (8.63%) followed by IC269337 (9.04%), IC269222 (9.31%) and IC269104 (9.59%).

Screening for collar rot at Jabalpur showed that minimum infection was observed in IC269269 (3.30%) followed by IC269398 (3.90%), IC269282 (4.20%), IC269023 (4.30%) and IC269353 (4.40%). Screening for pod borer incidence was carried out at the two locations (Almora and Pantnagar). The mean value showed that three entries *viz.*, IC269307, IC269375 and IC269399 were affected to the extent of 15.95%, 20.65% and 20.55% respectively.

Data received from two locations (Gulberga and Durgapura) for rainfed situations showed that IC269271 had maximum seed yield (1156.25 kg/ha) followed by IC269191, IC269263 and IC269236 with seed yield of 1093 kg/ha, 1052 kg/ha and 1025 kg/ha respectively.

The data in respect of protein content showed that the maximum protein content (22 to 23%) was available in accessions IC269062, IC269162, IC269272, IC269353 and IC269354.

During rabi 2004-05, 487 accessions are being evaluated for biotic/ abiotic stresses at 19

Table 9: Multi-location evaluation of wheat

Zone/Centre	Evaluation activity		
	Agronomic traits	Biotic stresses	Quality
North West Plain Zone			
DWR, Karnal		Yr, Br	√
PAU, Ludhiana	√	Yr, Br, KB	*
GBPUA&T, Pantnagar	√	Yr, Br	-
North East Plain Zone			
BHU, Varansi	√	LB	*
NDUA&T, Faizabad	√	Br, LB	-
Central Zone			
ARS, Powarkheda	√	Br, Bl	*
WRS, Vijapur	√	Br, Bl	-
Peninsular Zone			
ARI, Pune	√	Br, Bl	*
UAS, Dharwad	√	Br, Bl	-
NBPGR, New Delhi	Multiplication and supply of germplasm		

Yr: Yellow rust, Br: Brown rust, KB: Karnal bunt, LB: Leaf blight, BL: Black rust
* Centers will supply germplasm to DWR for quality analysis

locations and 930 accessions for agronomical traits at 8 locations *viz.*, Hisar, Ludhiana, Kanpur, Ranchi, Rahuri, Sehore, Bangalore and Coimbatore.

A total of 1,192 accessions from the National Gene Bank were sent for multiplication to three locations, namely, 800 accessions to SK Nagar, GAU; 200 accs to JNKVV, Jabalpur and 192 to ARS, Durgapura, Rajastrhan.

2.12.4 Pigeonpea germplasm evaluation: Seven-hundred-fifty accessions were sent for evaluation against biotic/ abiotic stresses and for agronomical evaluation at 10 locations (Kanpur, Ludhiana, Badnapur, Bangalore, New Delhi, Coimbatore, Samastipur, Dharwad, Gulberga, Varanasi and Rahuri), 312 accessions were sent for estimation of protein content, 39 accessions were sent for DNA fingerprinting and 1,500 accessions are being multiplied at SK Nagar, Gujarat.

2.13 Germplasm Advisory Committee (GAC)

Germplasm Advisory Committee meetings on rice, wheat and barley and commercial crops were organized to advise NBPGR in different activities and management of Plant Genetic Resources. The recommendations are being pursued.

Research Project (Code: Title, Project Leader; Associates)

PGR/GEV- BUR-DEL-01-00: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of various crops (Mahendra Singh).

PGR/GEV- BUR-DEL-01.01: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of wheat, barley and triticale (Dinesh Kumar; Ambrish Kumar Sharma, PS Mehta, KC Muneem, DCBhandari).

PGR/GEV- BUR-DEL-01.02: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of maize (Ambrish Kumar Sharma, Dinesh Kumar, PS Mehta and Someshwara Rao).

PGR/GEV- BUR-DEL -01.03: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of cowpea and pea (S Sardana, NKGautam, Babu Ram, DC Bhandari and IP Singh).

PGR/GEV- BUR-DEL -01.04: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of oil seeds with special reference to *Brassica* and sunflower (Ranbir Singh, Vandana Joshi, YS Rathi, Neelam Bhatnagar, NK Dwivedi and N Sivraj).

PGR/GEV- BUR-DEL -01.05: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of tomato, spinach, palak, and cucurbits (VK Dobhal- upto April 2004, Gunjeet Kumar*, SK Yadav, BL Meena, KS Varaprasad and M Abdul Nizar).

PGR/GEV- BUR-DEL -01.06: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of brinjal, carrot, radish, fruits and ornamentals (Gunjeet Kumar*, VK Dobha –upto April 2004, SK Yadav, BL Meena and V Shivraj).

PGR/GEV- BUR-DEL -01.07: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of bottle gourd, methi, chinese cabbage & coriander (Gunjeet Kumar*, VK Dobhal –upto April 2004 SK Yadav and BL Meena).

PGR/GEV- BUR-DEL -01.08: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of onion & garlic, and medicinal & aromatic plants. (Ashok Kumar, SK Pareek, Archana Raina, Jitendra Mohan, CS Raghav and Poonam Suneja).

PGR/GEV- BUR-DEL -01.09: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of forages and in aonla, ber & bael (Vandana Joshi, Harinder Singh, and I.P.Singh).

PGR/GEV- BUR-DEL -01.10: Biochemical evaluation of germplasm resources of various field crops (S Mandal and Sangita Yadav).

PGR/GEV- BUR-DEL -01.11: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under utilized crops (B.S.Phogat, Hanuman Lal, RS Rathi, N Dixit, JB Tomar, KS Negi and DK Hore).

PGR/GEV- BUR-DEL -01.13: Studies on statistical techniques for efficient management of PGR (RK Mahajan).

PGR/GEV- BUR-DEL -01.14: Genetic Resources Information Programme (RK Mahajan and RC Agrawal).

PGR/GEV- BUR-DEL -01.15: Genetic enhancement of crop species with particular reference to sesame and mungbean (I S Bisht, Z Abraham and M Latha).

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* on study leave

3. DIVISION OF GERMPLASM CONSERVATION

Summary: A total of 31,935 germplasm accessions of various cropsand their wild relatives were received for long-term conservation in the National Genebank. These were processed following the genebank standards. Out of these 25,793 accessions were added to the base collection, raising the germplasm holding to 2,87,028. A total of 7,281 accessions out of the 12,103 received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (2,733 accessions) and updating of passport data (2,909 accessions) were carried out. Longevity of castor, groundnut, pigeonpea, sponge gourd and cotton was found to be more when seeds were dried to ultra low moisture contents (1 to 3% moisture). Methods for breaking seed dormancy in *Kigelia pinnata*, *Chlorophytum borivillianum* and *Caturegehum spinosa* were established.

The Division continued its efforts to function as the national repository by long-term storage of seeds of various agricultural and horticultural crops in the National Genebank (-18 ^{0}C). Also, voucher samples of introduced and collected accessions were maintained in the medium-term store at (7 ^{0}C and RH 35%) for reference. In addition, the registration and augmentation of potentially valuable germplasm and conservation of released varieties and genetic stocks identified under the National Agricultural Research System were the other activities carried out on priority. Supportive research directed towards identification of factors that prolong the storage life of seeds to maintain the genetic integrity of conserved germplasm in a cost effective manner and exploring the storage behaviour of seeds of hitherto unexplored species continued.

3.1 Germplasm Augmentation

A total of 31,935 germplasm accessions of various agricultural crops were received for long-term conservation at the National Genebank. These include 4,438 accessions restored from International Crops Research Institute for Semi-Arid Tropics (ICRISAT) to NBPGR under an Indian Council of Agricultural Research (ICAR)-ICRISAT collaborative project on "Restoration of ICRISAT mandate crop germplasm to NBPGR". During this period a total of 25,793 accessions qualified for conservation as per the genebank standards and were stored as base collections at –18 ^{0}C.

The crop wise details of the various accessions received and added to the National Genebank are listed in Table 1. The total germplasm holding in the National Genebank has now increased to 2,87,028. In addition, a total of 6,033 exotic accessions of different crops received from six countries were kept as voucher specimen in the medium-term storage module.

3.1.1 Germplasm received at the GHU

The Germplasm Handling Unit (GHU) received a total of 12,103 seed accessions collected from 181 explorations conducted in ten NATP zones. In addition, 54 accessions of vegetative propagules were received. Of these, a total of 7,281 accessions were stored in medium-term storage module for safety, as reference material and 124 were handed over for cryo-preservation.

3.2 Germplasm Registration

A total of 247 proposals were received for germplasm registration and 121 germplasm lines were registered in the 12th and 13th PGRC meeting.

3.3 Documentation and Database Management

Efforts were continued to update passport data on germplasm conserved before NATP. Data pertaining to a total of 2,909 accessions comprising oilseeds (800), fibres (577), and vegetables (1,532) were updated.

3.4 Monitoring of Germplasm

Germplasm stored in the long-term storage module for 10 years or more were monitored for seed viability, seed quantity and seed health to identify accessions that may require regeneration as per the genebank standards. This included accessions of cereals (556), fibres (634), forage (29), oilseeds (800), pulses (250), vegetables (449) and spices (15). Viability of all the accessions is maintained conforming to the genebank standards.

3.5 Regeneration of Germplasm

A total of 5,649 germplasm samples of various crops were supplied for seed multiplication/ characterization/ evaluation/ restoration of lost active collections. These comprise accessions of wheat (3,289), paddy (1,010), maize (228), sesame (442), sorghum (32), coriander (14) and exotic germplasm (634).

3.6 Supportive Research

To develop protocols for cost effective conservation, studies on storability of seeds dried to low moisture contents were continued in various crops. In cotton, groundnut, pigeonpea and castor, seeds dried to 2-3 per cent moisture retained higher germination than those stored at higher moistures at ambient temperature even after more than 5 years of storage. Similarly, in sponge gourd, seeds stored at 5 and 2.5 per cent moisture maintained more than 85 per cent germination after two years of storage. Ultra desiccated seeds of date palm (3.1%) maintained a good germination (70 to 80%) after 5 years of storage. However in *Dalbergia* seeds with moisture content of 1.7 and 2.3 lost 70 per cent of their initial viability over a period of three years under ambient temperatures but maintained a reasonably good viability (60 to 70 percent) at 4 and −18 °C storage temperatures.

Studies on *Baliospermum montanum* and *Aegle marmelos* have shown that the seeds have intermediate storage behaviour while in *Wrightia tinctoria* they have orthodox storage behaviour. Methods to break seed dormancy were worked out in *Kigelia pinnata* a tropical tree species and medicinal plant species, namely *Chlorophytum borivillianum* and *Caturegehum spinosa*. In the former, treatment with concentrated sulphuric acid for four hours and subsequent washing with water for 24 hours resulted in 80 per cent germination. While in the later, treatment with gibberellic acid and sulphuric acid (50%) for 30 minutes proved successful. Seed treatment with GA_3 (50 ppm) in case of *Crambe* and KNO_3 (0.2%) in *Putranjiva* improved seed germination. Pre-soaking of seeds in water overnight enhances both seedling vigour and rate of germination in *Perilla*, Olive and *Jatropha* seeds.

3.7 Human Resource Development

A training programme on 'Principles and Techniques of Seed Storage and Genebank Management' was organised for technical personnel from 19-31, July 2004. A total of 24 participants from ICAR institutes and SAU's attended the meeting.

Table 1: Status of germplasm holdings in the National Genebank (-18 °C)

Crop Group	January to December 2004	Present status (Total)
Paddy	6890	71673
Wheat	2019	34275
Maize	597	5508
Others	922	9372
Cereals	**10428**	**120828**
Sorghum	1682	17483
Pearl millet	1102	6737
Minor millet	1178	16798
Others	1225	2176
Millets and forages	**5187**	**43194**
Amaranth	364	3521
Buckwheat	43	293
Others	80	169
Pseudo Cereals	**487**	**3983**
Chickpea	613	15644
Pigeonpea	1344	7520
Mung bean	154	2959
Others	832	16718
Grain Legumes	**2943**	**42841**
Groundnut	1496	11437
Brassica	68	7163
Safflower	184	6124
Others	2873	12172
Oilseeds	**4621**	**36896**
Cotton	41	4594
Jute	192	2585
Others	124	1426
Fibre Crops	**357**	**8605**
Brinjal	498	3032
Chilli	2	1981
Others	852	11905
Vegetables	**1352**	**16918**
Custard apple	-	57
Papaya	-	23
Others	-	92
Fruits	**-**	**172**
Opium poppy	1	293
Ocimum	3	194
Tobacco	1	937
Others	96	1181
Medicinal & Aromatic Plants & Narcotics	**101**	**2605**
Coriander	1	296
Sowa	-	59
Others	162	198
Spices & Condiments	**163**	**553**
Pongam oil tree	-	42
Others	154	42
Agro-forestry	**154**	**198**
Lentil	-	7712
Pigeonpea	-	2523
Duplicate Safety Samples	**-**	**10235**
Total	**25793****	**287028***

*The figure includes1647 Released varieties and 677Genetic stocks
**The figure includes 252 Released varieties and 207Genetic stocks

Research Projects (Code: Title, Project Leaders; Associates)

PGR/GCN- BUR-DEL-01.00: *Ex Situ* Conservation of Plant Genetic Resources of Agricultural and Horticultural Crops Using Conventional Seed Storage Methods (AK Singh)

PGR/GCN- BUR-DEL-01.01: Management of Information and National Germplasm Conservation Network (AK Singh, S Saxena, RC Agrawal)

PGR/GCN- BUR-DEL-01.02: Conservation of Legume Germplasm using Conventional Seed Storage Methods (Neeta Singh)

PGR/GCN- BUR-DEL-01.03: Conservation of Paddy using Conventional Seed Storage Methods (Sanjeev Saxena, AD Sharma)

PGR/GCN- BUR-DEL-01.04: Conservation of Oilseed, Fruit Crops and Variety Germplasm using Conventional Seed Storage Methods (J Radhamani, AK Singh)

PGR/GCN- BUR-DEL-01.05: Conservation of Cereals excluding Paddy and Agro-Forestry Crops Germplasm using Conventional Seed Storage Methods (Kalyani Srinivasan, Manju Uprety)

PGR/GCN- BUR-DEL-01.06: Conservation of Pseudocereals, Spices, Medicinal and Aromatic Plant Germplasm using Conventional Seed Storage Methods (Veena Gupta)

PGR/GCN- BUR-DEL-01.07: Conservation of Millets and Minor Millets Germplasm using Conventional Seed Storage Methods (AK Singh)

PGR/GCN- BUR-DEL-01.08: Conservation of Forage, Fibre Crops and Registered Germplasm using Conventional Seed Storage Methods (Anjali Kak, AK Singh)

PGR/GCN- BUR-DEL-01.09: Conservation of Vegetable Germplasm using Conventional Seed Storage Methods (Chitra Pandey)

PGR/GCN- BUR-DEL-01.10: Investigating Seed Dormancy, Seed Storage Behaviour and Physiological and Biochemical Changes during Storage (Kalyani Srinivasan, Neeta Singh, Veena Gupta, J Radhamani, S Saxena, Chitra Pandey, Anjali Kak, AD Sharma, Manju Uprety)

4. DIVISION OF PLANT QUARANTINE

Summary: A total of 28,668 accessions (78,772 samples) comprising 28,536 exotic accessions (78,640 samples [including 64,398 samples of international nurseries trial/ breeding material] of various crops and 132 accessions under export were processed for quarantine clearance. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 4,798 samples were found infested/infected contaminated with various pests *viz.*, insects/ mites -4,257 samples including 219 samples with hidden infestation; nematodes- 242; fungi/ bacteria- 122; and viruses- 177. Of the 4,798-infested/ infected/-contaminated samples, 4,756 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip, ethyl alcohol wash and mechanical cleaning. Forty-two samples of soybean from USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. Twenty-one Phytosanitary Certificates were issued for consignments meant for export. A total of 2,395 samples collected indigenously were processed for pest-free conservation. Of the 279 infested/-infected samples, 217 were salvaged and 2,676 samples were released for pest-free conservation. Six thousand five hundred and ninety eight samples of transgenic crops *viz.*, paddy and wheat, were processed for quarantine clearance. Based on the field studies on virus spread, the seed standards for certification against *Soybean mosaic virus* (SMV) of soybean and *Black-eye cowpea mosaic virus* (BlCMV) of cowpea is concluded as 0.5%. Diagnostic kits against both SMV and BlCMV were prepared and can be efficiently utilized for quality control of seeds.

4.1 Import Quarantine

4.1.1 Quarantine examination: A total of 28,536 exotic accessions (78,640 samples) including material of nurseries/ trial breeding material (14,264 entries; 64,398 samples) of various crops comprising both true seed and vegetative propagules were processed for the detection of associated exotic insect pests, and mites, plant parasitic nematodes, plant pathogens (fungi, bacteria, viruses) and weed seeds by various detection techniques. Of the import samples, 4,572 samples were exposed to X-ray radiography for detection of hidden infestation of bruchids and chalcids. A total of 4,798 samples were found infested/ infected/ contaminated. Of these, 4,257 samples were infested with insects/ mites including 219 samples with hidden infestation; 242 samples infected with nematodes and 122 found infected with fungi/ bacteria and 177 infected with viruses. A number of pests of quarantine importance were intercepted (Table 1).

4.1.2 Salvaging of infested/ infected/ contaminated germplasm: Of the total 4,798-infested/ infected/-contaminated samples, 4,756 were salvaged by various disinfestation treatments like mechanical cleaning to remove damaged/ abnormal seeds, soil clods, plant debris etc., fumigation with ethylene dichloride-carbon tetrachloride mixture @ 320 mg/ litre at 30 ^{0}C under normal air pressure against insect infestation and hot water treatment at 52 ^{0}C for 30 minutes for various seed-borne pathogens and nematodes and X-ray screening, pesticidal dip/ spray. Samples (4,257) infested with insects/ mites were salvaged through fumigation (4,033), X-ray radiography (219) and pesticidal dips (5); 242 samples infected with nematodes were salvaged by hot water and nematicidal dip treatments. Eighty samples infected with fungi/ bacteria were salvaged by fungicidal seed treatment (76), ethyl alcohol wash (4); and 177 samples infected with viruses were salvaged through grow-out test. Forty-two samples of soybean from USA were rejected due to the

Table 1: Pests intercepted in the exotic germplasm during the year 2002

Pest	Crop	Source
Insects and Mites		
*Bruchus dentipes**	*Vicia faba*	ICARDA (Syria)
B. emarginatus	*Pisum* sp.	Russia
*B. ervi**	*Lens* sp.	ICARDA (Syria)
B. lentis	*Lens culinaris, Vicia faba*	ICARDA (Syria)
B. pisorum	*Pisum* sp.	ICARDA (Syria), Russia
Callosobruchus analis	*Vigna unguiculata*	USA
C. chinensis	*V. unguiculata*	ICARDA (Syria), USA
C. maculatus	*V. unguiculata*	USA
Rhizopertha dominica	*Hordeum vulgare*	Syria
	Oryza sativa	ICARDA (Syria), Malaysia
	Triticum aestivum	Mexico
Sitophilus oryzae	*Oryza sativa*	Malaysia, Philippines
	Triticum aestivum	Mexico (CIMMYT), Nepal
S. zeamais	*Zea mays*	Mexico
Sitotroga cerealella	*Z. mays*	Bolivia
Tribolium castaneum	*Hordeum vulgare*	Syria
	Sesamum	USA
	Zea mays	Thailand, USA
	Triticum aestivum	ICARDA (Syria), Nepal
Mites	Kiwi fruits	Belgium
	Salix spp.	Italy
Nematodes		
Aphelenchoides sp.	*Arachis hypogeae*	USA
	Solanum tuberosum	USA
Pratylenchus sp.	*Prunus* sp.	France
Tylenchorhynchus sp.	*Prunus* sp.	France
Tylenchus sp.	*Solanum tuberosum*	USA
Fungi		
Alternaria brassicicola	*Brassica juncea*	Australia
	B. oleracea	Russia
A. padwickii	*Oryza sativa*	Malaysia, Philippines
A.sesami	*Sesamum indicum*	Japan
Claviceps purpurea	*Agropyron* sp., *Amblypyrum muticum*, *Elymus* spp., *Elytrigia juncea*, *Leymus* sp.	USA
Colletotrichum dematium	*Clitoria ternate*	Australia
	Medicago sativa	USA
C. gloeosporioides	*M. sativa, Vigna unguiculata*	USA
Drechslera maydis	*Zea mays*	Indonesia
D. oryzae	*Oryza sativa*	Malaysia
D. rostrata	*Sorghum vulgare*	Mali
D. sorghicola	*S. vulgare*	Mali
	Zea mays	USA
Fusarium oxysporum	*Glycine max*	Brazil
F. poae	*Hordeum vulgare*	Canada
F. solani	*Medicago sativa*	USA
Macrophomina phaseolina	*Vigna unguiculata*	USA
*Peronospora manshurica**	*Glycine max*	Brazil, Taiwan, Thailand, USA
Phoma betae	*Beta vulgaris*	Russia
Puccinia carthami	*Carthamus tinctorius*	USA

Rhizoctonia bataticola	*Vigna unguiculata*	USA
Septoria nodorum	*Triticum aestivum*	USA
Tilletia foetida	*T. aestivum*	Italy, Syria
Viruses		
Alfalfa mosaic virus (AMV)	*Glycine max*	AVRDC (Taiwan), Brazil, Myanmar, IITA (Nigeria), USA
	Phaseolus vulgaris♣	Canada, Kenya, USA
	Vigna radiata♣	Japan
Bean common mosaic virus (BCMV)	*Glycine max*♣	IITA (Nigeria), AVRDC (Taiwan), USA
	Phaseolus vulgaris	CIAT (Colombia), Kenya, USA
	Vigna unguiculata	Guyana, Nigeria
	V. radiata	Japan, Taiwan, USA
Bean common mosaic necrosis virus (BCMNV)	*Phaseolus vulgaris*	Kenya
Bean yellow mosaic virus (BYMV)	*Glycine max*	Myanmar, IITA (Nigeria), USA
	Vicia faba	Spain, ICARDA (Syria)
Broad bean stain virus (BBSV)*	*V. faba*	Syria
Cowpea aphid-borne mosaic virus (CABMV)	*Glycine max*♣	Myanmar, IITA (Nigeria), USA
	Vigna unguiculata	Guyana, IITA (Nigeria)
Cowpea mosaic virus (CPMV)	*V. unguiculata*	Nigeria
Cucumber mosaic virus (CMV)	*Glycine max*	Brazil, Myanmar, IITA (Nigeria), AVRDC (Taiwan), USA
	Vigna unguiculata	Nigeria
Pea seed-borne mosaic virus (PSbMV)	*Pisum sativum*	Russia, USA
	Vicia faba	Spain, ICARDA (Syria)
Southern bean mosaic virus (SBMV)	*Glycine max*	IITA (Nigeria), USA
Soybean mosaic virus (SMV)	*G. max*	AVRDC (Taiwan), IITA (Nigeria), USA
Tobacco ring spot virus (TRSV)	*G. max*	Myanmar, IITA (Nigeria)
Tomato black ring virus (TBRV)	*Phaseolus vulgaris*♣	Brazil, Canada, CIAT (Colombia), Kenya, USA

* Pest not yet reported from India

♣ Pest present in India but not recorded on the host on which intercepted

presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India.

4.1.3 Prophylactic treatments: A total of 43,027 seed samples were given prophylactic fumigation, 1,728 samples of vegetative propagules were given prophylactic dip/spray treatment and 12, 402 samples of paddy were given mandatory hot water treatment. In order to prevent the introduction of new strains of tobamoviruses through seeds, all the introduced germplasm samples of chilli (98), and tomato (207) were subjected to prophylactic seed treatment with 10% tri-sodium orthophosphate.

4.1.4 Grow-out test in Post-Entry Quarantine Nursery (PEQN): International nurseries trial material (4,688 entries) comprising wheat (3,344), barley (1,141) and triticale (203) from CIMMYT Mexico; ICARDA, Syria; exotic germplasm of wheat (41) and barley (28) from various sources and registered germplasm (62) of wheat were grown in PEQN. Loose smut of wheat (*Ustilago nuda* f. sp. *tritici*) was intercepted in 2 entries (IDTN-05-107 and IDTN-04-109) and loose smut of barley (*Ustilago nuda*) was intercepted in one entry (EC550772). Infected plants were uprooted and destroyed. Two lines

of wheat from CIMMYT, Mexico showed virus-like symptoms but reacted negatively with antiserum to *Arabis mosaic virus, Brome mosaic virus, Barley stripe mosaic virus* and *Wheat streak mosaic virus.*

A total of 493 samples of exotic germplasm comprising *Glycine max* (153), *Phaseolus* spp. (124), *Pisum* spp. (15), *Vicia faba* (10), *Vigna radiata* (67) and *V. unguiculata* (124) were grown in Post-entry Quarantine Greenhouses. The plants showing virus-like symptoms were tested by electron microscopy and using specific antiserum against various seed-transmitted viruses using enzyme-linked immunosorbent assay. The harvest from only healthy plants of different accessions was released to the indentors. The interceptions made are presented in Table-1.

4.2 Export Quarantine

A total of 132 accessions/ samples of various crops intended for export to various countries were processed for detection of associated pests. Of these, 7 samples were found infested with insect pests. All the infested samples were salvaged through fumigation. Fifty-four samples were given prophylactic treatments *viz.*, fumigation (51) and pesticidal dip/spray (3). Important insects intercepted were *Rhizopertha dominica, Sitophilus zeamais,* and *Tribolium castaneum* on maize; and *Tribolium castaneum* on pearl millet. Twenty-one Phytosanitary Certificates were issued.

4.3 Seed Health Testing of Indigenous Germplasm

A total of 2,395 samples collected indigenously under NATP-PB were processed for seed health testing and salvaging for their conservation in a pest-free state. All the samples were examined by using different techniques. A total of 279 samples were found infested/ infected including 211 with hidden infestation. Of the total infested/ infected, 217samples were salvaged while 62 samples highly infested with insects, were rejected. A total of 2,676 samples were released for pest-free conservation. Important insect-pests detected were *Bruchidius augustifrons* and *Bruchophagus mellipes* in *Sesbania*; *Bruchus lentis* in *Lens culinaris*; *B. pisorum* in *Pisum sativum; Callosobruchus* spp. and *C. chinensis* in *Glycine max; Callosobruchus* spp in ricebean, black gram and pigeonpea; *Callosobruchus maculatus* in cowpea; *Rhizopertha dominica* in *Oryza sativa; Rhizopertha dominica* and *Sitophilus oryzae* in *O. sativa* and *Zea mays; Sitophilus zeamais* in *Z. mays*; *Sitotroga cereallela* in *Oryza sativa* and *Zea mays;* and *Tribolium castaneum* in *Acacia* spp.

The fungi detected were *Colletotrichum dematium* in *Capsicum annuum, Drechslera oryzae* in *Oryza sativa* and *Alternaria besseyi* in *O. sativa.*

4.4 Quarantine for Transgenic Planting Material

With the approval of RCGM, imported transgenic planting material received during the period included 6598 samples of transgenic rice lines from Temasek Life sciences Laboratory, Singapore for Metahelix Life Sciences, Bangalore. This material comprised putative insertional mutant rice lines (*Oryza sativa* cv Nipponbare) carrying maize transposable element Ds and is under processing. Besides, 81 samples comprising wheat (43) and rice (38) received from Germany during 2003 for Mahyco were processed and 36 samples *viz.*, wheat (11) and rice (25) were released to the indenter. Important interceptions included *Nigrospora oryzae, Drechslera oryzae* and *Curvularia*

lunata in rice from Germany and *D. oryzae, Phoma glumarum, C. lunata, Fusarium moniliforme* and *F. semitectum* in rice from Singapore. Rice from Singapore was found infested with various insect pests *viz., Cryptolestes pusillus, C. ferrugineus* (a pest not reported from India), *Rhizopertha dominica, Sitotroga cerealella, S. oryzae, Tribolium castaneum* and psocids. Infected/ infested material was salvaged by various disinfestation treatments like mechanical cleaning, fumigation with ethylene dichloride-carbon tetrachloride mixture @ 320 mg/ litre at 30 ^{0}C under normal air pressure against insect infestation and hot water treatment at 52 ^{0}C for 30 minutes for various seed-borne pathogens and nematodes. Post-entry quarantine inspection of wheat and rice imported from Germany grown in containment at Mahyco, Aurangabad was done and the crops were found to be free from exotic pests/ diseases.

4.5 Human Resource Development

An Orientation Course, fifth in the series, on "Biosafety Considerations for Evaluation of Transgenic Crops" was organized from 22nd November to 1st December, 2004 at NBPGR, New Delhi. Fourteen participants engaged in research in Biotechnology, Biochemistry, Cytogenetics, Plant breeding and Plant protection in various ICAR Institutes, State Government Departments, Universities, Private sector organizations and International Center for Genetic Engineering and Biotechnology (ICGEB), New Delhi attended the course. Training comprised of lectures by eminent Biotechnologists, Plant breeders, Plant protection specialists, Policy makers, representative of private sector like Monsanto, Mahyco, TERI, Panacea biotech and also from International Service for the Acquisition of Agri-biotech Applications (ISAAA) covering different aspects like Indian plant genetic resources management system, global scenario of transgenic crops, National plant quarantine system and regulatory mechanism, exchange and safe movement, risk assessment, Cartagena Protocol, transgenic pharmaceutical plants, pest control through transgenics, environmental issues/concerns, implication of transgene flow, management of containment glass house, Intellectual property rights, and experiences of private sector etc.

4.6 Diagnostics and Development of Seed Certification Protocols

For the management of seed-transmitted viral diseases of grain legumes, the seed standards for certification against *Soybean mosaic virus* (SMV) of soybean and *Black-eye cowpea mosaic virus* (BlCMV) of cowpea is proposed to be 0.5%. Diagnostic kits against both SMV and BlCMV were prepared and can be efficiently utilized for quality control of seeds.

4.7 Classical Biological Control of *Mikania micrantha* with *Puccinia spegazzinii*

The rust *Puccinia spegazzinii* inoculated plants were received from CABI-UK and the inoculum was multiplied on the *Mikania* plants in the Containment Facility. Seventy-four plants species including cereals, millets, oilseeds, spices, fruits, vegetables, plantation, fibres ornamentals, medicinal and forest crops have been screened against the rust in the Containment Facility.

Research Projects (Code, Title, Project Leader, Associates)

PGR/PQR- BUR-DEL-01.00: Quarantine clearance of germplasm under exchange and supportive research *(ICAR)* (RK Khetarpal).

PGR/PQR-BUR-DEL-01.01: Quarantine clearance of germplasm under exchange Joint inspection and prophylactic treatments (PC Agarwal, Usha Dev, Rajan, Baleshwar Singh, Kavita Gupta, Charan Singh, Ashok Maurya, Dinesh Kumar, K. D. Joshi).

PGR/PQR- BUR-DEL-01.02: Quarantine clearance of germplasm under exchange and supportive research: Entomological Aspects (B Lal, Manju Lata Kapur, Shashi Bhalla, Kavita Gupta, Charan Singh).

PGR/PQR- BUR-DEL-01.03: Quarantine clearance of germplasm under exchange and supportive research: Nematological Aspects (Arjun Lal, Rajan).

PGR/PQR- BUR-DEL-01.04: Quarantine clearance of germplasm under exchange and supportive research: Mycological Aspects (Usha Dev, PC Agarwal, Baleshwar Singh, Dinesh Chand, KD Joshi).

PGR/PQR- BUR-DEL-01.05: Quarantine clearance of germplasm under exchange and supportive research: Virological Aspects (Shamsher Singh, DB Parakh, Celia Chalam V, Ashok Maurya).

PGR/PQR- BUR-DEL-01.06: Quarantine clearance of transgenic planting material and supportive research (Manju Lata Kapur, Rajan, Baleshwar Singh, Shashi Bhalla, Celia Chalam V).

Externally Funded Projects

1. Seed health testing of germplasm of different agri-horticultural crops for pest-free conservation of germplasm *(NATP)* (Arjun Lal, RKKhetarpal, Shamsher Singh, PC Agarwal, B Lal, Usha Dev, Manju Lata Kapur, Rajan, Baleshwar Singh, DB Parakh, Shashi Bhalla, V Celia Chalam, Kavita Gupta, Charan Singh, AK Maurya, Dinesh Chand, KD Joshi).

2. National containment/quarantine facility for transgenic planting material *(DBT)*(RK Khetarpal, Gurinder Jit Randhawa and Manju Lata Kapur).

3. Diagnostics and development of seed certification protocols for management of seed-transmitted viral diseases of grain legumes *(NATP)* (RK Khetarpal, Celia Chalam V).—Completed March, 2004.

4. ICAR-CABI Classical biological control of *Mikania micrantha* with *Puccinia spegazzinii (DFID)* (Usha Dev)

5. GERMPLASM EXCHANGE UNIT

Summary: During the period under report 28, 437 accessions (78,571 samples) were imported from 51countries and these included germplasm (14,173 accessions) as well as trial material (14,264 entries; 64,398 samples) of different agricultural and horticultural crops. Requirement for germplasm from abroad was met by arranging material from different sources in India and 132 samples were sent to nine countries. Based on requests received from research workers 13,008 samples of diverse crops were supplied to users for crop improvement programs in the country.

5.1 Import of Plant Genetic Resources

PGR introductions were made to meet the specific requirement of scientists working in ICAR research institutes, state agricultural universities (SAUs) and non-governmental organizations (NGOs). Introductions comprised material obtained on request from the scientists as well as collaborators for international trials to be conducted in India.

Accessions procured and processed	28,536 Accessions (78,640 samples)
(a) Germplasm	13,805
(b) Trials	14,264 (64,398)
Number of transgenic material imported	36
Number of countries involved	51
Number of import permits issued	789

Cereals and Millets: *Eleusine floccifolia* (1), *E. jaegeri* (1) and *Eleusine* sp (10) from Kenya; *Hordeum vulgare* (5) from USA and (2) from Canada; *Oryza alta* (2) *O.australiensis* (7), *O. barthii* (7), *O. brachyantha* (2), *O. eichingeri* (7), *O. granulata* (1), *O. grandiglumis* (2), *O. glumaepatula* (2), *O. glaberrima* (12), *O. latifolia* (2), *O. longiglumis* (2), *O. longistaminata* (2), *O. meridionalis* (2), *O. minuta* (3), *O. nivara* (2), *O. officinalis* (3), *O. punctata* (4), *O. rhizomatis* (1), *O. ridleyi* (2), *O. rufipogon* (2), *O. sativa* (3995) from IRRI, Philippines, (33) from USA, (2) from Brazil, (9) from Spain, (12) from China, (25) from Germany, (2) from Malaysia, (450) from Belgium; *Panicum antidotale* (1), *P. coloratum* (1), *P. coloratum* var *kakarokariensis* (1), *P. lanipes* (1), *P. milioides* (1), *P. queenslandicum*(1), *P. schinzii* (1), *P. stapflanum* (1), *P. virgatum* (1), *P. milliaceum* (5) from USA; *Pennisetum alopecuroides* (1), *P. basedowii, P. flaccidum* (1), *P. latifolium* (1), *P. macrourum* (1), *P. orientale* (1), *P. pedicellatum* (1), *P. setaceum* (2), *P. unisetum* (1), *P. polystachyon* (1), *P. squamulatum* (1) all from USA; *Setaria australiensis* (1), *S. incrassata* (17), *S. italica,* sub sp. *viridis* (13), *S. lachnca* (5), *S. neglecta* (2), *S. parviflora* (3), *S. sphacelata* (27), *S. sphacelata* var *anceps* (3) and *S. verticillata* (8) all from USA; *Sorghum bicolor* (89) from USA and (3) from West Africa; *Triticum aestivum* (11) from Germany, (137) from Australia, (202) from Switzerland, (588) from USA; *T. aestivum* sub sp. *compactum* (2), *T. aegilopoides* (203) from USA, *T. durum* (47) from Italy, (4) from Australia, (7) from Ukraine, *T. ispahanicum* (2) *T. monococcum* ssp. *aegilopoides* (203), *T. monococcum* ssp. *monococcum* (102), *T. aestivum* ssp. *macha* (2), *T. aestivum* ssp. *spelta* (2), *T. aestivum* ssp. *sphaero coccum* (1), *T. tauschii* (1), *T. tauschii* ssp. *typica* (1), *T. timopheevii* ssp. *armeniacum* (4), *T. timopheevii* sp *timopheevii* (2), *T. turgidum* ssp. *carthlicum* (2), *T.*

turgidum ssp. *dicoccoides* (3), *T. turgidum* ssp. *dicoccum* (1), *T. turgidum* ssp. *polonicum (02), T. turgidum* ssp. *turgidum* (2) *T. urartu (102), T. vavilovii* (2), *T. zhukovsky* (2) all from USA; *Triticum* sp. (10) from Australia and (22) from Mexico; *Zea mays* (162) from USA, (680) from Mexico, (341) from Thailand, (74) from Philippines, (26) from Spain, (108) from Bolivia, (4) from Columbia, (248) from Brazil, (56) from Bulgaria, (9) from Sri Lanka, and (23) from Zimbabwe.

Trials: *Oryza sativa* (3281 entries, 5422 samples) from IRRI, Philippines 31st IIRON A&B, 30th IURON, 29th IRBN, 24th IRFAON, 14th IRTN, 10th IRHON, 25th IRSSTN, 27th IDRON, 26th IRLON, 5th IRTON, 29th IRBNS, 24th IRSSTN, *Zea mays* (3099 entries ; 20,772 samples) +IEYU0451, EVT 17EY, ILHYB, EPOP, ILPOP,CHTHLW, IEYH 410, ILWH 407, ILWQ 411, 1 LYH408, CHTTY 2004, ILYQ 412 CHTTY1 2004, 1 LWV 401 EVT 12, ILWQ 405 2004 EVT 12Q, ILYV 402 EVT 13, IEYV 404 EVT 14 a, EWWV 403 2004 EVT 14 B, EVT 17 EY, ILWP431, IPTT-42, ILWP 432 IPTT 44, IEWH 415 TTW CEW, IEYH 416 2004 TTWCEY, STCY 04-08, STCY 04-09, STCY-0414, TTWCLWQ 04-01, TSCLWC-04-02, TSCLWQ 04-03, TSCLWQ-04-04, TSCLYQ 04-06, TSCLWQ 04-07, TTWCLW -04-10, TSCLW-04-13, TSCLWQ-04-08, TSCLW-04-14, TSCLW -04-18, TTWCLW-04-11, TSCLY-04-16, TSCLW-04-20, TSCE-04-27, ILWH 413 TTWCWL, WHEAT (6980 entries 32,034 samples) from CIMMYT, Mexico; CIMMYT Nepal) IBRWAGP, RWYT-MR, RWYT-LR/SC, RWKLDN-CWA, RWGP-CWA, RWCB, WON-D, IDYT-CA, RWYT-LR/CA 22nd SAWSN, 16th ASWSN, 12th SAWYT, 37th IBWSN, 34th EDUYT, 36th IDSN, 36th ITSN, 12th HTWYT, 36th IDYN, 14th HBSN, 32th IBON, 36th ITSN, 25th ESWYT, 12th HRWYT, 15th HRWSN, MISCSN, MFSYCINT, 5th IAT, ME 11 Q 03. Barley (350 entries; 1922 samples) from CIMMYT, Mexico, ICARDA Syria, INBON, IBYT-LRA-M, IBYT-LRA-C, IBYT-NRA, IBON-LRA-C.

Grain Legumes: *Cajanus cajan* (36) from ICRISAT, Niger; *Cicer arietinum* (1) from Spain, (99) from ICRISAT, (802) from Syria, (760) from USA, (6) from Australia; *Cicer bijugum* (1) from USA, *C. chorassanicum* (2), *C. cuneatum* (2), *C.echinospermum* (12), *C. bijugum* (2), *C. judaicum* (12) *C. pinnatifidum* (12), *C. reticulatum* (6), *C. yamashitae* (2) from Syria and *C. multifugum* (1), *C. reticulatum* (343) from USA; *Glycine max* (62) from USA, (3) from Sri Lanka, (10) from Myanmar, (15) from Brazil. *Lathyrus ochrus* (28) from Syria, (1) from Germany; *L. aphaca* (49) from Syria, (1) from Germany, *L. aphaca* var. *floribundus* (2) from Syria, *L.annuus* (14) from Syria, (1) from Germany, *L. cicera* (38) from Syria, (1) from Germany, *L. ciliolatus* (2), *L. clymenum* (3) from Syria, *L. gloeospermus* (1) from Germany; *L.gorglni* (13) from Syria, (1) from Germany; *L.odoratus* (1) from Germany; *L.pratensis* (1) from Germany; *L.pseudocicera* (12) from Syria, *L.pratensis* (1) from France; *L.sativus* (17) from Syria; *L.pseudocicera* (1) from Germany; *L. sylvestris* (1) from Germany, (1) from Syria, *L.tingitanus* (2) from Syria; *L.tuberosus* (1), *L.vernus* (1) from Germany; *L. hierosolymitanus* (21) from Syria, (1) from Germany; *L. hirsutum* (1), *L. blephari carpus* (7) from Syria, *L. inconspicuus* (37) from Syria, *L. inconspicuus* (1) from Germany, *L. hirsutum*, *L. latifolia* var. *ensifolius* (1) from Germany; *L. marmoratus* (10) from Syria; *Lens*

culinaris (1) from USA; (3) from Syria, *L.culinaris* ssp. *culinaris* (50) from Syria; *Macrotyloma axillare* (11) from USA, *Phaseolus vulgaris* (41) from USA, (1) from Brazil and (5) from Columbia; *Pisum sativum* (14) from USA, *P. arvense* (5), *P. abyssinicum* (1) from Russia, *Pisum elatius* from Russia; *Vigna radiata* (2) from Sri Lanka, *Vigna radiata* (36) from Taiwan, *V. aconitifolia* (2) *V. adenantha* (4), *V. angularis* (19), *V. glabrescens* (1) *V. luteola* (7), *V. minima* (1), *V mungo* var *mungo* (22), *V.radiata* (6), *V.mungo* (1) from Sri Lanka, *V umbellata* (16), *V. vexillata* (11) all are from USA, *V. unguiculata* (1) from Guyana, (32) from USA, *V. unguiculata* ssp. *cylindrica* (1), *V. unguiculata* ssp. *dekindtiana* (1), *V. unguiculata* ssp. *pubescens* (2), *V. unguiculata* ssp. *sesquipedalis* (18), *V. unguiculta* ssp. *unguiculata* (200) all from USA; *Vicia faba* (1) from Spain.

Trials: *Cicer arietinum* (235 entries; 2020 samples) from ICARDA; Syria CIABN-2005, CICTN, CIEN-SLI, CIEN-SLZ, CIFWN, CIF 3 NSL; *Lens culinaris* (298 entries; 2041 samples) from ICARDA, Syria LIDTN, LIEN-EC, LIEN-L, LIENSS;LIF 3 N-L, LIF3N SS, LIFWN, LIRN; *Lathyrus* (14 entries, 180 samples) from ICARDA, Syria LS.ILAT; *Vicia faba* (7 entries; 7 samples) from ICARDA Syria.

Oilseeds: *Arachis archeri* (1), *A. benensis* (1), *A. burchellii* (1), *A. cruziana* (1), *A. cryptopotamica* (1), *A. decora* (1), A. *glandulifera* (1), *A. hermannii* (1) from USA; *A. hypogaea* (1) from *Cyprus*, (1) from Zimbabwe, (26) from Ghana, (8) from Malawi, (595) from ICRISAT, Niger; *A. appressipila* (1), *A. batizogaca* (1), *A. duranensis* (3), *A. kretschmeri* (1), *A. monticola* (2), *A. paraguaroensis* (1), *A. stenophylla* (1) all from ICRISAT, Niger; *A. major* (1), *A. matiensis* (1), *A. palustris* (1), *A. pintoi* (1), *A simpsonii* (1), *A. trinitensis* (1), *A. williamsii* (1) from USA; *Carthamus tinctorius* (88) from USA; *Brassica juncea* (37) from Australia; *Helianthus agrophyllus* (1) from Yugoslavia, *H. annuus* (1) from South Africa, *H. glaucophyllus* (1) from Yugoslavia, *H. grosseerratus* (1), *H. laevigatus* (2), *H. petiolaris* (1) all from Yugoslavia; *H. annuus* (79) from Australia, (18) from USA; *Linum angustifolium* (1), *L. austriacum* (1), from Russia, *L. altaicum* (1), *L. austracum* (1), *L. bienne* (1), *L. decumbens* (1), *L. flavum* (1), *L. grandiflorum* (1), *L. lewisii* (1), *L. perenne* (1), *L. usitatissimum* (9) all from Canada; *L. bienne* (1) from Russia, *L. grandiflorum* (1) and *L. usitatissimum* from Russia; *Ricinus communis* (1) from Nepal, (2) from ICRISAT, Niger and (1) from USA; *Sesamum indicum* (39) from USA.

Vegetables: *Brassica oleracea* var. *botrytis* (10) from USA, *B. oleracea* var. *capitata* (17) from China, *Abelmoschus esculentus* (3) from Sri Lanka, (2) from Guyana; *Capsicum annuum* (31) from Taiwan, (5) from China, (3) from Sri Lanka; *C. baccatum* (2); *C. chacoense* (2), *C. chinense* (3), *C. pubescens* (2) all from Taiwan; *C. frutescens* (2) from Guyana *Cucumis melo* (5), *C. melo* ssp. *melo* (25) from USA; *C. melo* (1) from spain, (1) from Guyana;. *C. melo* var. *cantaloupensis* (2) from China, *Cucumis sativa* (6) from Taiwan, (1) from Guyana, *Citrullus lanatus* (8) from China, *Capsicum* sp. (52) from Taiwan, *Lycopersicon chilense* (10), *L. esculentum* (294), *L. hirsutum* (5), *L. pimpinellifolium* (3), *L. peruvianum* (3) from Taiwan, *Lycopersicon* sp (20) from Russia, (56) from USA, *L. esculentum* (6) from

China, (4) from Sri Lanka; *Solanum aethiopicum* (3), *S. americanum* (2), *S.macrocarpon* (2), *S. mammosum* (1), *S. melongena* (8) *S. scabrum* (3), *S. sisymbrifolium* (1), *Solanum* sp. (1), *S. torvum* (2) all from Taiwan, *S. melongena* (13) from Taiwan, (4) from Philippines.

Fruits: *Actinidia arguta* (2), *A. chinensis* (2) both from Belgium; *Annona atemoya* (1) from Sri Lanka, *A. muricata* (1) from Sri Lanka; *Carya illinoensis* (74) from USA, *Citrus grandis* (1) from Niger; *Cocos nucifera* (29) from UK; *Ficus carica* (1) from Niger; *Juglans hindsii* (1), *J. regia* (1) from USA; *Macadamia integrifolia* (10) from Australia, *Malus sylvestris* (5) from USA, *M. pumila* (95) from Shimla; *Mangifera indica* (2) from Niger, (1) from Guyana; *Prunus armeniaca* (2) *P. persica* (2), *P. salicina* (4), *Prunus* sp. (1) all from USA; *Prunus* sp. (9) from France, *Psidium guajava* (3) from Guyana, (1) from Niger and (1) from South America; *Punica granatum* (3) from Niger, South America and Guyana, *Persea grantissima* (1) from Sri Lanka, *Pyrus malus* (7) from Italy; *Tamarindus indica* (1) from Niger; *Vitis vinifera* (5) from Niger, (1) from Czech Republic, (1) from Japan, (21) from Uzbekistan.

Fibres: *Gossypium hirsutum* (108) from USA, (2) from Australia and *Gossypium* sp. (2) from Bulgaria.

Tubers: *Solanum tuberosum* (9) from USA and (25) from Peru.

Plantation crops: *Hevea brasiliensis* (41) from Malaysia.

Forages: *Acacia difficilis* (4), *Acacia torulosa* (4), *Acacia tumida* var *tumida* (2) from Australia; *Agroplqron cimmericum* (1), *A.cristatum* (2), *A. cristatum* var. *imbricatum* (2), *A cristatum* var *pectinatum* (2), *A. clasyanthum* (1), A. *desertorum* (2), *A fragile* (2), *A. fragile* ssp. *sibiricum* (2), *A.michnoi* (2), *A. mongolicum* (2), from USA; *Amblyopyrum muticum* (3), *Australopyrum retrofracium* (2), *Austrodanthonia pilosa* (2), *Brachiaria hybrid* cv-*Mulato* (2), from USA; *Casuarina cunninghamiana* ssp. *cunninghamiana* (2), *Centrosema pascuorun* (1), *Chukrasia tabularis* (1), *Clitoria ternetea* (1); *Dasypyrum hordeaceum* (1), *D. villosum* (2) all from USA; *Desmanthus* sp. (3), *D. intortum* (1), *D. unicinatum* (1), from Australia; *Elymus abolinii* (2), *E. agropyroides* (2), *E. antareticus* (2), *E. agropyroides* (2), *E. antarcticus* (2), *E. antiquus* (2), *E. aristiglumis* (2), *E. atrtus* (2), *E. austromontanus* (1), *E. bakeri* (2), *E. barbicallus* (1), *E. batalinii* (2), *E. brachyaristatus* (1), *E. breviaristatus* (2), *E. breviaristatus* ssp. *scabrifolius* (2), *E. canadensis* (2), *E. caninus* (2), *E. caueasicus* (2), *E. cilioris* (2), *E. ciliaris* ssp *amurensi* (1) *E. confusus* (2), *E. curvatus* (2), *E. dahuricus* (2), *E. dahuricus* ssp. *excelsus* (2), *E. dentatus* (2), *E. drobovii* (2), *E. elymoides* (2), *E. elymoides* ssp *californicus* (1), *E. elymoides* ssp *elymodies* (2), *E. fedtschenkoi* (2), *E. fibrosus* (2), *E. glaucissimus* (2), *E. glaucus* (2), *E. gmelinii* (2), *E. grandiglumis* (1), *Elymus haffmannii* (1) from USA; *E. interruptus* (1), *E. kengii* (2), *E. kokonoricus* (1), *E. lanceolatus* (2), *E. laxiflorus* (1), *E. longearistatus* (2), *E. macrourus* (1), *E. magellanicus* (1), *E. melantherus* (1), *E. multisetus* (3), *E. mutabilis* (2), *E.mutabilis* ssp. *paecaespitosus* (2), *E. mutabilis* var. *oschensis* (2), *E. nevskii* (4), *E. nipponicus* (1), *E. nutans* (2), *E. panormitanus* (1), *E. parishii* (1), *E. patagonius* (2), *E. pendulinus* (2), *E. praeruptus* (2), *E. psettdonutans* (1),

E. purpurariistus (1), *E. rectisetus* (4), *E. retusus* (1), *E. rigidulus* (2), *E. scaber* (1), *E. scabervar parviflorus* (2), *E. scaber* var *scaber* (2), *E. scabriglumis* (2), *E. semicostatus* (2), *E. sibiricus* (2), *E. stenachyrus* (2), *E. strictus* (2), *E. submuticus* (2), *E. tenuis* (1), *E. thoroldianus* (1), *E.trachycaulus* (2), *E. trachycaulus* ssp. *subsecundus* (2), *E. transhyrcanus* (2), *E. tschimganicus* (2), *E. uralensis* (1), *E. uralensis* ssp. *komarovii* (1), *E. vaillantianus* (2), *E. villosus* (1), *E. virginicus* (2), *E. wawawaiensis* (2), *Elytrigia.caespitosa* ssp *nodosa* (2), *Elytrigia elongata* (2), *E.intermedia* (2), *E. juncea* (2), *E. juncea* ssp. *juncea* (2) *E. lolioides* (1), *E. pontica* (2), *E. pungens* (2), *E. pycnantha* (2), *E. rechingeri* (1), *E.repens* (2), *E. repens* ssp. *elongatiformis* (2), *E. scirpea* (2); *Eremopyrum bonaepartis* (2), *E. distans* (1), *E. orientale* (1), *E. triticeum* (1); *Henrardia persica* (1); *Hordelymus europaeus* (1), *Leymus akmolinensis* (1), *L.alaicus* (1), *L. alaicus* ssp *karataviensis* (2), *L.angustus* (2), *L. arenarius* (2), *L. chinensis.*(2), *L. cinereus* (2), *L. condensatus* (1), *L. innovatus* (1), *L. karelinii* (1), *L. pseudoracemosus* (1), *L. racemosis* (1), *L. racemosus* ssp. *sabulosus* (1), *L. ramosts* (1), *L. salinus* (1), *L. secalinus* (2), *L. triticoides* (1) all from USA; *Lolium multiflorum* (28) USA, *Macroptilium atropurpureum* (1) from Australia; *Medicago sativa* (7) from Syria; *Poa annua* (3) from USA; *Trifolium alexandrinum* (11) from Syria, *T. angustifolium* (7) *T. repens* (2), *T. subterraneum* (3) from Syria; *Medicago arabica* (4), *M. biflora* (1), *M. blancheana* (4), *M. brachycarpa* (2), *M. cancellata* (2), *M. ciliaris* (8), *M. constricta* (4), *M. coronata* (2) from USA; *M. disciformis* (4), *M. doliata* (4), *M. doliata varmuricata* (2), *M. fischeriana* (2), *M. heyniana* (3), *M. hybrida* (2), *M. intertexta* (8), *M. italica* (4), *M. laciniata* (6), *M. lesinsii* (4), *M. liltoralis* (8), *M. lupulina* (6), *M. marina* (1), *M. medicaginoides* (1), *M. minima* (6), *M. monantha* (2) *M. monspeitaca* (2), *M. murex* (7), *M. muricoleptis* (3) *M. noeana* (5), *M. orbicularis* (10), *M. papillosa* (2), *M. pironae* (2), *M. platycorpos* (3), *M. polymorpha* (3), *M. polymorpha* var. *bevispina* (5), *M. polymorpha* var. *polymorpha* (3), *M. polymorpha vulgaris* (1) from USA; *M. popovii* (1), *M. praecox* (4), *M. radiata* (6), *M. rigidula* (5), *M. rigiduloides* (3), *M. rotata* (6) from USA, *M. rugosa* (6), *M. ruthenica* (2), *M. sativa* ssp. *hemicycla* (2) from USA, *M. sativa* ssp *mvaria*, (2) *M. sativa* ssp *caerulea* (2), *M. sativa* ssp *falcata* (2), *M. sativa* ssp *glomerata* (2), *M. sativa* ssp *sativa* (2), *M. sauvagei* (4) from USA; *M. scutellata* (6), *M. secundiflora* (3), *M. spiepardii* (3), *M. soleirolii* (4), *M. suffruticosa* (2), *M. suffruticosa* ssp. *leiocarpa* (1), *M. tenoreana* (3), *M. truncatula* (7), *M. turbinate* (3), *M. granadensis* (2), *M. lanigera* (1) all from USA; *Pascopyrum smithii* (2), *P. sathyrostachys fragilis* (1), *P. juncea* (2), *P. seudoroengeria eniculata* (1), *P. geniculata* ssp. *pruinifera* (1), *P. gracillima* (1), *P. pseudoroegneria kosaninii* (1), *P. kbanotica* (2), *P. spicata* (2), *P. strigosa* ssp *aegilopoides* (1), *P. tauri* (1); *T. aeniatherum caput-medusae* (2), *T. aeniatherum caput-medusae* ssp. *asperum* (1), *T.aeniatherum caput-medusae* ssp. *caput-medusae* (1), *T. aeniatherum caput-medusae* ssp. *crinitum* (1) all from USA.

Agroforestry plants: *Acacia mangium* (4), *Eucalyptus agrophloia* (1), *E.camaldulensis varobtuse* (3), *E. tereticornis* ssp. *tereticornis* (2) from Australia, *Salix aegyptiaca* (1) from USA, *S. alba* (16) from Netherlands, (1) from

UK, (1) from Germany, (1) from USA, (10) from Sweden, (01), from Switzerland, (2) from Finland (2) from New Zealand, *S. alba* var. *vitellina* (2) from Italy; *S. atrocinera* (1) from USA, *S babylonica* (1) from Japan, (3) from USA, (1) from Switzerland, *S. blanda* (1) from USA, *S. caprea* (2) from Italy, (1) from Switzerland, *S. daphnoides* (1) from Germany, (1) from Italy, (1) from USA, (3) from Sweden, (1) from Switzerland. *S. dasyclados* (7) from Sweden (2) from Finland; *S. fragilis* (1) from UK, (1) from Germany, (1) from Japan, (2) from Finland, *S. glatfelteri X S. alba* (1) from Sweden, *S. gracilistyla* (1) from USA, *S. humbodtiona* (1) from Germany, *S. jessoensis* (7) from Japan, *S. matsudana* (2), *S. matsudana* X *S. alba* (6), *S. matsudana,*X S. *pentandra* (2) from New Zealand; *S.miyabeana* (1), *S. muscina* (1) from USA, *S. nigra* (3) from Germany, *S. nigra* (2) from New Zealand, *S. pentandra* (1) from USA, *S. pierotii* (2) from Japan, (1) from USA, *S. purpurea* (1) from UK, (2) from Italy, (1) from Finland, *S. rorida* (2) from Japan, *S. rosharinifolia* (2) from Italy, *S. sepuloralis* (2) from USA, *Salix sp.* (9) from Turkey, (1) from Sweden, (9) from UK, *S. triandra* (1) from UK *S. udensis* (1) from USA; *S. viminalis* (4), *S. viminalis caprea* (1) from Sweden. *S. viminalis* (1) from Finland, (3) from Yugoslavia.

Medicinal and Aromatic Plants: *Silphium laciniatum* (2) from USA; *Glycyrrhiza echinata* (2), *G. uralensis* (1) from Russia.

Ornamental: *Monarada* sp. (1) from Canada and *Passiflora* sp (1) from Niger.

Narcotics & Beverages: *Nicotiana tabacum* (5) from USA.

Table 1: Promising introductions made during the year 2004

Crop	EC No.	Traits	Supplied to
Biotic Stress			
Oryza sp. (Rice)	EC 539103-10 EC 539111-118 EC 539131-38 IRRI, Philippines	BPH resistant lines Bacterial blight resistant lines Tungro virus resistant lines	• DRR, Hyderabad, AP
	EC 56738-3 EC 546740 IRRI, Philippines	Blast resistant lines BPH resistant	• CRURRS Hazaribagh, Jharkhand
var. MR 219, MR 220	EC 548000-001 Malaysia	Multiple disease resistant	• DRR, Hyderabad, AP
	EC 549239 IRRI, Philippines	Sheath blight resistant	• TNAU, Coimbatore, TN
var. Boliviar	EC 550177 USA	Resistant to blast, narrow brown leaf spot (*Cercospora janseana*)	• DRR, Hyderabad, AP
var. Saber	EC 550175 USA	Resistant to blast *(Pyricularia grisea)* and sheath blight (*Rhizoctonia solani*), brown leaf spot (*Cercospora janseana*), leaf smut (*Entyloma oryzae*) and panicle blight	• DRR, Hyderabad, AP

Triticum aestivum var. Bigsky	EC 538958 USA	Resistant to stem rust	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. Outlook	EC 541189 USA	Resistant to wheat aphid (*Diuraphis noxia*) due to presence of resistance gene Dn4, stem rust (*Puccinia graminis*) and moderately resistant to stagonospora blotch (*Stagonospora nodurum*)	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. Deloris	EC 552125 USA	Resistant to dwarf bunt (*Tilletia controversa*)	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. OK 101	EC 5438493 USA	Resistant to *Wheat soil borne mosaic virus*	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. Caledonia	EC 550175	Resistant to loose smut (*Ustilago tritci*),	
var. Richland	EC 550176 USA	*Wheat spindle streak mosaic virus* and *Wheat mosaic virus*	• DWR, Karnal, Haryana • NBPGR, New Delhi
GP 97L9521	EC 550180	Resistant to stem rust (*Puccinia graminis*)	• DWR, Karnal, Haryana • NBPGR, New Delhi
GP N 95 L 11881	EC 550181		
var. OK-102	USA EC 550632 USA	Resistant to leaf rust (*Puccinia triticina*), tan spot (*Pyrenophora tritici-repentis*) powdery mildew *(Blumeria graminiss*) and *Wheat soil borne mosaic virus*	• DWR, Karnal, Haryana • NBPGR, New Delhi
Zea mays (Maize)	EC 546871 Indonesia	Downey mildew resistant	• DMR, IARI, New Delhi • NBPGR, New Delhi
Hordeum vulgare var. UC 933	EC 538157 USA	Resistant to stripe rust, *Barley yellow dwarf virus*, leaf rust, powdery mildew net blotch and scald	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. UC 969	EC 538158 USA	Resistant to *Barley yellow dwarf virus*, leaf rust, net blotch and scald	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. UC 960	EC 538159 USA	Resistant to BYDY, leaf rust, PM, net blotch and scald	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. UC 937	EC 538160 USA	Resistant to stripe rust, BYDY, leaf rust, powdery mildew, net blotch and scald	• DWR, Karnal • NBPGR, New Delhi
var. Vivan	EC 540807	Resistant to covered smut, false loose smut, common root rot	• DWR, Karnal, Haryana • NBPGR, New Delhi
Panicum miliaceum var. Horizon	EC 552153 USA	Resistant to Russian wheat aphid (*Diuraphis noxia*), head rot associated with stem maggot (*Meromyza* sp.) and European corn borer	• PC (Small Millets), UAS, Bangalore, Karnataka
Glycine max var.Washita	EC 537946 USA	Resistant to root knot nematodes (*Meloidogyne incognita)*	• NRC Soybean, Indore, MP
var. Catoosa	EC 537947 USA	Resistant to soybean cyst nematode (*Heterodera glycines)* and root knot nematode (*Meloidogyne incognita)*	• NRC Soybean, Indore, • Madhya Pradesh
	EC 538800	Rust resistant lines	• NRC Soybean, Indore, MP
	EC 538829	Root knot nematode resistant Madhya Pradesh	• NRC Soybean, Indore,

	EC 538834	Resistant to soybean scab	• NRC Soybean, Indore, MP
	EC 538841	Resistant to soybean cyst nematode	• NRC Soybean, Indore, MP
GP- D98- 1216	EC539008	Resistant to phytophthora rot (*Phytophthora sojae)* and races 3 and 14 of soybean cyst nematode (*Heterodera glycines)*	• NRC soybean, Indore, MP
Cicer arietinum	EC 539009 Spain	Resistant to ascochyta blight(*Ascochyta rabie*)	• IIPR, Kanpur, UP • Genetics Division, IARI, New Delhi
Cicer echinospermum (Wild chickpea)	EC 539329 ICARDA, Syria	Resistant to Fusarium wilt	• IIPR, Kanpur, UP
Cicer bijugum (Wild chickpea)	EC 541549-50 ICARDA, Syria	Resistant to leaf miner, bruchids and ascochyta blight	• PAU, Ludhiana • IIPR, Kanpur, UP
Cicer echinospermum (Wild chickpea)	EC 541555-556 ICARDA, Syria	Fusarium wilt resistant	• PAU, Ludhiana • IIPR, Kanpur, UP
Cicer judaicum (Wild chickpea)	EC 541557-558 ICARDA, Syria	Resistant to leaf miner, bruchids and ascochyta blight	• PAU, Ludhiana • IIPR, Kanpur, UP
Cicer pinnatifidum (Wild chickpea)	EC 541559 ICARDA, Syria	Fusarium wilt resistant	• PAU, Ludhiana • IIPR, Kanpur, UP
Cicer judaicum (Wild chickpea)	EC 541561-62 ICARDA, Syria	Resistant to bruchids and cyst nematode	• PAU, Ludhiana • IIPR, Kanpur, UP
Phaseolus vulgaris	EC 537955	Resistant to *Bean common mosaic virus*	• NBPGR Regional Station,
var. AC Pintoba	Canada	(BCMV) and Fusarium wilt	Shimla, HP
var. ORCA	EC 538843 USA	Dominant I gene for resistance to *Bean common mosaic virus,* curly top virus, root rot complex caused by *Fusarium solanii, Rhizoctonia solani* and *Pythium* sp.	• NBPGR Regional Station, Shimla, HP
GP-USPT-Ant-1	EC 539010 USA	Resistant to rust race-53, endemic to Michigan which infers presence of the UR-3 rust resistance gene and hypersensitive necrosis response to the NL-3 strain which infers presence of the I gene for resistance to BCMV	• NBPGR Regional Station, Shimla, HP
var. EMGOPA 201-OURO	EC 541908Brazil	Resistant to *Bean common mosaic virus,* and angular leaf spot (*Phaeoi ariopsis griseola*)	• NBPGR Regional Station, Shimla, HP
	EC 540793-794 CIAT, Columbia	Resistant to angular leaf spot, caused by *Phaeoidariopsis griseola* and anthracnose (*Colletotrichum lindemuthianum* and BCMV	• NBPGR Regional Station, Shimla, HP
Pisum sativum	EC 538177	Resistant to fusarium wilt race 1, 2 and 5	• IIHR, Bangalore, KS
var. Accord.	USA		
var. Barok	EC 538178 USA	Resistant to fusarium wilt race 1, 2 and 5	• IIHR, Bangalore, KS

var. Bridger.	EC 538179 USA	Resistant to Common Pea Mosaic Virus and Common Wilt Virus	• IIHR, Bangalore, KS
var. Duke	EC 538180 USA	Resistant to fusarium race-1, powdery mildew and Common Pea Mosaic Virus	• IIHR, Bangalore, KS
var. Early Frosty	EC 538181 USA	Resistant to fusarium wilt, Yellow Bean Mosaic Virus	• IIHR, Bangalore, KS
Carthamus tinctorius	EC 548822 USA	Resistant to alternaria, pseudomonas bacterial blight and head rot	• DOR, Hyderabad, AP
	EC 548825-29 USA	Resistant to verticillium wilt	• DOR, Hyderabad, AP • DOR, Hyderabad, AP
	EC 548830-46 USA	Resistant to phytophthora root rot	• DOR, Hyderabad, AP
	EC 548847-48 USA	Resistant to verticillium wilt, striped hull	• DOR, Hyderabad, AP
	EC 548849 USA	Thrip resistant line	• DOR, Hyderabad, AP
Linum usitatissimum	EC 541217-223	Rust resistant	• PC (Linseed), CSUAT
	EC 541218, 541226 Russia	Fusarium wilt resistant	• Kanpur, UP • NBPGR, New Delhi
Cucumis melo var. TGR 1551	EC 541901 Spain	Resistant to *Cucumber mosaic virus*	• PAU, Ludhiana, Punjab • IIVR, Varanasi, UP
Cucumis melo ssp. *melo*	EC 539195-219 USA	Tolerant to *Cucumber mosaic virus* (CMV) and fusarium wilt	• PAU, Ludhiana • IIVR, Varanasi, UP
Lycopersicon esculentum	EC 538398-400 AVRDC, Taiwan	Resistant to bacterial wilt, *Tobacco mosaic virus*	• IIVR, Varanasi, UP
	EC 538415-416 AVRDC, Taiwan	Resistant to white fly transmitted *gemini virus* (WTG), bacterial wilt, *Tobacco mosaic virus*, Fusarium wilt race I (F1)	• IIVR, Varanasi, UP
	EC 538429-431 AVRDC, Taiwan	Fruit worm resistant lines	• IIVR, Varanasi, UP
	EC 538432-435 AVRDC, Taiwan	Resistant to Bacterial wilt, *Tobacco mosaic virus*, leaf blight and fusarium wilt	• IIVR, Varanasi, UP
	EC 552129-137 AVRDC, Taiwan	Resistant to white fly transmitted gemini virus conditioned by TY-2 gene, bacterial wilt, fusarium wilt race 1	• NBPGR, New Delhi
	EC 552143-2148 AVRDC, Taiwan	Resistant to tomato mosaic virus conditioned by the TM 2a allele	• IIVR, Varanasi, UP • NBPGR, New Delhi
	EC 542063 AVRDC, Taiwan	Homozygous for SW-S allele resistant to *Tomato spotted wilt virus*	• Southern Petrochemicals Industries Corporation, Hosur, Karnataka
	EC 542064 AVRDC, Taiwan	White fly-transmitted gemini virus conditioned by TY-2 gene from H 24 (WTG), bacterial wilt, *Tobacco mosaic virus* conditioned by the TM29 allele, fusarium wilt race 1 (F1), gray leaf spot pathogen	• Southern Petrochemicals Industries Corporation, Hosur, Karnataka

	EC 548605-13 AVRDC, Taiwan	Resistant to white fly transmitted gemini virus conditioned by the Ty-2 gene from H 24 (WTG), bacterial wilt, *Tomato mosaic virus* conditioned by the TM2a allele (TMV), gray leaf spot pathogen and fusarium wilt race 1 (F1)	• Horticultural College and Research Institute Periyakulam, Kerala
Capsicum sp.	EC 538331-32 AVRDC, Taiwan	Resistant to anthracnose, tolerant to aphids	• IIVR, Varanasi, UP
	EC 538333-34, 538351 AVRDC, Taiwan	Resistant to bacterial wilt, bacterial black spot and potato virus Y	• IIVR, Varanasi, UP
	EC 538335-339 AVRDC, Taiwan	Resistant to *Pepper veinal mottle virus*, *Chilli veinal mottle virus* (CVMV), Potato virus Y (PVY) and potato virus Y	• IIVR, Varanasi, UP
Solanum melongena	EC 550890 Philippines	Tolerant to fruit and shoot borer, resistant to bacterial wilt and leaf hoppers	• MAHYCO Life Sciences Research Centre, Maharashtra
		Abiotic Stress	
Oryza sativa	EC 539139-44 IRRI, Philippines	Iron toxicity tolerant lines	• DRR, Hyderabad, AP
	EC 541909-916	Submergence tolerant lines	• NDUA & T, Faizabad, UP
	EC 541917-928	Salinity tolerant lines	
	EC 541929-939 IRRI, Philippines	Zinc deficiency tolerant lines	
	EC 546319-340	Phosphorus deficiency tolerant lines, Iron toxicity tolerant lines	• Indira Gandhi Agricultural University Raipur, Chhattisgarh
	EC546341-50,52,53,56,57,59 EC 546354, 60, 61 IRRI, Philippines	Aluminium toxicity tolerant lines	
	EC 548158-81 IRRI, Philippines	Salinity tolerant lines	• Anbil Dharmlingam • Agricultural College and Research Institute, Tamil Nadu
	EC 550863-7 EC 550872-81	Restorer lines TGMS lines	• Syngenta India Ltd. Pune, Maharashtra
Triticum aestivum	EC 538234-35EC 538236-56 EC548493 EC 550180,181 USA	Salinity tolerant lines Salinity tolerant lines Acidic soil tolerant Lodging resistant	• DWR Karnal, Haryana NBPGR, New Delhi
Zea mays	EC 552705-08 CIAT, Columbia	Acid soil tolerant	• DMR, IARI, New Delhi
Hordeum vulgare var. Vivan	EC 540807 Canada	Drought tolerant	• DWR, Karnal, Haryana • NBPGR, New Delhi

Panicum miliaceum var. NE-1	EC 552154 USA	Lodging tolerant	• PC (small millets), UAS, GKK, Bangalore
Glycine max	EC 537946	Lodging tolerant	• NRC Soybean, Indore, MP
	EC 538805, 538811-12	Drought tolerant lines	
	EC 538823-30 USA	Drought and heat tolerant lines	
Pisum sp.	EC 548807-13 Russia	Genotypes with stiff stem, lodging resistance	• PC (MULLaRP), IIPR, Kanpur, UP
Linum usitatissimum	EC 541198 EC 541204 EC 541206 Russia	Lodging resistant	• PC (Linseed), AICRP, CSUAT, Kanpur, UP. • NBPGR, New Delhi
Lycopersicon esculentum	EC 538417-28 AVRDC, Taiwan EC 550834, 836 Srilanka	Heat tolerant lines	• IIVR, Varanasi, UP
Brassica oleracea var *botrytis* (Cauliflower)	EC 548146-49 USA	Cold tolerant lines	• IIHR, Bangalore, Karnataka
Gossypium hirsutum	EC 541867-76 USA	Upland cotton resistant to adverse conditions	• CCICR, Nagpur, Maharashtra
		Value Added Traits	
Oryza sativa GP KBNT Lpa 1-1	EC 552817 USA	Low phytic acid (39%)	• DRR, Hyderabad, AP
GP GLPA	EC 552822 USA	Gold hull, low phytic acid germplasm	• DRR,A Hyderabad, AP
	EC 546247-79	New plant types	• CRRI, Cuttack, Orisa
	EC 541940-972 EC540540-781	New plant types (reduced number of tillers, all tillers are fertile, increased no. of grains per panicle and larger panicle size)	• Syngerta India Ltd, Pune, Maharashtra
	EC 541907 IRRI, Philippines	High iron content	• Indira Gandhi Agricultural University, Raipur, Chattisgarh
	EC549244, IRRI, Philippines	Iron rich line	• TNAU, Coimbatore, TN
GP Aromatic	EC 550889 USA	Good aroma and cooking quality of Basmati 370	• DRR Hyderabad AP
var. Boliviar var. Saber	EC 550177 EC 550178 USA	Long grained, superior parboiling and canning quality	• DRR Hyderabad AP
Triticum aestivum var. Big Sky	EC 538958 USA	High grain protein content	• DWR, Karnal, Haryana • NBPGR, New Delhi

var. Nusky	EC 538959 USA	Excellent qualities for bread and noodle production	• DWR, Karnal, Haryana • NBPGR, New Delhi
GP 97L9521	EC 550180	Strong gluten	• DWR, Karnal, Haryana
GP N 95 L11 881	EC 550181 USA		• NBPGR, New Delhi
Zea mays (Maize)	EC 539005-007 USA	High amylose content, high lysine content and waxy germplasm	• DMR, IARI, New Delhi • NBPGR, New Delhi
Sorghum bicolor	EC 538162-76 USA	Sweet types	• PAU, Ludhiana, Punjab • NRC Sorghum, Hyderabad, AP
Glycine max	EC 538824 USA	Low lipoxygenase	• NRC Soybean, Indore, MP
	EC 538833 USA	Less than 5.5% linolenic acid	• NRC Soybean, Indore, MP
Lens culinaris var. Merit	EC 550084 USA	Large seeded	• PC (MULLaRP), IIPR, Kanpur, UP • Genetics Division, IARI, New Delhi • NBPGR, New Delhi
Carthamus tinctorius	EC548814-15, EC548818-21- USA	High oleic acid content lines	• DOR, Hyderabad, AP
	EC548816-17, 548833-36 USA	High oil content	• DOR, Hyderabad, AP
Capsicum annuum	EC 538330 AVRDC, Taiwan	Cayenne type large thick red	• IIVR, Varanasi, UP
Cucumis melo ssp. *melo*(musk melon)	EC 539195-9219 USA	High TSS content, orange fleshed, netted exterior	• PAU, Ludhiana, Punjab • IIVR, Varanasi, UP
		Other Agronomic Traits	
Oryza sativa GP LGRU	EC 552825 USA	Early flowering	• DRR, Hyderabad, AP
GP Aromatic	EC 550889 USA	Early maturing	• DRR, Hyderabad, AP
	EC 546752-71 IRRI, Philippines	Weed competitive lines	• CRURRS, Hazaribagh, Jharkhand
var. Boliviar	EC 550177	Early maturing	
var. Saber	EC 550178 USA	Early maturing	• DRR, Hyderabad, AP
Triticum aestivum	EC 537952-54 USA	High yielding	• DWR, Karnal, Haryana • NBPGR, New Delhi
var. Big sky	EC 538958 USA	High yielding	• DWR, Karnal, Haryana
var. Nusky	EC 538959 USA	Superior adaptation	• NBPGR, New Delhi
var. Caledonia	EC 550175 USA	High yielding	
var. Richland	EC 550176 USA	High yielding	
	EC 550180,181	High grain yielding (3554 kg/ha)	• DWR, Karnal, Haryana • NBPGR, New Delhi

Zea mays	EC 546871 Indonesia	Early maturing	• DMR, IARI, New Delhi • NBPGR, New Delhi
Hordeum vulgare			
var. UC-933	EC 538157	Early maturing	• DWR, Karnal, Haryana
var. UC-969	EC 538158	Early maturing	• NBPGR, New Delhi
var. UC-937	EC 538160	High yielding	
var. Vivan	EC 540807	High grain yielding and shattering	• DWR, Karnal, Haryana
var. Niobe	EC 548499	resistant	• NBPGR, New Delhi
	Canada	High yielding and early maturing	
Panicum miliaceum			
var. Horizon	EC 552153	Widely adapted	• PC (small millets), UAS,
var. NE-1	EC 552154 USA	High yielding	• GKK, Bangalore, Karnataka
Cicer arietinum	EC 539009 Spain	Early flowering	• IIPR, Kanpur, UP • Genetics Division, IARI, New Delhi
Elymus haffmanii			
GP RS-H	EC 538230 USA	High yielding	• IGFRI, Jhansi,UP • NBPGR, Reg. Stn. • Bhowali, Uttaranchal
Glycine max			
var Washita	EC 537946	High yielding resistant to shattering	• NRC, Soybean, Indore,
var. Catoosa	EC 537947 USA	High yielding	MP
Phaseolus vulgaris			
var. EMGOPA 201-OURO	EC 541908 Brazil	High yielding excellent Cooking qualities	• NBPGR, RS .Shimla, HP
Lens culinaris			
var. Merit	EC 550084USA	High yielding	• PC MULLaRP, IIPR, Kanpur, UP. • Genetics Division, IARI, New Delhi
Vicia faba			
var. UN 56	EC 550179 Spain	Unifoliate genetic stock significantly higher branching from basal nodes	• IIPR, Kanpur, UP
Linum usitatissimum	EC 541202 EC 541226 Russia	Early maturing	• PC (Linseed), CSAUAT, • Kanpur, UP. • NBPGR, New Delhi
Lycopersicon esculentum	EC 538398-400 AVRDC, Taiwan		• Early maturing • IIVR, Varanasi, UP

		Lines for Exploitation of Heterosis	
Oryza sativa	EC 546287-318 IRRI, Philippines EC 546362-73 IRRI, Philippines	Monogenic lines Introgression lines	• Indira Gandhi Agricultural University, Raipur, Madhya Pradesh
	EC 546374 -87 EC 546388-487 EC 546488-90 IRRI, Philippines	CMS and maintainers Restorer TGMS lines	• Maharastra Hybrids Seeds Co.Ltd, Andhra Pradesh
	EC 539085-94 EC 539095-02 IRRI,Philippines	Isogenic lines Pyramided lines	• DRR, Hyderabad, AP
	EC 546243-6246 IRRI, Philippines	Mutant lines	• Centre for Plant Molecular Biology, TNAU,Coimbatore
	EC 550863-71 EC550872-81 IRRI, Philippines	Restorer lines and TGMS lines	• Syngenta India Ltd., Pune, Maharashtra
	EC 552826-856 IRRI, Philippines	CMS, maintainer, TGMS and restorer lines	• DRR, Hyderabad, AP
	EC 541514-517 EC 541518-31 IRRI, Philippines	TGMS lines restorer lines	• Nuziveedu Seeds Ltd. Secunderabad, AP
	EC 546232-6242 IRRI, Philippines	Introgression lines	• Centre for Plant Molecular Biology, TNAU, Coimbatore
	EC 1973-542056 IRRI Philippines	Introgression lines	• Department of Plant Molecular Biology, PAU, Ludhiana, Punjab
Sorghum bicolor (sorghum)	EC 538941-46 EC 558947-55 USA	Maintainers of the A1, cytoplasmic genetic male sterility system Restorers of the A1, cytoplasmic genetic male sterility system	• NRC Sorghum, Hyderabad, Andhra Pradesh
Lycopersicon esculentum	EC 550834, 836 Sri Lanka	Heat tolerant	• IIVR, Varanasi, UP
Brassica oleracea var. *botrytis*	EC 548146-56 EC 548157 USA	CMS Lines Male fertile line	• IIHR, Bangalore
		New Crops	
Monarada sp.	EC 538844 Canada	Dwarf type, good winter hardiness and resistant to powdery mildew	• Division of Floriculture and Landscaping, IARI, New Delhi
Brachiaria hybrid Cv. Mulato	EC 549024-25 USA	Stoloniferous growth, excellent forage production, vigorous regrowth, excellent palatability, drought tolerant, and produces forage round the year	• IGFRI Reg Stn, Dharwad, Karnataka.

5.2 Inland Supply of Plant Genetic Resources

The seed and plant materials of diverse agri-horticultural and silvicultural crops were supplied to ICAR institutes/coordinated projects, agricultural universities, and farmers in different states and union territories of India. Based on specific requests received 13,008 samples were supplied by the Bureau as per the details given below.

Crop	Germplasm samples	State/Union Territories
Cereals and Millets		
Oryza sativa	581	Kerala, Orissa, Meghalaya, UP, Delhi, Bihar, HP, TN
Triticum sp	407 (Germplasm) 7505 (Trials)	Delhi, Bihar, J&K, HP, Haryana, Uttaranchal, TN, UP, Punjab, WB, Rajasthan, MP
Zea mays	83	Haryana, UP, Punjab, Sikkim, Bihar, Delhi
Hordeum sp.	945	Delhi, Haryana, Rajasthan, Uttaranchal, Punjab, UP, Bihar, HP, TN, J&K, and WB
Sorghum bicolor	1	MS
Avena sp.	25	Delhi, UP
Eleusine coracana	34	UP, MS
Setaria italica	61	Maharastra, UP, Delhi
Paspalum scrobiculatum	14	MS
Fagopyrum esculentum	17	Meghalaya
Pennisetum glaucum	35	UP, Delhi
Panicum sp.	56	Maharastra, UP
Echinochloa sp.	6	MS
Grain Legumes		
Cicer arietinum	17	Punjab
Vigna aconitifolia	208	Haryana, Rajasthan, MP, MS
Pisum sativum	149	Delhi, Haryana, Rajasthan, UP, Punjab, J&K, Uttaranchal, MS
Glycine max	28	Maharashtra
Cajanus cajan	67	Madhya Pradesh, Maharashtra
Vicia faba	5	Delhi
Vigna sp.	3	Delhi
Cyamopsis sp.	121	Rajasthan, Kerala, Karnataka
Lens sp.	123	UP, Haryana, Delhi, AP, Rajasthan, Punjab, J&K
Dolichos lablab	9	Maharashtra
Phaseolus sp.	10	Maharashtra
Macrotyloma sp.	1	Maharashtra
Lathyrus sp.	2	Maharashtra
Khesari	1	MS
Canavalia gladiata	10	TN
Oilseeds		
Ricinus communis	2	Rajasthan
Brassica sp.	278	MS, Karnataka, Sikkim, Haryana, Rajasthan, UP, MP, Gujarat, J&K, WB, and Delhi
Helianthus annuus	25	MS, UP
Arachis hypogaea	244	AP, TN, MS, Gujarat

Linum usitatissimum	65	MS
Sesamum indicum	337	MS
Vegetables		
Abelmoschus esculentum	32	MS, Kerala
Solanum melongena	244	MS,AP, Gujarat, Jharkhand, Uttaranchal, Punjab, Rajasthan, Kerala, Karnataka
Lycoperiscon esculentum	103	Uttaranchal, Gujarat, Delhi, J&K,T.N.
Cucurbita pepo	4	Karnataka
Capsicum annuum	203	HP, AP, J&K, MS, Delhi, WB, TN
Trichosanthes sp.	16	Kerala
Momordica charantia	36	AP, Kerala, Delhi
Spinacea oleracea	19	MS, Delhi
Luffa acutangula	50	Delhi
Cucumis sp.	23	UP, J&K, Delhi, Haryana
Citrullus colocynthis	20	Haryana
Trigonella sp.	20	Punjab
Fruits		
Musa sp.	49	Delhi, Karnataka, TN, Kerala
Opuntia ficus indica	1	Rajasthan
Physalis edulis	1	Delhi
Physalis sp.	53	HP, Uttaranchal
Morus sp.	2	Kerala
Ornamentals		
Gladiolus sp.	1	Delhi
Tagetes sp.	1	Kerala
Spices		
Ammi majus	1	J&K
Zingiber sp.	14	Kerala
Pongamia pinnata	16	AP
Pimenta officinalis	20	Delhi
Fibres		
Corchorus sp.	100	W.B.
Camelina sativa	5	Punjab
Crotalaria sp.	1	Delhi
Under-Utilized Plants		
Sesbania sp.	4	MS, UP
Amaranthus sp.	7	West Bengal
Chenopodium sp.	3	West Bengal
Medicinal and Aromatic Plants		
Artemisia annua	12	A.P, Delhi
Vetiveria zizanioides	10	Haryana
Plantago ovata	3	J&K, Uttaranchal
Andrographis paniculata	12	UP, Karnataka, Tamil Nadu
Palmarosa	10	Haryana
Ocimum sp.	27	UP, Karnataka, J&K, Chhattisgarh, Uttaranchal & UP
Cassia angustifolia	1	J&K
Psoralea corylifolia	12	J&K

Citronella sp.	1	Haryana
Withania sp.	04	J&K
Catharanthus sp.	06	J&K
Palmarosa	10	Haryana
Ammi majus	1	Uttaranchal
Anethum graveolens	2	Uttaranchal, UP
Carum carvi	17	Uttaranchal, Karnataka
Matricaria	1	Uttaranchal
Silybium marianum	1	Uttaranchal
Lepidium sativum'	4	Delhi
Selinum vaginatum	2	Uttaranchal
Chlorophytum borivilianum	1	Orissa
Curcuma zedoaria	1	Orissa
Curcuma sp.	29	Kerala, TN, Uttaranchal
Urginia indica	7	Delhi
Withania somnifera	1	Kerala
Callicarpa sp.	1	Kerala
Aloe vera	1	Kerala
Cymbopogon	1	Kerala
Pyrethrum	1	Kerala
Tinospora	1	Kerala
Mentha spicata	1	Kerala
Asparagus officinalis	1	Kerala
Salvia sclorea	1	Kerala
Matricaria chamomilla	1	UP
Pongamia pinnata	16	AP
Pimenta officinalis	20	Delhi
Asparagus racemosus	1	J&K
Withania somnifera	1	J&K
Plumbago zeylanica	1	J&K
Tribulus terrestris	1	J&K
Millingtonia pudica	1	J&K

5.3 Export of Plant Genetic Resources

The seed and planting material of agri-horticultural crops were exported on the basis of (1) requests received by the Bureau/ ICAR headquarters (ii) requests received from the scientists working in ICAR institutes/agricultural universities in India under various protocols/ work plans/ memoranda of understanding with different countries/CGIAR institutions.

The plant material intended for export was procured from known Indian sources through correspondence and the same were forwarded to the indentors in foreign countries alongwith phytosanitary certificates issued by the Plant Quarantine Division of the Bureau and import permit, if any. The volume of export of seed/ plant materials during 2004 is indicated below.

Number of consignments exported	19
Number of requests registered	19
Number of countries to which material exported	09
Number of samples received/ handled for export	132 (132 samples)

Cereals and millets: *Oryza sativa* was exported to Philippines (22), Sri Lanka(3) and UK(1); *Zea mays* to Mexico (33), Australia (1), Sri Lanka(2), Afghanistan (18)and East Timor

(7); *Setaria glauca* to Sri Lanka (7), *Sorghum bicolor* to Sri Lanka (5.)

Grain legumes: *Glycine max* to Sri Lanka (7) and *Brassica campestris* to UK (8)

Fruit crops: *Ziziphus mauritiana* to Kenya (2), *Emblica officinalis* to Niger (1)

Tuber crops: *Solanum tuberosum* to Sri Lanka (3)

Oilseeds: *Arachis hypogaea* to Sri Lanka (2)

Weeds: *Phalaris minor* to UK (10)

Country-wise export of PGRs from India: Afghanistan (18) of *Zea mays*; Australia (1) of *Zea mays*; East Timor (7) *Zea mays*; Kenya (2) of *Ziziphus mauritiana*; Mexico (33) *of Zea mays*; Niger (1) of *Emblica officinalis*; Philippines (22) of *Oryza sativa*; Sri Lanka (7) of *Setaria glauca* (3) of *Oryza sativa*, (2) of *Zea mays*, (5) of *Sorghum bicolor,* (3) of *Solanum tuberosum* , (7) of *Glycine max* and (2) of *Arachis hypogaea*; UK (8) of *Brassica campestris,*(10) of *Phalaris minor* and (1) of *Oryza sativa.*

Research Projects (Code, Title, Project leader)

PGR/GEX-BUR-DEL-01.00: Exchange of plant genetic resources with foreign countries (import, export and inland supplies of the resources) and related information to the scientists/users in the country (RV Singh).

PGR/GEX-BUR-DEL-01.01: Import, export and inland supplies of plant genetic resources and exchange of related information to the scientists/users in the country (Deep Chand).

PGR/GEX-BUR-DEL-01.02: To compile the available information on introduced/ indigenously collected material and publish it in the form of quarterly bulletin called "Plant Germplasm Reporter (Vandana Tyagi).

PGR/GEX-BUR-DEL-01.03: Survey of literature for procurement of new PGR of different crops for their introduction (Nidhi Verma)

PGR/GEX-BUR-DEL-01.04: To procure the literature viz. Index Seminums, catalogues, seed lists, reprints of paper etc. for introduction of exotic material and to bring out the crop inventories on plants genetic resources (AK Singh).

6. TISSUE CULTURE AND CRYOPRESERVATION UNIT

Summary: A total of 1,579 accessions belonging to fruit crops, bulbous and tuber crops, medicinal, aromatic and rare/ endangered plants, spices, plantation and new industrial crops, and others were conserved as *in vitro* cultures under culture room conditions and/ or at low temperature. The average subculture duration ranged from 4-24 months, depending on the species. Research emphasis was laid on standardizing *in vitro* slow growth and cryopreservation protocols in different species. Plantlet regeneration protocols were standardized in *Allium fistulosum* and *Curculigo orchioides*. *In vitro* corms were induced in *Colocasia esculenta*. *In vitro* slow growth experiments yielded varying degree of success in alliums, *Bacopa monnieri, Colocasia esculenta, Curcuma longa, Elettaria cardamomum, Gentiana* and *Plumbago*. Cryopreservation experiments yielded encouraging results in *Allium chinense, Bacopa, Gentiana, Humulus lupulus* and *Musa*. Employing RAPD and ISSR markers, no differences were observed, between *in vitro*-conserved clones and their respective mother clones, in *Zingiber officinales,* and between R_0 plants and their respective mother plants, *in Colocasia esculenta*. A total of 61 accessions of *Musa* and one of *Gladiolus* cultivar were supplied as *in vitro* cultures to various indentors. A total of 5,810 accessions of orthodox, intermediate and recalcitrant seed species were conserved in the cryobank. Pollen of 102 accessions of mango and dormant buds of 20 accessions of mulberry were successfully cryostored.

The objectives of TCCU are *in vitro* conservation and cryopreservation of germplasm, and monitoring genetic stability of *in vitro*- conserved and cryopreserved germplasm. Salient achievements during the year are detailed below:

6.1 *In Vitro* Conservation and Cryopreservation

During the year, 183 new accessions were added to the *in vitro* repository which included alliums (18)), *Colocasia esculenta* (38), *Curcuma* spp. (18), *Dioscorea* spp. (27), *Fragaria* (1), *Gladiolus* (1), *Ipomoea batatas* (5), medicinal and aromatic plants (28), *Morus* spp. (6), *Musa* (27), *Vitis vinifera* (1), *Xanthosoma sagittifolium* (6) and *Zingiber* spp. (7). A total of 1,579 accessions belonging to different crop plants were maintained *in vitro* and subcultured at periodic interval (Table 1).

6.1.1 Tropical fruits: A total of 368 accessions of *Musa* (in the form of ~ 4400 cultures) and 2 accessions of *Vitis vinifera* were conserved as *in vitro* cultures at 25^{0}C and 8/16 h photoperiod. The average subculture interval under these conditions varied from 6-12 months in banana, depending on the genotype. In all, 27 new accessions of banana and one accession of grape were added to the *in vitro* repository during the year. Banana suckers (48 accessions) procured from Kerala Agriculture University (KAU), Kannara, Kerala, were processed for *in vitro* establishment

To cryopreserve shoot meristems of banana, the vitrification method was applied in four accessions of banana (*Musa* spp.) belonging to subgroups Cavendish (AAA), Monthan (ABB), Ash Monthan (ABB) and Bluggoe (ABB). Post-thaw recovery varied from 25-48% in different accessions. These accessions have been cryopreserved in LN for long-term conservation.

6.1.2 Bulbous crops: A total of 151 accessions belonging to 16 species (*Allium* spp. and Gladiolus cultivar) were conserved as *in vitro* cultures under culture room conditions and/or at low temperature (4^{0}C) with the average subculture interval varying from 4-23 months, depending on the species.

During the year, 19 new accessions were established *in vitro* which include *A. sativum*

Table 1: Status of *in vitro* conserved germplasm in TCCU (as on December 31, 2004)

Crop groups	Storage temperature (°C)	Subculture interval (months)	Accessions in culture (no.)
Fruits			
Musa spp.	25	8-12	368
Actinidia spp.	25	10-12	3
Aegle marmelos	25	12	1
Fragaria spp.	25	8-10	48
Prunus spp.	25	4-6	2
Rubus spp.	25	8-10	5
Malus sp.	25	4-6	4
Morus spp.	25	8-10	48
Vitis vinifera	25	3-4	2
			481
Tuber Crops			
Alocasia spp.	25	10	3
Colocasia esculenta	25	8-10	131
Dioscorea spp.	25	8-12	75
Ipomoea batatas	25	8-12	255
Xanthosoma sagittifolium	25	10	9
			473
Bulbous Crops			
Allium sativum	25, 4	6-12	133
Allium spp.	25, 4	4-23	16
			149
Medicinal and Aromatic Plants			
Aristolochia indica	25	-	1
Bacopa monnieri	25	6	14
Centella asiatica	-	-	6
Coleus aromaticus	-	-	2
Coleus forskohlii	25	12	14
Cholorophytum sp.	-	-	2
Costus speciosus	-	-	1
Curculigo orchioides	-	-	2
Digitalis spp.	4	11	6
Eremostachys superba	4	10	2
Gentiana kurroo	4	12	1
Kaempferia galanga	25	-	5
Kaempferia rotundata	25	-	4
Mentha sp.	4	12	24
Peristrophe bicalyculata			1
Picrorhiza kurroa	4	12	9
Plumbago zeylanica	25	6-10	9
Pogostemon patchouli	25	12	2
Pycnanthemum spp.	4	12	4
Rauvolfia spp.	25	12	11
Rheum spp.	4	12	5
Saussurea lappa	4	12	3

Swertia chirayita	4	6	3
Tylophora indica	25	6-12	8
Valeriana wallichii	4	12	9
			148
Spices			
Curcuma spp.	25	6-10	109
Elettaria spp	25	15	5
Piper spp.	25	10-22	7
Zingiber spp.	25	8-24	180
Vanilla planifolia	25	6	4
			305
Industrial Plants			
Humulus lupulus	25	-	8
Simmondsia chinensis	25	6	12
			20
Others			
Cicer microphyllum	-	-	1
Gladiolous sp.	-	-	2
			3
Total			**1579**

Total no. of species : 124

(16), *Allium* spp.(2) and *Gladiolus* (1). Plantlet regeneration protocol was standardized in *A fistulosum*. In tree onion, (*Allium cepa* var. *proliferum*), contamination-free cultures transferred to various media for shoot proliferation produced only a single shoot.

Regarding *in vitro* slow growth, in *A. hookeri*, maintenance of cultures on sucrose-free nutrient medium was not beneficial in prolonging the subculture duration whereas that on only agar-containing medium, prolonged it to 32 wks with polypropylene caps as closures, under culture room conditions. In *A. ramosum*, subculture duration could be extended from 8 wks to 28 wks on shoot multiplication medium containing high sucrose (10%) or on MS basal medium, half-strength or full-strength. Interestingly, alginate-encapsulated shoot base explants of *A. tuberosum* and *in vitro* bulblets of *A. chinense* could be maintained for 8 wks, in cryovials, without any nutrient medium.

As part of developing suitable pretreatment strategy for optimizing cryopreservation protocol, in *A. tuberosum*, air-drying of explants before PVS2 dehydration didn't improve regrowth of cryopreserved explants and in non-frozen controls, it even led to a decline in regrowth. Using encapsulation-dehydration technique, *in vitro* shoot bases of *A. tuberosum*, encapsulated in 3% calcium alginate, exhibited 60-80% survival following sucrose dehydration. In *A. chinense*, *in vitro* shoot bases exhibited 10% post-thaw regrowth following vitrification technique. In *A. sativum* using vitrification technique, shoot buds isolated from cloves could tolerate PVS2 dehydration for 40 min. at 0°C but failed to survive LN freezing.

6.1.3 Medicinal, aromatic and rare / endangered plants: *In vitro* maintenance of

148 accessions belonging to 23 genera and 32 species was achieved through periodic subculture (4-24 months) either under culture room conditions and/or at low temperature.

A total of 14 collections comprising *Bursera* (1), *Centella* (3) *Coleus aromaticus* (2), *Kaempferia* (1), *Plumbago* (3), *Tylophora* (3) and *Valeriana* (1) were procured from various sources and processed for *in vitro* introduction

A total of 28 accessions belonging to 14 genera were added in the repository which include *Bacopa monnieri* (2), *Centella asiatica* (3), *Chlorophytum* sp. (1), *Coleus aromaticus* (1), *Coleus forskohlii (2), Costus speciosus (1), Curculigo orchioides* (1) *Kaempferia galanga* (2) *Picrorhiza kurroa* (3), *Plumbago zeylanica* (4), *Rauvolfia serpentina* (1), *Rheum* sp. (2), *Tylophora indica* (2) and *Valeriana wallichii (3).*

Plantlet regeneration protocol was standardized in *Curculigo orchioides.* Regarding *in vitro* slow growth, in *Bacopa* and *Plumbago,* replacement of cotton plugs with polypropylene caps as closures was beneficial in prolonging subculture duration from 3 wks to 52 wks. In another study, in *Bacopa,* encapsulated shoot tips, conserved in a cryovial without nutrient medium, remained viable for 4 wks at 15 and 25°C while those stored at 4°C lost viability. In *Gentiana*, at 0.1% mannitol, 83% cultures survived up to 36 wks and in *Plumbago* inclusion of sucrose (6% & 9%) extended the subculture duration up to 40 wks at 25°C. In *Bacopa,* inclusion of mannitol (0.1% -1.0%) and sucrose (6 %) resulted in 50-80% survival up to 12 months at 25°C

In *Bacopa* and *Gentiana,* cryopreservation experiments continued by modifying pre-freezing and post-thaw treatments to improve regeneration. In *Bacopa,* shoot tips isolated from cultures maintained on mannitol-supplemented medium and pre-grown on DMSO-supplemented medium could tolerate PVS2 treatment up to 40 min at 4°C but failed to survive freezing. Using encapsulation-dehydration technique, up to 10% shoot regrowth was obtained following cryopreservation.

In *Gentiana* using encapsulation-dehydration and vitrification techniques, shoot tips exhibited 50 and 20 % survival, respectively following LN freezing .

6.1.4 Spices, plantation and new industrial crops: A total of 325 accessions (in the form of ~4600 cultures) comprising 180 of *Zingiber* species, 109 of *Curcuma* species, 7 of *Piper* species, 5 of *Elettaria*, 4 of *Vanilla planifolia,* 12 of *Simmondsia chinensis* (6 each of male and female), 8 of *Humulus lupulus* were maintained under short- to medium-term storage. A total of 25 accessions belonging to *Curcuma* (18) and ginger (7) were added to the *in vitro* repository.

An experiment on reduction of cost of conservation was conducted in *Curcuma longa* cv Pratibha using low-cost carbohydrate sources and gelling agent in the culture medium. Analytical grade sucrose was substituted by market sugar (granulated and in cubes) and agar-agar by 'isabgol'. The viability of the cultures varied between 74-94% after 7 months of conservation in the different media tested.

However, number of shoots/culture was significantly reduced by use of 'isabgol'. The experiment is continued for further studies on survival of cultures.

In vitro multiplication and conservation

experiments were carried out in one accession of *Elettaria cardamomum* using different gelling agents (agar, phytagel), sucrose concentrations (3, 6, 8 and 10%) and two nutrient concentrations (full or half concentration of major elements). Maximum proliferation of shoots (~16 shoots/culture) was obtained in MS medium gelled with a combination of agar and phytagel, and 3% sucrose. Till 8 months, 80-93% cultures survived on various media combinations.

Cryopreservation experiments in hops (*Humulus lupulus*) were carried out using the encapsulation-dehydration technique. Cold treated shoot tips (4°C, 2 wks) could survive LN exposure and showed 15% recovery. Optimization of protocol for maximizing recovery is being attempted.

6.1.5 Temperate and minor fruit crops: A total of 111 accessions comprising 48 of *Fragaria* spp, 48 of *Morus* spp., 5 of *Rubus* spp., 4 of *Malus* sp., 3 of *Actinidia* spp., 2 of *Prunus* spp. and 1 of *Aegle marmelos* were maintained under short- to medium-term storage. The average subculture interval varied from 4 to12 months in the aforementioned crops.

6.1.6 Tuber crops: A total of 57 accessions of tuber crops were obtained from various sources including taro (*Colocasia esculenta*) (38), greater yam (*Dioscorea alata*) (18) and potato yam (*D. bulbifera*) (1).

A total of 76 accessions of tuber crops including taro (38), greater yam (27), tannia (*Xanthosoma sagittifolium*) (6) and sweet potato (*Ipomoea batatas*) (5) were added to existing cultures of the *in vitro* repository.

In taro, i*n vitro* corm formation was achieved on MS medium containing 8-10% sucrose, 22 µM N^6-benzyl aminopurine (BAP), 0.6 µM á-naphthaleneacetic acid (NAA) and 0.8% agar. The corm forming cultures could be conserved up to 15 months at 25 ± 2°C as compared to shoot-forming cultures which could be conserved for only 6 months on MS (3% sucrose) + 2.2 µM BAP + 0.6 µM NAA + 0.8% agar. Plantlets with *in vitro* corms, exhibited 100% survival upon transfer to the field and developed normal corms. The regenerants were uniform for 12 qualitative and 10 quantitative morphological traits, related to leaf, petiole, corm and root.

Regarding *in vitro* slow growth in taro, inclusion of ABA (20 µM) along with 0.2% agar significantly enhanced the subculture interval from 6 to 12 months, with 100% survival of cultures.

Two accessions each of *Dioscorea rotundata* and *D. alata* have been experimented for cryopreservation using shoot tips as explants. In *D. rotundata*, cryopreserved shoot tips exhibited post-thaw regeneration following LN exposure. However, in *D. alata* further refinement of protocol is continued.

6.1.7 Other crops: In tea (*Camellia sinensis*), germplasm obtained from Palampur, Himachal Pradesh was established in tissue culture. However, after 3 months it exhibited poor growth. Further experiments to optimize the multiplication protocol are underway.

In *Cicer microphyllum*, an important cold-tolerant wild species, shoot cultures were maintained under culture room conditions and/or at low temperature through periodic subculture.

6.2 Genetic Stability of *In Vitro* Conserved Germplasm

In ginger (*Zingiber officinales*), a total of 35

random primers and six inter-simple sequence repeat (ISSR) primers were screened for amplification and polymorphism. Out of these, 11 primers for RAPD and six for ISSR were polymorphic and produced 4 or more amplification products. There were no significant differences in RAPD and ISSR profiles of 10 accessions of *in vitro*-conserved clones and their respective mother clones.

In taro (*Colocasia. esculenta*), 13 RAPD and 6 ISSR markers were used to determine the genetic stability of R_0 plants of 5 accessions. A total of 856 and 344 bands respectively, were generated using the above markers. On the basis of RAPD and ISSR banding patterns, no differences were observed between R_0 plants and their respective mother plants. *In vitro* cormed plantlets exhibited uniformity with respect to 12 quantitative and 10 qualitative morphological traits.

6.3 *In Vitro* Germplasm Supply

A total of 61 banana accessions were supplied as *in vitro* cultures. These comprised 35 exotic accessions procured from International Network for Improvement of Banana and Plantain (INIBAP) Transit Centre, Belgium, to NRCB for field evaluation purpose. The accessions consisted of germplasm to be evaluated under the International Musa Testing Programme (IMTP), Phase III, of the INIBAP. Additionally, 10 banana accessions were supplied to Kerala Agricultural University, Banana Research Station, Kannara, Thrissur, for field evaluation purpose, 9 accessions to Indian Institute of Horticulture Research, Bangalore and 7 accessions to Jawaharlal Nehru University for research purposes. Cultures of one accession of Gladiolus cultivar were supplied to School of Biotechnology, I.P. University, for research purpose.

6.4 Seed Cryopreservation

Cryopreservation of various crops has been undertaken using seeds, embryos and embryonic axes (Table 2). During the period, 795 accessions belonging to diverse crop groups were received and a total of 587 accessions were cryostored as seeds/ embryonic axes. Cryostored accessions comprised temperate fruits and nuts (232), agroforestry species (87), M & AP (57), landraces and wild relatives of legumes (11), oilseeds (62), millets and forages (36), vegetables (18), fibres (16), cereals (17) and others (42). The cryostored germplasm included released varieties, wild species, wild relatives, landraces, registered germplasm, and rare and endangered species.

Table 2: Status of cryopreserved germplasm in TCCU (as on December 31, 2004)

Categories	Accessions (no.)
Recalcitrant and Intermediate	
Fruits and Nuts	1413
Spices and Condiments	56
Plantation Crops	19
Agroforestry and Forestry	1695
Orthodox	
Cereals	208
Millets and Forages	282
Pseudo-cereals	76
Grain Legumes	616
Oilseeds	339
Fibres	58
Vegetables	410
Medicinal and Aromatic Plants	597
Narcotics and Dyes	32
Miscellaneous	9
Total	***5810***
Wild sp.*	*666*
Varieties*	*376*
Endangered sp.*	*49*
Registered germplasm*	*22*

*Included in respective crop groups
Total no. of species : **548**

Four exploration trips were undertaken; one to south-west Rajasthan for collection of minor fruits, second to CISH, Lucknow for collection of mango pollen and two to Haryana, Punjab and Rajasthan for *Jatropha* sp., *Salvadora oleoides* and other crops. Pollen grains of 102 accessions of mango, obtained from CISH, Lucknow, were cryostored. In addition, dormant buds of 20 accessions of mulberry were also processed for cryostorage.

Retesting of 50 accessions belonging to oilseeds, pulses and fruits cryostored for various periods was conducted to monitor the viability during storage. Initial viability values were retained in all the accessions.

Morphological characterization of about 100 accessions of Citrus and allied genera was undertaken. Experiments were undertaken on seed storage behavior and, desiccation and freezing sensitivity in *Alangiun salvifolium, Buchanania lanzan, Diospyros melanoxylon* and *Jatropha curcas*. Standardization of regrowth conditions for embryonic axes of *Juglans regia* and *Prunus armeniaca* was also done. In addition, germination and recovery growth requirements for dormant buds of mulberry were also standardized.

Research Projects (Code: Title, Project Leader; Associate)

PGR/TCCU-UR-DEL-01.00: *Ex situ* conservation of genetic resources of vegetatively propagated crops using *in vitro* and cryopreservation techniques (RK Tyagi)

PGR/TCCU-UR-DEL-01.01: *In vitro* conservation of tuber crops with special reference to sweet potato, yams and taro (BB Mandal; Zakir Hussain).

PGR/TCCU-UR-DEL-01.02: *In vitro* conservation of spices, plantation and industrial crops (RK Tyagi; Anuradha Agrawal, RP Yadav).

PGR/TCCU-UR-DEL-01.03: *In vitro* conservation of bulbous and ornamental crops (Ruchira Pandey).

PGR/TCCU-UR-DEL-01.04: *In vitro* conservation of medicinal and aromatic plants with special reference to rare and endangered species (Neelam Sharma).

PGR/TCCU-UR-DEL-01.05: *In vitro* conservation of tropical fruit crop species (Anuradha Agrawal; RK Tyagi).

PGR/TCCU-UR-DEL-01.06: *In vitro* conservation of temperate and minor fruit crops (Sandhya Gupta*; BB Mandal).

PGR/TCCU-UR-DEL-01.07: Studies on genetic stability of *in vitro* conserved and cryopreserved germplasm Zakir Hussain; RK Tyagi).

PGR/TCCU-UR-DEL-02.00: *Ex situ* conservation of plant genetic resources of agricultural and horticultural crops using cryopreservation of seeds (Rekha Chowdhary).

PGR/TCCU-UR-DEL-02.01: Cryopreservation of orthodox and intermediate seed species in various forms using standard protocols (Rekha Chowdhary; SK Malik).).

PGR/TCCU-UR-DEL-02.02: Investigating desiccation and freezing tolerance in sub-orthodox seed species for cryopreservation (SK Malik; Rekha Chowdhary).

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* On deputation abroad from 29 March 2004 to 28 March 2005.

7. NRC ON DNA FINGERPRINTING

Summary: A total of 778 crop varieties and elite landraces were analysed for DNA fingerprinting during the year. Microsatellite fingerprinting (STMS) was conducted in rice, wheat, pea, soybean and cotton while AFLP was used to fingerprint varieties of lentil and pigeon pea.

7.1 DNA Fingerprinting

7.1.1 Rice: Hundred-thirty-two varieties procured from National Genebank representing 14 states (Andhra Pradesh, Delhi, Gujarat, Haryana, Punjab, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Orissa, Tamilnadu, Uttaranchal and West Bengal), were taken up for DNA fingerprinting with 30 STMS markers. Data analysis and interpretation of 72 varieties was completed. A total of 58 alleles were detected with a mean of 1.93 alleles per locus and the average Polymorphism Information Content (PIC) value was 0.62. All the accessions were diverse from each other at 0.55 similarity coefficient. Cluster analysis on the basis of dendrogram generated using Jaccard's similarity coefficient, grouped all the rice varieties in two main clusters. All eight Basmati and four upland varieties grouped into cluster I whereas nine lowland and four early varieties grouped into cluster II.

7.1.2 Wheat: Forty STMS primer pairs representing different chromosomes were screened using three varieties of wheat. Of these, ten selected primer pairs were used to fingerprint 112 varieties released from different centres. The preliminary analysis of ten microsatellite loci data based on agarose gel electrophoresis system showed low level of polymorphism with an average allele number of 3.5 as compared to other published reports. STMS fingerprinting with additional primer pairs is in progress.

7.1.3 Fingermillet: Fourteen ISSR primers were screened and protocol standardized for DNA fingerprinting of finger millet. Seven selected anchored and non-anchored ISSR primers were employed for fingerprinting of 94 accessions that included released varieties and elite germplasm lines representing different states of India and African countries. The results showed that approximately 50% markers were polymorphic.

7.1.4 French bean: Twenty-six released varieties were analyzed with 12 AFLP and 28 STMS primer pairs. In AFLP, a total of 256 amplicons were scored, which indicated presence of high genetic differences. These results were confirmed by the STMS analysis where 115 alleles at an average of 4 per locus were scored. The number of alleles per STMS locus varied from 1 to 8 with the primer pairs used. All varieties studied were distinguished with the profiles generated. Gujarat Bean-1, Varun and IC296363 were observed to be highly diverse for their molecular profiles.

7.1.5 Soybean: STMS profiling of 72 released varieties and 35 landraces of soybean from Uttaranchal state was completed with 18 selected primers. An average of 5.8 alleles per locus were observed. Data analyses and comparison of genetic diversity in released varieties and landraces is in progress.

7.1.6 Pigeon pea: 96 germplasm lines from 14 states have been analyzed using selected 12 AFLP primer pairs. Data scoring is in progress. The results will be used for comparing the genetic diversity in released varieties and germplasm lines.

7.1.7 Lentil: Fingerprinting work in lentil was done using amplified fragment length polymorphism (AFLP) markers. Sixty-four primer combinations were screened and five, CAT-AAG, CAT-ACA, CAT-AGC, CTA-ACA and CTG-ACA were finally chosen based on reproducibility, amplif cation, and quality of the data. The five primer pairs produced 54, 62, 22, 18 and 80 amplification products, respectively in 41 cultivars and landraces.

7.1.8 Pea: STMS fingerprinting work in pea was initiated during the year under report. PCR conditions for fingerprinting were standardized for five primer pairs and 38 cultivars and germplasm lines were fingerprinted using the standardized conditions for three primer pairs. The three amplified loci were P1, P8 and P12 which produced 9, 7 and 14 alleles respectively in the material under investigation. Further fingerprinting work is in progress.

7.1.9 Cotton: STMS fingerprinting work initiated during 2004 was continued. Ninety four tetraploid *Gossypium hirsutum* cultivars were fingerprinted using standardized PCR conditions for fifteen loci. Fingerprinting work using additional primers is in progress. In another study on seed purity testing in cotton commercial hybrids, analysis was carried out in nine hybrids (20 to 40 plants per hybrid). More than 90% genetic purity was observed in all the hybrids, except 'Om Shankar' wherein 82.5% genetic purity was observed.

7.1.10 Chlorophytum: Twenty one accessions of safed musali (*Chlorophytum borivilianum)* from Madhya Pradesh, Rajasthan and Haryana were DNA fingerprinted using 60 polymorphic random primers that generated 88.2% of polymorphism. All the accessions could be differentiated from each other at 0.345 similarity coefficient. Ten ISSR primers have been also employed for the genetic diversity study in these accessions.

7.1.11 Palmarosa: Thirty four accessions of Palmarosa collected from Issapur farm were fingerprinted employing 40 polymorphic random primers. All the accessions were diverse and could be differentiated from each other at 0.449 similarity coefficient.

7.1.12 Vetivar: Twenty four accessions of Vetivar collected from two different locations were DNA fingerprinted using 75 polymorphic random Operon primers. All 17 accessions from Issapur and 7 accessions from Thrissur were grouped separately into the dendrogram generated based on Jaccard's Similarity Coefficient. Two accessions collected from Issapur with high oil content grouped in cluster I with 100% similarity.

7.2 Microsatellite Marker Development

7.2.1 Mungbean and uradbean: STMS primer sequences in various *Vigna* group of pulses, available in data bases were screened for suitability in DNA profiling of released varieties of cowpea, mungbean, uradbean and rice bean. A total of 67 primer pairs were screened. These included 46 primer pairs from cowpea, 8 from adzukibean and 13 from mungbean. The primer pairs that were found to amplify target SSR regions were 32 in cowpea, 21 in mungbean, 22 in uradbean and 17 in ricebean. These selected primer pairs generated amplification products optimally and their size differences in the

screened varieties were considerable indicating their suitability in DNA profiling. A genomic library with short inserts (350 to 800 bp) has also been constructed. This is being screened for identifying SSR containing inserts and for generating primer sequence information.

7.2.2 Pigeon pea: A random genomic library of pigeon pea has been constructed in pBlueScript vector. About 350 colonies were screened and 150 have been identified as suitable for RFLP analyses. A genomic library with short inserts (350 to 800 bp) has been constructed. This will be screened for identifying SSR containing inserts and sequenced for generating primer information.

7.2.3 Chilli: A genomic library of chilli enriched in microsatellites has been constructed for the variety Pusa Jwala. Six repeat regions were used for enrichment. Following selection, on 800 colonies were identified and screened against the repeat regions. Subsequent to primary and tertiary screening, hundred positives were identified. These were sequenced on the ABI prism 310 genetic analyser. These are now being analysed for designing STMS primers that would be used for fingerprinting.

7.3 Crop DNA Fingerprint Database and Statistical Analysis Package

Crop DNA Fingerprint Database has been developed to store and retrieve profile data in an organized format. Ten statistical analytical modules for profile data comparison have been developed. Major work was done to update the database with profile tables of different crops. Presently database consists of 864 varieties of 15 crops. Table 1 shows list of crops with respective technique and number of varieties stored in the database.

Table 1: Profile table of crops with respective techniques as stored in the database

S. no.	Crop	Technique	Varieties stored in Database
	Cereals		
1.	Rice	STMS	72
	NonAro_Rice	STMS, RAPD	80
	Aro_Rice	STMS, RAPD	40
2.	Sorghum	AFLP	29
3.	Barley	RAPD	50
	Pulses		
4.	Chickpea	AFLP	23
5.	Mungbean	AFLP	27
	Oilseeds		
6.	Brassica	AFLP	42
7.	Soybean	AFLP	72
	Fibre		
8.	Cotton	AFLP, RAPD	48
	Vegetables		
9.	Tomato	RAPD	27
10.	Chillies	ISSR	38
	Fruits and Nuts		
11.	Banana	AFLP	107
12.	Mango	ISSR, AFLP	23
13.	Citrus	AFLP	33
14.	Cashew	ISSR, AFLP	140
	Medicinal and Aromatic Plants		
15.	Saffron	AFLP	13
	Total		**864**

7.4 Website

Web Pages of NRCDF website has been updated including, future thrust page, project details pages, individual scientists pages, varieties fingerprinted page, publications pages, human resource development page.

7.5 Digital Photo Library

Digital Photo Library software has been modified to upgrade some more features for storing, retrieving and saving pictures.

Externally funded projects

DBT project: Analysis of Genetic Diversity and Phylogenetic Relationships in *Solanum melongena* L. and Related Wild and Weedy taxa

A total of 153 accessions of *Solanum melongena*, 25 accessions of *S. insanum* and 6 accessions of *S. incanum* were collected from Andhra Pradesh, Karnataka, Kerala, Tamilnadu and Pondicherry. On-site morphological characterization studies were made on 51 accessions using 15 qualitative characters. Two field experiments involving a total of 90 accessions were laid out, one of cultivated *S. melongena* and the other of wild and weedy forms, *S. incanum* and *S. insanum* AFLP analysis of forty-eight accessions comprising ten species was performed. Forty-five primer pairs were screened for the analysis out of which 12 primer pairs amplifying highly discernable bands were used for further study. AFLP data based on these 12 primer pairs clearly differentiated species belonging to the eggplant complex (*S. melongena*, *S. insanum*, *S. incanum*) from the rest. The "intermediate" accessions occupied positions among the *S. melongena*, *S. insanum* and *S. incanum* accessions indicating that they might be natural hybrids of these species. It is probably due to the presence of such hybrids in nature that the distinctions between the three species are often blurred resulting in confusion in their identity and taxonomy.

DBT project: National Containment/ Quarantine Facility for Transgenic Planting Material (Transgene Testing)

Primers were designed for detection of transgenes *Scfv*, antifungal peptide, human serum albumin, *Xa*21 genes, *cre* sequence and scorable/selectable markers *hpt* and *npt*; regulatory sequences such as CaMV 35S promoter, *nos* terminator.

Transgenic wheat and rice lines tested for *bar* gene with designed primers were found to be positive. All transgenic samples were tested for terminator gene using primer specific to *cre* sequence. No amplicon of corresponding size was observed in any of the tested samples. Hence, transgenic lines received confirmed for absence of terminator gene.

DBT project: Development of PCR Based Methods for Testing of Transgenic Planting Material

NBPGR was assigned to develop PCR based protocols for detection of *barnase* and *barstar* genes in transgenic mustard, *Cry 1Ac* gene in *Bt* cotton and *epsps* gene in transgenic soybean, which have been successfully standardized. Protocol for multiplexing of 35S promoter and *epsps* gene in soybean has also been standardized. Cross validation of the standardized detection protocols with CFTRI Mysore and CDFD, Hyderabad has been also successfully completed.

Research Projects (Code: Title, Project Leader; Associates)

PGR/DFP-BUR- DEL-0.1.00:Technology development for DNA fingerprinting of cereals and millets (Lalit Arya; GJ Randhawa, Sunil Archak*, Rakesh Singh*).

PGR/DFP-BUR-DEL-0.2.00:Technology development for DNA fingerprinting of pulses, oilseeds and fibre crops (KV Bhat; MK Rana, GJ Randhawa, AB Gaikwad).

PGR/DFP-BUR-DEL-0.3.00:Technology development for DNA fingerprinting of horticultural crops (JL Karihaloo, AB Gaikwad, Sunil Archak*).

PGR/DFP-BUR-DEL-0.4.00:Technology development for DNA fingerprinting of medicinal plants (GJ Randhawa; Rakesh Singh*).

PGR/DFP-BUR-DEL-0.5.00: Crop DNA fingerprint database and statistical analysis package (Madhu Bala).

Externally funded projects

1. TMC Mini Mission I – ICAR project on molecular characterization of promising genetic materials of cotton (MK Rana).
2. DBT funded project on Analysis of genetic diversity and phylogenetic relationships in *Solanum melongena* L. and related wild and weedy taxa (JL Karihaloo, AB Gaekwad, Z Abraham, N Shivraj).
3. DBT funded project on National Containment/Quarantine facility for transgenic planting material-detection of transgenes (RK Khetrapal, GJ Randhawa).
4. DBT funded project on Development of PCR based methods for testing of transgenic planting material (GJ Randhawa; Rakesh Singh*).

* on study leave

8. PGR POLICY PLANNING UNIT

The PGR Policy Planning unit is functioning at NBPGR (HQs) since 1996 with the following objectives:

- To collect and document information on concurrent international and national developments concerning plant genetic resources and related fields such as biosafety, germplasm utilization, exchange and quarantine.
- To provide analytical inputs as per requirements of the policy makers for negotiations and formulations of policies at various national and international fora on issues related to PGR management.

The following outstanding issues concerning plant genetic resources policy were undertaken during the period under report.

8.1 Implementation of the FAO funded project on "Establishment of Information Sharing Mechanism for Monitoring the Implementation of Global Plan of Action"

Food and Agriculture Organisation (FAO) through Department of Agriculture & Cooperation, Ministry of Agriculture (GOI) have sponsored the above-mentioned project in November 2003, to monitor the implementation of Global Plan of Action with Japanese funding. Dr. Stefano Diullgeroff from FAO Rome visited NBPGR to discuss the project for establishment of information sharing mechanism in India involving all possible stakeholders of PGRs for Food and Agriculture in June, 2004. The objectives of the project are -

- Collecting information regarding twenty priority areas defined under GPA for conservation and sustainable utilization of PGRFA;
- Involving all possible stakeholders of PGRFA, including Ministry of Agriculture, Department of Agriculture & Cooperation, Indian Council of Agricultural Research (NARS), Ministry of Environment and Forests, Department of Biotechnology, State Agricultural Universities and Non-Governmental Organisations.

A meeting of the National Advisory (Functional) Committee was organised on 11.8.2004 to discuss the involvement of national stake holders and work plan of the project. The project monitoring and evaluation committee that was approved by the Advisory Committee met on 22.11.2004, for commitment building, finalization of the list of stake holders and time schedule as per the work plan. Finalized work plan was sent to FAO and LoA signed by Ministry of Agriculture and FAO in January 2005

During the discussions, it was felt that the information to be collected for India is enormous and complex. At the same time it is important to assess the implementation of GPA and collect information on priority activities defined by the GPA to know the gaps in existing efforts and future thrusts.

8.2 Technical Inputs Provided to ICAR / DAC / Ministry of Environment and Forests

The technical inputs on following international and national issues were provided to various departments from time to time as mentioned below:

a) **International issues**

(i) On agreement to formulate Global Crop Diversity Trust, to ICAR

(ii) Country report on conservation of plant genetic resources for food and agriculture for South, South East and East Asia (SSEEA) presented during the meeting held in October, 2004 and also a proposal for funding for the Region of South Asia.

(iii) Draft document for the 7th meeting of the Inter-Governmental Commission on Genetic Resources, traditional knowledge and folklore of the WIPO, to Department of Agriculture & Cooperation.

(iv) For IPGRI workshop on "Access and Benefit Sharing" held at MS Swaminathan Foundation in September, 2004.

(v) Provided input to the Department of Agriculture and Cooperation on the comments and queries received from Government of Chile, USDA and European Union on The Plant Quarantine (Regulation of import into India) Order 2003 for revision of the Order and clarifications raised.

(vi) Provided technical input to the DAC for revision of International Standards of Phytosanitary Measures 3 (Code of conduct for the import and release of exotic biological control agents) and ISPM 5 (Glossary of Phytosanitary Terms) during the country consultation stage of IPPC.

(vii) Participated and deliberated in Workshops/ Symposia/ Seminars/ Conferences/ Meetings on various aspects of SPS Agreement of WTO.

b) **National Issues**

(i) Comments and views on the second set of draft rules and regulations of the Protection of Plant Varieties and Farmer Rights Act.

(ii) A background note was sent to DARE on exchange of genetic resources after notification of all sections of BDA and also to the issues raised by committee formulated by ICAR/DARE for the said purpose.

Research Projects (Code, Title, Project Leader; Associates)

PGR/PPU-BUR-DEL-01.00: Policy planning and back-up research (P Brahmi).

PGR/PPU-BUR-DEL-01.01: PGR management and related issues. (P Brahmi; S Saxena, GJ Randhawa)

PGR/PPU-BUR-DEL-01.02: Policy issues related to plant quarantine (Rajan; Kavita Gupta).

9. REGIONAL STATION, AKOLA

Summary: A total of 185 accessions comprising cereals (7), millets (12), pulses (25), oilseeds (11), vegetables (54), horticultural crops (10), fibre crops (10), spices (14), medicinal plants (9), ornamentals (1), dye yielding plants (2), miscellaneous (1) and wild relatives (29) were collected from Konkan and western region of Maharashtra. A total of 8,989 accessions comprising NATP (1,023), pre-NATP (7794), AVT (22) and multi-location (150) accessions were grown during *kharif* and *rabi*, 2004. Observations on quantitative traits of millets (229), pulses (345) and oilseeds (458) were recorded. A total of 1,033 accessions comprising millets (251), pulses (248) and oilseeds (534) were conserved in the National Genebank. A total of 1,969 samples were supplied to various indentors.

9.1 Exploration and Collection of Germplasm

Two exploration trips were undertaken and a total of 185 accessions comprising cereals (7), millets (12), pulses (25), oilseeds (11), vegetables (54), horticultural crops (10), fibre crops (10), spices (14), medicinal plants (9), ornamentals (1), dye yielding plants (2), miscellaneous (1) and wild relatives (29) were collected from Konkan and western Maharashtra. Areas explored and diversity collected is mentioned. (Table-1)

9.1.1 Exploration and collection of wild relatives of crop plants from Maharashtra: An exploration programme was undertaken for the collection of minor fruits and wild relatives of crop plants in Maharashtra and 145 accessions were collected. District–wise collection included Ahmednagar (19), Buldhana (5), Nasik (15), Pune (26), Raigad (13), Ratnagiri (45) and Satara (22). Crop group-wise accessions collected included cereals (7), millets (12), pulses (25), oilseeds (10), vegetables (51), fruits (14), spices (14), M &AP (7), dye yielding plants (1), fibre (1), wild fruits (2) and wild relatives (1).

Crop-wise accessions collected included *Trigonella foenum-graecum* (8), *Vigna mungo* (7), *Cyamopsis tetragonoloba* (6), five accessions each of *Sesamum indicum, Cucumis sativus, Spinacia oleracea,* four accessions each of *Zea mays, Eleusine coracana, Lens culinaris, Macrotyloma uniflorum, Phaseolus vulgaris,* Amaranth, *Lablab purpureus, Vigna unguiculata*, three accessions each of *Oryza sativa, Pennisetum typhoides, Sorghum bicolor, Guizotia abyssinica, Vigna aconitifolia, Coriandrum sativum, Peucedanum graveolens*, two accessions each of *Annona reticulata, Artocarpus heterophyllus, Garcinia indica, Tamarindus*

Table 1: Explorations undertaken during 2004

Areas explored	Period of collection	Diversity collected	No. of accessions
Konkan and Western Maharashtra region	1 to 7 April	Multi-crop & minor fruits	145
Akola, Buldhana, Aurangabad, Ahmednagar, Pune, Mumbai, Thane, Nasik and Jalgaon districts of Maharashtra	26 to 30 October	Wild relatives of crop plants	40

indica, Panicum miliaceum, Brassica juncea, Cicer arietinum, Cuminum cyminum, Pisum sativum, Abelmoschus esculentus, Luffa acutangula, Momordica charantia, Moringa oleifera, Raphanus sativus, one accession each of *Bixa orellana, Ceiba pentandra, Aegle marmelos, Annona squamosa, Citrullus lanatus, Elacourtia montana, Feronia, Rhodomyrtus parviflora, Bouhamia racemosa, Cassia fistula, Ocimum sanctum, Sapindus laurifolius vahi, Semecarpus anacardium, Terminalia chebula, Vamguna spinosa, Vigna radiata, Trachyspermum ammi, Canavalia* sp., *Capsicum annuum, Cucumis melo, Cucurbita moschata, Daucus carota, Lycopersicon esculentum, Solanum melongena, Trichosanthes anguina, Solanum indicum* and *Zanthoxylum rhetsa.*

9.1.2 Exploration and collection of wild relatives of crop plants from Maharashtra: An exploration was undertaken for the collection of wild relatives of crop plants in Maharashtra during 26th to 30th October, 2004. A total of 40 accessions comprising fifteen genera and twenty-two species were collected from nine districts of Maharashtra. District–wise collection included Akola (1), Buldhana (9), Aurangabad (8), Ahmednagar (1), Pune (8), Mumbai (1), Thane (5), Nasik (4) and Jalgaon (3). The total germplasm collected included *Abelmoschus ficulneus* (5), *A. tetraphyllus* (3), *A. tuberculatus* (3), *Aloe vera* (1), *Amaranthus* sp. (2), *Annona squamosa* (3), *Brassica* sp.(1), *Bryonopsis laciniosa* (1), *Cucumis callosus* (1), *Cucumis hardwickii* (6), *Cucumis* sp.(1), *Cucurbita* sp. (1), *Datura metel* (1), *Lycopersicon esculentum* (1), *Lycopersicon* sp.(1), *Momordica* sp.(1), *Sesbania aculeata* (2), *Solanum nigrum* (2), *S. torvum (1), Trichosanthes cucumeriana* (1), *Trichosanthes* sp.(1) and *Vigna trilobata* (1).

Variability was recorded in fruit characteristics of *Abelmoschus* species and *Cucumis hardwickii.* The fruit length varied from 2.9 cm to 4.16 cm and fruit width 1.2 to 1.76 cm in case of *Abelmoscus ficulneus;* 4.0 to 5.1cm and 1.33 to1.46 cm in case of *A. tuberculatus*, 2.96 to 4.33 cm and 0.98 to 1.3cm in case of *A.tetraphyllus.* The length and width of fruits of *Cucumis hardwickii* showed variation from 3.25 to 5.23 cm and 1.76 to 2.53 cm respectively.

9.2 Characterization of Germplasm

A total of 8,989 accessions comprising NATP (1023), pre-NATP (7794), AVT (22) and multi-location (150) accessions were grown in the experimental farm of NBPGR Regional Station, Akola and Satellite Center, Amravati during *kharif* and *rabi*, 2004. Crop-wise accessions grown during 2004 are presented in (Table-2). Standard cultural practices and plant protection measures were adopted.

Observations on quantitative traits of millets (229), pulses (345) and oilseeds (458) were recorded on five randomly selected plants and post harvest observations were recorded in the laboratory. Range of variability observed for some traits is mentioned in Table 3 and promising accessions identified are given in Table 5.

Table 2: Cropwise accessions grown during 2004-2005

Crop group	NATP	Pre NATP	AVT	Multi-location	Total	Checks
Millets						
Sorghum	-	140	-	-	140	
Pearl millet	-	19	-	-	19	
Barnyard millet	71(53)	112	-	-	183	K-21, PS-118
Little millet	53(47)	112	-	-	165	PRC-3, CO-2
Proso millet	19(18)	-	-	-	19	PRC-3, CO-2
Kodo millet	46(39)	33	-	-	79	GPUK-3, IPS-147
Foxtail millet	54(46)	295	-	-	349	K-221, PS-118
Finger millet	76(26)	380	-	-	456	VL-149, PR-202
	319	**1091**	**-**	**-**	**1410**	
Pulses						
Mung bean	-	911	-	-	911	
Black gram	-	18	-	-	18	
Moth bean	-	17	-	-	17	
Horse gram	100	782	-	-	882	Raigad local
Chickpea	208	-	-	-	208	Chaffa, PG-12
Grass pea	46	304	-	-	350	Naygaon local
	354	**2032**	**-**	**-**	**2386**	
Oilseeds						
Sesame	-	1500	-	-	1500	
Niger	252(225)	650	-	-	902	CHH-1, CHH-2
Castor	-	-	-	150	150	RLC-6, J-23-10
Linseed	69	135	06	-	210	
Safflower	-	601	-	-	601	Bhima
	321	**2886**	**06**	**150**	**3363**	
Vegetables						
Lab lab bean	-	236	-	-	236	
Cowpea	-	24	-	-	24	
Canavalia	-	09	-	-	09	
Winged bean	-	246	-	-	246	
Amaranth	29	1245	16	-	1290	Suvarna, Akola local
	29	**1760**	**16**	**-**	**1805**	
Wild relatives						
Carthamus sp.	-	25	-	-	25	
	-	**25**			**43**	
Grand total	**1023**	**7794**	**22**	**150**	**8989**	

*Figures in the parentheses indicate number of accessions characterized.

Table 3: Range of variability observed for some morphological traits

Crop	Traits	Range	Mean ± SEM	CV(%)
Rabi (2003-2004)				
Chickpea	Plant height (cm)	23.2-54.9	39.4± 0.4	14.5
	No. of primary branches/plant	2.3-6.4	4.1 ± 0.04	16.5
	Days to 50% flowering	45-78	55.9 ± 0.37	9.5
	No. of pods/ plant	4-68.6	38.2 ± 1.02	38.4
	No. of seeds/pod	1-2.2	1.3 ± 0.01	20.9
	Days to 80% maturity	93-111	98.6 ± 0.2	4.0
	100 seed weight (g)	9.06-35.05	14.5 ± 0.2	24.1
Lathyrus	Plant height (cm)	9.4-47.3	17.01 + 0.9	36.0
	No. of primary branches/plant	2-5	3.1 ± 0.1	25.7
	Days to 50% flowering	71-76	73.4 ± 0.2	2.3
	No. of pods/ plant	1.8-38.2	10.3 ± 1.08	65.4
	Pod length (cm)	1.9-4	2.6 ± 0.05	12.3
	No. of seeds/pod	1.6-3.7	2.5 ± 0.06	17.2
	Days to 80% maturity	98-104	101.2 ± 0.3	2.1
	100 seed weight (g)	4.2-8.9	5.2 ± 0.1	21.5
Linseed	Plant height (cm)	14.5-43.04	30.4 ± 0.2	14.0
	Days to 50% flowering	57-100	69.2 ± 0.4	10.0
	No. of capsules/ plant	2.6-121.4	43.9 ± 1.1	39.1
	Days to 80% maturity	85-125	97.09 ± 0.4	6.7
	100 seed weight (g)	0.11-0.83	0.3 ± 0	33.7
Kharif-2004				
Finger millet	Plant height (cm)	28.0-94.2	55.6 ± 3.4	31.6
	Culm branching	2.2-3.8	2.8 ± 0.0	16.0
	Effective tillers	1.0-4.4	1.3 ± 0.1	34.8
	Days to 50% flowering	67-92	79.9 ± 1.4	9.0
	Days to 80% maturity	100-124	112.3 ± 1.4	6.3
	Ear exertion (cm)	1.4-9.5	4.3 ± 0.4	49.4
	Finger length (cm)	4.7-13.4	8.4 ± 0.5	31.1
	Glume length (cm)	2.3-2.8	4.0 ± 0.2	26.4
	100 seed weight (g)	0.1-0.4	0.2±0.0	27.8
Little millet	Plant height (cm).	47.2-110.4	73.4± 2.1	20.0
	No. of basal tillers	2.6-8.8	5.3 ± 0.2	26.7
	Culm branching	2.8-6.2	4.5 ± 0.1	17.8
	Flag leaf length (cm)	9.6-31.1	16.1 ± 0.6	28.3
	Length of flag leaf sheath (cm)	4.9-13.1	8.2 ± 0.2	22.9
	Peduncle exertion (cm)	1.2-8.4	4.0 ± 0.3	51.7
	Inflorescence length (cm)	10.7-30.5	17.9 ± 0.6	26.6
	Nodes/primary axis of inflorescence	4.1-7.2	4.9 ± 0.1	15.5
	Days to 50 % flowering	47-64	53.3+0.8	11.1
	Days to 80 % maturity	78-95	84.6+0.7	5.9
	100 seed wt. (g)	0.1-0.3	0.2±0.0	18.6
Proso millet	Plant height (cm)	59.6-101.1	79.3 ± 3.5	18.8
	No. of basal tillers	4.8-9.4	6.4 ± 0.2	19.5
	Flag leaf length (cm)	16.3-35.1	23.3 ± 1.0	18.4
	Sheath length of flag leaf (cm)	4.5-14.1	8.8 ± 0.5	24.3
	Inflorescence length (cm)	15.1-28.4	21± 0	20.3
	Nodes/ primary axis of inflorescence	2.6-8.8	5.4 ± 0.2	22.5
	Days to 50 % flowering	78-89	83.6 ± 0.8	4.2
	Days to 80 % maturity	107-120	115.3 ± 0.9	3.3
	100 seed wt. (g)	0.1-0.2	0.1±0.0	33.6

Kodo millet	Plant height (cm)	29.2-66.1	43.8 ± 1.4	21.0
	No. of basal tillers	2.2-7.1	4.3±0.1	27.9
	Flag leaf length (cm)	12.1-35.7	22.9 ± 0.9	25.9
	Inflorescence length (cm)	5.8-16.1	9.6 ± 0.3	25.2
	Days to 50 % flowering	65-73	68.2 ±1.3	3.6
	Days to 80 % maturity	94-106	98.6 ± 0.5	3.3
	100 seed wt. (g)	0.1-0.2	0.1±0.0	33.6
Foxtail millet	Plant height (cm)	56.2-123.6	102.9±2.79	15.9
	Flag leaf length (cm)	19.4-42.3	31.2±0.85	16.1
	Flag leaf width (cm)	1.7-3.2	2.5±0.06	17.8
	Sheath length of flag leaf (cm)	9.1-26.4	11.4±0.46	17.2
	Inflorescence length	11.3-26.3	20.2±0.68	22.0
	Days to 50 % flowering	46.0-64.0	59.3±0.61	9.1
	Days to 80 % maturity	73.0-87.0	78.6 ± 0.5	4.4
	100 seed wt. (g)	0.1-0.3	0.2±0.0	17.0
Barnyard millet	Plant height (cm)	26.8 – 102.5	69.3 ± 1.7	18.2
	No. of basal tillers	1.7 - 5.2	3.3 ± 0.1	23.0
	Blade length of flag leaf (cm)	9.2- 27.8	18.7± 0.5	22.5
	Sheath length of flag leaf (cm)	4.5- 17.5	10.1± 0.3	28.2
	Inflorescence length (cm)	7.5- 22.5	14.2± 0.3	18.9
	Nodes/ primary axis of inflorescence	3.1- 8.7	5.5± 0.1	17.4
	Days to 50 % flowering	48 - 94	61.8± 0.9	10.6
	Days to 80 % maturity	80 - 97	90.9± 0.6	4.9
	100 seed wt. (g)	0.2-0.4	0.3±0.0	13.9
Niger	Plant height (cm)	44.8-107.0	74.4±0.6	13.6
	No. of primary branches	5.8-17.2	10.1±0.1	21.6
	Leaf length (cm)	9.6-18.9	13.7±0.1	11.2
	Leaf width (cm)	3.3-6.7	4.8±0.0	12.6
	Days to 50 % flowering	44-74	54.0±0.5	13.8
	Days to 80 % maturity	74-97	82.5±0.3	6.6
	100 seed wt. (g)	0.2-0.4	0.3±0.0	12.8

Table 4: Morphotype studies in millet germplasm

Barnyard millet (*Echinochloa crus-galli*)	
Purple panicle type	IC325944, IC340240, IC340228, IC340191
Compact panicle	IC340224
Open panicle	IC340238, IC340203, IC340210, IC340134, IC340106
Tall plant type	IC372607, IC325966.
Dwarf plant type	IC 340220, IC340195, IC340187, IC340167, IC340163, IC340155, IC340124, IC340103
Foxtail millet (*Setaria italica*)	
Purple panicle type	IC325968, IC326031
Dwarf	IC372606, IC326012
Tall	IC325968
Tall & Purple	IC344224
Dwarf & Purple	IC 340225
Proso millet (*Panicum miliaceum*)	
Dark purple	IC344152, IC 344160, IC344206
High yielding	IC344156, IC344204, IC344206, IC344112.
Finger millet (*Eleusine coracana*)	
Long, open & straight panicle	IC340142
Tall types	IC344138

Table 5: Promising germplasm lines identified in different crops

Crop	Accessions superior over checks		Check value
Barnyard millet	Inflorescence length (cm):	IC-340210 (24.7)	KL-1 (16.9 cm)
	Days to 50% flowering:	IC-340124 (40)	KL-1 (47)
	100 seed wt. (g):	MKSP-117 (0.44)	VL-29 (0.31)
Little millet	Inflorescence length (cm):	KANR-II/44 (36.2)	PRC-3 (27.5)
	Days to 50% flowering:	IC-340223 (44)	PRC-3 (53)
	100 seed wt. (g) :	IC-340246 (0.32),	PRC-3 (0.24)
Kodo millet	Inflorescence length (cm):	IC-340161 (16.0)	GPUK-1 (9.2)
	Days to 80% maturity:	RR-9 (97)	GPUK-1 (99)
	100 seed wt. (g) :	IC-340194 (0.62g)	IPS-147 (0.48)
Foxtail millet	Inflorescence length (cm):	IC-340225 (27)	PS-118 (23.2)
	Days to 80% maturity:	MKSP-203 (65)	PS-118 (75)
	100 seed wt. (g) :	IC-340225 (0.32)	PS-118 (0.28)
Finger millet	Finger length (cm):	IC-340142 (15.2)	VL-149 (9.4)
	Days to 80% maturity:	MD-36 (98)	PR-202 (111)
	100 seed wt. (g) :	IC-340127 (0.29g), IC-344136 (0.26g)	PR-202 (0.2)
Niger	High yielding :	IC-320933, IC-340123, IC-340200, IC-340244, IC-320979, IC-341315, IC-341319	CHH-1, CHH-2

9.3 Conservation of Germplasm in the Long Term Storage

A total of 1033 accessions of germplasm comprising finger millet (10), foxtail millet (119), barnyard millet (49), kodo millet (33), horse gram (67), chick pea (167), grass pea (14), safflower (09) and linseed (525) were sent for long term conservation in the National Genebank.

9.4 Seed supply

A total of 1,968 samples were supplied to various indentors in the country.

Research Projects (Code: Title, Project leader; Associate)

PGR/GEV-BUR-AKO-01.00: Augmentation, characterization, evaluation, documentation and conservation of PGR in Central Indian Plains (I P Singh).

PGR/GEV-BUR-AKO-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of pulses (pigeon pea and chickpea), vegetables (winged bean, amaranth and okra) and under utilized crops (IP Singh; N Dikshit).

PGR/GEV-BUR-AKO-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of oil seeds (sesame, niger, castor, groundnut, safflower, soybean and linseed), millets and minor millets (N Dikshit; IP Singh).

10. REGIONAL STATION, BHOWALI

Summary: Three multi-crop and one crop specific explorations were undertaken in Uttaranchal and 186 accessions including landraces and primitive cultivars comprising cereals (69), minor millets (7), pulses (30), vegetables (3), horticultural crops (13), M & AP (33) and others (31) were collected from remote areas of hills under NATP (PB) and G-15 project. In addition, four explorations were undertaken by cooperators in parts of Uttaranchal under NATP (PB) and 272 accessions comprising cereals (92), pulses (32), oilseeds (20), vegetables (70), grasses (26), M & AP (4) and others (28) were collected . A total 731 accessions were received for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material namely *Allium tuberosum* (990), *Allium schoenoprasum* (200), *Artemisia annua* (425 g), Rose geranium (38181 Nos.), Lavender (3060 Nos.), Lemon grass (2004 Nos.), *Marjorana hortensis* (2226 Nos.), Rosemary (9570 Nos. + 20.900 Kg herbage); *Cryptomeria japonica* (123 Nos.), Kiwi (358 Kg + 210 Nos.) were supplied to different farmers/ indentors. A total of 108 accessions were supplied to user scientists in the country and 1189 accessions deposited in National Gene Bank for conservation.

10.1 Exploration and Germplasm Collection

A total of 186 germplasm accessions were collected through four explorations (3 multi-crops and 1 crop-specific) during the period under report from parts of Uttaranchal under NATP (PB) and G-15 (M & AP). This year emphasis was mainly laid on the collection of germplasm of land races/ primitive cultivars of various crops from the inaccessible and remote areas of mid hill regions. One crop-specific exploration was especially undertaken for the collection of pomegranate from US Nagar, Haridwar, Pauri, Tehri and Nainital. The collected germplasm comprised cereals (69), minor millets (07), pulses (30), vegetables (03), horticultural crops (13), M&AP (33) and others (31) as per the details given in Table 1. In addition, four explorations were undertaken by cooperators in parts of Uttaranchal under NATP (PB) collecting germplasm of 272 accessions during 2004. The collected germplasm included

Table 1: Explorations undertaken during 2004 by Bhowali under NATP(PB) and G-15 project on M & AP

Period	Areas explored	Total Accession collected	Cereals	Minor millets	Pulses	Vegetable crops	Hort. crops	M&AP	Others
May 25 to 29	Villages of Thailisan, Bharsar, Cheela of District Pauri	55	23	—	08	03	—	02	19
Sep. 8 to 14	US Nagar, Haridwar, Nainital, Tehri and Pauri districts	19	—	—	—	—	13	—	06
Oct. 4 to 10	Villages of Nanda devi Biosphere Reserve (NDBR), Chamoli and Tehri districts.	26	08	02	05	—	—	08	03
Oct. 12 to 18	Pauri, Tehri and Uttarkashi districts	63	38	05	17	—	—	—	03
Oct. 12-18	Pauri, Tehri and Uttarkashi districts	23	—	—	—	—	—	23	—
	Total	186	69	7	30	3	13	33	31

cereals (92), pulses (32), oilseeds (20), vegetables (70), grasses (26), M & AP (4) and others (28).

10.2 Germplasm Evaluation

The germplasm accessions collected from Kumaon and Garhwal regions of Uttaranchal were sown at Bhowali for characterization, initial seed increase and multiplication during *kharif* and *rabi* seasons 2003-2004 (Tables 2 - 6).

Table 2: Germplasm characterization during Kharif 2004

Crop	No. of Accs.	Checks used
Maize	35	VL - 16 & HIM - 129
Amaranth	300	Annapurna & Swarna
French bean	993	VL- 1, VL- 63, PLB - 10-1, PLB - 14 - 1, Chaffi local, Ramgarh local
Cowpea	60	FTC - 27, NS 24-82 & Local
Soybean	66	VLS - 2, VLS - 21, VLS - 47, VLS - 54 and VLS - 77
Horse gram	72	Local
Black gram	26	Local
Rice bean	52	PRR-1 and PRR-2
Foxtail millet	15	Local

Table 3: Multiplication/ seed increase during Kharif 2004

Crop	No. of Acc.	Purpose
Groundnut	31	LTS*
Sunflower	01	LTS
Green gram	02	LTS
Pigeon pea	04	LTS
Mucuna spp	04	LTS
Sorghum	04	LTS
Ash gourd	04	LTS
Ridge gourd	20	LTS
Brinjal	01	LTS
Adzuki bean	02	LTS
Snake gourd	01	LTS
Chenopod	02	LTS

Barley (*Hordeum vulgare*) germplasm grown at Bhowali for characterization

Table 4: Promising accessions identified in various crops during *rabi* 2003-2004 and *kharif* 2004.

Crop	Main attributes	Accessions identified for specific/desired traits
Barley (267) Checks: VLB-1, VLB-60, VLB-64	Plant height> 95 cm Early maturity <162 days Yield plant > 13.84 g No. of seeds/spikes>62.66	IC260873 EC192385, EC492302 EC192193, EC942241 IC393135, IC266686
Wheat (457) Checks: UP-2425, UP- 2382, HS-240	Plant height> 89.83 cm Early maturity <191.24 days 100 seed weight > 4.8 g Yield plant > 12.07 g	IC406685, IC398300 IC337357, IC337358 IC398294, IC406709 IC263155, IC240976
Lentil (143) Checks: VL- 105, VL- 108, PL- 406, PL- 639, PL- 830	Plant height> 34 cm Early maturity <113 days 100 seed weight > 4.3 g Yield plant > 3.9 g	IC383669, IC212676 IC366132 IC315628, IC393204 IC281822, IC345628

French bean (993) Checks: VL-1, VL- 63, PLB-10-1, PLB- 14-1, Ramgarh local, Chaffi local	Early maturity< 90 days	IC340877, IC340919, IC341051 IC360833, IC360868, IC341408
	100 grain weight >44.04 g	IC340828, IC340837, IC340913, IC340938, IC341343, IC360839
	Yield/Plant > 25.06 g	IC340877, IC340906, IC340923, IC355993, IC356031
	Pods/Plant > 14 nos.	IC356015, IC356051, IC341408, IC338730, IC383665
Cowpea (65) Checks: FTC-27, NS-24/82, Local	Early maturity < 110 days	IC391485, IC360843
	100 grain weight >19.42 g	IC422614, IC391507, IC383483
	Yield/Plant > 42.84 g	IC341199, IC391508, IC391564
	Pods/Plant > 38 Nos.	IC341199, IC391564, IC383622

Table 5: Range, mean and coefficient of variation in various crops

Crop	Character	Range	Mean	CV%
Amaranth (300)	Days to 50% flowering	43.00-81.00	62.43	3.07
	Days to maturity	102.00-146.00	123.10	2.44
	Leaf length (cm)	6.30-60.00	16.45	6.09
	Plant height (cm)	29.1-221.6	116.71	5.54
	Inflorescence length (cm)	13.60-77.00	45.97	4.94
	1000 seed weight (g)	0.32-1.15	00.71	4.64
Rice bean (52)	Days to 50% flowering	66.00-96.00	92.10	2.30
	Days to maturity	126.00-145.00	138.00	1.60
	Pod length (cm)	6.00-11.80	09.30	3.74
	Plant height (cm)	62.00-211.00	139.60	5.32
	100 seed weight (g)	3.80-12.70	07.50	4.30
Horse gram (72)	Days to 50% flowering	48.00-61.00	54.59	2.55
	Days to maturity	106.00-113.00	110.00	1.45
	No. of Pods/Plant	15.00-178.00	52.00	7.46
	Plant height (cm)	42.50-106.30	77.60	4.34
	Pod length (cm)	4.10-7.20	4.90	3.13
	100 seed weight (g)	2.20-3.90	2.80	3.64
Sem bean (66)	Days to 50% flowering	52.00-92.00	67.88	3.55
	Days to maturity	115.00-148.00	128.82	2.88
	No. of Pods/Plant	25.00-286.00	132.00	5.90
	Plant height (cm)	40.00-245.00	95.80	6.12
	100 seed weight (g)	04.00-39.00	14.00	6.54
Cowpea (60)	Days to 50% flowering	62.00-81.00	70.80	2.53
	Days to maturity	110.00-151.00	128.00	2.62
	No. of Pods/Plant	3.20-81.00	20.40	8.26
	Plant height (cm)	55.67-272.00	166.80	5.35
	Pod length (cm)	4.63-28.33	15.17	5.18
	100 seed weight (g)	4.67-21.77	11.34	5.96
Triticum sp. (49)	Days to 75% ear emergence	133.00-177.00	160.50	2.51
	Days to maturity	172.00-221.00	207.81	2.23
	Plant height (cm)	48.33-182.66	89.21	4.89
	100 seed weight (g)	01.02-06.79	03.19	5.97

Aegilops sp. (46)	Days to 75% ear emergence	152.00-190.00	161.55	2.44
	Days to maturity	197.00-220.00	208.91	1.75
	Plant height (cm)	23.04-150.00	42.69	7.84
	100 seed weight (g)	00.30-1.10	00.63	6.19
Avena sativa (19)	Days to 75% ear emergence	135.00-161.00	144.50	2.81
	Plant height (cm)	132.20-165.35	150.46	3.03
	100 seed weight (g)	2.59-5.51	3.40	6.45

Table 6: Germplasm characterized during *rabi* 2004

Crop	Acc.	Date of sowing	Checks used
Barley	179	16.11.04	VLB-1, VLB-60 & VLB-64
Wheat	295	19.11.04	UP-2425, UP-2382, HS-240 & HB-208
Lentil	18	16.11.04	VL-1, VL-105, VL-108, PL-406, PL-639 & PL-830
Rapeseed mustard (*Brassica rapa* ssp. *campestris* (70); *B. campestris* var. *yellow sarson* (16), *B. nigra* (33), *B. alba* (22) and *B. napus* (02)	177	01.10.04	Kiran, Kranti & PT-303, PT-30, T- 9, PT-507, Pusa Gold YST- 151, Rajivis, Pusa Jai Kisan, Varuna, GSL-1
Garlic	116	13.09.04	Lohit and Local
Aegilops spp. (wild)	09	25.11.04	—-
Triticum sp. (wild)	85	25.11.04	—-
Avena spp. (wild)	16	02.12.04	—-
Pea	26	15.11.04	Lincon, Harbhajan & Selection -18
Coriander	50	16.11.04	Pant Harit & Bhowali Local
Fenugreek	30	16.11.04	P.E.B & Kasturi methi
Lepidium sativum	07	16.11.04	—-
Faba bean	16	25.11.04	—-
Radish	10	01.09.04	Govind safed
Onion	05	19.11.04	—-
Spinach	115	15.11.04	—-

Table 7: Horticultural germplasm characterized / evaluated during 2004

Crop	Accs	Check used	Number of descriptor	Range of variation
Fruit germplasm				
Almond	**05**		**39**	Fruit length (2.59-3.16 cm), fruit width (1.71-2.36 cm), fruit weight (2-2.66 g)
Apple	**40**		**45**	Fruit length (3.26-6.85 cm), fruit width (4.58-7.37 cm), fruit weight (13-86 g)
Apricot	**16**		**41**	Stem girth (1.41-4.40 cm), leaf length (3.31-7.98 cm), leaf width (2.47-7.15 cm)
Cherry	**03**		**37**	Stem girth (1.40-1.50 cm), leaf length (8.92-11.36 cm), leaf width (4.20-4.76 cm)
Kaku	**03**		**30**	—
Kiwi	**07**		**32**	Stem girth (6.00-10.30 cm), fruit length (5.29-7.03 cm), fruit width (3.75-5.14 cm), fruit weight (50-85 g), TSS (13.5-17)
Peach	**19**		**42**	Plant height (0.38-2.13 m), fruit length (3.43-6.33 cm), fruit width (3.45-5.59 cm), fruit weight (21.25-62. 61 g)

Plum	07		42	Plant height (0.45-1.47 m), fruit length (3.23-3.84 cm), fruit width (3.02-3.82 cm), fruit weight (26.50-64.00 g)
Pyrus	21		43	—-
Rubus	21		20	Plant canopy (870-7560 sq cm), Number of fruit vesicles (4.73-92.6), TSS (8-12)
Strawberry	82		37	Fruit length (1.23-3.35 cm), fruit width (1.12-2.09 cm), 10 fruit weight (10-40 g), TSS (4-9)
Walnut	27		32	Plant height (0.8-3.96 m), tree girth (1.65-9.57 g), tree spread (0.22-66.70 sq m)
Vegetable germplasm				
Chilli	287	Pant C-1, C-2, JCA-283, LCF-206	37	Plant canopy (1275-2959.2 sq cm), fruit length (1.69-15.22 cm), fruit width (0.59-10.00 cm), number of fruit/plant (2-77.2)
Ornamental germplasm				
Gladiolus	31	Red and Butterfly	24 agro-botanical traits	Plant height (86.60-162.60 cm), spike length (85.02-148.80 cm), rachis length (25.62-77.20 cm)

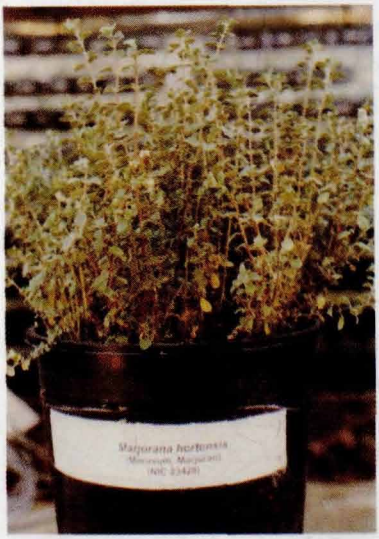
Fruit variability collected in shape, size and colour in *Cucumis hardwickii*

Horticultural crops: Horticultural germplasm evaluation was continuously done in the field genebank and all regular cultural operation were undertaken time to time. The summary is presented in Table 6.

10.3 Maintenance of Horticultural Germplasm

(i) Conservation in field Gene Bank: Fruits (517 accs), vegetables (Chillies -1250, Others-28), perennial flowering plants (82), annual flowering plants and other horticultural crops (75) are maintained in glass house/ field Gene Bank/ MTS at R/S Bhowali.

(ii) Post harvest work: (a) Chilli pods (527 accs.) were submitted to biochemistry lab at HQs, New Delhi for biochemical analysis, (b) Chillies seed (167 accs.) were cleaned for MTS/ LTS.



Marjorana hortensis - a successful introduction established at Bhowali

(iii) Transfer of Technology: Technical know how was given about following at farmers field by the staff of NBPGR, R/S Bhowali.

i. Kiwi propagation through cuttings

ii. Citrus propagation through nucellar seedlings/cuttings

PCPGR-HTP 1- Bhowali Unit:

I. Green house maintenance (Clonal Repository): All regular operations were timely attended for the maintenance of clonal repository /regeneration of the promising fruit material/collected materials (2500 pots).

II. Nursery management:

a. Kiwi and Citrus: Grafting of Hayward and Allision scion and cuttings were maintained in field conditions.

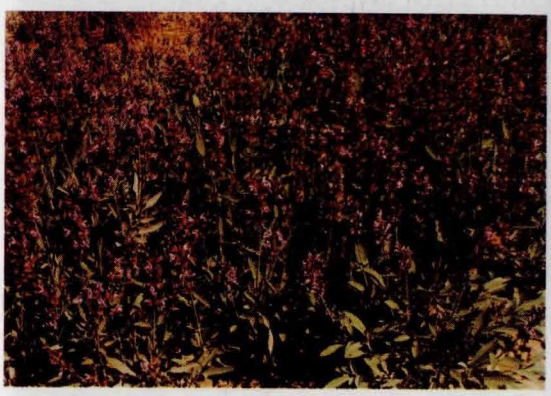
b. Kiwi at farmer's field: Kiwi nursery management was done at selected farmer's field in different places in Nainital, Uttaranchal.

III. Regeneration of promising accessions: Plants/ seeds of Kagzi nimbu (IC319045), Santra (IC319065), Malta (IC319066), Chakotra (IC319044), Pahadi Nimbu (IC319067), Kiwi (EC64093, EC24672, EC64094, EC64090, EC137263, EC64092), *Zinia* (IC318926, IC318927, IC318928), *Glardia* (IC320219, IC320220), Tuberose (IC319156), *Tagetes* (IC318939), *Phlox* (IC319010, IC319011, IC319012) accessions were regenerated through cuttings, grafting and other vegetative means and through seeds.

10.4 Wild and Economically Useful Plants

- **Preliminary Evaluation of *Allium* sp.:**

Variability in *Gladiolus* germplasm grown at Bhowali



Salvia officinalis - a successful plant introduced and estabilished at Bhowali

A total of 40 accessions of *Allium* spp. (wild only) are being maintained and evaluated in field gene bank. Few of them i.e., *Allium auriculatum, A. consanguineum, A. carolinianum, A. griffithianum* and *A. royleii* are being multiplied for seed increase.

- **Maintenance of wild Economically Useful Plants:** A total of 110 accessions of wild related species of *Abelmoschus, Brayopsia, Crotalaria,* Cucumber, *Dioscorea, Myrsine, Macrotyloma, Parthenocissus, Ribes, Solanum,* raspberries etc. are being maintained in the field gene bank.

Wild wheat (*Triticum* spp.) germplasm characterized at Bhowali

- **Maintenance of Arborescent Plants:** A total of 190 accessions of arborescent plants comprising of 150 species (92 genera belonging to 50 families of both exotic and endemic origin) are being maintained in the station's Biodiversity Botanical Garden.
- **Maintenance of Bamboosetum:** A total of 40 accessions comprising of 18 species are being maintained.
- **Maintenance of forage legumes and grasses:** *Medicago* sp. (141 accessions) and *Trifolium* sp. (39 accessions) are being maintained.
- **Temperate Grasses:** A total of 54 accessions of temperate grasses are being maintained in the field gene bank.

10.5 Medicinal and Aromatic Plants

A total of 330 accessions (vegetatively propagated- 100; seed producing- 230) comprising of 207 species and 117 genera belonging to 37 families have been conserved in field gene bank/herbal garden of the station. Nearly 30 species of promising and high prized aromatic plants such as *Aloe, Alpinia, Artemisia, Asparagus, Bunium, Carum, Centella, Chrysanthemum, Cymbopogon, Hedychium, Lavendula, Matricaria, Marjorana, Melissa, Mentha, Ocimum, Origanum, Pelargonium, Plantago, Pyrethrum, Rosa, Rosmarinus, Salvia, Spilanthus, Stevia, Tagetes, Thymus, Valeriana, Withania* and *Zanthoxylum* were multiplied for their supply to the indentors. Steam distillation unit was being operated in different seasons for extracting essential oil from aromatic plants including scented Rose geranium, Clary sage, Lemon grass, Sweet marjoram and others.

10.5.1 ***Determination of percentage of essential oil:*** A total of 30 accessions of aromatic plants were extracted for percentage of essential oil in different seasons through steam and hydro (Clevenger apparatus) distillation unit. A part of this oil was also sent to chemistry unit, NBPGR, New Delhi for further chemical analysis. The range of oil percentage observed in different species is as follows: **Stem Distillation Unit:** Clary sage (0.09-0.11), Lemon grass (0.32-0.40), Rose geranium (0.08-0.13), Sweet marjoram (0.29-0.34); **Hydro Distillation Unit (Clevenger Apparatus)**: *Achillea millefolium* (0.18), *Acorus calamus* (1.4-1.5), *Alpinia galanga* (0.02), *Amomum aromaticum* (0.06-0.10), *Callicarpa macrophylla* (0.05), *Chenopodium ambrosoides* (0.30), *Coleus forskohlii* (0.21-0.70), Garden sage (0.30-2.00), Rose geranium (0.04-0.16), *Hedychium spicatum* (0.05-0.40), *Juniperus indica* (2.1-5.4), *Lavendula angustifolia* (0.40-2.40), *Ocimum basilicum* (0.02), *Ocimum gratissimum* (0.30-0.50), *Ocimum kilimandscharicum* (0.30-0.62), *Pogostemon cablin* (0.80-1.46), *Rosmarinus officinalis*

(0.63), Sweet marjoram (0.16), *Valeriana jatamansi* (0.60-2.00).

10.6 Germplasm Conservation

A total of 1,189 accessions of different crops *viz. Aegilops* spp. (19), *Avena sativa* (4), amaranth (49), barley (108), bottle gourd (30), chenopods (2), chamsoor (4), Coriander (88), cowpea (16), fenugreek (59), French bean (34), gram (1), khesari (3), lentil (127), linseed (1), maize (54), moth bean (2), M. & AP. (44), onion (5), pea (11), rapeseed mustard (114), radish (65), rice bean (9), sem bean (5), soybean (86), turnip (1), *Triticum* spp (wild-41) and wheat (207) were supplied to the NGB for their conservation.

Seeds (14 accessions) of following horticultural fruit crops were deposited for **Long Term Storage (LTS)** for establishing protocol *Passiflora edulis* (Passion fruit) IC340597, *Pyrus pashia* (Garh mehal) IC318930, *Pyrus communis* (Pear) IC318906, *Prunus amygdalus* (Almond) IC247453, IC247454, *Rubus ellipticus* (Hisalu) IC219046, *Rubus niveus* (Hisalu) IC219047, *Prunus persica* (Peach) IC247430, IC247431, IC320193, IC360693, *Juglans regia* (Walnut) IC319206 and *Prunus domestica* (Plum) IC247421, IC247421.

10.7 Germplasm Supply

A total of 108 accessions of different crops were supplied to various Research Organisations/ Indentors under MTA. These comprised *Hordeum bulbosum* (1), *Hordeum spontaneum* (1), rice bean (5), foxtail millet (10), *Citrus* sp. (86), chilli (25), French bean (2), pea (2), *Medicago* sp. (20), M & AP (19 acc. *Anethum* sp. - 1, *Artemisia* sp.- 8, *Curcuma* sp. -1, *Matricaria* sp. -1, *Ocimum basilicum* - 2, geranium - 2, rosemary -2, *Selinium*-1, *Urgenia indica*- 1) and WEUPS-27 acc. (*Allium* spp.-2, *Cucumis hardwickii*-24, *Macrotyloma sar garhwalensis*-1). Seed samples and live rooted plant material *viz.* M & AP and WEUPS: *Allium fistulosum* (5), *Allium tuberosum* (990), *Allium schoenoprasum* (200), *Ammi majus* (10 g), *Artemisia annua* (425 g), *Asparagus* sp. (35 g), caraway (600 g), *Coleus forskohlii* (01), *Conium maculatum* (100), *Curculigo orchoide* (10), Clary sage (200 g+ 145), *Digitalis perpurea* (10 g), Garden sage (2995+ 17.320 Kg herbage), Geranium (38181), *Ginkgo* sp. (10), Grasses (15 acc. + 90 kg), Lavender (3060), Lemon grass (2004), *Marjorana hortensis* (2226), *Mentha cardiaca* (2 Kg Herbage), *Matricaria chamomile* (185), *Malaxis* sp. (01), *Melissa officinalis* (15), *Ocimum basilicum* (40 g), *Ocimum gratissimum* (500), *Pelargonium tomentosum* (47 kg herbage), *Pyrethrum* sp (85 g), Rosemary (9570 + 20.900 Kg herbage), *Salvia* sp. (10), *Spilanthus* sp. (55 g), *Stevia rebaudiana* (57), *Tagetes* sp. (150), *Taxus baccata* (02), *Valeriana* sp. (210), *Withania* sp. (100 g), Horticultural Plants: *Citrus* sp. (288 Nos.), *Cryptomeria japonica* (123), Kiwi (358 Kg + 210), Kagzi (48), Passion fruits (06), Peach (31 Kg+89), Plum (160 Kg+02), Strawberry (7 Kg + 250) and Walnut (01) were supplied to different farmers / indentors.

Research Projects (Code: Title, Project leader; Associate)

PGR/PGC-BHO-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of the northern Himalayas and adjoining plains (KS Negi).

PGR/PGC-BHO-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of field crops with emphasis on ethno botanical aspects (KC Muneem; KS Negi).

PGR/PGC-BHO-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of temperate horticultural crops (SK Verma).

PGR/PGC-BHO-01.03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of medicinal and aromatic, wild economically useful, rare and endangered species (KS Negi; KC Muneem).

11. EXPLORATION BASE CENTER, CUTTACK

Summary: Three explorations were undertaken including two special missions in the Sunderban area of West Bengal and one exploration in Phulbani district of Orissa. A total of 384 accssions were collected. The major collections included cultivated rice, vegetable crops, turmeric, jute, allied fibres, M&AP and wild relatives of crop plants. The important collections made were *Asparagus racemosus, Andrographis paniculata, Abroma angusta,* very pungent chilli and wild turmeric. During the special exploration missions, landraces of various crops having salinity tolerance traits were collected. A total of 1,862 accs. comprising cultivated rice (1,190), turmeric (132), mungbean (40) and sesame (500) were grown for preliminary characterization and seed multiplication. A total of 682 accs. are being maintained in the field genebank of the center and 350 accs. were deposited as voucher specimens in the MTS. A total of 359 accs. comprising 223 accs. of multi-crop and 136 accs. of jute and allied fibres received from CRIJAF were deposited in the NGB. Thirty herbarium specimens were deposited to NHCP. Information on indigenous technical knowledge and ethno-botanical information on various plant genetic resources were also collected and documented.

11.1 Exploration and Germplasm Collection

Three explorations were undertaken for collection of agri-horticultural crops, medicinal plants and other wild relatives of crops plants from various parts of Orissa and West Bengal. These explorations also included a special mission in Sunderban area of WB. A total of 384 accessions comprising cereals (45), pulses (21), vegetables (79), oilseeds (9), horticultural crop (8), fibre crops (27), spices & condiments (109), root crops (28), M&AP (35), wild relatives of crop plants (10) and others (13) were collected during the explorations. Some important collections *viz.*, *Asparagus racemosus, Andrographis paniculata, Abroma angusta,* very pungent (hot) chilli, and wild turmeric were made. During special exploration mission, landraces of different crops having salinity tolerance traits were collected. The exploration-wise details with period of collection, region/areas covered, crop diversity and number of accessions collected are given below.

11.1.1 Special exploration mission to Sunderban: The Sunderban area is considered to be unique because of its species richness in terms of diverse mangrove flora comprising mangrove associated species of fauna. This unique ecosystem has been declared as a *World Heritage Site* and very recently included as 'Ramsar Site'. Keeping this in view, the special exploration mission in Sunderban region of WB was undertaken from 23 to 29 February 2004. The entire Sunderban region lies 40% in India and 60% in Bangladesh. Out of the 103 islands in Sunderban under Indian territory, 54 islands are inhabited and rests are reserve islands. The exploration team surveyed different islands during the trip and a total of 181 accs. of different crops *viz.*, cereals (29), pulses (10), vegetables (63), oilseeds (4), fibre crops (17), horticultural plant (8), spices and condiments (12), tuber crops (16), medicinal plants (13) , wild relatives (2) and others (7) were collected.

The second special exploration mission in Sunderban region of WB was undertaken from 30 Nov. to 4 Dec., 2004. The exploration team surveyed different islands during the trip and 106 accs. of different crops viz., cereals (16), pulses (11), vegetables (16), root crops (12), oilseed (05), fibre crop (10), M&AP (22), wild relatives (08) and others (06) were collected.

Period of collection	Crops collected	Area explored	No. of accs.
23 – 29 Feb., 2004	Multi crop	*Sunderban (WB)	181
26 Oct. – 1 Nov., 2004	Turmeric	Phulbani (Orissa)	97
30 Nov. – 4 Dec., 2004	Multi crop	*Sunderban (WB)	106

* Special exploration mission to Sunderban area of WB.

Crop group-wise diversity collected

Crop group	Expl. 1	Expl. 2	Expl. 3	Total
Cereals	29		16	45
Pulses	10		11	21
Oilseeds	04		05	09
Fibre crops	17		10	27
Vegetables	63		16	79
Tuber crops	16		12	28
Horticulture crops	08			08
M & AP	13		22	35
Spices & condiments	12	86		98
Wild relatives	02	11	08	21
Others	07		06	13
Total	**181**	**97**	**106**	**384**

Indigenous / traditional seed storage structure in Sunderban, WB

Although the area of Sunderban is inaccessible, the crops grown in the Islands are dominated by improved varieties as the settlers are migrants from the main land.

11.1.2 Collection of turmeric germplasm from Phulbani district of Orissa: The exploration programme for collection of turmeric germplasm from Phulbani district of Orissa was undertaken from 26 Oct. to 1 Nov., 2004. A total of 97 accs. of turmeric including 11 accs. of wild turmeric were collected. Wide ranges of variability in rhizome colour and rhizome size were recorded during the exploration mission. The material has been deposited with the zonal leader zone-III for onward transmission to NBPGR, New Delhi and conservation in field gene bank at NBPGR, Cuttack.

Raw material of medicinal plants for sale in tribal areas

11.2 Preliminary Characterization of Germplasm

A total of 1,581 accessions comprising cultivated rice (1,416 accs.) and turmeric (165 accs.) were

grown during *kharif* 2004 for preliminary characterization and seed multiplication. Out of the 1416 accs. of rice, 493 accs. were grown for characterization including194 accs. received from NBPGR, Thrissur for multilocation trial and 697 accs. for seed multiplication. Besides, 165 accs. of turmeric were planted for characterization.

11.2.1 Cultivated rice *(Oryza sativa)*: A total of 1,416 accessions of rice germplasm were sown in nursery bed and one month old seedlings were transplanted in augmented design with checks at regular intervals. Each accession was maintained in four rows of three-metres length. Standard cultural practices were followed with normal recommended dose of N:P:K (60:30:30). Herbicides/pesticides were not applied during any stage of crop growth. Observations on various morpho-agronomic traits *viz.*, basal leaf, sheath pigmentation, colour of the leaf blade, auricle, collar, internode, lemma and palea, plant height, days to maturity, leaf length and width, EBT and panicle length were recorded during vegetative, late vegetative, flowering and maturity stages of crop growth.

Wide range of variability was observed at inter- and intra-varietal level with regards to qualitative traits i.e. basal leaf, sheath pigmentation, leaf blade colour, pubescence, ligule, auricle, collar, inter node, lemma & palea colour etc and quantitative traits i.e. plant height, days to maturity, leaf length and width, EBT, panicle length etc.

11.2.2 Turmeric:A total of 165 accs. with 4 checks were planted in Augmented Randomized Block Design for multi location trial. Each germplasm was maintained in one row with a spacing of 30X75 cm. Observations on morpho-agronomic traits were recorded according to minimal descriptor. The planting material was received from NBPGR, Thrissur.

Wild species of *Oryza* in natural habitat collected from Orissa

Exploration team on a special germplasm collection mission in Sunderban, WB

11.3 Germplasm Conservation

Medium Term Storage: A set of 350 accs. comprising 330 accs. of various agri-horticultural crops and 20 accs. of M&AP collected under NATP (PB) were deposited as voucher specimen for MTS at NBPGR, New Delhi.

Long Term Storage: A total of 359 accs. comprising cereals (139), pulses (66), oil seeds (06), jute and allied fibres (139) and others (09) were deposited for LTS in the National Gene Bank at NBPGR, New Delhi.

Rhizomes of high yielding turmeric collected from Phulbani

Solanum trilobatum - a wild relative of brinjal collected from Sagar Island

NHCP: A set of 30 herbarium specimens was deposited to the NHCP at NBPGR, New Delhi.

11.4 Germplasm Supply

A total of 26 accs. of M&AP (live plants) were supplied to PI, NATP (PB), 23 accs. of coloured rice and 114 accs. of upland rice to Head, Plant Exploration Division (NBPGR) for research purposes.

11.5 Germplasm Maintenance

A total of 3,300 accessions comprising 2,561 accs. of rice, 40 accs. of mung bean, 500 accs. of sesame, 1 acc. of pigeon pea,157 accs. of wild relative of crop plant, 204 accs. of M&AP, 393 accs. of spices, 16 accs. of banana, 19 accs. of betel vine and 24 accs. of economic plants are being maintained at Cuttack.

Research Project (Code: Title, Project leader)

PGR/EXP-BUR-CUT-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources in Orissa and adjoining regions (DP Patel).

12. REGIONAL STATION, HYDERABAD

Summary: A total of 19,500 samples (11,474 import and 8,026 export samples) were processed for quarantine clearance and 150 phytosanitary certificates were issued. Several pathogens of quarantine importance were intercepted. A total of 2,472 import samples was found infested/ infected with pests/ pathogens of which 2,360 samples could be salvaged but 76 samples, infected with quarantine pathogens could not be salvaged and hence detained. A total of 36 samples were rejected as they were infected with pathogens. In exports, 184 samples were rejected due to the association of quarantine pests/ pathogens. Quarantine service was extended to more than 30 organizations in South India. During the reporting period about 1,976 accessions of different agri- horticultural crops comprising brinjal, chillies, blackgram, finger millet, maize, sorghum, tomato and other agri-horticultural crops and wild species were sown/ maintained for evaluation/ rejuvenation/ multiplication. A total of 13 explorations were conducted and 1524 accessions of paddy, pearl millet, minor millets, niger, *Pongamia* sp., tuber crops, pulses, ginger, turmeric, grapes, medicinal and aromatic plants and wild relatives were collected. A total of 1,979 samples of different agri-horticultural crops were added to the MTS facility during 2004 making a total of 51,959 germplasm samples as on 31.12.2004. The multiplied accessions of exotic germplasm comprising paddy (274), wheat (114), sorghum (46), and pearl millet (97) were sent to the National Gene Bank (NGB), New Delhi for long-term conservation. Three germplasm awareness days for sunflower, pigeonpea, groundnut and a short-term training programme on 'Intellectual Property Rights and PGR Management' were organized.

NBPGR Regional Station, Hyderabad was established in 1985, with a major responsibility of quarantine processing and clearance of ICRISAT mandate crops, rice and other crops meant for the Research Institutes /Universities located in southern region of India. It serves as an exploration base centre for the collection of agri-horticultural crops in Andhra Pradesh and adjoining areas.

12.1 Quarantine of Germplasm

During the year 2004, a total of 19,5003 samples of different crops were received and processed for quarantine clearance. Out of these, 11,474 were imported from different countries and the rest were meant for export to different countries.

12.1.1 Imports processed and released: During the period under report, 11,474 samples (10,199 accession) including paddy samples 3,923 (3,350 accs), *Triticum* spp 645 (645 accession), *Aegilops* spp. 2,355 (2,355 accession), maize 1,450 samples (754 accession), sorghum 75 (75 accession), pearl millet 290 (290 accs), *Brachiaria* spp (2 accession), chickpea (2,149 accession), groundnut 24 (24 accession), sunflower 125 (125 accession), safflower 70 (70 accs), tomato 218 (218 accs), chilli 55 (55 accession), peas 6 (6 accession) and others 87 (81 accession) were examined and released to the respective consignee after giving the mandatory treatments.

Six pea exotic lines from USA meant for IIHR, Bangalore were subjected to grow-out test in the Quarantine greenhouse for virus symptom observations. None of the plants showed virus symptoms. Seventeen accessions of groundnut from Cyprus (1), Ghana (6), Malawi (8), Niger (1) and Zimbabwe (1) were tested by ELISA against PStV and PMV and none of them found infected. Accessions that were found free from virus infection were grown in the quarantine greenhouse and tested against bacterial wilt organism. Healthy seedlings, which were found free from *Ralstonia solanacearum* infection, were released for post-entry growing in the greenhouse.

Twenty-nine samples consisting of *Triticum* spp (3) and *Aegilops* spp. (26) were rejected due to the infection of *Botrytis cinerea, Fusarium nivale* and *Xanthomonas* sp. Two sunflower accs infected with *Botrytis cinerea* were detained. All safflower accessions infected with *Puccinia carthami* were salvaged using alcohol. Five accessions of chickpea were rejected as they were infected with *Botrytis cinerea* and *Fusarium oxysporum*. Plant quarantine unit of ICRISAT was advised to grow 25 accessions of chickpea, infected with seed rot bacteria in the glass house for post entry quarantine growing. Identification of the isolated bacteria from chickpea seed from USA revealed that the bacteria were of saprophytic nature.

12.1.2 Import quarantine interceptions: All the import samples were subjected to various seed health tests like visual examination, blotter test, X-ray radiography, Enzyme Linked Immunosorbent Assay (ELISA), centrifugation and microscopic examination. The following pathogens were intercepted during the reporting period.

12.1.3 Post entry quarantine observations: Sorghum accessions from Columbia, grown in PEQIA of ICRISAT were inspected after harvest for release to the consignee.

Inspected the sowing and transplantation of pearlmillet accessions (177) from UK in the glasshouse and PEQIA of ICRISAT and recorded weekly observations.

Pathogen	Crop	Country
Cercospora sp., *Fusarium culmorum, F. longipes, F. nivale, F. solani,* and Unidentified bacteria	*Triticum* spp.	USA
Bipolaris setariae, Botrytis cinerea, Fusarium longipes, F. nivale, Xanthomonas sp., *Pseudomonas aeruginosa* and *P. pseudomallei*	*Aegilops* spp.	USA
Drechslera sorghicola and *Rhizoctonia* sp.	Maize	USA
Colletotrichum graminicol and *Phoma sorghina*	Sorghum	Mali
Cercospora sp.	Pearl millet	UK, USA
Fusarium oxysporum, F. solani, Phoma medicaginis, Sclerotium rolfsii and Seed deteriorating saprophytic bacteria	Chickpea	USA
Botrytis cinerea, Fusarium oxysporum and Seed rot bacteria		Taiwan
Fusarium solani	Sunflower	Yugoslavia
Puccinia carthami	Safflower	USA
Ralstonia solanacearum	Groundnut	Malawi, Zimbabwe
Alternaria brassisicola	*Brassica oleracea*	USA
Alternaria solani & Colletotrichum sp.	Brinjal, tomato, chilli	China China & Taiwan

Total number of samples infested/ infected in imports	-	2,472
Pathogens	-	104
Insects	-	66
Nematodes	-	302
Number of samples salvaged	-	2,360
Number of samples detained	-	76
Number of samples Rejected	-	36

Inspection of paddy accessions (50) and sugarbeet (5) were carried out at Advanta India Ltd., Bangalore on 5.3.04 and all accessions were found healthy.

Weekly observations were recorded on 177 pearl millet accessions from UK in the PEQ isolation area of ICRISAT and found smut

(*Tolyposporium penicillariae*) in two accessions.

Sowing of 348 treated maize accessions from CIMMYT, Zimbabwe in the farm of Metahelix Life Sciences Pvt. Ltd., Bangalore was inspected by the Pathologist of the station on 6th July, 2004 to check the isolation distance etc.

Soybean (200 accs.) imported from USA for rust screening and grown at Ugar Khurd, Belgaum, Karnataka was inspected during the active crop growth stage for the second season by the Pathologist of the station on 20th August, 2004. Diseased leaves exhibiting the viral symptoms revealed the presence of peanut bud necrosis virus. Rust symptoms were noticed on all accessions.

Sorghum (46 accs.) imported from USA, grown at research farm of Pioneer Corporation Ltd., Hyderabad was inspected during the active crop growth stage by the Pathologists of the station on 24th September, 2004. Diseased leaves exhibiting bacterial symptoms revealed no infection. Incidence of *Puccinia sorghi*, *Gloeocercospora sorghi*, *Rhizoctonia solani* was noticed on many accessions.

Two accesssions of groundnut (one each from Zimbabwe and Cyprus) and 6 of wild *Arachis* spp., grown in the glasshouse of Plant Quarantine unit, ICRISAT were inspected at weekly intervals.

Detained chickpea accessions (51) from USA, infected with bacteria and grown in the glasshouse at ICRISAT are being inspected at weekly intervals. Two accs were found infected with wilt pathogen, *Fusarium oxysporum* f. sp. *ciceri*.

12.1.4 Export quarantine: Out of 8,026 export samples (sorghum-1,506; pearlmillet-1,043; chickpea-2,187; pigeonpea-1335; groundnut-1,915 and small millets-40), 184 samples were rejected due to the association of various pests and pathogens. In all, 150 phytosanitary certificates were issued during the reporting period. The details are given as under:

Crop	No. of samples		
	Received	Rejected	Released
Sorghum	1506 (903)	38(36)	1468 (867)
Pearl millet	1043 (1043)	52(52)	991(991)
Chickpea	2187 (1493)	72 (48)	2115 (1445)
Pigeonpea	1335 (1335)	17 (17)	1318 (1318)
Groundnut	1915 (1349)	5 (5)	1910 (1344)
Small millets	40 (40)	-	40 (40)
Total	**8026 (6163)**	**184 (158)**	**7842 (6005)**

* Figures in parentheses indicate number of accessions.

12.1.5 Interceptions of pests: The rejections in the export germplasm of ICRISAT mandate crops were mainly due to total loss of germination or infection with bacteria, *Fusarium oxysporum, F. solani, Botryodiplodia theobromae, Phoma medicaginis, Rhizoctonia bataticola, R. solani, Sclerotium rolfsii, Acremonium strictum* and *Verticillium* sp. Some samples were rejected due to lack of necessary documents like DARE certificate, back history and FAO trust.

12.1.6 Quarantine services provided by NBPGR, Hyderabad to other organizations

ICRISAT- Patancheru, Hyderabad

ICAR institutes- Directorate of Rice Research, Directorate of Oilseeds Research, and National Research Centre for Sorghum, Rajendranagar, Hyderabad; Indian Institute of Horticultural Research, Bangalore; Central Tobacco Research Institute, Rajahmundry; IGFRI Regional Research Station, Dharwad, Karnataka; Indian Institute of Spices Research, Calicut; IARI Regional Station, Nilgiris, Wellington.

Universities/ State Government Organizations- ANGRAU, Hyderabad; Tamil Nadu Agricultural University, Coimbatore; Kerala Agricultural University, Palghat, Kerala; University of Agricultural Sciences, Bangalore; Agricultural Research Station, Paramakudi, Tamil Nadu; Horticultural College & Research Institute, Periyakulam and Krishi Vigyan Kendra, Suttur, Mysore.

Private Industries- Advanta India Pvt. Ltd., Bangalore; Monsanto Technology India Ltd., Karnataka; MAHYCO Ltd., Medak, Andhra Pradesh; Metahelix Life Sciences, Bangalore and Pioneer Overseas Corporation Pvt. Ltd; Hyderabad; Pioneer Overseas Corporation Pvt. Ltd; Bangalore; Syngenta India Ltd., Pune, Maharashtra; Nuziveedu Seeds Pvt Ltd., Hyderabad; M/S. SPIC Seed controlling Unit, Hosur, Tamil Nadu; Chelmi Cotton & Chemical Co (P) Ltd., Guntur.

12.2 Genetic Resources

12.2.1. Exploration and Germplasm Collection : During the period under report, 13 explorations were conducted and 1,524 accessions of crop germplasm including medicinal and wild plant species were collected from the South East Coastal Zone, the details of which are given below.

Blackgram and other pulses: The survey was conducted in parts of Visakhapatnam, Vizianagaram and Srikakulam districts of Andhra Pradesh and 301 accesssions were collected including blackgram (55), other pulses (158), cereals (48), and others (40). Variation and diversity was observed in colour, size and shape of the various pulses. Ten herbarium specimens were also collected and processed for the NHCP. Pods of *Oroxylum indicum* and *Xylia xylocarpa* were collected for display in the museum.

Horsegram: Two surveys, one in parts of Khammam, East Godavari, Srikakulam, Vizianagaram and Visakhapatnam districts and the other in Anantapur, Kurnool, Chittoor and Cuddapah districts of Andhra Pradesh were conducted and 264 accessions including horsegram (214), millets (9), oilseeds (5), pulses (16), vegetables (5), spices (5) and fibre crops (2) were collected. Eight accessions of wild species including *Sesamum alatum* and *Trichosanthes* sp were also collected.

***Brassica* spp.:** The survey was conducted in

A short and spreading type of *Brassica* spp. collected from Warangal, Andhra Pradesh

the Telangana region of Andhra Pradesh including districts of Mahbubnagar, Ranga Reddy, Nalgonda, Warangal, Karimnagar, Adilabad, Nizamabad and Medak. A total of 121 accessions comprising 82 accessions of *Brassica* spp., 11 of cereals, 9 of pulse crops, 4 of oilseeds, 12 of vegetable crops, one of turmeric, one medicinal plant and one wild accessions were collected during the survey. Diversity in the *Brassica* germplasm was observed for seed colour (brown to yellow through green) and plant height (erect, bushy and prostrate types).

Vegetables: Two surveys, one in the north Telangana region including Medak, Nizamabad, Adilabad, Karimnagar and Warangal, and the other in parts of southern districts of Andhra Pradesh were undertaken and 476 accessions of different vegetables and 68 accessions of medicinal and aromatic and wild species were collected

Brinjal: Under the DBT Project, a survey was conducted in North coastal districts of Andhra Pradesh covering Visakhapatnam and Vizianagaram districts and Koraput district of Orissa and Bastar and Dantewara districts of Chhattisgarh. A total of 113 accessions were collected including 96 accessions of *Solanum melongena*, 12 of *S. insanum* and five of *S. incanum*.

Ginger and turmeric: The survey was undertaken in collaboration with ANGRAU in South coastal and Rayalseema region of Andhra Pradesh mainly from districts of West Godavari, Krishna, Guntur and Cuddapah. In all, 125 accessions were collected including turmeric (79), ginger (11), and others (35). In turmeric diversity was observed in size and shape of mother rhizome, branching, size and length of fingers, inter-nodal distance and colour. In ginger, variability was observed for rhizome size, branching, compactness and fibrousness. The important local types collected in turmeric include *Cuddapah, Duggirala, Erra kommu, Errakanda, Errakatte, Erupu, Maredumilli, Mydukuru, Nallagattu pasupu, Nallakatte, Nallakommu, Natu, Pragadavaram, Pulla kommu, Pullakatte, Sannapasupu, Sukandam, Tekurupeta, Tekurupeta erupu, Tekurupeta telupu, Tellakanda, Tellakatte, Telupu* and *Tuni* in ginger.

Medicinal and Aromatic plants: The survey was undertaken in parts of Kambakkam hills of Chittoor district of Andhra Pradesh. A total of 60 accessions were collected including *Cycas beddomei, Cycas circinalis, Ceropegia* sp. and *Terminalia pallida*.

***Pongamia*:** Two surveys were undertaken for the collection of *Pongamia* germplasm and identification of plus trees, one in Adilabad district of Andhra Pradesh and the other in North coastal districts of Andhra Pradesh including Srikakulam, Vizianagaram, Visakhapatnam and Khammam. A total of 68 accessions were collected. Variation was observed in pod bearing, number of seeds per pod and pod colour.

Pongamia* and *Jatropha: In association with Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad, two explorations for the survey of *Pongamia* and *Jatropha* germplasm were conducted, one in parts of Adilabad district of Andhra Pradesh and the other in parts of the districts of Chittoor, Cudappah and Anantapur. A total of 64 accessions (*Pongamia pinnata* -33 and *Jatropha curcas*-31) were collected during the survey.

12.2.2 Germplasm evaluation

Sorghum: Two-hundred-and-eight accessions

were characterised and evaluated for 20 descriptors. Limited variation was observed for midrib colour and waxy bloom. Panicles were either semi compact, elliptic or with loose erect/ drooping branches with pigmented glumes and red non-lustrous bold grains. Range of variation recorded for different quantitative traits included plant height (58-207 cm), leaf length (25-69 cm), leaf width (2-7 cm), total no. of leaves (4-12), panicle length (11-41 cm), panicle width (3-23 cm), and days to 50% flowering (49-85).

Blackgram: One-hundred-and-seventy-six accessions along with three checks T-9, PU-19 and LBG-20 were characterised and evaluated for 18 descriptors in an Augmented Randomized Block Design. Accessions observed superior to check were IC 382807 for plant height (80 cm), IC398989 for primary branches (9.7), IC261182 for clusters / plant (30.7) and IC436566 for total pods / plant (150).

Horsegram: One-hundred-and-fifty accessions were characterised and evaluated for 13 descriptors. Accessions identified as superior to the checks for yield, plant type and clusters/pod include were IC436587, IC436588 and IC436596.

Cowpea: Eighty-four accessions of cowpea germplasm collected from the SEC zone were characterised and evaluated for 19 descriptors along with check varieties GC-3, C-152 and COVU-702. Accessions observed superior to check were IC282057 for the longest primary branch (202 cm), IC282010 for no. of pods / cluster (3.6), IC398999 for plant spread (256cm), and IC436847 for pod length (19.2 cm) and seeds / pod (18).

Sunflower: Ninety-five accessions of sunflower were characterised for six characters. EC494386, -494399, -494421 and EC494422 were found at par with checks (Morden, Surya, KBSH-17) regarding days to 50% flowering.

Chillies: One-hundred-and-forty-three accessions of chilli germplasm and 19 chilli varieties were characterised and evaluated. Accessions identified as superior over checks included IC 382260 for plant canopy width (101 cm), IC383079 for plant height (127 cm), IC413713 for fruit length (15 cm), and IC413714 for fruit pedicel length (4.2 cm).

Tomato: One-hundred-and-fifteen accessions of tomato were characterised and evaluated for 19 descriptors. Accessions identified as superior over checks included EC 513811 for corrugated fruit surface and EC 513844 for small fruits and large no. of fruits/plant.

Dolichos beans: Ninety-three accessions of Dolichos bean collected under the NATP (PB) programme were characterised / evaluated for 27 descriptors. Accessions observed superior to check were IC 261010 for days to 50% flowering (34 days), IC 261256 for days to first pod harvest (70), IC 369641 and IC 36-711 for primary branches (11), IC 372119 for seeds/pod (7), and IC 384038 for pedicel length (15cm).

Brinjal: Fifty-four accessions collected under the NATP (PB) programme were characterised and evaluated for 43 descriptors. Accessions observed to be superior over checks included IC 345287 for days to flowering (75), IC 383190 for fruits/cluster (25), IC 383106 for fruit breadth (12 cm) and IC383195 for fruit length (31 cm). Herbarium specimens of 45 accession of wild and cultivated brinjal were sent to NHCP, New Delhi.

12.2.3 Germplasm conservation

Medium-term storage: A total of 1,979 accessions collected under the NATP (PB)

programme (paddy-127, minor millets-270, pulses – 213, pongamia-18, brinjal-1, brassica and others-119, sesame –101, horsegram-109, vegetables - 287, henna – 46, M&AP - 15 and miscellaneous -673) were sent to Germplasm Handling Unit (HQs). Status of active germplasm holdings in MTS facility at Hyderabad as on 31.12.04 is given below.

Crop / Category	Total samples in MTM	Additions during 2004
Brinjal	6116	
Blackgram	710	
Chillies	3021	
Tomato	304	
Voucher samples of Maize received from NBPGR, New Delhi	99	
Voucher samples of NATP evaluated Sorghum received from NRCS	377	
Import Voucher Samples	24,198	**6548**
Export Voucher Samples	3192	
NBPGR Collection (Pre-NATP)	1789	
NATP Collection & augmented samples from collaborating institutes	8445	**1651**
NPTC collection	947	
Released & Research Material (Restoration from ICRISAT)		
Sorghum	244	
Chickpea	1168	
Pigeonpea	846	
Collaborating Institutes		
ANGRAU – Paddy, Vegetables, Sunflower	32	
DOR – Sunflower	74	
DRR – Paddy	258	
CTRI-Rajahmundry (Tobacco)	139	
Grand Total	**51,959**	**8199**

Long-term storage: Three-hundred-and-eighty accessions of released varieties of paddy, received from DRR as part of the DUS trials, were sent to NGB for long term conservation. In addition to this, 195 accessions of paddy germplasm collected under the NATP (PB) and multiplied by DRR along with 253 accessions of sorghum (133 multiplied by NRCS) were processed and sent to the NGB for long-term storage. Besides, chillies (330), blackgram (244), cowpea (20) and tomato (19) were also processed and sent for long-term storage.

Exotic germplasm sent to LTS: The exotic germplasm of paddy (274), wheat (114), sorghum (46), and pearl millet (97) submitted by the private companies after multiplication was sent to the National Gene Bank (NGB), New Delhi for long term conservation.

12.2.4 Germplasm distribution: A total of 239 accessions of various agri-horticultural crops were distributed to various indentors as follows: 15 accs of tomato to GAU, Junagarh; 105 accs of chillies to MPKAV, Rahuri (24 accs.) and Andhra University, Visakhapatnam (15 accs), College of Agriculture and Research Institute, Valanad and Bidhan Chandra Krishi Vishwavidyalaya (36), CSKHPKVV, Palampur, HP (8), Central Institute for Temperate Horticulture, Srinagar (22); 94 accs. of pigeon pea to AICRP, Pulses, JNKVV, ZARS, Khargone (26

accs) and AICRP, Pulses, ARS, Badnapur, Jalna (41 accs), OUAT, Berhampur, Orissa (27 accs.) ; 25 accs. of brinjal to College of Agriculture, Vellanikara, Kerala.Two accessions of *Stevia* germplasm were supplied to NBPGR, Thrissur for maintenance. Paddy germplasm collected under a collaborative exploration programme were shared with collaborators (220-ANGRAU; 61-OUAT; 81-IGKVV) for maintenance, multiplication and utilization.

12.2.5 Germplasm distributed to NAGS: A total of 1,503 accessions of different agri-horticultural crops, collected in the SEC zone under NATP (PB) was distributed to different NAG sites for multiplication and conservation.

Crop	Accessions (no.)	NAGS
Paddy	31	ANGRAU
	245	DRR
Wheat	20	DWR
Maize	35	DMR
Sorghum	74	NRC Sorghum
Pearl millet	63	AICRP (pearl millet)
Small millets	182	AICRP (small millets)
Pulses	130	IIPR
Arid legumes	161	NRC Arid Legumes
Brassica	86	NRC Rapeseed and Mustard
Vegetables	17	IIHR
Onion and Garlic	17	NRC Onion and Garlic
Kenaf	406	CRIJAF, Barrackpore
Henna	36	CRIDA
Total	**1503**	

In addition, 276 accessions of diverse germplasm collected by ANGRAU under the NATP programme were sent to RARS Chintapalle for multiplication for deposition in the NGB and 220 accessions of blackgram, along with 39 accessions of cucurbit germplasm were sent to NBPGR, HQ for evaluation and multiplication.

12.2.6 Restoration of ICRISAT Germplasm: A total of 3,340 accessions of germplasm restored from ICRISAT after multiplication (groundnut-1,433, pigeonpea-1307, sorghum-320 and chickpea-280) was sent to NGB. In addition, 320 accessions of sorghum multiplied by NRCS along with accessions of pigeonpea multiplied at S K Nagar (458 accs.), TNAU, Coimbatore (89 accs.), and ARS, Warangal (225 accessions) were also sent to NGB for long-term storage.

Status of restoration of germplasm of ICRISAT mandate crops to NBPGR

Crop	No. of accs. identified for restoration	Restored to NGB	Restored to NBPGR in 2004 and to be multiplied	To be restored to NGB
Sorghum	14637	14408	216	13
Pearlmillet	7189	5568	1617	04
Chickpea	7488	5681	485	1322
Pigeonpea	5988	4401	1374	213
Groundut	6060	4592	1260	208
Small millets	3460	3403	-	57
Total	**44, 822**	**38053**	**1260**	**1817**

12.3 Supportive Research

- Forty paddy accessions were screened against root knot nematode (*Meloidogyne graminicola*) and found that all were susceptible to the nematode. Eleven tomato accessions that were identified having resistance to *M. javanica* were confirmed by inoculation. These accessions are planted in field for seed multiplication.

- Thirty-five tomato accessions were kept for screening against root knot nematode. *Rotylenchulus reniformis* culture was multiplied on castor for screening germplasm lines.

- Preliminary screening of 35 tomato accessions against *Meloidogyne javanica* (Root-knot nematode) in the greenhouse resulted in identification of four accessions, *viz.*, EC251790, 251706, 357842, 151628, which were showing resistance to the nematode.

- **PSND monitoring surveys:** In all, five surveys for PSND were conducted in Anantapur, during April, August, September and October. During April, PSND incidence was upto 3% in Venkatapuram, Reddipalli, Pathacheruvu and Gunmalakunta. *Parthenium* showed 39% incidence. The weed samples collected during July survey indicated occurrence of TSV on marigold (88%), *Parthenium* (40.4%) and Tridax (29.3%) in ELISA tests. The August survey also covering weed hosts showed 87%, 48.6% and 5.6% TSV incidence on marigold, *Parthenium*, or tridax.. TSV incidence on marigold, parthenium and tridax. During the survey conducted in September covering 16 villages, out of 351 groundnut samples collected, 231 were positive to TSV and 41 to PBNV and 81 to none of the two viruses. *Parthenium* showed 58-100 % incidence of TSV. The last survey conducted during October along with Dr. D.V.R. Reddy and Dr. Thotapally George. It was observed that several groundnut plants close to *Parthenium* showed symptom of stunting with chlorotic or pale leaves. Some plants showed stunting with distinct mosaic. all stunted plants with chlorotic leaves were positive to TSV and plants with distinct mosaic were positive to PBNV in ELISA tests. The incidence of TSV varied from 15-100% depending upon proximity to *Parthenium* where as PBNV incidence varied from 2-5%.

- **Testing virus suspected samples of other organizations:** From UAS, Dharwad, forty samples of sunflower were tested of which 35 were positive to TSV, none to PBNV and of 9 samples of soybean* were positive to TSV. Of 180 sunflower samples from ANGRAU, Hyderabad, 99 were positive to TSV and were also assayed on cowpea for confirmation. Of 22 chilli samples from Agricultural College, Bapatla, 18 were positive to PBNV and none to CMV. Of 59 cotton samples from Regional Agricultural Research Station, Nandhyal none were positive to TSV and PBNV. Of the 3 groundnut samples from CRIDA, assayed onto cowpea all were positive to PBNV.

- **Virus observations on field evaluated germplasm:** Brinjal showed PBNV, mosaic and little leaf incidence of 0.11%, 0.5% and 0% respectively. Tomato showed 0-24% of PBNV and 0-13% of leaf curl. Cowpea showed 0-14% mosaic virus incidence. Black gram showed PBNV incidence

ranging from 0-66.8% whereas green gram showed 50-100%.

- **Screening field promising lines by sap inoculation:** None of the field promising lines of chilli (35), brinjal (10) and green gram (19) tested against PBNV were resistant. However, two cultivars (EC 526511 & 52613) out of 23 tomato cultivars tested were resistant to PBNV. Twenty-eight groundnut advanced breeding lines were susceptible to TSV and 14 wild *Arachis* spp. and 16 groundnut cultivars were susceptible to both TSV and PBNV.

- **Virus transmission tests:** None of the 90 seeds of *Chenopodium auranticolor* and 4 of *C. quinox* collected from TSV infected plants showed seed transmission. Aphid transmission and seed transmission of BICMV in cowpea was confirmed although the per cent transmission was very low. TSV transmission by sprinkling infected pollen from sunflower on cowpea plants and releasing unidentified thrips resulted in virus transmission to 3 of 5 plants tested.

- Identification of seed rot causing bacteria (Gram negative-2) in chickpea was done using *NEFERM*-test kit. Both the Gram negative cultures belong to *Pseudomonas pseudomali*.

- Plating of grain mold infected sorghum revealed the presence of *Curvularia lunata, Fusarium moniliforme, Alternaria alternata, Exserohilum rostrata, Bipolaris sorghicola, Phoma sorghina, C.lunata* and *F. moniliformi* were found to be internally seed borne. Seed treatment with different fungicides, viz., carbendazim, thiram, benomyl and their combinations was tested to eradicate mold fungi from sorghum seed. Benomyl + thiram and carbendazim + thiram treatments could eliminate mold fungi effectively compared to the other treatments.

- Information on medicinal plants is being assembled in the database. It comprises taxonomic position of each species, its distribution, importance in terms of medicinal value and economics, and various pests associated and control measures wherever information available. Compilation on 10 medicinal plants completed.

- A set of 34 herbarium sheets of *Solanum melongena* and its wild/weedy relatives was deposited in the Madras Herbarium of Botanical Survey of India, Southern Circle, Coimbatore under DBT project on brinjal.

12.4 Oraganization of Field days/ Trainings

- Field day on pigeonpea germplasm was organized on 5th February, 2004 at NBPGR RS and at ICRISAT centre. Breeders from NARS have participated in the field visit and interactive session.

- Field day on sunflower germplasm was organized on 6th February, 2004 at NBPGR Regional Station. Five breeders from Directorate of Oilseeds Research, National Research Centre for Sorghum and Agricultural Research Institute, Rajendranagar have participated in the programme.

- Field day on groundnut germplasm was organized on 25th March, 2004 at NBPGR RS and at ICRISAT centre. Breeders from NARS have participated in the field visit and interactive session.

- A short-term training programme on 'Intellectual Property Rights and PGR Management' was organized by NBPGR RS Hyderabad and NAARM, Hyderabad during August 30th - September 2nd, 2004. Thirty-three participants from various ICAR institutes and SAUs attended the programme.
- Under the VI on-job training programme under NATP sub-project on HRD on Plant Genetic Resources Management in TOE mode, one participant, Dr. B. Augustine Jerard from CPCRI Coconut gene bank, Kidu, Karnataka had successfully completed training for 3 months from August 1 to 31st October, 2004. The course was on Documentation, Information Management, and Policy issues.

Research Projects (Project Code; Project Leader; Associates)

PGR/PQR- BUR-HYD-01.00: Quarantine processing of plant germplasm under exchange and supportive research (K S Varaprasad).

PGR/PQR- BUR-HYD-01.01: Detection, identification and control of pests associated with import and export of seed/ plant material (K Anita).

PGR/PQR- BUR-HYD-01.02: Developing a web database on pests and pathogens of quarantine significance (B Sarath Babu).

PGR/PQR- BUR-HYD-01.03: Developing detection techniques and treatment schedules for seed-borne pathogens (S K Chakrabarty).

PGR/PQR- BUR-HYD-02.00: Augumentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of Andhra Pradesh and South-East coastal zone (K S Varaprasad).

PGR/PQR- BUR-HYD-02.01: Augumentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of agricultural crops (cereals, millets, pulses, oilseeds etc.).

PGR/PQR- BUR-HYD-02.02: Augumentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of horticultural crops (vegetables, fruits, species, medicinal and aromatic plants etc.) and their wild relatives (Someswara Rao Pandravada).

PGR/PQR- BUR-HYD-02.03: Screening for biotic stresses with particular reference to pest and pathogens in selected agri-horticultural crops (R D V J Prasada Rao).

PGR/PQR- BUR-HYD-02.04: Documentation and information management of plant genetic resources (N Sivraj).

13. REGIONAL STATION, JODHPUR

Summary: During the period under report, five exploration trips including one local trip and three crop specific trips were undertaken in various parts of Gujarat and Rajasthan. In all, 277 collections comprising cereals (5), millets (59), oilseeds (1), fruits (96), medicinal and aromatic plants (62), multipurpose tree species (62), dye yielding plants (1) and wild relatives (3) were made. Vegetatively propagated material (75) was also collected which is being maintained in the field. Observations were recorded on 1,219 accessions sown during rabi, 2003. Since, the rainfall was good and timely, the *kharif* crops (2768 accessions) exhibited good performance. The seeds harvested have been kept in the MTS facility. A set of 606 accessions comprising *Amaranthus*, barley, *Brassica*, chickpea, fennel, fenugreek, maize and wheat were sown along with checks during rabi, 2004. Blocks of horticultural plants and plants of economic importance were maintained and data were recorded in Aonla, *Capparis decidua*, jamun, mulberry, *Salvadora* sp., *Aloe barbadensis*, *Andrographis paniculata*, *Jatropha curcas* and jojoba. A total of 5,982 accessions wre processed and kept in the MTS facility and 2317 accessions deposited in National Genebank for LTS. A total of (1677) Seed samples were supplied to various indentors.

13.1 Exploration and Germplasm Collection

Five exploration and collection trips including three crop-specific and one local trip were undertaken in parts of Gujarat and Rajasthan (Table 1). In all, 277 collections comprising cereals (5), millets (59), oilseed (1), fruits (96), medicinal and aromatic plants (62), multi-purpose trees (62), dye yielding plants (1) and wild relatives (3) were made. Vegetatively propagated material (75) was also collected and is being maintained in the field (Table 2).

13.1.1 Exploration and collection of *Prosopis cineraria* germplasm from parts of Gujarat: In all, 49 collections were made from areas of Ahmedabad, Banaskantha, Kachchh, Patan, Rajkot and Surendra Nagar districts of Gujarat during May 14 to 21, 2004. Variability was observed in plant height, canopy, branching pattern, number of branches; presence of spines on branches; stem bark colour (grey/ light grey/ greyish brown); pod length, pod colour (creamy/ light brown/ brown/ yellowish white/ brownish white/ pinkish white/ straw); pod thickness; pod taste; number of seeds per pod and size, shape and colour of seeds. Ethno-botanical uses were also recorded.

13.1.2 Exploration and collection of Kalingada (*Citrullus lanatus*) germplasm from parts of Gujarat: This exploration trip

Seed variability in germplasm of Mothbean

Fruit variability in Kalingada (*Citrullus lanatus*) collected from Gujarat

was undertaken in collaboration with Gujarat Agricultural University, SK Nagar. In all, 41 collections of Kalingada (*Citrullus lanatus*) were made from Banaskantha (38), Mehsana (2) and Patan (1) districts of North Gujarat during October 8th to 13th, 2004. Variability was recorded in number of vines; shape, size and lobation in leaves; number of fruits per vine; fruit shape (oblong/cylindrical/round/oval/pear/); fruit colour (creamish white/ creamy/ light green/ greenish yellow); fruit size (small/ medium/l arge); fruit streak colour (light green/ green/ light yellow); fruit pulp colour (white/creamish white/yellowish white); number of seeds per fruit and size (big/ medium/ small), shape and colour (creamish white/ light yellow/ light brown/ brown/ pinkish white/ light black) of seeds. In most of the areas surveyed mixed cropping was noticed. Kalingada was grown in association with pearl millet, guar, mothbean, mungbean and sesame. Ethno-bolanical uses were also recorded.

13.1.3 Exploration and collection of maize, forage pearl millet and sorghum from parts of Rajasthan: This exploration and collection trip was undertaken in collaboration with NBPGR, New Delhi. In all, 64 collections comprising maize (6), pearlmillet (35) and sorghum (23) were collected from Ajmer, Alwar, Bharatpur, Jaipur, Jodhpur and Pali districts of Rajasthan during October 10th to 18th, 2004. Variability was observed in plant height; number of tillers; thickness of tiller; shape, size and bearing of leaves; size, shape and colour of cobs; stiffness of cobs; number of effective tillers; internodal distance; presence of awn; awn colour; size, shape and colour of grains and number of seeds per cob. Ethno-botanical uses were also recorded.

13.1.4 Exploration and collection of multi crops from Gir forests in Gujarat: This collection trip was undertaken in collaboration with NBPGR, New Delhi. In all, 68 collections comprising millets (1), oilseeds (1), minor fruits (2), medicinal and aromatic plants (61) and wild relatives of crop plant (3) were made from Amreli, Junagarh and Porbandar districts of Gujarat during October 30th to November 10th, 2004. Out of these *Aloe barbadensis* (7), *Asparagus racemosus* (2), *Commiphora wightii* (4), *Murraya koenigii* (1), *Tinospora cordifolia* (4) and *Urginia indica* (1) collected in vegetative form (sucker/ bulb/ cutting/ live plant) were planted in the pots at this station. These taxa showed variability in their agro-morphological traits. *Canavalia gladiata* showed variability in size, shape and colour of pods and seeds. Ethno-botanical uses of these economically important plants were also recorded.

13.1.5 Exploration and collection of horticultural plants from Jodhpur, Rajasthan: Fifty-five collections comprising *Aegle marmelos* (9), *Annona squamosa* (1), *Citrus aurantifolia* (1), *Cordia myxa* (6), *Emblica officinalis* (16), *Psidium guajava* (6), *Punica granatum* (6), *Putranjiva roxburgii* (1), *Rauwolfia tetraphylla* (1), *Syzygium cumini* (6) and *Ziziphus mauritiana* (2) were made from parts of Jodhpur district of Rajasthan during July-October, 2004. All collections in vegetative form are being maintained in field gene bank of this station.

13.2 Characterization and Evaluation of Germplasm

13.2.1 Agricultural crops (*rabi*, 2003): Data were recorded on the following crops in *rabi*-2003 for various morphological and agronomical characters as per the descriptor list: barley (257 accs.), *Brassica* (37 accs.), *Carthamus oxycantha* (31 accs.), castor

(155 accs.), chickpea (65 accs.), coriander (26 accs.), *Eruca sativa* (39 accs.), fenugreek (21 accs.) and wheat (610 accs.). The seeds were stored in the MTS facility of the Regional Station. Promising accessions identified for desired traits are given in (Table 3).

13.2.2 Agricultural crops (*kharif*, 2004): During *kharif* 2004, a total of 2,768 accessions comprising castor (152), cowpea (22), guar (806) mothbean (591), mungbean (607), pearlmillet (266), sesame (241) and tumba (83) were sown for characterization. Multiplication trial was carried out in Akola (for castor) and Delhi (for pearlmillet). The crop stand was very good and data as per the descriptor lists were recorded for the crops.

13.2.3 Agricultural crops (*rabi*, 2004): A total of 606 accessions comprising Amaranth (30), barley (192), Brassica (35), chickpea (12), fennel (1), fenugreek (2), maize (14) and wheat (320) were sown along with checks during *rabi*, 2004. Out of these, 320 accessions of wheat and 5 lines of chickpea were received from NBPGR, New Delhi and Project Coordinator, AICRP on chickpea, IIPR, Kanpur respectively for multi-locational evaluation. The data are being recorded as per the descriptor list.

13.2.4 Horticultural plants: Seeds of pomegranate (EC546737) were sown in pots. Seedlings and saplings of aonla (16 accs.), ber (4 accs.), bael (9 accs.), *Carissa grandiflora* (3 accs.), custard apple (1 accs.), guava (6 accs.), jamun (6 accs.), lasora (6 accs.), lemon (1 accs.) *Murraya koenigii* (5 accs.), *Pithecelobium dulce* (11 accs.) and pomegranate (6 accs.) were transplanted in the field.

Observations recorded: Fruit weight of aonla, karonda, ker, lemon and west Indian cherry were recorded. Plant height, tree spread; internodal distance; leaf size; number of flowers per inflorescence; days to 50% maturity; fruit size; fruit weight; TSS (%); number of seeds per fruits and size, shape and weight of seeds were recorded in ber (24 accs.) and phalsa (5 accs.). Plant height and canopy were recorded for jamun (9 accs.), mulberry (13 accs.) *Salvadora persica* and tamarind (3 accs.). Cuttings of *Nerium odorum* (red flower) were planted.

13.2.5 Economically important plants: Sowing of *Andrographis paniculata* (7 acc.), *Jatropha curcas* (59 accs.), *Moringa concanensis* (1 accs.), *Mucuna prurita* (2 accs.), *Cyamopsis senegalensis C. serrata, Datura metel, Macroptilium atropurpurium* var. *Aztee, Centrosperma pascuorum* var. *cololcode, Clitoria terneata* var. *milgara, Neurada procumbens, Pennisetum alopecuroides, P. basedowii, P. flaccidum, P. latifolium, P. macrourum, P. orientale, P. pedicellatum, P. setaceum* and *P. unisetum* was carried out and seeds were harvested. Cuttings of *Cissus quadrangularis* (1 accs.), *Commiphora wightii* (4 accs.) and *Tinospora cordifolia* (5 accs.) were planted in earthen pots for rooting. Suckers of 28 different accessions of *Aloe barbadensis*, sapling of *Asparagus racemosus* (1 accs.), *Commiphora wightii* (2 accs.) and seedlings of *Moringa concanensis* (1 accs.) *Putranjiva roxburgii* (1 accs.), *Rauvolfia tetraphylla* (1 accs.) and *Simmondsia chinensis* (15 accs.) were transplanted in field.

Observations were made in *Aloe barbadensis* (28 accs.), *Andrographis paniculata* (7 accs.), *Centrosperma pascuorum* var. *covolcode* (1 accs.), *Clitoria terneata* var. *milgara (1 accs.), Commiphora wightii (15 accs.),*

Jatropha curcas (59 accs.), *Simmondsia chinensis* (74 accs.) and *Macroptilium atropurpureum* (1 accs.) for various morphological characters and fruits were harvested.

13.3 Conservation and Maintenance of Germplasm

In MTS at Jodhpur: A total of 5,982 accessions of different crops/plant species were processed and kept in the MTS facility. This included barely (190), amaranth (3), pearl millet (343), chickpea (66), cowpea (459), guar (495), mothbean (815), mungbean (870), *Brassica* spp. (66), castor (304), *Citrullus colocynthis* (95), *Jatropha curcas* (38), sesame (1833), *Ziziphus mauritiana* (3) and others (397). The germplasm holdings of the station in MTS is 21,929 accessions (Table 4).

In LTS at New Delhi: A total of 2,317 accessions of different crops/ wild relatives were processed and sent to the National Gene Bank, NBPGR, New Delhi for long term conservation. This material includes barely (60), wheat (85), pearl millet (1363), chickpea (65), cowpea (22), guar (158), Indian bean (19), moth bean (71), *Brassica* sp. (36), *Citrullus colocynthis* (18), *Eruca sativa* (39), coriander (26), cumin (5), fenugreek (21), *Anethum sowa* (1), brinjal (21), chilli (70), tomato (14), phalsa (4), *Carthamus oxycantha* (31), *Jatropha curcas* (24) and *J. gossypifolia* (3). Seed of phalsa, *Jatropha curcas* and *J. gossypifolia* were sent for cryo-preservation.

13.4 Germplasm Distribution

A total of 2,417 accessions comprising pearl millet (206), guar (218), mothbean (428), mungbean (318), chilli (50), *Aloe barbadensis* (8), *Citrullus colocynthis* (50), *Cymbopogon* sp. (1), *Jatropha curcas* (25), *J. gossypifolia* (3), *Lasiurus sindicus* (5), *Simmondsia chinensis* (2), castor (200) and *Atriplex* (30) were supplied to various research workers and plant breeders in the country.

Barley germplasm being evaluated at Jodhpur

Seed variability in chickpea germplasm

Table 1: Plant exploration and collection undertaken during-2004

Areas Surveyed (period)	Diversity collected	No of Accs.
Parts of Gujarat (Ahmedabad, Banaskantha, Kachchh, Patan, Rajkot and Surendra Nagar districts; May 14-21, 2004)	*Prosopis cineraria* (49)	49
Parts of Gujarat (Banaskantha, Mehsana and Patan districts; October 8-13, 2004)	*Citrullus lanatus* (41)	41
Parts of Rajasthan (Ajmer, Alwar, Bharatpur, Jaipur, Jodhpur and Pali districts; October 10-18, 2004)	*Pennisetum glaucum* (35), *Sorghum bicolor* (23), *Zea mays* (6)	64
Gir forest in Gujarat (Amreli, Junagarh and Porbandar districts of Gujarat; October 30-	*Abrus precatorius* (10), *Aegle marmelos* (1), *Aloe barbadensis* (7), *Asparagus racemosus* (2), *Balanites aegyptiaca* (1), *Canavalia gladiata* (3), *Ceasalpinia crista* (3), *Coccinia grandis* (5), *Commiphora wightii* (3), *Dioscorea bulbifera* (1), *Helecteres isora* (3), *Jatropha curcas* (2), *Lawsonia inermis* (1), *Marimia turpanthum* (1), *Mucuna prurita* (2), *Murraya koenigii*, *Ocimum canum* (5), *O. gratissimum* (1), *O. sanctum* (2), *Pennisetum glaucum* (1), *Sesamum indicum* (1), *Strychnos nux vomica* (1), *Tinospora cordifolia* (4), *Urginia indica* (1), *Wrightia tinctoria* (3) and *Ziziphus mauritiana* (2)	68
Parts of Jodhpur (July-October, 2004)	*Aegle marmelos* (9), *Annona squamosa* (1), *Citrus aurantifolia* (1), *Cordia myxa* (6), *Emblica officinalis* (16), *Psidium guajava* (6), *Punica granatum* (6), *Putranjiva roxburgii* (1), *Rauwolfia tetraphylla* (1), *Syzygium cumini* (6) and *Ziziphus mauritiana* (2).	55
	Total	**277**

Seed variability in castor germplasm

Scientists and farmers screening Moth germplasm during field day at Jodhpur

Table 2: Vegetatively propagated crops being maintained in the field

Crop	Plant material	No. of accessions
Fruits (53)	*Aegle marmelos*	9
	Annona squamosa	1
	Citrus aurantifolia	1
	Cordia myxa	6
	Emblica officinalis	16
	Psidium guajava	6
	Punica granatum	6
	Syzygium cumini	6
	Ziziphus mauritiana	2
Medicinal & Aromatic Plants (22)	*Aloe barbadenis*	7
	Asparagus racemosus	3
	Commiphora wightii	4
	Murraya koenigii	1
	Putranjiva roxburghii	1
	Tinospora cordifolia	4
	Urginea indica	1
	Total	**75**

Table 3: Promising accessions identified in various crops during *kharif* 2004

Crop	Main attributes	Accessions identified for specific/ desired traits
Pearl millet (258)	50% flowering < 42 days	IC325776 (40), IC420348 (40), IC333240 (40), IC370481 (40), IC370719 (39)
	Plant height > 245 cm Yield/ plant > 40 g	IC329061 (246.4), IC420315 (247.6), IC420324 (247.2) IC329058 (43.8), IC333121 (44.8), IC333179 (62.52), IC258098 (40.16)
	1000 seed weight > 11 g	NIC17771 (11.9), NIC17816 (11.1), IC370507 (11.5), IC373437 (11.1), IC-373466 (11.3)
Cowpea (18)	50% maturity < 40 days	IC349857 (37), IC415143 (37), IC354346 (37), IC333118 (39)
	Branches/plant > 5	IC370493 (5.8), IC415589 (5.6)
	Seed yield/plant > 22 g	IC373428 (54.6)
	100 seed weight > 15 g	IC370493 (17.2), IC324016 (17.4), IC415589 (20.6), IC354361 (15.7), IC333106 (16.3)
Guar (194)	50% maturity < 65 days Plant height > 100 cm Seed yield/plant > 30 g	IC370502 (64), IC373480 (63), IC373497 (63) IC421832 (100), IC285171 (109.6), IC370741 (111.2) IC373438 (30.9), IC421816 (32.2), IC402299 (32.6), IC402296 (32.0), IC402301 (35.0), IC420332 (32.3), IC310630 (36.5)
	100 seed weight > 3.5 g	IC311414 (3.6), IC421818 (3.9), IC410163 (3.8), IC432117 (4.0), IC432128 (3.6)
Mothbean (90)	50% maturity < 58 days	IC370471 (57), IC402283 (57)

	Plant height > 45 cm	IC311436 (47.8), IC395751 (49.1), IC395765 (52.3), IC395811 (47.4)
	Branches/plant > 10	IC395751 (10.2), IC395811 (10.4)
	Seed yield/plant > 24 g	IC329077 (25.8), IC370469 (24.6), IC415143 (24.7), IC258105 (24.9)
	100 seed weight > 4.0 g	IC311450 (4.1), IC415147 (4.7)
Mungbean (151)	50% maturity < 33 days	EC520041 (32), IC420310 (32), IC420313 (32), IC311445 (30), IC311446 (31)
	Plant height > 100 cm	IC415598 (108.3)
	Branches/plant > 5	EC512792 (5.8), EC520009 (5.6), IC311437 (5.2), IC311445 (5.4)
	Seed yield/plant > 17 g	EC520038 (17.2), EC520041 (17.2), IC370721 (17.5), IC258102 (17.3)
	100 seed weight > 8.5 g	EC512793 (8.75), EC520042 (8.5), EC520043 (8.6), IC258102 (8.9)

Research Projects (Project Code, Title, Project Leader, Associate)

PGR/GEV-BUR-JOD-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources in arid and semi arid regions (NK Dwivedi; Neelam Bhatnagar, S Gopalkrishnan).

PGR/GEV-BUR-JOD-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of cereals, pearl millet, minor millet and horticultural crops (NK Dwivedi; S Gopalkrishnan).

PGR/GEV-BUR-JOD-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of legumes and oilseeds (N K Dwivedi; Neelam Bhatnagar).

PGR/GEV-BUR-JOD-01.03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of fodder, forage, fuel, medicinal and other aromatic plants (Neelam Bhatnagar; NK Dwivedi).

14. EXPLORATION BASE CENTER, RANCHI

Summary: During period under report six explorations were undertaken and a total of 638 accessions of various crops and their wild relatives were collected and conserved/ maintained in the field genebank. The wild species like *Gossypium barbadense, Musa balbisiana, Artemisia scoparia, Jatropha curcas, Abelmoschus crenata,* several medicinal, aromatic and dye yielding plants were collected and are being maintained at the center.

14.1 Plant Exploration and Germplasm Collection

During the year 2004, six explorations were undertaken and 638 accessions of different agri-horticultural crops including wild types were collected. The details of each exploration are given below.

Area and period of exploration	Crop (number of collections)	Collections
Bhabhua, Rohtash, Arra & Buxar districts of Bihar 24.03.04 to 4.04.04	*Allium sativum* (1), *Anethum graveolens* (1), *Brassica* sp. (18), *Cajanus cajan* (24), *Canavalia ensiformis* (1), *Capsicum annuum* (1), *Cicer arietinum* (7), *Coriandrum sativum* (1), *Dioscorea alata* (1), *Diospyros* sp. (1), *Dolichos lablab* (8), *Hordeum vulgare* (5), *Ipomoea batatas* (1), *Lathyrus sativus* (17), *Lens esculenta* (24), *Linum usitatissimum* (11), *Luffa cylindrica* (4), *Luffa hermaphrodita* (1), *Mucuna* sp.(2), *Pisum arvense* (4), *Pisum sativum* (6), *Ricinus communis* (2), *Tamarindus indica* (1), *Vicia faba* (3), *Ziziphus mauritiana* (1), *Foeniculum vulgare* (1)	147
East Singhbhum district of Jharkhand 21.03.04 to 29.03.04	*Annona reticulata* (1), *Brassica* sp. (13), *Cajanus cajan* (23), *Cicer arietinum* (5), *Colocasia esculenta* (2), *Coriandrum sativum* (4), *Diospyros* sp. (1)*, *Dolichos lablab* (8), *D. biflorus* (9), *Eleusine coracana* (11), *Gossypium barbadense* (1), *Guizotia abyssinica* (5), *Helianthus annuus* (1), *Hibiscus* sp. (7), *Lagenaria siceraria* (2), *Lathyrus sativus* (18), *Lense esculenta* (10), *Linum usitatissimum* (16), *Luffa hermaphrodita* (2), *Luffa cylindrica* (4), *L. acutangula* (1), *Lycopersicon esculentum* (1), *Oryza sativa* (30), *Panicum sumatrense* (2), *Pisum arvense* (6), *P. sativum* (1), *Raphanus sativus* (1), *Ricinus communis* (5) *Sesamum indicum* (2), *Solanum* sp.(wild) (1), *S. xathocarpum* (1), *Sorghum vulgare* (9), *Vicia faba* (1), *Vigna mungo* (17), *V. radiata* (4), *V. unguiculata* (3), *Zea mays* (1), *Abroma augusta* (1)	229
WB, Bihar & Jharkhand state 12.07.04 to 19.07.04	*Adiantum capillus-veneris* (1), *Ananas comosus* (3), *Artemisia scoparia* (1), *Artocarpus heterophyllus* (4), *Byttneria herbacea* (1), *Carissa carandas* (1), *Cassia sophera* (1), *Curcuma* sp. (1), *Eclipta prostrata* (1), *Glycosmis pentaphylla* (1), *Hedychium spicatum* (1), *Kaempferia galanga* (1), *Momordica dioica* (1), *Musa balbisiana* (3), *Musa paradisiaca* (6), *Nigella sativa* (1), *Paederia maxima* (1), *Portulaca oleracea* (1), *Solanum viarum* (1), *Tinospora cordifolia* (1), *Tribulus terrestris* (1), *Typhonium trilobatum* (1), *Aristolochia oncocephalus* (1), Parsik ajwain (1), Jivanti (1)	35
Ranchi, Garhwa, Daltonganj, Netarhat & Gumla districts	*Abelmoschus* sp. (1), *Anacardium occidentale* (1), *Asparagus racemosus* (1), *Bacopa monnieri* (1), *Buchanania lanzan* (2), *Celastrus paniculatus* (1), *Chlorophytum borivilianum* (2), *Chlorophytum* sp. (2),	45

ofJharkhand 26.07.04 to 4.08.04	*Chlorophytum tuberosum* (1), *Citrus paradisi* (1), *C. reticulata* (1), *C. sinensis* (1), *Curculigo orchioides* (1), *Curcuma amada (2), Dioscorea hamiltonii (1), Embelia ribes* (1), *Ficus glomerata* (1), *Grewia hirsuta* (1), *Ipomoea pes-tigridis* (1), *Lawsonia inermis* (5), *Madhuca indica* (1), *Nyctanthes arbortristis* (1), *Pterocarpus marsupium* (1), *Randia dumetorum* (1), *Schleichera oleosa* (1), *Semecarpus anacardium* (1), *Smilax macrophylla* (1), *Sterculia urens* (1), *Symplocos racemosa* (2), *Syzygium* sp. (1), *Tephrosia purpurea* (1), *Tinospora cordifolia* (2), *Urginea indica* (1), *Zingiber officinale* (1), *Zingiber* sp. (1)	
West Champaran district of Bihar 25.10.04 to 5.11.04	*Amaranthus hybridus* (1), *Amorphophallus campanulatus* (1), *Brassica* sp. (20), *Capsicum annuum* (3), *Coccinia* sp.(2), *Coriandrum sativum* (2), *Dioscorea* sp. (3), *Jatropha curcas* (3), *Lathyrus sativus* (4), *Lepidium sativum* (2), *Lens esculenta* (14), *Linum usitatissimum* (10), *Luffa cylindrica* (4), *Luffa hermaphrodita* (3), *Oryza sativa* (7), *Pennisetum glaucum* (1), *Sesamum indicum* (1), *Vicia faba* (13), *Vigna radiata* (2), *Zea mays* (10)	106
Hazaribag district of Jharkhand 25.11.04 to 30.11.04	*Brassica* sp. (5), *Colocasia esculenta* (1), *Cucumis melo* var *utilissimus* (1), *Datura stramonium* (1), *Eleusine coracana* (5), *Glycine max* (1), *Guizotia abyssinica* (7), *Hordeum vulgare* (1), *Jatropha curcas* (5), *Lathyrus sativus* (1), *Lens esculenta* (2), *Linum usitatissimum* (1), *Luffa cylindrica (2), Macrotyloma uniflorum (4), Momordica charantia* (1), *Oryza sativa* (3), *Pisum arvense* (1), *Pisum sativum* (1), *Sorghum vulgare* (3), *Vigna mungo* (7), *V. radiata* (4), *V. unguiculata* (2), *Zea mays* (17)	76
		638

Species-wise total germplasm collections

Abelmoschus sp.(1)	*Adiantum capillus-veneris* (1)	*Allium sativum* (1)
Amaranthus hybridus (1)	*Amorphophallus campanulatus* (1)	*Anacardium occidentale* (1)
Ananas comosus (3)	*Anethum graveolens* (1)	*Annona reticulata* (1)
Aristolochia oncocephalus (1)	*Artermisia scoparia* (1)	*Artocarpus heterophyllus* (4)
Asparagus racemosus (1)	*Bacopa monnieri* (1)	*Brassica* sp (57)
Buchanania lanzan (2)	*Byttneria herbacea* (1)	*Cajanus cajan* (47)
Canavalia ensiformis (1)	*Capsicum annuum* (4)	*Carissa carandas* (1)
Cassia sophera (1)	*Celastrus paniculatus* (1)	Chansur *(2)*
Chlorophytum borivilianum (2)	*Chlorophytum* sp. (2)	*Chlorophytum tuberosum* (1)
Cicer arietinum (12)	*Citrus paradisi* (1)	*Citrus reticulata* (1)
Citrus sinensis (1)	*Coccinia* sp. (2)	*Colocasia esculenta* (3)
Coriandrum sativum (7)	*Cucumis melo* var *utilissimus* (1)	*Curculigo orchioides* (1)
Curcuma amada (2)	*Curcuma* sp. (1)	*Datura stramonium* (1)
Dioscorea alata (1)	*Dioscorea hamiltonii* (1)	*Dioscorea* sp. (3)
Diospyros tomentosa (2)	*Dolichos biflorus* (13)	*Dolichos lablab* (17)
Eclipta prostrata (1)	*Eleusine coracana* (16)	*Embelia ribes* (1)
Glycine max (1)	*Glycosmis pentaphylla* (1)	*Gossypium barbadense* (1)
Grewia hirsuta (1)	*Guizotia abyssinica* (12)	*Helianthus annuus* (1)
Hibischus sp (7)	*Holostemma annulari* (1)	*Hordeum vulgare* (6)
Ipomoea batatas (1)	*Ipomoea pes-tigridis* (1)	*Jatropha curcas* (8)

Jivanti (1)	*Kaempferia galanga* (1)	*Lagenaria siceraria* (2)
Lathyrus sativus (39)	*Lawsonia inermis* (5)	*Lens esculenta* (50)
Linum usitatissimum (38)	*Luffa acutangula* (2)	*Luffa cylindrica* (15)
Luffa hermaphrodita (4)	*Lycopersicon esculentum* (1)	*Madhuca indica* (1)
Momordica charantia (1)	*Momordica dioica (1)*	*Mucuna purpurea* (1)
Mucuna prurita (1)	*Musa balbisiana* (3)	*Musa paradisiaca (6)*
Nigella sativa (1)	*Nyctanthes arbor tristis* (1)	*Oryza sativa* (40)
Paederia maxima (1)	*Panicum sumatranse* (2)	Parsik ajwain (1)
Pennisetum glaucum (L) (1)	*Pisum arvense* (12)	*Pisum sativum* (8)
Portulaca oleracea (1)	*Pterocarpus marsupium* (1)	*Randia dumetorum (1)*
Raphanus sativus (1)	*Ricinus communis* (7)	Saunf (1)
Schleichera oleosa (1)	*Semecarpus anacardium* (1)	*Sesamum indicum (3)*
Smilax macrophylla (1)	*Solanum* sp. (1)	*Solanum xanthocarpum* (1)
Solanum viarum (1)	*Sorghum vulgare* (12)	*Sterculia urens* (1)
Symplocos racemosa (2)	*Syzygium* sp. (1)	*Tamarindus indica* (1)
Tephrosia purpurea (1)	*Tinospora cordifolia* (3)	*Tribulus terrestris* (1)
Typhonium trilobatum (1)	*Ficus glomerata* (1)	*Urgenia indica (1)*
Vicia faba (16)	*Vigna mungo* (24)	*Vigna radiata* (10)
Vigna unguiculata (5)	*Zea mays* (28)	*Zingiber officinale* (1)
Zingiber sp. (1)	*Ziziphus mauritiana* (1)	**Total = 638**

Crop group-wise collection

Cereals	74	Fruits	30
Pseudocereals	1	Medicinal & Aromatic Plants	45
Millets	33	Spices and Condiments	15
Grain legumes	207	Pulses	47
Oilseeds	126	Tubers	10
Fibers	8	*Lawsonia* sp.	5
Vegetables	37	**Total**	**638**

Flow of germplasm (exploration-wise)

Collector No.	No. of Collections	Sent to MTS	Field Gene Bank	NAGS
VKG-28/-	147	144	8	140
JBT-38/-	229	226	15	216
JBT-39/-	35	0	35	6 (Cryo)
JBT-40/-	45	0	45	0
VKG-29/-	106	102	4	102
VKG-30/-	76	75	1	75

14.2 Maintenance of Germplasm in Field Genebank

A total of 136 accessions of Jackfruit, 51 of tamarind, 46 of jamun, 53 of bael, 37 of custard apple, 24 of henna (*Lawsonia inermis)* are being maintained in field genebank.

14.3 Multiplication of Germplasm

Colocasia (9), Ginger (7), *Dioscorea* (7) and Horsegram (9) were multiplied for LTS.

14.4 Maintenance of Medicinal Plants

The following medicinal and aromatic plants are being maintained in the herbal garden.

Botanical Name	No. of accessions	Botanical Name	No. of accessions
Abroma augusta	2	*Bryophyllum* sp.	2
Abrus precatorius	7	*Buchanania lanzan*	5
Acacia nilotica	1	*Bulbophyllum*	2
Acacia concinna	2	*Butea monosperma*	3
Acorus calamus	4	*Canna indica*	3
Adhatoda vasica	2	*Cassia fistula*	2
Aloe sp.	5	*Catharanthus roseus*	4
Alpinia galanga	4	*Celastrus paniculatus*	2
Alstonia scholaris	1	*Centella asiatica*	2
Andrographis paniculata	8	*Chlorophytum* sp.	11
Asparagus racemosus	12	*Cissus quadrangularis*	2
Atylosia sp.	2	*Clerodendron* sp.	3
Azadirachta indica	5	*Clitoria ternatea*	3
Bacopa monnieri	2	*Coleus amboinicus*	2
Barleria prionitis	3	*Costus speciosus*	8
Bauhinia sp.	3	*Curculigo orchioides*	9
Bombax ceiba	2	*Curcuma caesia*	2
Curcuma sp.	9	*Ocimum* sp.	8
Desmodium gangeticum	2	*Oroxylum indicum*	3
Dioscorea sp.	14	*Piper longum*	3
Diospyros tomentosa	1	*Plumbago zeylanica*	4
Glycosmis pentaphylla	2	*Pongamia pinnata*	4
Gmelina arborea	4	*Premna herbacea*	2
Gymnema sylvestre	2	*Pterospermum acerifolium*	1
Hemidesmus indicus	5	*Rauvolfia serpentina*	5
Holarrhena antidysenterica	1	*Rauvolfia tetraphylla*	3
Indigofera tinctoria	2	*Semecarpus anacardium*	2
Jatropha curcas	1	*Smilax* sp.	4
Jatropha gossypifolia	1	*Shorea robusta*	4
Lagerstroemia speciosa	2	*Sterculia* sp.	1
Martynia diandra	2	*Tectona grandis*	9
Mirabilis jalapa	3	*Terminalia arjuna*	7
Moringa oleifera	4	*Terminalia bellirica*	6
Mucuna sp.	3	*Terminalia catappa*	2
Murraya koenigii	1	*Terminalia chebula*	1
Terminalia tomentosa	1	*Urginia indica*	4
Thespesia lampas	2	*Vanda tessellata*	3
Tinospora cordifolia	9	*Withania somnifera*	4
Typhonium trilobatum	3	*Zingiber* sp.	5
Cinnamomum zeylanicum	2	**Total -**	**291**

14.5 Germplasm Distribution

Head, Evaluation Division, New Delhi: *Anethum graveolens* (1), *Brassica* sp. (56), *Canavalia* sp. (1), *Coriandrum sativum* (7), *Hordeum vulgare* (6), *Luffa cylindrica* (14), *Pisum arvense* (11), *Pisum sativum* (8), Saunf (1), *Helianthus annuus* (1), *Lagenaria siceraria* (2), *Luffa acutangula* (1), *Luffa*

hermaphrodita (5), *Lycopersicon esculentum* (1), *Raphanus sativus* (1), *Solanum* sp.(wild) (1), *Solanum xanthocarpum* (1), *Vigna unguiculata* (3), *Zea mays* (28), *Jatropha curcas* (8), *Coccinia* sp.(2), Chansur (2), *Cucumis melo* var *utilissimus* (1), *Datura stramonium* (1), *Glycine max* (1), *Momordica charantia* (1) *Linum usitatissimum* (38).

CRRI, Cuttack: *Oryza sativa* (40)

IIPR, Kanpur: *Cajanus cajan* (47), *Cicer arietinum* (12), *Lathyrus sativus* (40), *Lens esculenta* (50), *Vigna radiata* (6), *Vigna mungo* (7), *V. unguiculata* (2).

DOR, Hyderabad: Castor (7)

UUC, New Delhi: *Amaranthus hybridus* (1), *Vicia faba* (17)

NBPGR Hydarabad: *Capsicum annuum* (3)

CCPI (NATP-PB)Zone-VIII, HARP, Ranchi: *Dolichos lablab* (16)

AICSMIP, Banglore: *Eleusine coracana* (16), *Panicum sumatrense* (2)

CICR, Nagpur; *Gossypium barbadense* (1)

NRC, Sorghum: *Sorghum vulgare* (12), *Pennisetum glaucum* (1)

NBPGR Akola: *Sesamum indicum* (3), *Guizotia abyssinica* (12), *Macrotyloma uniflorum* (4)

CRIJ&AF, Barrakpore: *Hibiscus* sp. (7)

Research Projects (Code : Title, Project Leader; Associate)

PGR/PGC-BUR-RAN-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, Documentation and distribution of genetic resources in Bihar, Jharkhand and adjoining areas (JB Tomar; VK Gupta).

PGR/PGC-BUR-RAN-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of agriculture crops, their wild relatives and economic species (JB Tomar; VK Gupta).

PGR/PGC-BUR-RAN-01.02: Augmentation characterization, evaluation maintenance, regeneration, conservation and documentation of genetic resources of horticultural crops and medicinal plants (VK Gupta; J B Tomar).

15. REGIONAL STATION, SHILLONG

Summary: A total 1,327 accessions of various crop plants and their wild relatives were collected through eleven explorations made from NEH region. Out of this, five trips were conducted exclusively for the collection of medicinal plants germplasm. Extensive range of diversitie was collected for rice, maize, French bean, ricebean and cowpea. A few uncommon medicinal plants germplasm was also assembled. During the year, a total of 2,493 accessions were characterized and the promising genotypes for various attributes identified. A zonal (NEH) meeting of the NATP cooperators for the project on Plant Biodiversity was also held during the year.

15.1 Exploration and Germplasm Collection

Eleven exploration trips were conducted and a total of 1,327 accessions collected from Papum Pare, Lower Subansiri, Upper Subansiri, West Kameng and Tawang districts of Arunachal Pradesh; Nagaon and Karbi Anglong districts of Assam; Dimapur and Kohima districts of Nagaland; Lunglei, Serchhip and Saiha districts of Mizoram and North & West districts of Sikkim. Out of these, 792 accessions were sent for MTS in the National Genebank for conservation, while 535 accessions were retained at the station for necessary multiplication. The Defence Research Laboratory, Tezpur; NRC on Orchids; AAU, Jorhat; NBPGR, New Delhi and NRC on Rapeseed & Mustard, Bharatpur collaborated in execution of different trips. Details of diversity collected during these exploration trips are given (Table 1). The details of crop-wise collections are given in Table 2 and 3 .

15.1.1 Crop diversity collected from Arunachal Pradesh: Four trips were undertaken in this state during the year. Two trips were executed for multi-crop germplasm collection from upper and lower Subansiri, West Kameng and Tawang while other two were meant exclusively for collection of medicinal plant germplasm. The surveyed areas were parts of Papum Pare, Lower Subansiri, Upper Subansiri, West Kameng and Tawang districts of the state. A total 486 multicrop germplasm were collected in both the trips. Thirty-six accessions of medicinal plants were collected from other two trips and all these are retained at the regional station for their multiplication. Out of 486 multicrop accessions, 389 were sent for MTS at the National Genebank while 97 were retained at this station.

The Upper Subansiri and Lower Subansiri districts are rich in crop diversity. Major agri-horticultural crops like paddy, maize, millets, orange and pineapple are grown abundantly in these areas. Timber, bamboo and canes are also dominant elements of the vegetation. A range of crop diversity was found in chillies, cowpea, French bean, maize, paddy and pumpkin. The *indica* rice landraces of Apatani plateau are worth mentioning. Millets (finger millet and foxtail millet) are grown by the local tribes and are mainly used for the preparation of local drinks (beer).

The area of West Kameng and Tawang districts of Arunachal Pradesh falls between 1600 m to 4200 m altitudes. Diversity was mostly found in maize, French bean, soybean, chilli and buckwheat. The surveyed area is dominated by wild banana species i.e. *Musa velutina* and *Musa balbisiana.* The important medicinal plants collected were – *Rauvolfia serpentina, Coptis teeta, Rubia cordifolia, Piper*

Table 1: Exploration and collection of germplasm from NEH region

Sl. No.	Area surveyed	Period	Collaborator	Crop collected	Total collected
1.	Papum Pare & W. Kameng districts, Arunachal Pradesh	29.3.04 to 4.4.04	NBPGR, Shillong	Medicinal Plants	13
2.	West Khasi Hills, Meghalaya	4.6.04	NBPGR, Shillong	Medicinal Plants	13
3.	Lower & Upper Subansiri (Arunachal Pradesh)	6.9.04 to 18.9.04	NBPGR, Shillong and NRC, Orchids	Multicrop & Orchids	251
4.	Nagaon (Hojai & Lanka) district of Assam	19.8.04 to 22.8.04	NBPGR, Shillong	Medicinal Plants	23
5.	Tawang & West Kameng (Arunachal Pradesh)	23.9.04 to 2.10.04	NBPGR, Shillong and DRL, Tezpur	Multicrop	235
6.	Dimapur & Kohima of Nagaland	26.9.04 to 6.10.04	NBPGR, Shillong and NRC, Orchids	Multicrop & Orchids	54
7.	Karbi Anglong & NC Hills of Assam	24.10.04 to 1.11.04	NBPGR, Shillong and AAU, Jorhat	Multicrop	76
8.	Tawang & West Kameng (Arunachal Pradesh)	23.9.04 to 2.10.04	NBPGR, Shillong	Medicinal Plants	23
9.	North & West Sikkim districts	11.12.04 to 23.12.04	NBPGR, New Delhi and Shillong	- Do -	33
10.	Southern districts of Mizoram	4.2.05 to 16.2.05	NBPGR, Shillong	Multicrop	418
11.	Dimapur & Kohima of Nagaland	1.3.05 to 6.3.05	NRC on Rapeseed and Mustard and NBPGR, Shillong	Both crop specific and multicrop	188
Total					**1327**

mullesus, Withania somnifera, Andrographis paniculata, Asparagus indica, Elaeocarpus ganitrus, Aquilaria agallocha, Adhatoda vesica, Phyllanthus sp., *Vitex negundo, Heliotropium* sp., *Swertia chirayita, Potentilla* sp., *Plantago major, Illicium griffithii, Artemisia vulgaris, Pelargonium graveolens, Picrorrhiza kurroa, Acorus calamus* and *Taxus baccata.*

15.1.2 Crop diversity collected from Assam: Specific pockets of Nagaon and Karbi Anglong districts of Assam were explored and 23 accessions of various medicinal plants were assembled from Lanka and Hojai area of Nagaon district and 76 accessions of various crops were made from Karbi Anglong (Mikir Hills). Out of the total 76 accessions, 65 accessions were sent to the MTS, while 11 accessions have been retained at this station. All the 23 accessions of medicinal plants germplasm were retained at the station for their establishment and propagation. The significant crop germplasm collected are as follows– *Aquilaria agallocha, Solanum indicum, Vitex negundo, Costus speciosus, Hyptis suaveolens, Pandanus latifolia, Sauropus androgynus, Artemisia pallens, Houttuynia cordata, Ocimum basilicum, Andrographis*

paniculata, Boerhaavia punarnava, Paederia foetida, Mucuna pruriens, Clausena haptaphylla, Vanilla planifolia, Tinospora cordifolia, and *Terminalia citrina.*

15.1.3 Crop diversity collected from Mizoram: Southern part of the state comprising Serchhip, Lunglei, Chimtuipui (Saiha) and Longtlai districts was explored. The entire area is bordering Myanmar and Bangladesh on either side of the state. A total of 407 accessions of various crops and 11 accessions of medicinal plants were collected. Out of this, 169 accessions of various crops and 11 accessions of medicinal plants were retained at the station. The significant collections of the trip included– rice, maize, cowpea, pumpkin, *Perilla,* chilli, *Solanum gillo. Colocasia, Spilanthus, Mimosa pudica, Gelsemium elegans, Bergenia ciliata, Artemisia* sp., *Cymbopogon flexuosus. Xanthoxylum* and *Ocimum.* Use of *Colocasia* stem and tubers for odd days and their storage methodology is a novelty of the Mizo tribe. The state is rich in diversity of banana and papaya. Both wild banana and bamboos were found to grow as mixed community in undisturbed forest.

15.1.4 Crop diversity collected from Sikkim: All districts of the state were explored to collect M & AP germplasm. A total of 33 accessions of various medicinal plants germplasm was collected mostly as vegetative propagules. The important and significant collections were as follows – *Acorus calamus, Tupistra nutans, Artemisia* sp., *Ocimum basilicum, Sapindus mukorossi, Centella asiatica, Berginia ciliata, Swertia chirayita, Astilbe rivularis, Picrorrhiza kurroa, Allium wallichi, Kaempferia rotunda, Aconitum ferox, Aconitum heterophyllum, Nardostachys jatamansi, Podophyllum hexandrum, Curcuma aromatica, Tinospora cordifolia, Aloe barbadensis, Curcuma caesia, Mimosa pudica* and *Costus speciosus.*

15.1.5 Crop diversity collected from Meghalaya: Thirteen collections of medicinal plants were made from a specific pocket of West Khasi hills. In addition to collection, an interactive discussion was arranged with a local doctor who grows the medicinal plants and treats the patients. Important species of medicinal plants included: *Curcuma aromatica, Asparagus* sp., *Nepenthes khasiana, Centella asiatica, Acorus calamus, Berberis* sp., *Cinnamomum tamala* and *Potentilla fulgens.*

15.1.6 Crop diversity collected from Nagaland: Two trips were conducted by two different teams in the same district but in different locations. The first trip in the state was conducted in collaboration with NRC on Orchids, Gangtok and 54 accessions (apart from Orchids) were collected. The second exploration in the state was executed in collaboration with NRC on Rapeseed & Mustard, Bharatpur, Rajasthan, where 188 accessions of various crops were collected.

Coix lacryma jobi germplasm being characterized at Shillong

Table 3: Exploration and Collection of germplasm from NEH region

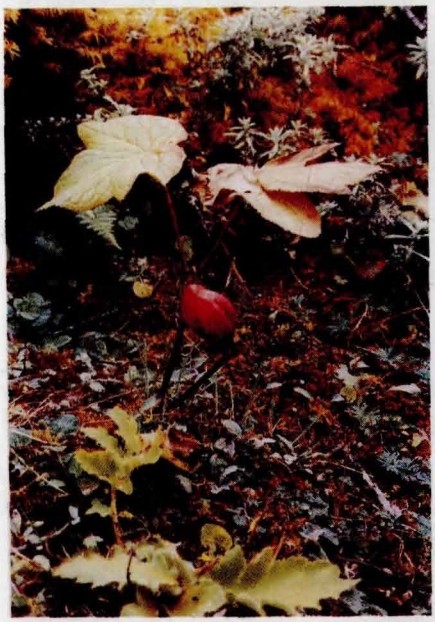
Crops	Lower & Upper Subansiri	Tawang & West Kameng	Dimapur & Kohima	Karbi Anglong & NC Hills	Southern districts of Mizoram	Dimapur & Kohima of Nagaland	Total
Cereals	Paddy (49); Maize (50) = 99	Paddy (10); Maize (49); Wheat (06) = 65	Paddy (11); Maize (10) = 21	Paddy (28); Maize (7) = 35	Paddy (39); Maize (34) = 73	Paddy (36); Maize (34) = 70	363
Pseudo-cereals	Finger millet (27); Foxtail millet (2); *Sorghum* (1) = 30	Amaranth (7); Buckwheat (14); Finger millet (14); *Sorghum* (2); Foxtail millet (1); Chenopod (1) = 39	-	Finger millet (1); Foxtail millet (1) = 2	*Sorghum* (1) = 01	*Coix (2);* *Sorghum* (1) = 3	75
Grain Legumes/ Pulses	French bean (10); Cowpea (8); Soybean (3); Rice bean (1) = 22	French bean (50); Soybean (14); Cowpea (4); Lima bean (5); Pea (1); Jack bean (1); Rice bean (2) = 77	French bean (5); Cowpea (1) = 6	Cowpea (2); *Rice bean* (1) = 3	French bean (6); Soybean (4); Cowpea (30); Rice bean (7) Winged bean (6); Sem bean (1) = 54	Rice bean (14); Soybean (6); Cowpea (10); French bean (17); Winged bean (2); Sem bean (7); *Phaseolus* (1); Urd bean (1); Jack bean (1) = 59	221
Oilseeds	Sesame (1) = 1	Brassica (1) = 01	-	Sesame (5); Brassica (3) = 8	Mustard (7); Sesame (9); *Perilla* (21) = 37	*Perilla* (12); Sesame (4) = 16	63
Vegetables	Pumpkin (14); Bottle gourd (5); Bitter gourd (1); Water melon (3); Cucumber (5); Cabbage (1); Brinjal (6); Okra (6); Tomato (2); Amaranth (1); Brassicae (3) = 47	*Cyclanthera* (4); *S. gilo* (3); Pumpkin (7); Cucumber (3); Bottle gourd (2) = 19	Pumpkin (6); Okra (1) = 7	Water melon (1); Ridge gourd (3); Brinjal (2); Pumpkin (6); Okra (3); Cucumber (1); Sponge gourd (1) = 17	Ladies Finger (17); Radish (3); Brinjal (15); *S. gilo* (12); Pumpkin (27); Bitter gourd (9); Cucumber (15); Bottle gourd (1); Snake gourd (13); Musk melon (6); Water melon (10); Ash gourd (11); *M. cochin-chinensis* (2) = 141	*Cyclanthera* (1); Pumpkin (12); Ash gourd (2); Sponge gourd (1); Bitter gourd (1); *Citrullus* (1); Okra (1); Tomato (2); *Solanum* (1) = 22	253
Spices	Ginger (1); Chilli (34); Garlic(1) = 36	Chilli (19); Garlic (4); Coriander (4) = 29	Chillies (10); Garlic (6) = 16	Chilli (4); Turmeric (1); Ginger (1) = 6	Chilli (33); Ginger (7); *Celosia* (7); Onion (1); *Spilanthes* (4); *Zanthoxylum* (1); *Curcuma* (1) = 54	Chilli (4); Garlic (2); Ginger (4) = 10	151

Tuber Crops	*Colocasia* (4); *Dioscorea* (7); *Amorphophallus* (1) = 2	*Colocasia* (1) = 1	-	*Dioscorea* (1); *Colocasia* (2) = 3	*Colocasia* (10); *Dioscorea* (2); *Pachyrrhiza* (1) = 13	*Colocasia* (4) = 4	33
Fruits	*Citrus* (1); Banana (1) = 2	Walnut (1) = 1	Guava (2); *Citrus* (1) = 3	Papaya (1) = 1	Banana (8); Papaya (1) = 9	Papaya (1); Water melon (1)	18
Fibre Crops	-	-	Cotton (1) = 1	-	*Hibiscus subdariffa* (14) = 14	-	15
Miscellaneous	Sugarcane (1); *Solanum spirale* (1) = 2 10	*Illicium* (1); *Xanthoxylum* (2) = 3	-	*Maranta* (1) = 1	Orchid (1); *Rhododendron* (1) = 2	Coffee (1); *Zanthoxylum* (1) = 2	10
Unidentified	-	-	-	-	Unidentified (4) = 4+5 = 9	-	9

15.2 Germplasm Characterization and Maintenance

Germplasm of different agri-horticultural crops collected from this region was grown (total 2708 accs.) for preliminary evaluation. After screening of germplasm continuously for three successive years, the material was sent to the National Genebank for conservation. In addition to this, germplasm of mandate crops of the station was also received from outside the region for characterization. Based on yield and

A traditional method of drying and storage of maize in Arunachal Pradesh



Podophyllum hexandrum collected from Arunachal Pradesh

The following crops were characterized during the year 2004-05.

Crop	No. of accessions		Superior genotypes identified
	Sown	Harvested	
1. Upland Paddy	184	182	IC340058
2. Lowland Paddy	224	219	IC319409
3. Maize	175	175	IC330377
4. Rice bean	887	887	LRB-238; VUM-79
5. Buckwheat	92	73	IC340363; IC340307
6. Job's tear	57	57	IC012703
7. *Perilla*	50	50	IC006444; IC334313
8. Ginger	214	199	IC330293
9. Turmeric	146	145	IC211431
10. *Colocasia*	310	299	RS13/98
Total	2339		

resistance against the stress parameters, the promising genotypes were identified.

At present 86 accessions of banana and 78 accessions of citrus and 4 exotic accs. of Passion fruit are being maintained among the fruit crops. Under-utilized fruit crop species of *Myrica, Elaegnus, Emblica, Artocarpus, Simarouba, Ziziphus, Pyrus* are also being maintained.

The germplasm of following crops and their wild relatives is being maintained at the station.

Cereals: *Oryza granulata, Zizania latifolia.*

Solanaceous: *Solanum gilo, S. spirale, S. mammosum, S. torvum, S. indicum.*

Bulbous and Rhizomatous: *Heliconia dasyantha, Alpinia galanga, A. officinarum, Hedychium* sp., *Allium* sp., *Gladiolus* sp., *Curcuma caesia, Dahlia* sp., *Tupistra* sp., *Moghania, Homalomena* sp.

Grain legumes: *Parkia roxburghii, Mucuna utilis, Canavalia ensiformis.*

Fruits: *Mangifera, Artocarpus, Passiflora, Musa velutina.*

Ornamentals: Various orchids, *Rosa, Nerium, Dombia, Callistemon, Plumeria, Thunbergia, Hibiscus, Caladium, Jacaranda, Calliandra, Hedera, Begonia, Hydrangia, Camellia, Viola, Cuphea, Canna, Epiphyllum* etc.

Wild relatives of crop plants: *Oryza granulata, Zizania latifolia, Psidium guineense.*

Medicinal and aromatic plants: *Taxus, Podophyllum, Panax, Picrorrhiza, Astilbe, Aloe, Adhatoda, Lavendula, Mucuna, Swertia, Withania, Alpinia, Andrographis* and *Aquilaria* etc.

15.3 Germplasm Distribution

The following active germplasm collections were distributed to the indenters for their research purpose.

Indenter	Crop	Accesions
CICR, Sirsa, Haryana	*Gossypium arboreum*	
NRC on M&AP, Anand, Gujarat	*Alpinia galanga, Curcuma caesia, Cryptolepis buchanani*	01
Division of Agronomy, ICAR NEH, Barapani, Meghalaya	Rice (*Oryza sativa*)	03 (1-each)
SASRD, Nagaland University, Medziphema, Nagaland	Rice bean (*Vigna umbellata*)	04
UBKVV, Cooch Behar, West Bengal	Buckwheat (*Fagopyrum esculentum*)	03
Head, Germplasm Exchange Division, NBPGR, New Delhi	Rice bean (*Vigna umbellata*)	30
Head, Botany Department, NEHU, Shillong, Meghalaya	*Fagopyrum tataricum, Fagopyrum esculentum*	10 (5-each)
ICAR (NEH), Sikkim Centre, Tadong, Gangtok, Sikkim	Passion fruit (*Passiflora edulis*)	04
Head, Plant Breeding Division, CTRI, Rajahmundry, Andhra Pradesh	Tobacco (*Nicotiana rusticum*)	01
ICAR (NEH), Sikkim Centre, Tadong, Gangtok, Sikkim	Maize (*Zea mays*)	01
Tissue Culture Laboratory,	*Dioscorea alata*	04
NBPGR, Pusa, New Delhi-12	*Moghania vestita*	01

15.4 Germplasm Conservation

A total of 718 accessions were deposited in the National Genebank for LTS, out of which 57 accessions were meant for cryopreservation.

Crop	No. of accs.	Remarks
1. *Coix*	14	Cryopreservation
2. *Perilla*	43	Cryopreservation
3. Maize	57	LTS
4. Upland Paddy	45	LTS
5. Lowland Paddy	84	LTS
6. Buckwheat	48	LTS
7. Rice bean	427	LTS

Wild banana (*Musa balbisiana*) collected from Arunachal Pradesh

Research Projects (Project Code, Title, Leader; Associates)

PGR/BUR-SHL-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of plant genetic resources in Northeastern India (DK Hore).

PGR/PGC-BUR-SHL-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of agricultural and horticultural crops, plants of economic importance, their wild relatives and under-utilized crops under the AICRP (DK Hore).

PGR/PGC-BUR-SHL-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of indigenous and exotic lines of chilies, ginger, turmeric, yams, taros, citrus, banana and passion fruits (Rakesh Srivastava).

Externally Funded Project

Project – II: Sanction Order No. BT/MAP/01/GB-N/98 dated 10-1-2003. National Genebank for medicinal and aromatic plants (G-15).

16. REGIONAL STATION, SHIMLA

Summary: Nine explorations were undertaken and a total of 618 accessions comprising cereals (133), pseudocereals (31), millets (6), pulses (53), oilseeds (27), vegetables (53), fruits (68), minor fruits (70), ornamentals (19), spices & condiments (18), forages (4), M&AP (83), wild relatives (51) and other economic plants (2) were collected. Frenchbean (330)and pecan nut (74) were introduced from USA, Columbia and Taiwan. A total of 2,665 accessions of various agri-horticultural crops were characterized and multiplied for conservation and 359 accessions were sent for medium term storage as voucher specimens, 804 accessions for long-term storage and 55 accessions of wild fruits were sent for cryobank in the National Gene Bank. A total of 828 accessions of fruit crops, medicinal plants and ornamentals were conserved and maintained in field gene bank, 758 new germplasm accessions were added to the MTS maintained at Shimla and 958 were replaced by rejuvenation. Germplasm accessions comprising agricultural crops (1194) and horticultural crops (465) were supplied to various indenters.

16.1 Germplasm Augmentation

16.1.1 Indigenous sources: Nine explorations were undertaken during the period under report and a total of 618 germplasm accessions were collected from different parts of Himachal Pradesh, Jammu & Kashmir and Uttaranchal (Table 1).

The major emphasis was given on collection of minor fruits, medicinal and aromatic plants and as a result, 153 germplasm accessions were collected. Other important collections were- *Swertia chirayita, Gloriosa superba* and *Calanthe tricarinata* (endangered plants), *Malus baccata,* and *Cicer microphyllum* (wild relatives of apple and chickpea respectively). One region specific exploration in collaboration with NBPGR Regional Station, Thrissur was undertaken to Nilgiri hills. The unique collections are *Eugenia uniflora* (ornamental and fruit plant), *Psidium cattleianum* (more cold tolerant than ordinary guava), *Berberis tinctoria* (endemic to Nilgiris), *Pterospermum*

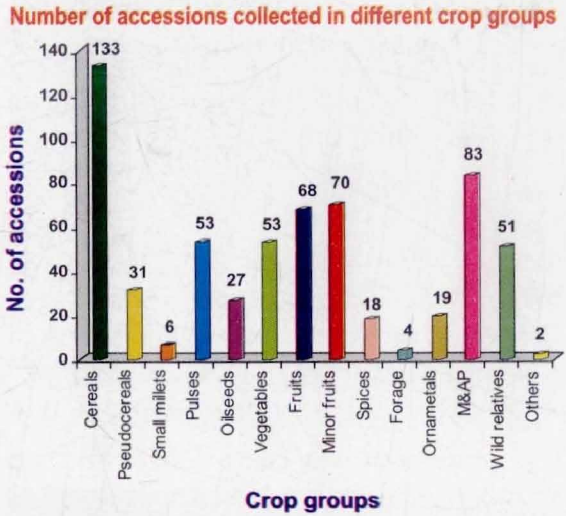


Table 1: Germplasm explorations undertaken from January to December, 2004

Exploration	Areas explored	Accs. collected
Multi-crop	Bilaspur, Hamirpur, Kangra and Una	103
Medicinal & Aromatic Plants	Haripur Dhar	14
Medicinal & Aromatic Plants	Lahaul Valley	11
Multi-crop	Kullu especially GHNP	130
Minor fruits	Upper Shimla	21
Multi-crop	Kinnaur	56
Multi-crop	Chamba	114
Multi-crop	Nilgiris	93
Multi-crop	Rewalsar and Ponta Sahib	76

suberifolium and *Elaeocarpus oblongus* (minor fruits and new to western Himalayan region), *Piper schmiditii* (cold tolerant) *Fagopyrum esculentum* (bold seeded), *Rubus moluccana* (fruits big, dark red) and *Solanum muricatum* (squash is prepared out of it and new to the region).

16.1.2 Exotic sources: A total of 404 accessions of French bean (330) from Columbia and Taiwan and Pecan nut (74) from USA were introduced.

16.2 Germplasm Characterization and Evaluation

Mandate crops: Amaranth, buckwheat, chenopod, French bean, adzuki bean, pea (hill type), apple, pear, apricot, peach, plum, walnut, pecan nut, almond, hazelnut and kiwi

16.2.1 Germplasm characterized during *rabi* 2003-2004

Pea: Two-hundred accessions were characterized for 20 descriptors in Augmented Block Design with 3 checks. The mean, range and coefficient of variation are given in table-2. The coefficient of variation was high for no. of pods per plant (18.60%) followed by seed yield per plant (16.67%) and no. of seeds/pod (14.11).

The germplasm was characterized for two consecutive years and promising genotypes were identified for various quantitative and qualitative characters such as:

Days to 50% flowering (<100 days) IC394033, IC394031, IC394027, IC291543

Days to maturity (<143 days) IC394012, IC381453, IC279225

Pods/ plant (>30) IC342060, IC342022, IC342035, IC342053, IC342030

IC 35407 - a variety of grain amaranth identified for release during 2004

Table 2: Range, mean and coefficient of variation in pea germplasm

Character	Range	Mean ± SE	CV%
Days to maturity	143-179	152.5 ± 2.15	11.14
Pod length (cm)	4.3-8.4	6.9 ± 0.81	10.23
No. of pods per plant	12.0-57.0	30.0 ± 1.94	21.60
No. of seeds per pod	3.0-8.0	5.47 ± 1.01	14.11
100 seed weight (g)	11.1-24.5	18.17 ± 2.22	19.67

Seeds/ pod (>7.0) IC394007, IC291543, IC279225, IC342026, IC279113

Pod length (>8.0) IC291544, IC581844, IC291543, IC381450

100 seed wt. (>22g) IC291544, IC291541, IC381453 and IC 291544.

IC279217 and IC279142 showed field resistance to powdery mildew and IC258401 to *Ascochyta* blight.

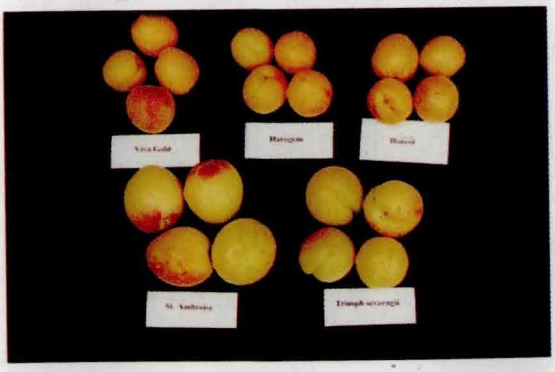
16.2.2 Germplasm characterized during *kharif* 2004

Agricultural crops: A total of 2,665 germplasm accessions of different crops, namely, Frenchbean (1685), adzukibean (38), ricebean (50), horsegram (12), foxtail millet (10), finger millet (12), cowpea (12), amaranth (182), buckwheat (550), chenopod (51), maize (34) and husk tomato (29) were grown for characterization. The germplasm is characterized in Augmented Block Design along with two standard and one local check. The data were recorded as per the descriptors developed by NBPGR. The data recorded were analyzed for mean and range and given in table 3 along with promising accession identified for important traits.

Diospyros lotus - a promising minor fruit and rootstock for cultivated persimmon

Rubus ellipticus - a promising minor fruit for domestication in the hills

Apple cultivation replacing buckwheat in Himachal Pradesh



Promising varieties of apricot introduced at Shimla

Table 3: Range, mean and promising accession identified during *kharif*, 2004

Crop	Character	Range	Mean ± SE	Promising accessions (value)
French bean	No. of pods/plant	5.0-56.0	22.52±2.01	EC28657, EC500458, IC328658, IC326959 (>52)
	Pod length (cm)	7.1-15.9	10.80±1.44	EC241425, EC500768, IC326971 (>14.8)
	No. of seeds/pod	4-8	6.21±1.61	EC500779, EC500308, EC500317, IC199227 (>6)
	Days to maturity	76-131	118.80±3.80	IC328657, IC329647, IC326624, EC500773 (<81)
	100 Seed wt. (g)	13:8-65.8	38.15±3.28	EC400391, IC258279, IC329146, EC500534 (>62.8)
Adzuki bean	No. of pods/ plant	17-73	48.11±1.98	EC341952, EC008708, EC340263, EC108080 (>61)
	No. of primary branches	3.5-6.5	4.10±1.09	EC120460, EC108080, EC187896 (>6)
	Days to maturity	115-135	126.94±1.01	EC340247, EC000251, EC182577, EC340263 (<118)
	100 seed wt. (g)	8.6-16.2	11.8±2.15	EC187896, EC290251, EC340284 (>12.8)
Amaranth	Leaf length (cm)	9.4 -30.4	22.64±4.98	IC415274, IC415272, IC415271, IC415236 (>26.9)
	Inflorescence length (cm)	48.5–117.4	74.46±4.52	IC415460, IC423468, IC423448, IC423400 (>104)
	Days to maturity	122-169	148.40±3.77	IC423408, EC519554, EC519532, EC519550 (<135)
	1000 seed wt (g)	0.4-0.8	0.59±0.08	IC415266 (>0.8)
Buckwheat	Leaf length (cm)	4.35–19.75	14.24±1.80	IC381243, IC341674, IC341675, IC107971 (>10.7)
	Cyme length (cm)	2.4–13.15	7.28±1.21	IC109239, IC109551 (>19.9)
	Days to maturity	81.00–145	125.04±4.20	IC411836 (<85)
Chenopod	Inflorescence length (cm)	18.75 – 40.00	29.02±5.49	IC341715, IC411825, IC415477, EC507734 (>34.0)
	Leaf length (cm)	4.8 – 18.25	10.90±1.99	IC415402, IC415402, NIC15022, IC109480 (>16.2)
	Days to maturity	102.00 – 173	150.00±8.24	EC507739, EC507741, EC507734, IC411824 (<115)
	1000 seed wt. (g)	0.3 – 1.4	0.95±1.24	IC415439, IC411824, EC507733, IC328877 (>0.7)

Horticultural crops: During the year following germplasm were characterized

Crop	Accessions	Descriptors	Crop	Accessions	Descriptors
Apple	86	36	Apricot	17	31
Pear	17	35	Walnut	22	32
Plum	23	32	Pecan nut	11	18
Peach	39	35	Persimmon	4	21

The data were analyzed for frequency distribution, range and promising accessions. In apple, early fruit maturing accessions recorded were 31, intermediate 28 and late 27 and average fruit weight ranged from 28 to 235g of which 37 accessions were having less fruit weight (25-75 g); 34 medium (75-125 g) and 13 large (175-226 g). In pear, fruit weight ranged from 35 to 184.0 g and four accessions had good eating quality. In plum, fruit weight ranged from 14 to 89 g. In peach, average fruit ranged from 37-164 g and eight accessions had good fruit eating quality. In apricot, fruit weight ranged from 14-49 g and TSS from 13.70-18.90%. In walnut, variation was observed for nut shape (round, long trapezoid, broad elliptic, ovate, short trapezoid and elliptic), nut diameter from 15.40–33.11 mm, nut length from 18.82–38.74 mm, nut weight from 3.90–8.97 g and kernel (%) from 17.4–52.2. In husk tomato, variability was observed for leaf colour (light green, green, dark green), leaf shape (oblong, roundish oblong, lanceolate, hastate), leaf margin (dentate, serrate, crenate), berry shape (round, globose, oblong) and pulp colour (orange, dark yellow, light green, cream, yellowish orange) among qualitative characters. Promising accessions recorded for some important characters in fruit crops are given in table 4.

Table 4: Promising accessions in different fruit crops

Crop	Character	Promising accessions
Apple	Earliness	EC202711, IC349913, EC100218
	Fruit weight (>200g)	EC127112, EC453536
	TSS (>15%)	EC108179, EC115985, EC100144
	High productivity	EC115820, EC513663, EC127112, EC144038
Pear	Earliness	EC264696, EC280768
	Fruit length (>75mm)	EC126286, EC168557
	Fruit width (>70 mm)	EC126287
	TSS (>14 %)	EC126286
Plum	Earliness	EC382626, EC393740
	Fruit weight (>25g)	EC382624
	TSS (>18%)	EC034048, EC020085
Peach	Earliness (<50 days)	EC174084, EC280769
	Fruit weight (>125g)	EC027793, EC038736
	TSS (>13 %)	EC027793, EC468326, EC468324
Apricot	Fruit weight (>35g)	EC168421, EC280843, EC100224, EC140316
	Eating quality	EC140316, EC140315
	TSS (25 %)	IC349968
Walnut	Nut weight (>10g)	EC38836, IC19370, IC20068, IC20119, IC20107, IC20114
	Kernel weight (>4g)	EC38836, EC26891, IC19370, IC20107
	Thin shelled	EC36748, EC38833, EC26891

16.3. Germplasm Conservation

16.3.1 Germplasm conserved in the MTS: A total of 359 germplasm accessions were conserved in the NGB as voucher specimens and 758 new germplasm accessions were added to the MTS and 958 were replaced by rejuvenation.

16.3.2 Germplasm conserved in the LTS: A total of 804 germplasm accessions of various crops were conserved in the NGB and 55 accessions of wild fruits were kept in cryobank. Besides, germplasm is also conserved as active collections in the MTS (5820) and in the field genebank (828). Crop-wise details are given in below in table 5 and 6.

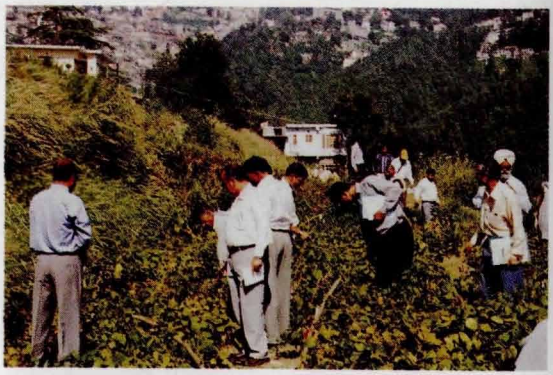
Table 5: Status of germplasm holdings as active collections in MTS as on 31/12/04

Crop	Active collection	MTS	Crop	Active collection	MTS
Amaranth	2658	2278	Horse gram	38	24
Buckwheat	709	659	Pea	197	168
Chenopod	98	91	Lentil	54	39
Frenchbean	2568	2126	*Cuphea*	16	16
Ricebean	231	212	Meetha karela	25	24
Adzukibean	158	154	Husk tomato	29	29

Table 6: Status of germplasm holdings in the field gene bank as on 31/12/04

Crop	Accession	Crop	Accession	Crop	Accession
Apple	155	Plum	26	*Rubus* spp.	26
Pear	51	Pecan nut	12	*Ribes* spp.	5
Apricot	34	Walnut	180	Persimmon	4
Cherry	8	Hazelnut	18	Pomegranate	121
Almond	12	Kiwi	7	Wild & minor fruits	36
Peach	49	Grape	9	M & AP	75

IC 258233 - Buckwheat accession registered for easy dehulling



Scientists from ICAR and SAUs screening germplasm on a field day at Shimla

16.3.3 Conservation of wild relatives of crop plants: A special emphasis was given on the conservation of wild relatives in the field gene bank. The important wild relatives that are being maintained at the station are given in table 7.

Table 7: Status of wild relatives of agri-horticultural crops, minor fruits and some important medicinal plants conserved in the field gene bank

Crops	Crop species
Amaranth	*Amaranthus hybridus, A. retroflexus, A. lividus, A. viridis, A. graecizans, A. dubius, A. spinosus,* and *A. tricolor*
Buckwheat	*Fagopyrum emarginatum, F. tataricum* var. *himalaicum* and *F. gigataenum*
Chenopod	*Chenopodium amaranticolor, C. botrys, C. murale and C. ambrasioides.*
French bean	*Phaseolus lunatus* and *P. coccineus,*
Faba bean	*Vicia hirsuta, V. tetrasperma.*
Apple	*Malus baccata, M. baccata* var. *himalaica, M. baccata* var. *dirangensis* and *M. sikkimensis, Malus glaucensis*
Pear	*Pyrus pyrifolia P. pyrifolia* var. *kumaonii, P. jacquemontii, P. pashia, P. serotina*
Prunus	*Prunus nepaulensis, P. armeniaca, P. cerasoides, Prunus behmie*
Walnut	*Juglans nigra, J. mandshurica, J. ailantifolia*
Hazelnut	*Corylus colurna, C. ferox*
Kiwi	*Actinidia callosa, A. arguta*
Grapes	*Vitis himalayana, V. ficifolia, V. arizonica, V. riparia, V. acerifolia, V. gerdina, V. astivalis, V. amurensis, V.cinerea*
Pistachio	*Pistachio atlantica, P. terebinthus, P. chinensis*
Rubus sp.	*Rubus ellipticus, R. niveus, R. biflorus, R lasiocarpus, R. paniculatus, R. calycinus, R. opulifolius, R. hexagynus*
Ribes sp.	*Ribes nigrum, R. rubrum*
Minor fruits	*Punica granatum, Cotoneaster acuminata, C. frigida; Crataegus wenlandii, C. melanocarpa, C. oxycantha, Feijoa sellowiana, Cydonia oblonga; Docynia hookeriana, D. indica; Viburnum cotinifolium, V. lanata, Cornus oblonga, Elaeagnus umbellata, Castanea crenata, Olea cuspidata., Ziziphus jujuba, Diospyros lotus, Hippophae rhamnoides, Pinus gerardiana, Ficus palmata*
Important medicinal and aromatic plants	*Tinospora cordifolia, Centratherum anthelminticum, Vitex negundo, Celastrus paniculatus, Withania sominifera, Melia azedarach, Bacopa monnieri, Roylea elegans, Acorus calamus, Asparagus adscendens, Habenaria intermedia, Habenaria edgeworthii, Viola serpens, Viola odorata, Hedychium spicatum, Taxus baccata, Heracleum candicans, Thymus serphyllum, Dioscorea deltoidea, Heracleum candicans, Podophyllum hexandrum, Polygonatum cirrhifolium, P. verticillatum, Valeriana wallichii, Asparagus filicinus, Roscoea procera, R. alpina, Achillea millefolium, Bunium persicum, Betula utilis, Ephedra gerardiana*

16.4 Monitoring of seed viability in MTS

The medium term storage module at Shimla became functional in the year 1999. Seeds of the 1998 harvest were kept in the module in aluminum foils after drying the seed at 4-5% moisture content and 8°C. After five years, random samples of French bean, adzuki bean, rice bean, amaranth and buckwheat were taken

and germination test in Petri plates and in pots was conducted. The results are given in the table 8.

Crop	Viability (%)	
	Lab	Pots
French bean	95.49	93.52
Adzuki bean	78.33	65.00
Rice bean	88.49	79.50
Amaranth	77.5	79.75
Buckwheat	100.0	96.50

16.5 Germplasm Supply to Indentors

- **Seeds:** Amaranth (203), buckwheat (136), chenopod (14), French bean (170), rice bean (52), adzuki bean (41), *Melilotus* spp. (4), *Medicago* spp.(25), *Trifolium* spp.(13), *Physalis* spp. (53) and others (13)
- **Rooted plants:** Apple (12), pear (65), peach (13), apricot (17), persimmon (10), almond (1), kiwi (55), plum (2), M & AP (39), pecan nut (8), *Feijoa* spp.(6), walnut (14), quince (10), ornamentals(13)
- **Bud sticks:** Pecan nut (14), apple (70), kiwi (14), pear (50), peach (8), persimmon (100), walnut (40)

Externally Funded Projects

Assessment and data collection on bio-resources of agriculture and forestry for three watersheds in Himachal Pradesh

The project is being operated in Me Gad (high hills), Moolbari (mid hills) and Mandhala (foot hills) watersheds located in Himachal Pradesh. The major objective of the project is to collect data on plant bio-resources from the watersheds and its integration with data of other disciplines such as soil, fauna, hydrology etc. in GIS mode. The data are being generated on plant species richness, classification of flora at species level, genetic erosion, cropping intensity, weed intensity, role of invasive alien species and bio-prospecting potential. Eight surveys were undertaken, 200 herbaria prepared and information on more than 350 plant species of crops, weeds, forestry and grass species was recorded. Conclusions made from the data analysis were

- Fallow land has increased due to low and scanty rainfall, poor/ lack of irrigation facilities, and wild life menace.
- Traditional crops and varieties have been replaced by cash crops and improved varieties. The cultivation of plant like *Aconitum, Angelica* and *Inula* has been taken up recently in Me-Gad watershed.
- Overall share of economic plants in the total plant bio-resources has reduced and unwanted flora has increased manifolds.
- The pollution load of weedy/alien invasive species viz. *Eupatorium, Lantana camara, Ipomoea carnea, Parthenium hystophorus, Ageratum conyzoides, Tricosanthes,* and *Diplocyclus* sp. has increased on cultivated land and grasslands.
- Bioprospecting analysis shows that plant such as *Valleriana, Viola, Polygonatum, Thymus, Habenaria, Roscea, Geranium, Hedychium, Hypericum, Myrica, Rubus* have industrial value and domestication potential.

Germplasm conservation (*ex situ* and *in situ*) of minor millets and pseudocereals in participatory mode in Himachal Pradesh

The main objective of the project is to promote on-farm conservation of minor millets and pseudocereals in some of its diversity rich areas in different parts of HP. Five explorations were undertaken and 136 accessions were collected

which comprised of *Amaranthus hypochondriacus* (44), *A. caudatus* (10), *Fagopyrum esculentum* (13), *F. tataricum* (3), *Chenopodium album* (7), *Eleusine coracana* (37), *Panicum sumatrense* (4), *Panicum miliaceum* (8), and *Setaria italica* (7). Eight sites were selected in Chamba (Bharmour and Holi), Kullu (Gusaini and Bahu), Shimla (Kupvi and Sarhan) and Kinnaur (Nichar and Sangla) for on-farm conservation. 89 farmers were contacted for taking up on-farm conservation and finally 35 were selected depending upon various criteria fixed for selection.

Participants during a brain storming session on 'On-farm conservation' at Shimla

Research Projects (Code: Title, Leader, Associates)

PGR/GEV/BUR-SHM-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and supply of plant genetic resources of Northwestern Indian Himalayan region (VD Verma, JC Rana, SK Yadav -upto30.10.2004, K Pradheep).

PGR/GEV-BUR-SHM-01.01: Augmentation, characterization, evaluation, conservation, maintenance, documentation and supply of germplasm of pseudocereals, pulses and other lesser-known hill crops (JC Rana, VD Verma, SK Yadav-upto 30.10.2004, K Pradheep).

PGE/GEV-BUR-SHM-01.02: Augmentation, characterization, evaluation, conservation, maintenance, documentation and supply of germplasm of temperate fruits, vegetables and medicinal and aromatic plants (VD Verma, JC Rana, SK Yadav -upto 30.10.2004, K Pradheep).

Ad-hoc Research Projects

1 Assessment and data collection on bio- resources of agriculture and forestry for three watersheds in Himachal Pradesh. (DST) (PI - JC Rana).

2. Germplasm conservation (*ex situ* and *in situ*) of minor millets and pseudo-cereals in participatory mode in Himachal Pradesh. (Govt. of Himachal Pradesh) (PI - JC Rana).

17. REGIONAL STATION, SRINAGAR

Summary: Four explorations were undertaken in different areas of Kashmir, Jammu and Ladakh (J&K) and a total of 252 accessions comprising different agrihorticultural crops and their wild relatives were collected. A total of 86 accessions of paddy germplasm were also collected from SKUAST Rice Research Center Regional Station, Khudavani, Kashmir.

NBPGR Regional Station, Srinagar was established in 1989 with major responsibility of germplasm exploration and collection in the region. This station was temporarily closed in 1990 and once again reopened in July 1999. Since then, alongwith its major activity of plant germplasm exploration, evaluation of different agri-horticultural crops are being carried out, despite unfavourable socio-political environment. NBPGR Regional Station, Srinagar office is located at Sanatnagar (8 km away from Lal Chowk of Srinagar towards south direction). Experimental farm of this station is situated at KD Research Farm, Old Airfield, Rangreth, about 14 km from Srinagar City.

17.1 Exploration and Germplasm Collection

Four explorations were undertaken in different areas of Jammu, Kashmir and Ladakh regions and a total of 252 accessions comprising cereals (12), fruits (7), oilseeds (5), vegetables (100), medicinal and aromatic plants (98), and others (38) were collected. A total of 86 accessions of paddy germplasm were also collected from SKUAST Rice Research Center Regional Station, Khudavani, Kashmir.

17.2 Germplasm Evaluation

A total of 231 accessions of wheat (123), barley (57) and mustard (51) were grown during *rabi* (2003- 2004) and a total of 191 accessions were sown during *rabi* (2004-2005) for characterization and evaluation.

Research Project (Code: Title, Project Leader; Associates)

PGR/PGC-BUR-SRI-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources from Jammu and Kashmir region. (KK Gangopadhyay; D Gautam).

18. REGIONAL STATION, THRISSUR

Summary: During the report period, ten explorations were carried out in Kerala, Karnataka, Goa, Tamil Nadu and bordering areas of Andhra Pradesh. A total of 697 accessions comprising cereals (68 accessions), millets (4), fibres (1), fruits (71), grain legumes (37), oilseeds (5), spices (7), tuber crops (37), vegetables (376), wild relatives (75), M&A plants (5) and others (11) were collected. Also eight explorations were undertaken in A & N Islands and 181 accessions comprising cereals & millets (124), fruits (22), grain legumes (2), tuber crops (3), vegetables (9), M&A plants (15) and others (6) were collected. A total of 370 accessions were collected by seven co-operating centres of Zone-II (South West Coastal Region and A & N and Lakshadweep Islands) under NATP-PB. *Solanum melongena* (159 accs), *S. insanum* (42), *S. incanum* (4), and *S. macrocarpum* (1) were collected from Kerala, Tamil Nadu, Karnataka and Pondicherry under the DBT funded project. Rice (196 accs. in *Rabi* and 360 accs. in *Kharif*), horsegram (197), lablab bean (19), bitter gourd (15), taro (60), greater yam (194), jackfruit (72), turmeric (159), black pepper (20), Malabar tamarind (5), *Mucuna* (15), *Curcuma* (275), and *Trichosanthes* (19) were characterized and evaluated using appropriate checks, and promising accessions for important traits were identified. Tissue culture plants of cassava (43 accs.), black pepper (28) and ginger (198) were maintained *in vitro*. A total of 792 accessions were supplied to 15 user agencies. A total of 775 accessions (306 from explorations and 469 from regenerated/ multiplied germplasm) were deposited in the National Genebank for long-term conservation and 229 accs. for cryopreservation.

18.1 Exploration and Germplasm Collection

A total of 697 accessions were collected in 10 exploration missions and one-day trips carried out in Kerala, Karnataka, Goa, Tamil Nadu and bordering areas of Andhra Pradesh. These included 68 accessions of cereals, 4 of millets, 1 of fibre, 71 of fruits, 37 of grain legumes, 5 of oilseeds, 7 of spices, 37 of tubers, 376 of vegetables, 75 of wild relatives, 5 of M&A plants and 11 of others. These were collected from Kerala (146), Tamil Nadu (206), Karnataka (288), Goa (53) and Andhra Pradesh (4).

In all, 491 accessions of exploration material collected by this station were sent to MTS facility at NBPGR, New Delhi. Ninety-three accessions collected by the station were sent to 13 regeneration sites.

Variability in seed colour of field bean germplasm collected from TN

The following unique collections were made:

Acc. No.	Crop / botanical name	Importance
IC 17446	*Abelmoschus moschatus* ssp. *tuberosus*	Rare and endangered species
IC439582 and IC439608	*Nephelium ramboutan-ake*	Pulasan – edible rambutan-like fruits, superior to true rambutan with an average fruit weight of 50g/fruit and with better shelf-life (5 days).
IC439610	*Garcinia wightii*	Wild mangosteen with sour aril, can be used as a rootstock for mangosteen
IC439588	Cucumber	Small white salad landrace of cucumber, cultivated commercially

During eight exploration and collection missions undertaken in Andaman & Nicobar Islands, 181 accessions comprising cereals and millets (124), fruits (22), grain legumes (2), tubers (3), vegetables (9), M&A plants (15) and others (6) were collected.

In 15 exploration and collection missions conducted (13 within Zone-II and 2 outside), 370 accessions of germplasm were collected by seven co-operating centres of Zone-II (South West Coastal Region and A & N and Lakshadweep Islands) under NATP-PB.

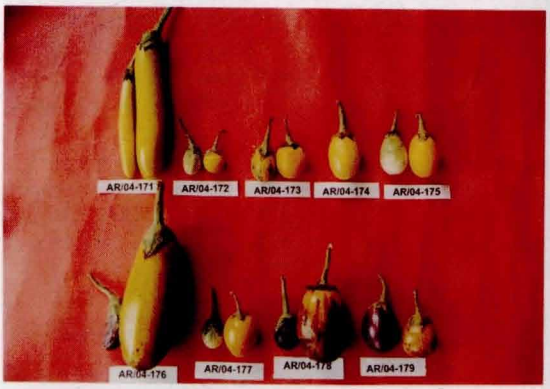
In total, 531 accessions received from 8 co-operating centres were also forwarded to NBPGR, New Delhi for conservation under MTS (223 accs.) and LTS (308 accs.).

Under the DBT funded project, six independent trips and 4 trips combined with NATP-PB missions were carried out resulting in collection of 206 accessions. These included 159 accessions of *Solanum melongena*, 42 of *S. insanum*, 4 of *S. incanum* and one of *S. macrocarpum*. These were collected from Kerala (24), Tamil Nadu (138), Karnataka (38) and Pondicherry (6).

Herbarium specimens of 37 accessions of 13 species were prepared and deposited in the NHCP, NBPGR, New Delhi, comprising both pre-NATP and NATP-PB collected germplasm. A duplicate set of 25 accessions of voucher herbarium specimens comprising 21 of *Solanum insanum* and 4 of *S. incanum* were sent to the BSI, Coimbatore under the DBT Project on *Solanum melongena*.

Variability in tubers of Chinese potato collected from North Kerala

A wild relative of snake gourd collected from Kerala



Variability in brinjal fruits collected from TN

18.2 Maintenance, Characterisation and Evaluation

Rice (*Oryza sativa*): A total of 196 accessions were raised during *rabi* 2003-04 in an Augmented Block Design along with 4 check varieties namely, Ahalya, Jaya, Jyoti and Thulasi and evaluated for 11 quantitative and 13 qualitative characters.

Superior accessions identified for grain yield (> 20 g/plant)

Accession	Mean	Superiority over best	Source of collection check (% increase)
IC 70879	21.5	113.9	Madurai, Tamil Nadu
IC 66295-A2	22.7	125.9	Tiruchirapalli, Tamil Nadu
IC 85807	28.8	187.1	Tindivanam, Tamil Nadu
IC 85812-A	23.1	129.6	Gudalur, Tamil Nadu
IC 85834	30.2	200.8	Uttar Pradesh
EC 182353	20.6	105.3	Sri Lanka
EC 182358	25.3	151.7	Sri Lanka

Best check for grain yield: Thulasi - 10.0 g/plant

During *kharif* 2004, 360 accessions of rice germplasm were evaluated along with 4 checks for 10 quantitative and 14 qualitative characters. All the accessions evaluated were inferior in performance compared to the checks used.

Horsegram (*Macrotyloma uniflorum*): A total of 197 accessions were evaluated in an Augmented Block Design along with 3 checks namely Local 1, Local 2 and CO-1 during *rabi* 2003-04 for 10 qualitative and 9 quantitative characters. Superior accessions identified for seed yield (>6.0 g/ plant) are as follows:

Accession	Mean	Superiority over best check (% increase)	Source of collection
IC145306	6.3	101.6	Bihar
IC068602	6.7	114.6	Palakkad
IC071777	7.0	123.6	Tamil Nadu
EC027602	7.5	139.2	Exotic
Best check for seed yield : CO-1 - 3.1 g/plant			

IC 022791A (source: Madhya Pradesh) showed no infection and IC 145326 (source: Kanyapuram, Madurai, Tamil Nadu) showed 3.9% infection against mosaic virus under field epiphytotic conditions as per the feedback received from RARS, Pattambi (Kerala).

Lablab bean (*Lablab purpureus*): Nineteen accessions of lablab bean were evaluated in Randomized Block Design (RBD) along with 3 checks in 2 replications for 10 qualitative and 7 quantitative characters (in *rabi* 2003-04).

Bitter gourd (*Momordica charantia*): Fifteen accessions of bitter gourd were evaluated during *kharif* 2004 along with 3 check varieties namely Priya, Preethi and Priyanka in an Augmented Block Design for 18 qualitative and 16 quantitative characters.

Greater yam (*Dioscorea alata*): A total of 194 accessions of greater yam were planted in the field (two pits per accession) during *kharif* 2002. Of these, one pit/accession was harvested during 2003 and the other pit was left as such for observing the performance of the crop on leaving permanently in the field without harvesting. The second pit was harvested in 2004. Data on tuber traits *viz.*, number of tubers, larger tuber weight, smaller tuber weight

and total weight were recorded in 149 accessions. This indicated that germplasm of greater yam need not be regenerated annually; instead the tubers can be left without harvesting for two years continuously, with no loss of germplasm thereby reducing the cost of field maintenance.

Jackfruit (*Artocarpus heterophyllus*): Out of 72 accessions of jackfruit maintained, 57 flowered and fruited during 2004. These accessions were observed for number of fruits per tree. Out of 57 accessions that flowered and fruited this year, 20 were observed for 25 fruit and seed characters (16 quantitative and 9 qualitative).

Turmeric: A total of 159 accessions were raised in an Augmented Block Design along with 4 check varieties namely, Sobha, Kanthi, Suvarna and Pattikkad Local. These were evaluated for 23 quantitative characters. IC212587, -212580, -137051 and -310563 were found to be superior over the check varieties and are presented below:

IC No.	Total fresh rhizome wt/ plant (g)	Total mother rhizome wt/ plant (g)	Fresh tuber wt (g)	Dry wt. (%)	Total dry tuber wt (g)	Source
IC212587	275.5	65.0	100.0	84.6	109.1	Karbi Anglong, Assam
IC212580	557.9	74.1	105.0	90.5	68.4	Shillong, Meghalaya
IC137051	105.9	92.7	108.3	99.1	142.4	NBPGR, Thrissur
IC310563	431.4	65.1	111.6	87.4	118.7	Visakhapatnam, AP
Sobha	110.0	67.5	42.5	32.8	27.1	KAU, Thrissur, Kerala
Kanthi	67.5	40.0	27.5	37.7	19.8	KAU, Thrissur, Kerala
Suvarna	75.0	50.0	27.5	32.0	22.7	KAU, Thrissur, Kerala
Pattikkad Local	72.5	47.5	25.0	26.1	18.9	Thrissur, Kerala

Black pepper (*Piper nigrum*): In black pepper, 20 accessions were characterized for 14 quantitative and 7 qualitative characters during *rabi* 2003-04.

Malabar tamarind (*Garcinia cambogia*): Five accessions of Malabar tamarind were studied for 15 fruit characters. IC IC244100-2 (INGR No. 04061) and IC244111-1 (INGR No. 04062) were registered as genetic stocks.

Kokam (*Garcinia indica*): In kokam, yield traits, namely, total fruit weight, total number of fruits and average fruit weight were recorded in 3 accessions as detailed below. IC136687-3 was found superior to other accessions and registered as a genetic stock (INGR no.04063).

Accession No.	Total no. of fruits/ tree/ year	Total fresh fruit wt/ tree/ year (kg)	Average fresh fruit wt (g)
136687-2	465	9.8	21.1
136685-1	1915	24.0	12.5
136687-3	2087	33.5	16.1

Mucuna pruriens: Fifteen accessions of *Mucuna pruriens* were characterised for 9 quantitative characters during *rabi* 2004-05..

***Curcuma* spp:** During *kharif* 2004, incidence of Taphrena leaf spot and Colletotrichum leaf blotch diseases was studied in 275 accessions of *Curcuma* species. Taphrena leaf spot disease was not observed so far in wild *Curcuma* species but it is common in turmeric. Coletotrichum leaf blotch was not noticed in *C. aeruginosa* (4 accs.), *C. comosa* (2 accs.), *C. caesia* (5 accs.), *C. mangga* var. *sylvestris* (4 accs.), *C. coriacea* (4 accs.), *C. kudagensis* (2 accs.) and *C. pseudomontana* (2 accs.). Forty-four accessions in seven species of *Curcuma* with scale leaves (glabrous, ovate/ oblong and their tip obtuse/acute with hairs) were characterised.

***Dioscorea* spp.**: Eight accessions of *Dioscorea* species (*D. pentaphylla* – 6 and *D. wallichi* – 2) were observed for 20 qualitative and 9 quantitative vegetative characters.

***Trichosanthes* spp.:** Nineteen accessions of *Trichosanthes* spp. were characterized for 19 qualitative and 14 quantitative characters and it was observed that the accessions did not have variability for qualitative characters.

Establishment of introduced germplasm: Ten accessions of *Macadamia integrifolia* were received from the Director, Maroochy Horticultural Research Station, Queensland, Australia through the Head, GEX, NBPGR, New Delhi making a total holding of 20 accessions of surviving exotic germplasm.

18.3 Analysis of Genetic Diversity and Phylogenetic Relationship in *Solanum melongena* L. and Related Wild and Weedy Taxa

***Ex situ* characterisation: *Solanum* spp.:** Twenty accessions of *Solanum* spp. comprising five of *Solanum insanum*, three of brinjal and 12 of intermediate types raised during *rabi* 2003-04, in 3 replications were studied for 17 qualitative and 14 quantitative characters.

***In situ* characterisation:** Two accessions of *Solanum incanum*, eight of brinjal and 14 of *S. insanum* were characterised for 14 quantitative characters at the time of collection. The results indicated that there were significant differences among the species studied in plant height, stem prickle number per 10 cm and fruit pedicel prickle number. Six accessions of *Solanum insanum*, 8 of brinjal and 2 of *S. incanum*, collected from Tamil Nadu, were studied for 14 quantitative characters under *in situ* conditions.

Thirty-five accessions of brinjal were characterised for 10 quantitative characters *in situ* at the time of collection.

Twenty accessions of *Solanum insanum* and one accession of *S. incanum*, raised in 3 replications during the year 2004-05, were characterised for 13 quantitative and 8 qualitative characters.

18.4 *In Vitro* Propagation and Conservation

Tissue culture work was continued in the following crops/species and the results are summarised below:

Multiplication:

Species	Explant	Medium used (for multiplication)	No. accs. in culture
Zingiber officinale (Ginger)*	Rhizome buds	MS+BAP 2.5 mg/l	145*
Curcuma amada (1), *C.raktakanta* (1)	Rhizome buds	MS+BAP 2.5 mg/l	2
Dioscorea belophylla (1), *D.bulbifera* (1), *D. hispida* (1), *D.intermedia* (1), *D.oppositifolia* (1), *D.pentaphylla* (5), *D.pubera* (1), *D. tomentosa* (1)*D.wallichi* (1),	Nodal cuttings, axillary buds & shoot tip	MS	13
Garcinia cambogia (Malabar tamarind)	Shoot tip,	MS+BAP 0.5 mg/lMS+BAP 6 mg/l + NAA 2 mg/l	1
Garcinia indica (Kokam)	Shoot tip	MS+BAP 1 mg/l + Kinetin 0.5 mg/ lMS+BAP 2 mg/l + NAA 1 mg/lWPM +BAP 1mg/l	4

* Cultures transferred from TC & CP Unit, NBPGR, New Delhi

Conservation:

Crop	No. of accs. conserved	Medium used
Cassava	43	MS + Manitol 30g/ l+Sucrose 10g/l + Agar 6g/l
Black pepper	28	½ MS + Sucrose 15g/ l+Agar 6.5g/l
Ginger	53 + 145*	MS+BAP 2.0mg/ l+Sucrose 60g/l+ Agar 7g/l

* Cultures transferred from TC & CP Unit, NBPGR, New Delhi

In ginger, 22 accessions were planted in pots after hardening which proved the method being used since 2002 as working well without any mortality.

18.5 Germplasm Supply

A total of 792 accessions was supplied to 15 user agencies.

18.6 Germplasm Conservation

During the year under report, 119 accessions of *Vigna* spp., 77 of okra, 35 of rice received from KAU, Pattambi and 2,900 accessions in 5 species of *Triticum* and 27 of *Aegilops* brought from IARI, RS, Wellington were added to the MTS facility making a total of 11,778 including all crops and wild relatives.

A total of 306 accessions of exploration material was sent for conservation in the National Genebank, NBPGR, New Delhi for LTS.

Four hundred and sixty nine accessions regenerated and multiplied at this station were sent to the National Genebank, NBPGR, New Delhi for LTS.

A total of 229 accessions were sent to TC & CP Unit, NBPGR, New Delhi for cryopreservation and *in vitro* conservation.

Research Projects (Code: Title, Project Leader, Associates)

PGR/GEV-BUR-THR-01.00: Augmentation, characterisation, evaluation, maintenance, regeneration, conservation, documentation and distribution of plant genetic resources in southern India (Z Abraham)

PGR/GEV-BUR-THR-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of field crops (K Joseph John).

PGR/GEV-BUR-THR-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of horticultural crops (KC Velayudhan).

PGR/GEV-BUR-THR-01.03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of wild relatives of crops and economically important species (spices, medicinal & aromatic plants) (M Abdul Nizar).

PGR/GEV-BUR-THR-02.00: Use of *in vitro* technology for mass propagation and conservation of clonally / vegetatively propagated crops and their wild relatives (Z Abraham).

Externally Funded Projects

1. DBT Project "Analysis of genetic diversity and phylogenetic relationship in *Solanum melongena* L. and related wild and weedy taxa"
2. National Agricultural Technology Project on Sustainable Management of Plant Biodiversity (up to 31 December 2004)

19. GENERAL INFORMATION

19.1 Institute Management Committee

Chairman: Dr BS Dhillon, Director, NBPGR, New Delhi.

Members: Dr SP Tiwari, ADG (Seeds), ICAR, Krishi Bhawan, New Delhi; Director (Agriculture), Govt of Rajasthan, Jaipur; Development Commissioner (Rural), Govt of Delhi, New Delhi; Dr KL Chadha, Ex DDG (Horticulture), ICAR and National Professor, 7281, B-10, Vasant Kunj, New Delhi; Dr RK Arora, IPGRI South Asia Office, Ch Devi Lal NASC Complex, Pusa campus, New Delhi; Dr Rajendra Kumar, Head, Division of Seed Science and Technology, IARI, New Delhi; Dr JL Karihaloo, Project Director, NRC on DNA Fingerprinting, NBPGR, New Delhi; Dr RK Khetarpal, Head, Plant Quarantine Division, NBPGR, New Delhi; Dr Beche Lal, Principal Scientist, Plant Quarantine Division, NBPGR, New Delhi; Dr (Ms) Kalyani Srinivasan, Senior Scientist, Germplasm Conservation Division, NBPGR, New Delhi; Shri KK Hamja, Finance & Accounts Officer, IASRI, New Delhi.

Member Secretary: Ms Namrata Sharma, SAO, NBPGR, New Delhi.

The 28th, 29th and 30th meetings of IMC were held on 7th August 2004, 26th October 2004 and 21st December 2004 respectively under the Chairmanship of Dr BS Dhillon, Director, NBPGR.

19.2 Research Advisory Committee

Chairman: Dr EA Siddiq, National Professor, Directorate of Rice Research, Hyderabad-30

Members: Dr P Puspangadan, Director, NBRI, Lucknow (UP); Dr BL Jalali, Director (Research), CCSHAU, Hisar (Haryana); Dr AS Khera, 903, Phase 3-B-2, Sector 60, Mohali, Chandigarh (Punjab); Dr RK Arora, Ex-Coordinator, IPGRI, Pusa Campus, New Delhi; Dr KL Chadha, National Professor, IARI Campus, New Delhi; Padamshri Chandi Dan Detha, Roopayan Sansthan, Borunda, Jodhpur (Rajasthan); Dr DV Seshu, 208 Park View Enclave, Road No. 2, Banjara Hills, Hyderabad (AP).

Ex Officio Members: Director, NBPGR, New Delhi; ADG (Seed), ICAR, New Delhi; Two persons representing agricultural/ rural interests on the Management Committee of the NBPGR.

Member Secretary: Dr. PC Agarawal, Principal Scientist, NBPGR, New Delhi.

A meeting of RAC was held under the Chairmanship of Dr EA Siddiq on 14-15 May, 2004 at NBPGR, New Delhi.

19.3 Staff Research Council

Chairman: Dr BS Dhillon, Director, NBPGR, New Delhi

Member Secretary: Dr AK Singh, Head, Division of Germplasm Conservation, NBPGR

Following the guidelines from ICAR, the first (main) SRC meeting of the Bureau was conducted on 17-20 May 2004 and the second meeting was held on 17-19 November 2004. Dr BS Dhillon, Director, NBPGR chaired the meetings. The Secretary SRC presented the action taken report based on the recommendations of previous SRC and the house approved the proceedings of the same. Progress in all the projects (including externally

funded projects) both from Headquarters and Regional Stations was reviewed and emphasis was laid on fostering inter-institutional linkages especially for germplasm evaluation activities.

19.4 Institute Joint Staff Council

Chairman: Dr BS Dhillon, Director, NBPGR, New Delhi

Secretary (Official Side): Dr (Ms) Veena Gupta, Sr. Scientist

Members (Official Side): Dr Shamsher Singh, Principal Scientist; Dr SK Malik, Sr. Scienist; Ms Namrata Sharma, SAO, NBPGR; Mr BK Bansal, F&AO, NBPGR.

Secretary (Staff side): Mr Lalu Rai, SSGr-II

Members (Staff Side): Mr SS Ranga, T-5; Mr Rakesh Singh, T-5; Mr Yogesh Kumar Gupta, Sr. Clerk; Mr Girish Chandola, Sr Clerk; Mr Mahesh Ram, SSGr.

19.5 Personnel

i. **Scientific Staff**

Name	Designation	Discipline
Dr BS Dhillon	Director	RMP
Division of Germplasm Evaluation		
Dr Mahendra Singh	Head	Genetics
Dr RK Mahajan	Principal Scientist	Agricultural Statistics
Dr SK Pareek	Principal Scientist	Agronomy
Dr S Mandal	Principal Scientist	Biochemistry
Dr Ranbir Singh	Principal Scientist	Economic Botany
Dr (Ms) Saroj Sardana	Principal Scientist	Plant Breeding
Dr DC Bhandari	Principal Scientist	Economic Botany
Dr RP Dua	Principal Scientist	Plant Breeding
Dr IS Bisht	Senior Scientist	Plant Pathology
Dr Ashok Kumar	Senior Scientist	Plant Breeding
Dr RC Agarwal	Senior Scientist	Agricultural Statistics
Dr VK Dobhal	Senior Scientist	Plant Breeding
Dr Vandana Joshi	Senior Scientist	Economic Botany
Dr Dinesh Kumar	Senior Scientist	Plant Breeding
Dr Ambrish Sharma	Senior Scientist	Plant Breeding
Mr NK Gautam	Scientist (Selection Grade)	Economic Botany
Mr Gunjeet Kumar	Scientist	Horticulture
Ms Sangeeta Yadav	Scientist	Biochemistry
Dr (Mr) Archana Peshin	Scientist	Agricultural Chemistry
Dr S K Yadav	Scientist	Horticulture
Division of Plant Exploration and Collection		
D. SS Malik	Head & Principal Scientist	Economic Botany
Ms E Roshini Nair	Principal Scientist	Economic Botany

Dr (Ms) Anjula Pandey	Senior Scientist	Economic Botany
Dr KC Bhatt	Senior Scientist	Economic Botany
Division of Germplasm Conservation		
Dr AK Singh	Head	Plant Breeding
Dr Sidheshwar Prasad	Senior Scientist	Electrical Engineering
Dr (Ms) Neeta Singh	Senior Scientist	Plant Physiology
Dr Sanjeev Saxena	Senior Scientist	Plant Physiology
Dr (Ms) K Srinivasan	Senior Scientist	Plant Physiology
Dr (Ms) Veena Gupta	Senior Scientist	Economic Botany
Ms J Radhamani	Scientist (Selection Grade)	Plant Physiology
Dr Vivek Mitter	Scientist (Sr. Scale)	Seed Technology
Ms Anjali Kak	Scientist (Sr. Scale)	Economic Botany
Ms Chitra Devi	Scientist	Seed Technology
Division of Plant Quarantine		
Dr RK Khetarpal	Head & Principal Scientist	Plant Pathology
Dr Arjun Lal	Principal Scientist	Nematology
Dr Shamsher Singh	Principal Scientist	Plant Pathology
Dr PC Agarwal	Principal Scientist	Plant Pathology
Dr Beche Lal	Principal Scientist	Agricultural Entomology
Ms Usha Dev	Principal Scientist	Plant Pathology
Ms Manju Lata Kapur	Principal Scientist	Agricultural Entomology
Dr Rajan	Senior Scientist	Nematology
Dr DB Parakh	Senior Scientist	Plant Pathology
Dr Baleshwar Singh	Senior Scientist	Plant Pathology
Dr (Ms) Shashi Bhalla	Senior Scientist	Agricultural Entomology
Dr (Ms) Celia Chelam	Scientist (Senior Scale)	Plant Pathology
Dr (Ms) Kavita Gupta	Scientist (Senior Scale)	Agril. Entomology
Germplasm Exchange Unit		
Dr Ranvir Singh	Pr. Scientist & In Charge	Economic Botany
Mr Deep Chand	Scientist (Selection Grade)	Economic Botany
Dr (Ms) Vandana Tyagi	Scientist (Senior Scale)	Economic Botany
Ms Nidhi Verma	Scientist (Senior Scale)	Economic Botany
Dr Anil Kumar Singh	Scientist	Economic Botany
Tissue Culture and Cryo Preservation Unit		
Dr BB Mandal	Principal Scientist	Genetics & Cytogenetics
Dr (Ms) Rekha Chaudhary	Senior Scientist	Economic Botany
Dr RK Tyagi	Senior Scientist	Economic Botany
Dr (Ms) Ruchira Pandey	Senior Scientist	Economic Botany
Dr (Ms) Neelam Sharma	Senior Scientist	Economic Botany
Dr (Ms) Anuradha Agarwal	Senior Scientist	Economic Botany

Dr (Ms) Sandhya Gupta	Scientist (Senior Scale)	Economic Botany
Dr SK Malik	Scientist (Senior Scale)	Economic Botany
Dr Zakir Hussain	Scientist	Genetics
Regional Station, Shillong		
Dr DK Hore	Pr. Scientist & In-charge	Economic Botany
Mr Rakesh Srivastava	Senior Scientist	Horticulture
Dr WL Barwad	Senior Scientist	Agriculture Entomology
Regional Station, Thrissur		
Dr Z Abraham	Pr. Scientist & In-charge	Economic Botany
Mr KC Velayudhan	Principal Scientist	Economic Botany
Mr Joseph John K	Scientist (Selection Grade)	Economic Botany
Sh Mohd Abdul Nizar	Scientist (Senior Scale)	Economic Botany
Ms Asha KI.	Scientist (Senior Scale)	Economic Botany
Ms M Latha	Scientist (Senior Scale)	Plant Breeding
Dr R Senthil Kumar	Scientist	Horticulture
Regional Station, Jodhpur		
Dr NK Dwivedi	Pr. Scientist & In-charge	Economic Botany
Dr (Ms) Neelam Bhatnagar	Senior Scientist	Economic Botany
Dr S Gopalkrishnan	Scientist	Plant Breeding
Regional Station, Ranchi		
Dr JB Tomar	Pr. Scientist & In-charge	Economic Botany
Dr VK Gupta	Senior Scientist	Plant Breeding
Regional Station, Shimla		
Dr VD Verma	Pr. Scientist & In-Charge	Economic Botany
Dr JC Rana	Senior Scientist	Plant Breeding
Mr K Pradheep	Scientist	Economic Botany
Regional Station, Akola		
Dr I.P Singh	Pr. Scientist & In-charge	Plant Breeding
Mr Nilamani Dikshit	Scientist (Sel. Grade)	Economic Botany
Regional Station, Bhowali		
Dr KS Negi	Sr. Scientist & In-charge	Economic Botany
Mr KC Muneem	Principal Scientist	Plant Pathology
Dr SK Verma	Senior Scientist	Horticulture
Base Centre, Cuttack		
Dr DP Patel	Pr. Scientist & In-Charge	Economic Botany
Mr Diptiranjan Pani	Scientist	Economic Botany
Regional Station, Hyderabad		
Dr KS Varaprasad	Pr. Scientist & In-charge	Nematology
Dr RDVJ Prasada Rao	Principal Scientist	Plant Pathology
Dr SK Chakraborty	Senior Scientist	Plant Pathology

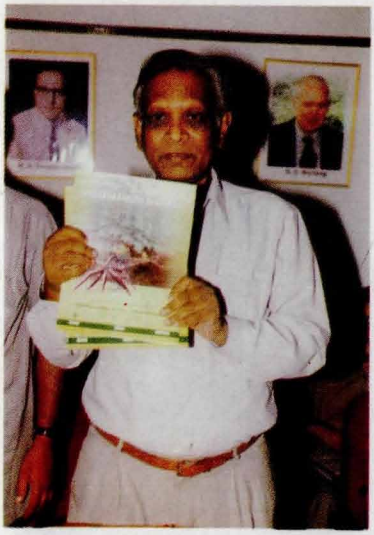
Dr B Sarath Babu	Senior Scientist	Agricultural Entomology
Mr SR Pandrawada	Scientist (Selection Grade)	Economic Botany
Ms Kamla Venkateshwaran	Scientist (Sel. Grade)	Economic Botany
Dr Natrajan Sivaraj	Senior Scientist	Economic Botany
Ms Anitha Kodaru	Senior Scientist	Plant Pathology
Ms T Rama Srinivasan	Scientist (Senior Scale)	Horticulture
Mr Neelam Sunil	Scientist	Economic Botany
Regional Station, Srinagar (J & K)		
Dr KK Gangopadhyay	Senior Scientist	Horticulture
Under Utilised and Under Exploited Plants		
Dr BS Phogat	Senior Scientist	Agronomy
Dr Hanuman Lal Raigar	Scientist	Agricultural Statistics
NRC on DNA Fingerprinting		
Dr JL Karihaloo	Project Director	Genetics & Cytogenetics
Dr (Ms) G Randhawa	Senior Scientist	Plant Physiology
Dr KV Bhatt	Senior Scientist	Plant Breeding
Dr MK Rana	Scientist (Senior Scale)	Plant Breeding
Mr Sunil Archak	Scientist	Bio–Technology
Ms Lalit Anand	Scientist	Bio-Chemistry
Ms Madhu Bala	Scientist	Computer Application
Dr (Ms) Ambika Baldev	Scientist	Bio–Technology
Mr Rakesh Singh	Scientist	Bio–Technology

II. Administrative Staff

Name	Designation
Ms Namrata Sharma	SAO
Mr BK Bansal	F&AO
Mr RP Dhasmana	AAO
Mr ML Bagga,	AAO
Mr Umesh Chandra Sati	Security Officer
Ms Archna Raghav	AD (OL)

III. Technical Staff (T-6 and above)

Name	Designation
Division of Germplasm Evaluation	
Dr Om Prakash Dahiya	T-6
Mr Jitender Mohan	T-6
Mr Harinder Singh	T-6
Dr PS Mehta	T-6
Ms Poonam Suneja	T-6



Dr E A Siddiq, Chairman, Research Advisory Committee releasing Catalogue on Cassava Genetic Resources

Division of Plant Exploration	
Sh. Dr Anil Kumar Singh	T-6
Dr CS Raghav	T-6
Division of Germplasm Conservation	
Mr Suresh Chander Sharma	T-8
Mr BP Dahiya	T-7
Dr (Ms) Manju Upreti	T-6
Ms Rita Rani	T-6 (Artist)
Tissue Culture & Cryo-Preservation Unit	
Sh. Ram Prasad Yadav	T-6
Germplasm Exchange Unit	
Mr Satya Pal Singh	T-6
Division of Plant Quarantine	
Smt. Indra Rani	T-6
Sh. Charan Singh	T-6
Mr KD Joshi	T-6
Technical Cell	
Sh. Rajiv Mathur	T-6
Dr Ranbir Singh Rathi	T-6
Hindi Unit	
Miss Sheela Kumari	T-6
NRC on DNA Fingerprinting	
Sh. Daya Shankar	T-6
NBPGR Regional Stations	
Mr Babu Abraham	T-6, Hyderabad
Mr BC Bachhawandia	T-6, Jodhpur
Mr Brij Pal Singh	T-6, Shimla
Mr K Ashokan Nair	T-6, Thrissur

19.6 Staff Reservations

Total number of employees in position and number of scheduled castes and scheduled tribes employees among them as on 31.12.2004

Dr P L Gautam, VC, GBPUA&T, Smt Radha Singh, Secretary, Agriculture with Dr B S Dhillon, Director, NBPGR looking on variability displayed by RS Bhowali

19.7 Staff Joined NBPGR (HQs) on Transfer

1. Mr Ranjit Singh, T-2 (Driver) transferred from NBPGR Regional Station, Bhowali to New Delhi wef 3-2-2004.
2. Dr SK Yadav, Scientist (Horticulture) transferred from Regional Station, Shimla to New Delhi wef 1-11-2004.

19.8 Promotions

1. Mr Babu Abraham, promoted as T-6 at NBPGR Regional Station, Hyderabad.
2. Mr Satya Pal Singh, promoted as T-6 at NBPGR (HQs), New Delhi.
3. Mr K Ashokan Nair, promoted as T-6 at NBPGR Regional Station, Thrissur.

Category	Total no. of Employees	Total no. of Scheduled Caste Employees	Total no. of Schedule Tribe Employees	Total no. of OBC Employees
Scientist	112	12	1	16
Technical	120	17	14	5
Administrative	61	14	4	1
Supporting	149	39	4	13

4. Mr KD Joshi, promoted as T-6 at NBPGR (HQs), New Delhi.
5. Ms Rita Gupta, promoted as T-5 at NBPGR (HQs), New Delhi.
6. Mr SS Bhoj, promoted as T-4 at NBPGR (HQs), New Delhi.
7. Mr SK Ojha, promoted as SS Gr III at Regional Station, Shillong.
8. Mr M Sriniwas, promoted as SS Gr II at Regional Station, Hyderabad wef 7-6-2004.
9. Mr KK Baklan, promoted as SS GR II at Regional Station, Thrissur wef 7-6-2004.
10. Mr Dhan Raj, promoted as SS Gr III at Issapur Farm, New Delhi wef 7-6-2004.
11. Mr Rantu Maya, promoted as SS Gr III at NBPGR (HQs), New Delhi wef 7-6-2004.
12. Mr Mohan singh, promoted as SS Gr IV at Regional Station, Bhowali wef 7-6-2004.
13. Mr Bhowani Dutt, promoted as SS Gr IV at Reg. Station, Bhowali wef 7-6-2004.

19.9 Awards / Honours

- M/ S. Pesticides Industries "Gold Medal" during the West Zone Meet of Indian Society of Mycology and Plant Pathology held on June 15, 2004 at Rajasthan College of Agriculture, MPUAT, Udaipur for the paper entitled "Prevalence of *Bean common mosaic virus* on urdbean and mungbean in India" by Dinesh Chand, V Celia Chalam, RK Khetarpal, Akhilesh Mishra, Anju Jain and Jitendra Mohan.
- Dr R K Khetarpal received the K C Mehta Manoranjan Mitra Memorial Lecture Award 2004 by Indian Phytopathological Society, New Delhi
- Best Poster Award in First Indian Horticultural Congress, 6-9 November 2004 at IARI, New Delhi for the paper entitled "Pest risk analysis for export of grapes under WTO Régime" by Shashi Bhalla, Rajan, Manju Lata Kapur and R K Khetarpal.
- Dr. Rekha Chaudhary, Sr. Scientist received the Panjabrao Deshmukh Woman Agricultural Scientist Award of the ICAR for the year 2003 for her outstanding contribution in the field of plant genetics. She has developed several cryopreservation protocols for diverse germplasm using different explants.

19.10 Deputation/ visit Abroad

Dr JL Karihaloo	Fifth International Symposium on *InVitro* culture and Horticulture Breeding	Debrecen, Hungary, 12-17 September, 2004
Dr Pratibha Brahmi	Global Training of Trainers Workshop on Law and Policy of Relevance to the Management of Plant Genetic Resources	Leipzig, Germany 19-24 July, 2004
Dr R K Khetarpal	XV International Plant Protection Congress	Beijing, China, May 11-16, 2004

19.11 Field Day Organized

1. A field day on Frenchbean, buckwheat, ricebean, adzukibean, amaranth and kiwi was organized on 3rd August, 2004 at Regional Station, Shimla.

2. Germplasm field day on black pepper and wild *Piper* species was organized on 22nd December, 2004 in which 13 participants from Agricultural Universities in Kerala and Tamil Nadu and IISR, Kozhikode participated. Among them 5 were women scientists, 1 from ICAR institute and 12 from SAUs. One indent for 10 accessions of black pepper and 5 of long pepper were received for supply of germplasm.

3. Germplasm field day on wild *Oryza* species was conducted on 28th December, 2004 in which eight participants from Agricultural Universities in Kerala and Tamil Nadu took part. Among them 4 were women scientists and all were from SAUs.

4. A field day for germplasm awareness was organised on the October 5th, 2004 at the Regional Station, Jodhpur in which 60 participants including farmers, scientists, research scholars and technical officers attended the field day and selected germplasm accessions.

5. Two field days were organized for different rabi crops, oilseeds and pulse crops on 20th March at Experimental Farm, Issapur and for wheat, barley and Triticale on 26th March, 2004 at New Delhi. A large number of scientists from different Institutes/ SAUs participated in the field days and selected the material of their choice for utilization in crop improvement programmes.

6. Field day on pigeonpea germplasm was organized on 5th February, 2004 at NBPGR RS and at ICRISAT centre. Breeders from NARS have participated in the field visit and interactive session.

7. Field day on sunflower germplasm was organized on 6th February, 2004 at NBPGR Regional Station. Five breeders from Directorate of Oilseeds Research, National Research Centre for Sorghum and Agricultural Research Institute, Rajendranagar participated in the programme.

8. Field day on groundnut germplasm was organized on 25th March, 2004 at NBPGR RS and at ICRISAT center. Breeders from NARS participated in the field visit and interactive session.

19.12 Workshops/ Group Meetings/ Trainings Organized by NBPGR during 2004

#	Title of the programm	Duration	Venue
1	Group meeting of cooperators (CCPIs of Zone-VIII) of NATP-PB	16 October	CICR, Nagpur
2	Zonal (Zone-VI) Group Meetings of CCPIs under NATP-PB	3-4 June	Regional Station, Shimla
3	An orientation training on "Characterization of Wild Relatives including Vegetatively Propagated Plant Materials and Post Collection Care of Germplasm"	27-30 August	Regional Station, Shimla
4	A Brainstorming session on the "*In Situ* Conservation of Native Hill Crops" organized in collaboration with *Directorate of Agriculture, Govt. of HP*	August 124	Regional Station, Shimla
5	Three month on-job training on "Collection and Evaluation of Plant Genetic Resources"	1 October to 31 December	Regional Station, Shimla
6	A training programme on 'Wild relatives of crop plants and the post handling care of collected germplasm'	26-28 July	Regional Station, Shillong
7	Group meeting of cooperators (CCPIs of Zone-V) of NATP-PB	29 July	Regional Station, Shillong
8	A one-day grass root level training for women farmers on Agricultural Biodiversity	8 March	Regional Station, Thrissur
9	Group meeting of cooperators (CCPIs of Zone-II) of NATP-PB	6 July	Regional Station, Thrissur
10	Sixth on-job short training course under ToE mode on "Germplasm Exploration, Collection and Field Evaluation	1 August to 31 December	Regional Station, Thrissur
11	Training on "Wild Relatives of Crop Plants and Post Collection Care of Germplasm"	5 to 8 October	Regional Station, Thrissur
12	Group meeting of cooperators (CCPIs of Zone-III) of NATP-PB	17 August	Base Center, Cuttack
13	A training programme on "Wild Relatives of Crop Plants"	27 September to 1 October	NBPGR, New Delhi
14	Plant varieties protection and farmers' rights (PVPFR)	6 April	Reg. Station, Hyderabad
15	Group meeting of cooperators (CCPIs of Zone-I) of NATP-PB	25 June	Regional Station, Jodhpur
16	Fifth Orientation Course on "Biosafety Considerations for Evaluation of Transgenic Crops"	22 November to 1 December	NBPGR, New Delhi
17	A training programme on "Principles and Techniques of Seed Storage and Genebank Management"	19 to 31 July	NBPGR. New Delhi
18	A short-term training programme on 'Intellectual Property Rights and PGR Management'	30 August to 2 September	Reg. Station, Hyderabad Reg. Station, Hyderabad
19	On-Job training on Documentation, Information Management, and Policy issues under NATP sub-project on HRD on Plant Genetic Resources Management in TOE mode	1 August to 31 October	

19.13 Participation of staff in workshops/trainings/seminars/symposia etc.

Name of employee	Title of the Seminar/Symposium/ conference	Place and period
A K Singh, Neeta Singh, Sanjeev Saxena, Kalyani Srinivasan, Veena Gupta, J Radhamani, Anjali Kak & Chitra Pandey	National Conference on Seed- A Global Perspective	26-28 March, 2004
AK Singh	National Symposium on "Harnessing Heterosis in Crop Plants"	IIVR, Varanasi 13-15, March 2004.
AK Singh	National Symposium on "Enhancing Productivity of Groundnut for Sustaining Food and Nutritional Security"	DOR, Hyderabad 13-14, October 2004
AK Singh	National Symposium on "Resource Conservation and Agricultural Productivity"	PAU, Ludhiana 22-25 November 2004
AK Singh	International Conference on "Agricultural Heritage of Asia"	NAARM, Hyderabad 5-7, December 2004
AK Singh, Arjun Lal, Manju Lata Kapur, Shashi Bhalla, S Prasad, Neeta Singh, S Saxena, K Srinivasan, Veena Gupta, J Radhamani, Anjali Kak, Chitra Pandey	National Conference on Transgenics in Indian Agriculture	NASC, New Delhi 9-10 March 2004
Ambrish Kumar Sharma	Training programme on Remote Sensing Techniques with Special Emphasis on Agro-ecosystem Management	IARI, New Delhi 28 April - 22 May.
Ambrish Kumar Sharma	Training programme on "DUS Testing in Maize"	CRIDA, Hyderabad 30 Dec. 2004 to 3 Jan. 2005
Anitha Kodaru	*Jatropha* seed procurement committee meeting	Hyderabad18th December 2004
Anuradha Agrawal	National Symposium on 'Frontiers of Science' organized by DST	INSA, New Delhi 11-12 December, 2004
Arjun Lal, Manju Lata Kapur, Shashi Bhalla	First Indian Horticultural Congress	IARI, New Delhi 6-9 November 2004
Ashok Kumar, KC Bhatt	XIV Group Meeting of All India Network Project (AINP) on Medicinal and Aromatic Plants	MPUA&T, Udaipur 11-14. December 2004
B Sharath Babu, N Sunil	Short-term training programme on 'Intellectual Property Rights and PGR Management'	NAARM, Hyderabad August 30-September 2, 2004
Bhag Chand	Training course on "Principles and Techniques of Seed Storage and Genebank Management'	NBPGR, New Delhi 19th to 31st July, 2004
Bhatt KC, KK Gangopadhyay, CS Raghav	National Seminar on Cultivation, Harvesting and Scientific Exploitation of Seabuckthorn	FRL, Leh 26-27 August 2004
Brahmi P	CBD and its Implication. In the NATP Training Programme on Intellectual Property Rights in Plant Genetic Resources Management	NAARM, Hyderabad 30 August - 2 September 2004.
BS Dhillon, JC Rana and AK Singh	First Indian Horticulture Congress	IARI, New Delhi 6-9 November 2004.
DB Parakh, V Celia Chalam, AK Maurya	XXVII Annual meeting of EMSI and Conference on Electron Microscopy and Allied Fields	NPL, New Delhi April 1-3, 2004
Dinesh Chand, V Celia Chalam, RK Khetarpal, Akhilesh Mishra, Anju Jain, Jitendra Mohan	Implications of WTO Agreements on Plant Protection.	MPUA&T, Udaipur June 15, 2004

Dinesh Kumar	Annual Workshop on Wheat and Barley	IARI, New Delhi 27 - 30 August
DK Hore	Conservation and Sustainable Utilization of Medicinal Plants of Northeast India	NEHU, Shillong 27-28 May '04
DK Hore	Farmer's Rights and Livelihood of Northeastern Himalayan Farmers	NEHU, Shillong 7 July 2004
DK Hore	Meeting of Farmer's Commission (MSSRF) on 'Rice Heritage of Northeast India'	ICAR Umiam, Meghalaya 4-6 Nov. 2004
DK Hore	National Seminar on ISM & H on 'Medicinal Plants Research & Utilization'.	R.K. Mission, Kolkatta25-26 Dec. '04
JB Tomar	National Symposium on "Advantages of National Resin –Lac"	Kolkata 2-3 July,
JB Tomar, V K Gupta	National Seminar on Rehabilitation of Land Under Anthropogenic Stress & Degradation	ICFR & E, Ranchi 20th January 2004
JB Tomar, VK Gupta	Workshop on state level research & extension linkage	HARP, Ranchi February 9 -10, 2004
JB Tomar, VK Gupta	XXIV Kharif Research Council Meeting	BAU, Ranchi 1-2 June 2004
JB Tomar, VK Gupta	National Seminar on "Lac-Industries- Convergence for Resurgence" presented a paper on "Lac-production: problem and prospect"	ILRI, Ranchi 20-21 September, 2004
JC Rana,VD Verma	National Seminar on Intellectual property Right on Horticultural Crops	YSP UH&F, Solan 10-11October,2004
Jitendra Mohan	First Indian Horticulture Congress	NPL, New Delhi6-9 November, 2004
Jitendra Mohan	National Symposium on "Recent Trend and Future Strategies in Ornamental Horticulture"	Karnataka Agriculture University 1 - 4 December
Zakir Hussain	National Seminar on Root and Tuber Crops in Nutrition, Food Security and Sustainable Environment (NSRTC-1)	CTCRI, Bhubaneshwar 29-31, October 2004
KS Varaprasad	5th National Workshop under NATP (PB)	NBPGR, New Delhi 17-18 March
KS Varaprasad	Ttraining programme on 'Implications of World Trade Agreement and Other Allied International Agreements on Indian Agriculture' Sharing of Genetic Resources in WTO era" and "Sanitary and Phytosanitary Measures and Agri Research"	NAARM, Hyderabad 1 October, 2004
KS Varaprasad	Pest Risk Analysis Workshop	Chennai 8-9 January 2004
KS Varaprasad	"Nematodes in Phytosanitary issues- Current trends and future directions"	GKVK, Bangalore, 17 November 2004
Kavita Gupta	National Workshop on Invasive Alien Species and Biodiversity in India.	BNU, Varanasi August 18-20, 2004
Kavita Gupta	Training on "Plant Genetic Engineering and Molecular Breeding"	IARI, New Delhi October 18 to November 7, 2004.
KC Velayudhan	VII Biennial Group Meeting of AICRP on Tuber Crops	CTCRI, Thiruvananthapuram 24th - 25th May 2004.
Keshvulu K, Randhawa GJ, Reddy BM	International Symposium on Rice: from Green Revolution to Gene Revolution	DRR, Hyderabad 4-6 October 2004
KI Asha,	Training programme on "Bioinformatics and	IISR, Kozhikode

	Biotechnology – Application in Agricultural Research"	26 September-16 October 2004
NK Dwivedi	5th National Workshop on National Agricultural Technology Project on Sustainable Management on Plant Diversity	NBPGR, New Delhi March 17-18, 2004.
NK Dwivedi	Management Advisory Committee (MAC) Meeting	NBPGR, New Delhi March 18, 2004.
NK Dwivedi, DP Yadav	National Seminar on "Millets: Research and Development of Future Policy Options in India"	Mandor, Jodhpur March 11-12, 2004.
N. Sivaraj	Safflower germplasm field day	DOR, Hyderabad 27.02.2004.
N Sivaraj, SR Pandravada, V. Kamala and N. Sunil	Sorghum germplasm field day	NRCS, Hyderabad 23rd March 2004
NK Dwivedi,Neelam Bhatnagar	International Conference on Multipurpose Trees in the Tropics: Assessment, growth and management	AFRI, Jodhpur Nov 22-25, 2004
NK Dwivedi, Neelam Bhatnagar	National Symposium on Arid Legumes for Sustainable Agriculture and Trade	CAZRI, Jodhpur Nov 5-7, 2004
Nayar, E Roshini	International Symposium on Plant Introduction: Achievements and Opportunities in South Asia	NBPGR, New Delhi 15-17 Feb. 2004
Nayar, E. Roshini.	First Annual Group Meeting for Preparation for Plant Variety Protection and DUS Testing through ICAR-SAU System	NBPGR, New Delhi 30th September –1st October 2004
Neeta Singh,J Radhamani	National seminar on Arid Legumes for Sustainable Agriculture & Trade	CAZRI, Jodhpur 5-7 November 2004
Poonam Suneja	National symposium on "Medicinal Plants Farming Science and Practice for improving Financial Status of Indian Farmers": Vision 21st Century.	Gorakhpur 26-27 June
Poonam Suneja and Jitendra Mohan	Training programme on GLC and HPLC Techniques 3 - 7 May	TERI, New Delhi
R Asokan Nair,	Training programme on "Principles and Techniques of Seed Storage and Genebank Management"	NBPGR, New Delhi 19-31 July 2004
RK Khetarpal	National Seminar on Emerging Trends in Applied Botany, Seed Science and Technology	Mysore, November 4-6, 2004
RK Khetarpal, Shamsher Singh, DB Parakh, V Celia Chalam, A K Maurya	National Symposium on Molecular Diagnostics for the Management of Viral Diseases,	IARI, New Delhi October 14-16, 2004
RDVJ Prasadarao	National Conference on Seed: A global prospective	IARI, New Delhi 26-28 March 2004
RK Tyagi	National Seminar on "Opportunities and Potentials of Spices for Crop Diversification"	JNKVV, Jabalpur 19-21 January, 2004
RK Tyagi and Anuradha Agrawal	International Conference on 'Agricultural Biotechnology Ushering in the Second Green Revolution'	FICCI, New Delhi 10-12 August, 2004
RK Tyagi, Ruchira Pandey, Neelam Sharma, Anuradha Agrawal, Sandhya Gupta, Zakir Hussain	National Conference on 'Transgenics in Indian Agriculture'	NASC, New Delhi 9-10 March, 2004
Raghav, CS	National Symposium on Medicinal Plants Farming Science and Practice for improving Financial Status of Indian Farmers, Vision 21st Century"	Gorakhpur 26-27 June 2004
Ranbir Singh	Annual Workshop on Rapeseed-mustard	PAU, Ludhiana 12 - 14 August
Ranbir Singh, Vandana Joshi	National Conference on "Transgenics in Indian Agriculture"	NASC, New Delhi 9 - 10 March

RDVJ Prasada Rao,	National Symposium on "Molecular diagnostics for the Management of Viral Diseases"	IARI, New Delhi 11-13 October 2004
RK Khetarpal	26th Annual Conference and Symposium of Indian Society of Mycology and Plant Pathology on Advances in Fungal Diversity and Host- pathogen Interactions	Goa University, Goa, October 7-9, 2004
RK Khetarpal and V Celia Chalam	Workshop on "Reenergising Agriculture in India"	Rajiv Gandhi Foundation, New Delhi December 17, 2004
RK Khetarpal, Baleshwar Singh, DB Parakh, V Celia Chalam, Ashok Kumar Maurya, Dinesh Chand	IPS Annual Meeting (Delhi Zone) and Symposium on Variability in Plant Pathogens and their Management,	IARI, New Delhi December 9, 2004.
RK Khetarpal, PC Agarwal and Usha Dev	NBAIM-CABI, UK Joint Workshop on "Isolation, preservation and conservation of agriculturally important microorganisms and use of potential molecular tools for their identification	NBAIM, New Delhi March 16-17, 2004
RK Khetarpal, Usha Dev, Rajan, Kavita Gupta	National Workshop on Pest Risk Analysis	Chennai January 8-9, 2004
RK Khetarpal, Usha Dev, Baleshwar Singh, V Celia Chalam, DB Parakh, AK Maurya, Anju Jain, Shamsher Singh, Indra Rani, Charu Jain, SK Maheshwari, Dinesh Rai	National Symposium on Crop Surveillance: Disease Forecasting and Management	IARI, New Delhi February 19-21, 2004
SK Chakrabarty	*PRAGNYA* course (Hindi classes)	NIRD, Rajendranagar 22.01.04.
S Mandal,S Sardana	National Symposium on Arid Legumes for Sustainable Agriculture and Trade	CAZRI, Jodhpur 5 - 7 November
S Sardana	National Symposium of Enhancing Productivity and Sustainability of Crops	NDRI, Karnal 28 - 29 May
S. Sardana	Annual Group Meet on Rabi, Chickpea and MULLARP Crop	Junagarh 15 - 17 September
S. Sardana	Annual Group Meet on Network Project on Genetic Evaluation and improvement of Sesbania and Crotalaria for Green manuring	NBPGR, New Delhi 30 - 31 October
SS Malik, D Mandal	International symposium On rice "From green revolution to Gene revolution	
SS Malik, D Mandal, Randhawa GJ	International Symposium on Rice: from Green revolution to Gene revolution	DRR, Hyderabad 4-6 October 2004
Someshwara Rao, Pandravada, Kamala Venkateshwaran	Training programme on Implications of World Trade Agreement and Other Allied International Agreements on Indian Agriculture	NAARM, Hyderabad 22 September to 12 October 2004.
V Celia Chalam	Training Workshop on Implementation of PIMSNET	IASRI, New Delhi June 8, 2004
V Celia Chalam	Training on "Plant Genetic Engineering and Molecular Breeding"	IARI, New Delhi September 23 to October 13, 2004.
VK Gupta	Workshop on "Networking Research in Eastern Region"	HARP Ranchi 18-19th May 2004.
V Kamala	Computer-training programme on "Advances in MS Office 2003, Outlook express and networking"	NRCS, Hyderabad 9.9.04 to 16.9.04
Z Abraham, M Latha,	Short course on "Strategies for Improvement	TNAU, Coimbatore

S Lakshmi Narayanan Z Abraham	and Utilization of Tree-Borne oilseeds" Science-Society Interface on Medicinal and Aromatic Rices of Kerala	KAU, Pattambi 20th August 2004
Z Abraham, KS Varaprasad, M Latha, R Asokan Nair	DBT sponsored Workshop on Agri-Informatics 2004	IISR, Kozhikode 16 October 2004
Z Abraham, M Latha, KI Asha, M Abdul Nizar, S Lakshmi Narayanan, C Rajamanickam, Cherian Varghese	UGC sponsored National Seminar on Plant Genetic Resources Management	Aluva, Kerala 28th October 2004
Z Abraham, KC Velayudhan, M Abdul Nizar, M Latha, AK Singh, RK Tyagi, Rekha Choudhary and DK Hore.	XVII Workshop of AICRP on Spices	IISR, Calicut 3-5 February 2004

19.14 Publications

I. Research Papers

1. Abraham Z and M Latha (2003) Correlation and Path analysis in ginger. *Journal of Spices and Aromatic Crops.* **12**(2): 87-89.

2. Agarwal P C, Baleshwar Singh, Usha Dev, Indra Rani, Dinesh Rai, K D Joshi, Dinesh Chand, A K Maurya and R K Khetarpal (2004) Interception of seed-borne pathogens in introduced germplasm. *Indian Journal of Microbiology* **44** (1): 37-42.

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4. Agrawal, A., Swennen, R. and Panis, B (2004) A comparison of four methods in cryopreservation of meristems in banana (Musa spp.). *CryoLetters* **25**:101-110.

5. Anitha K, SK Chakrabarty, RDVJ Prasada Rao, AG Girish, RPThakur, KS Varaprasad and RK Khetarpal (2004) Interceptions of bacterial wilt of groundnut from introduced germplasm-A case study. *Indian J. Plant Prot* **32**: 93-97.

6. Bhalla Shashi, Manju Lata Kapur, Charan Singh, Kavita Gupta, Naresh Kumar and B Lal (2004) Interception of Bruchids in imported lentil (*Lens* spp) germplasm. *Indian Journal Agricultural Sciences.* **74**:332-33

7. Bhat KV, Amaravati Y, Gautam PL, Velayudhan KC (2004) AFLP characterization and classification of Indian banana and plantain cultivars. *Plant Genetic Resources: Characterization and Utilization* **2**: 121-130.

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11. Brahmi P, Bhat KV (2004) Micro-morphological features of seeds of *Cyamopsis tetragonoloba* (L.) Taub. and related species. *Phytomorphology* 125-136.

12. Brahmi P, Bhat KV, Bhatnagar AK (2004) Study of allozyme diversity in guar [*Cyamopsis tetragonoloba* (L.) Taub] germplasm. *Genetic Resources and Crop Evolution* **51**: 735-746.

13. Chakraborty SK, K Anitha and RDVJ Prasada Rao. (2004) Seedborne fungi intercepted from introduced crop germplasm during 1993-2003. *Indian J. Plant Prot* **32**: 80-83.

14. Chalam VC, RK Khetarpal, A Mishra, Anju Jain, and GK Gupta (2004) Seed transmission and detection of *Soybean mosaic potyvirus* in soybean. *Journal of Mycology and Plant Pathology* **34** (1): 86-87.

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16. Chaudhury R and Malik SK (2004) Genetic conservation of plantation crops and spices using biotechnological approaches. *Indian J. Biotechnology* **3**: 348-358.

17. Dhillon BS, RP Dua, Pratibha Brahmi and IS Bisht (2004) On-farm conservation of Plant genetic resources for food and agriculture. *Current Science* **87**: 557-559.

18. Dinesh Chand, V Celia Chalam, RP Pant and RK Khetarpal (2004) Detection and symptomatology of seed-transmitted *Blackgram mottle carmovirus* in *Vigna mungo*. *Journal of Mycology and Plant Pathology* **34**(2): 202- 205.

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23. Nageswara Rao, GV, D. Rajaram Reddy and RDVJ Prasada Rao (2004) Host range of the virus causing blackgram leaf crinkle disease in Andhra Pradesh. *Indian J. Plant Prot* **32**: 107-110.

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37. Singh, AK (2004) Endangered Economic Species of Indian Desert. *Genetic Resources and Crop Evolution* **51**(4): 371-380.

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41. Tomar JB (2003) Conservation and Sustainable Management of Medicinal & Aromatic Plant. *Chottanagpur Horticulture* **20** (1-4) 47-56

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48. Yadav Sangita, KS Negi and S Mandal (2004) Protein and oil rich wild horsegram. *Genetic Resources and Crop Evolution.* **51**: 629 – 633.

II. Chapters in books, proceedings, bulletins, manuals, etc.

1. Abraham Z and S Lakshminarayanan (2004) Wild relatives of cultivated plants. In: Annamalai R (Ed.) *TamilNadu Biodiversity Strategy and Action Plan*. Tamil Nadu Forest Dept., Chennai, pp. 123-157.

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3. Abraham Z, M Latha, S Biju and S Lakshmi Narayanan (2004) Changing Pattern of Plant Biodiversity in Southern Western Ghats In: Dhillon BS, RK Tyagi, Arjun Lal and S Saxena (eds.) *Plant Genetic Resource Management*, Narosa Publishing House Pvt. Ltd, New Delhi, India, pp 113-135.

4. Abraham Z, M Latha, S Biju and S Lakshmi Narayanan (2004) Changing Pattern of Plant Biodiversity in Southern Western Ghats In: Dhillon BS, RK Tyagi, Arjun Lal and S Saxena (eds.) *Plant Genetic Resource Managemen,t* Narosa Publishing House Pvt. Ltd, New Delhi, India, pp 113-135.

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8. Bhalla Shashi, Rajan, Manju Lata Kapur and R K Khetarpal (2004) Pest risk analysis for import of table grapes into India. In: *First Indian Horticulture Congress-2004*, November 6-9, 2004, Horticultural Society of India, New Delhi, p 417.

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19.15 Budget estimates and expenditure incurred (Rs. in lakhs) for 2004-2005

A. Non Plan			
Head	**Allocation**	**Revised Allocation**	**Total Expenditure**
Estt. Charges	712.50	855.00	854.81
Wages	40.00	29.00	28.92
OTA	0.20	0.20	0.20
TA	6.90	7.80	7.79
Other Charges	211.40	228.00	227.60
ARMO	45.00	87.00	86.98
Works	8.00	73.00	72.96
Total	**1024.00**	**1280.00**	**1279.26**

B. Plan			
Head	**Allocation**	**Revised Allocation**	**Total Expenditure**
Estt. Charges	5.00	0.00	0.00
OTA	0.00	0.00	0.00
TA	11.00	11.00	11.00
HRD	1.50	0.00	0.00
Other Charges including Equipment	379.44	355.30	355.29
Works	250.00	130.50	130.50
Total	**646.94**	**496.80**	**496.79**

C. Plan - Shillong (NEH Region)			
Head	**Allocation**	**Revised Allocation**	**Total Expenditure**
TA	1.00	0.77	0.77
Contingencies	39.00	21.43	21.43
Total	**40.00**	**22.20**	**22.20**
Total (B+C)	**686.94**	**519.00**	**518.99**

NRC on DNA Fingerprinting			
Head	**Allocation**	**Revised Allocation**	**Total Expenditure**
Estt. Charges	12.50	0.00	0.00
TA	2.00	2.00	2.00
HRD	3.50	0.00	0.00
Other Charges	226.50	156.80	156.72
Total	**244.50**	**158.80**	**158.72**

प्रतिवेदन सारांश

पादप आनुवंशिक संसाधनों के उचित प्रबन्ध से संबंधित सभी गतिविधियों पर वर्ष 2004 के अन्तर्गत अर्जित उपलब्धियों का संक्षिप्त विवरण इस अध्याय में दिया गया है जो इस प्रकार है।

पादप अन्वेषण तथा जननद्रव्य संग्रहण

राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो (पादप ब्यूरो) तथा राष्ट्रीय कृषि प्रोद्योगिकी परियोजना-पादप जीवविविधता (एन.ए.टी.पी.-पी.बी.) के अन्तर्गत सहयोगी संस्थाओं के सहयोग से देशभर में कुल 115 अन्वेषण किए गये जिनमें विविध पादप प्रजातियों की कुल 7623 प्राप्तियां (जिसमें फसलीय तथा जंगली प्रजातियां सम्मिलित हैं) संग्रहित की गई। इनमें से मुख्यालय, नई दिल्ली द्वारा 12 अन्वेषणों के दौरान 691 प्राप्तियां संग्रह की गई।

पादप ब्यूरो के क्षेत्रीय केन्द्र, अकोला द्वारा महाराष्ट्र के कोंकण तथा पश्चिमी क्षेत्र से कुल 185 प्राप्तियां संकलित की गयी जिनमें धान्य (7 प्राप्तियां), मोटे अनाज (12), दलहन (25), तिलहन (11), सब्जियां (54), बागवानी (10), रेशेदार फसलें (10), मसाले (14), औषधीय पौधे (9), सजावटी पौधे (1), रंजक पौधे (2), अन्य (1) तथा वन्य प्रासंगिक पादप (29) सम्मिलित थे। क्षेत्रीय केन्द्र भवाली द्वारा उत्तरांचल प्रदेश से 458 प्राप्तियां संग्रह की। अन्वेषण आधार केन्द्र, कटक ने तीन अन्वेषणों के द्वारा 384 प्राप्तियां संग्रहित की जिनमें धान, बाजरा, सब्जियां, हल्दी, जूट, संवर्गीय रेशेदार फसलें, औषधीय एवं सगंधीय पौधे और वन्य प्रासंगिक पादप सम्मिलित थे। हैदराबाद केन्द्र द्वारा 13 अन्वेषणों में 1524 प्राप्तियां संग्रहित की जिनमें धान, बाजरा, मोटे अनाज, नाइगर, करंज, कन्दीय फसलें, दलहन, अदरक, हल्दी, अंगूर, औषधीय एवं संगधीय पौधे तथा वन्य प्रासंगिक पादप सम्मिलित थे। जोधपुर केन्द्र द्वारा पांच अन्वेषणों में धान्य (5), मोटे अनाज (59), तिलहन (1), फल (96), औषधीय एवं सगंधीय पौधे (52), बहुउद्धेश्यीय वृक्ष (62), रंजक (1) तथा अन्य वन्य प्रासंगिक पादप (3) की कुल मिलाकर 277 प्राप्तियां संग्रहित की। अन्वेषण केन्द्र, रांची द्वारा झारखंड प्रांत के दुर्गम क्षेत्रों से छः अन्वेषण कर कुल 638 प्राप्तियां संग्रहित की।

पादप ब्यूरो के क्षेत्रीय केन्द्र, शिलांग द्वारा पूर्वोत्तर पर्वतीय क्षेत्रों से 11 अन्वेषणों में विभिन्न फसलों एवं उनके वन्य प्रासंगिक पादपों की कुल 1327 प्राप्तियां संग्रहित की। इसी प्रकार क्षेत्रीय केन्द्र, शिमला द्वारा नौ अन्वेषणों में 618 प्राप्तियां, श्रीनगर केन्द्र द्वारा कश्मीर, जम्मू तथा लद्दाख से 252 प्राप्तियां तथा त्रिशूर केन्द्र द्वारा केरल, कर्नाटक, गोवा, तमिलनाडू, आन्ध्र प्रेदश, अण्डमान एवं निकोबार द्वीप समूह से 1037 संकलन संगृहित किए। संग्रहित पादप प्राप्तियां को संग्रहण स्थल के निकट (पादप ब्यूरो के क्षेत्रीय केन्द्र अथवा उचित मात्रा में उपलब्ध बीज को राष्ट्रीय जीनबैंक में दीर्घावधी भण्डारण हेतु संग्रहित किया गया।

विशेष पादप अन्वेषण मिशन के अन्तर्गत सुन्दरवन डेल्टा (सभी पादप प्रजातियों के लिए), छत्तीसगढ़ (औषधीय एवं सगंधीय पौधों हेतु), हिमाचल प्रदेश का शीत मरू क्षेत्र, जम्मू-कश्मीर (अल्प प्रयुक्त फलों

के संग्रहण हेतु), दक्षिणी राजस्थान (अल्प प्रयुक्त फलों एवं जेट्रोफा हेतु), पश्चिमी महाराष्ट्र (रंजक पादपों हेतु), अरूणाचल प्रदेश, सिक्किम, नागालैण्ड, मिजोरम तथा मेघालय (औषधीय एवं संगधीय, आर्किड आदि हेतु) में संस्थाओं के सहयोग से उपलब्ध विविधता को संग्रहित किया गया।

कुछ महत्वपूर्ण संकलन (जिनमें दुर्लभ एवं संकटापन्न पौधे शामिल हैं) जैसे: *क्रोकस सटाईवस, ग्लोरिओसा सुपर्वा, टेकसस बकाटा, सोलेनम खासीनम, सुसरिया लापा, स्वेर्टीया चिरायता, हेडीचियन कोरोनेरियम,* नेफेलियम रामवेटन (खाने योग्य रम्बूताना जैसा फल, वजन-50 ग्राम/फल, पांच दिन तक खराब नहीं होता) तथा खीरा (छोटी सफेद सलाद वाली लैण्ड रेस जो व्यावसायिक रूप से उगाई जाती है) भी एकत्र किए गए।

जननद्रव्य विनिमय

इस वर्ष 51 देशों से विभिन्न फसलों की 28,437 प्राप्तियां (78,571 नमूने) आयात की गई जिनमें 14,173 प्राप्तियां जननद्रव्य की तथा 14,264 प्राप्तियां (64,398 नमूने) परीक्षण सामग्री के लिए आयात किए गए। देश के विभिन्न स्त्रोतों से पादप सामग्री मंगाकर विदेशों की मांगपूर्ति हेतु 132 नमूने नौ देशों को भेजे गए। हमारे देश के अनुसंधानकर्त्ताओं के प्रतिवेदन के आधार पर विविध फसलों के 13,008 नमूने फसल सुधार कार्यक्रमों हेतु आपूर्ति किए गए। विभिन्न फसलों कें विशिष्ट गुणों वाले जननद्रव्यों का आयात किया गया जो इस प्रकार है:

धान: इ सी 539103-539110, ब्राउन प्लांट हापर (बीपीएच) प्रतिरोधी प्राप्तियां फिलीपीन्स से; इ सी 539111-531118 झुलसा रोग (जीवाणु द्वारा) रोधी, इ सी 539131-539138, झुलसा रोधी, एम.आर. 219 तथा एम.आर. 220 (इ सी 548000-001) बहुरोग रोधी किस्में मलेशिया से; बालिवियर किस्म ब्लास्ट तथा पत्ती धब्बा रोग रोधी तथा सबेरे किस्म झुलसा, ब्लास्ट, भूरा पर्ण चित्ती, पर्ण कण्डुवा रोग रोधी अमेरिका से मंगाई गई।

गेंहू: गेहूं की कई विकसित किस्में जैसे बिगस्काई (इ सी 538958), आऊटलुक (इ सी 541189), डेलोरिस (इ सी 552125), ओ.के. 101 (इ सी 543893), केलेडोनिया (इ सी 550175), रिचलैण्ड (इ सी 550176) जो क्रमश: तना रतुआ प्रतिरोधी, गेहूं एफीड प्रतिरोधी, डवार्फ बन्ट रोधी, मिट्टी से उत्पन्न होने वाले विषाणु रोग प्रतिरोधी, अनावृत कण्डुवा रोग रोधी किस्में अमेरिका से आयात की गई।

मक्का: इ सी 546871- डाउनी मिलड्यू रोग रोधी इन्डोनेशिया से आयात की गई।

जौ: अमेरिका से कई रोगरोधी किस्में जैसे यूसी-933 (इ सी 538157), स्ट्राइपरस्ट, चूर्ण फफूंद, नेट ब्लाच तथा पीला डवार्फ विषाणु रोग रोधी; यूसी 969 (इ सी 538158), जौ का पीला डवार्फ विषाणु, लीफ रस्ट, नेट ब्लाच तथा स्केल्ड रोग प्रतिरोधी, यूसी 960 (इ सी 538160) पीला डवार्फ विषाणु रोग, लीफ रस्ट, नेट ब्लाच आदि रोग प्रतिरोधी किस्म आयात की गई।

बाजरा: उन्नत किस्म होरीजन जो कई नाशीकीटों (रूसी एफीड, स्टेम मेगट तथा यूरोपियन मक्का छेदक) के प्रतिरोधी है अमेरिका से आयात की गई।

सोयाबीन: उन्नत किस्म वशिता (इ सी 537976) जो जड़-गांठ कृमि के प्रतिरोधी, कटूशा (इ सी 537947) जो सीस्ट कृमि के प्रतिरोधी किस्म तथा इ सी 539008 जो फाइटोफथोरा सड़न रोग तथा सीस्ट कृमि की रेस 3 तथा 14 के प्रतिरोधी है सभी अमेरिका से आयात की गई।

चना: इसी 539009 जो एस्कोचाइटा झुलसा रोग रोधी है- स्पेन से आयात की गई। **चना (जंगली प्रजातियां):** *साइसर इकानोस्परमम* (इ सी 539329, इ सी 541555-556) उकठा रोग (फ्यूजेरियम विल्ट) प्रतिरोधी, *साइसर बिजूगम* (इ सी 541549-50), पत्ती खोदक, ब्रुकिड़ तथा झुलसा रोग रोधी, *साइसर जुडाइकम* (इ सी 541557-558) पत्ती खोदक, ब्रुकिड तथा झुलसा रोगरोधी तथा इ सी 541561-62-बुकिड एवं सिस्ट कृमि रोधी, *साइसर पिनाटीफिडम* (इ सी 541559)-उकठा रोग रोधी- सभी प्रजातियां इकारड़ा, सीरिया से आयात की गई।

राजमा: उन्नत किस्म एसी पिनटोबा जो कनाडा से आयात की गई यह उकठा रोग तथा बीन कामन मौजेक विषाणु प्रतिरोधी है; ओरका किस्म (इ सी 538843) बीन कामन मौजेक विषाणु, कर्ली टाप विषाणु, जड़ सड़न रोग प्रतिरोधी अमेरिका से तथा इमगोपा 201-ओरो (इ.सी. 541908) बीन कामन मौजेक विषाणु एन्गुलर लीफ स्पाट रोधी किस्म ब्राजील से, इ सी 540793, 794 जो सियाट कोलम्बिया से आयात की गई।

मटर: फ्यूजेरियम विल्ट रोधी किस्म एकोर्ड (इ सी 538177) फ्यूजेरियम विल्ट (रेस-1,2,5) रोधी किस्म बरोक (इ सी 538178), कामन पी मौजेक विषाणु तथा कामन विल्ट विषाणु रोधी किस्म ब्रिजर (इ सी 538179), चूर्ण फफूंद, उकठा रोग (रेस-1) एवं कामन मौजेक विषाणु रोधी किस्म डयूक (इ सी 538180) सभी किस्में अमेरिका से आयात की गई।

कुसुम: कुसुम पर लगने वाली प्रमुख बिमारियों एवं कीटों की रोधी प्राप्तियां अमेरिका से आयात की गई जो इस प्रकार है: इ सी 548822-अल्टरनेरिया, जीवाणु झुलसा रोग एवं शीर्ष गलन रोग प्रतिरोधी, इ सी 548825-29 उकठा रोग, रोधी, इ सी 548830-46 फाइटोफथोरा जड़ गलन रोग रोधी, इ सी 548849-थ्रीप्स नाशीकीट प्रतिरोधी।

अलसी: रूस से इ सी 541217-223 रतुआ रोग प्रतिरोधी एवं इ सी 541218, 541236 उकठा रोग (फ्यूजेरियम द्वारा) प्रतिरोधी प्राप्तियां आयात किए गए।

खरबूजा: उन्नत किस्म टी.जी.आर- 1551 (इ सी 541901) कुकुम्बर मौजेक विषाणु रोधी स्पेन से आयात की गई। इ सी 539195-219 उकठा एवं मौजेक विषाणु प्रतिरोधी प्राप्तियां अमेरिका से आयात की गई।

टमाटर: ए.वी.आर.डी.सी.- ताईवान से टमाटर की कई रोगरोधी प्राप्तियां मंगाई गई। इ सी 538398-400 बेक्टेरियल विल्ट तथा टोबेको मौजेक विषाणु प्रतिरोधी, इ सी 538415-416-सफेद मक्खी द्वारा संचारित जेमिनी विषाणु, उकठा रोग (जीवाणु द्वारा), फ्यूजेरियम रेस-1, मौजेक विषाणु रोधी।

बैंगन: इ सी 550890 फल एवं प्ररोह वेधक अवरोधी तथा जीवाणु जनित उकठा रोग एवं लीफ हापर नाशकीट प्रतिरोधी प्राप्तियां फिलीपीन्स से आयात की गई।

अजैविक प्रभाव (एबायोटिकस्ट्रेश) अवरोधी जीनोटाइप भी अन्य देशों से आयात किए गए जो इस प्रकार हैं। धान: (इ सी 539139-44 लोह विषाक्ता; इ सी 541909-916 जल मग्न (बाढ़) अवरोधी, इ सी 541917-928 लवणता अवरोधी गुण, इ सी 541929-939 जस्ता अपूर्णता अवरोधी, इ सी 546319-340 फासफोरस अपूर्णता अवरोधी। गेहूँ: इ सी 538236-56 लवणता अवरोधी, इ सी 548493 अम्मलीय मृदा हेतु। मक्का: इ सी 552705-708 अम्लीय मृदा अवरोधी। जौ: इ सी 540807 (विवान किस्म)- सूखा अवरोधी। बाजरा: इ सी 552154 लाजिंग रोधी। सोयाबीन: इ सी 538805, 538811-12 सूखा अवरोधी, इ सी 538823-30 सूखा एवं गर्मी अवरोधी। कपास: इ सी 541867-76 असिंचित तथा विपरीत परिस्थितियों के लिए रोधी।

इसके अतिरिक्त विभिन्न फसलों की गुणवत्ता बढ़ाने के लिए विकसित किस्मों/प्राप्तियों का भी आयात किया गया। धान में अधिक लौह तत्व, लम्बे दाने, अधिक प्रोटीन तथा सुगन्ध के लिए, गेहूँ में अधिक प्रोटीन, ग्लूटेन के लिए, मक्का में अधिक लाइसिन तथा अमाइलेज के लिए, कुसुम में अधिक तेल एवं ओलिक अम्ल हेतु तथा खरबूजे में अधिक टी.एस.एस की मात्रा हेतु।

पादप संगरोध

अनुसंधान कार्यों के लिए विनिमय (आयात + निर्यात) होने वाले जननद्रव्यों की संगरोध जांच पादप ब्यूरो के मुख्यालय तथा क्षेत्रीय केन्द्र, हैदराबाद में की जाती है। जांच एवं परीक्षणों के आधार पर स्वस्थ पाये जाने वाले बीज एवं पौध सामग्री ही मांगकर्त्ता को भेजी जाती है।

नई दिल्ली में कुल 28,668 प्राप्तियां (78,772 नमूने) संगरोध जांच हेतु प्राप्त हुए जिनमें 28536 प्राप्तियां (78,640 नमूने) आयात हुए तथा 132 प्राप्तियां विदेशों को निर्यात की गई। इन नमूनों में बीज, जड़ सहित पौधे, कलम, कंद, टिश्यू कल्चर की पौध सम्मिलित थे। पौध संगरोधालयों में विस्तृत निरीक्षण करने पर 4798 नमूने कीटों द्वारा ग्रसित पाए गए, 219 अर्न्तग्रसित (कीट), 242 नमूने सूत्र कृमियों द्वारा, 122 फफूंद/जीवाणुओं से और 177 नमूने विषाणुओं द्वारा ग्रसित पाये गये। कुल 4,798 ग्रसित/संक्रमित नमूनों में से 4,756 नमूनों को विभिन्न विधियों जैसे धूमन, एक्सरे, रेडियोग्राफी, उष्ण जल उपचार, फफूंदनाशक एवं कीटनाशक रसायनों द्वारा उपचारित कर 'स्वस्थ बीज'/पौंध सामग्री को मांगकर्त्ताओं को भेजा गया। सोयाबीन के 42 नमूने जो कि अमेरिका से आयात किए गए थे डाउनी मिल्डयु फफूंद से ग्रसित पाये गये। इन ग्रसित नमूनों को जलाकर नष्ट कर दिया गया। निर्यात के लिए 132 नमूनों का गहन निरीक्षण कर 22 स्वस्थता प्रमाण पत्र जारी किए गए। राष्ट्रीय कृषि प्रोद्योगिकी परियोजना के तहत संग्रहित

2395 प्राप्तियों का कीट व्याधि रहित करने के लिए निरीक्षण किया गया। इनमें 279 ग्रसित/संक्रमित प्राप्तियों को रोग/कीट मुक्त करने के लिए उपचारित किया गया तथा कुल 2,676 प्राप्तियों को संरक्षण हेतु भेजा गया। ट्रासजैनिक फसलों के 6590 नमूने प्राप्त हुए जिन्हें संगरोधालय में गहन निरीक्षण किया गया। सोयाबीन तथा लोबिया में क्रमशः सोयाबीन मौजेक विषाणु एवं ब्लेक आई काउपी मौजेक विषाणु के लिए बीज प्रमाणीकरण के लिए 0.5 प्रतिशत संक्रमण को मानक निर्धारित किया गया। इन विषाणुओं के लिए डाइगोनेस्टिक किट तैयार किया गया जो कि गुणवत्ता जांच के लिए उपयोगी होगा।

क्षेत्रीय केन्द्र, हैदराबाद द्वारा 11,474 आयातित तथा 8,026 निर्यात हेतु प्राप्त नमूनों का परीक्षण किया गया तथा 150 स्वस्थता प्रमाण पत्र जारी किए गए। निरीक्षण के दौरान कुल 2,472 नमूने ग्रसित। संक्रमित पाये गये जिनमें से 2,360 नमूनों को उपचारित कर रोग मुक्त कर निर्यात किया गया तथा 76 नमूने (रोग ग्रसित) जलाकर नष्ट कर दिये गये। दक्षिण भारत में 30 संस्थाओं को पादप संगरोध सेवायें प्रदान की गई।

जननद्रव्य लक्षण वर्णन, मूल्यांकन तथा अनुरक्षण

पादप ब्यूरो के मुख्यालय, ईसापुर फार्म, क्षेत्रीय केन्द्रों तथा भारतीय कृषि अनुसंधान परिषद की विभिन्न संस्थाओं के साथ तैयार साझा कार्यक्रम के अन्तर्गत जननद्रव्यों को लक्षण वर्णन, मूल्यांकन एवं अनुरक्षण अथवा पुनरूत्पादन हेतु उगाया गया जो निम्नवत् है:- ईसापुर फार्म तथा मुख्यालय दिल्ली में 9375 प्राप्तियां, अकोला-8989 प्राप्तियां, भवाली-731 प्राप्तियां, कटक-1862 प्राप्तियां, हैदराबाद-1976 प्राप्तियां, जोधपुर-1219 प्राप्तियां, शिलांग-2493 प्राप्तियां, शिमला-2665 प्राप्तियां, तथा त्रिशूर-1676 प्राप्तियां। विभिन्न फसलों के पूर्व निर्धारित गुणों के लिए आंकड़े लिए गए तथा आंकलन पश्चात विशिष्ट गुणों के लिए प्राप्तियों की पहचान की गयी। विभिन्न फसलों के क्षेत्रीय केन्द्रों एवं मुख्यालय पर रबी तथा खरीफ में फसल दिवसों का आयोजन किया गया जिनमें अनुसंधान कर्त्ताओं ने भाग लेकर वांछित गुणों के आधार पर मूल्यांकन कर अच्छी प्राप्तियों का चयन किया। वानस्पतिक संवर्धन से उगाई जाने वाली फसलों पौधों को फील्ड जीनबैंक में उगाकर अनुरक्षण किया गया।

जननद्रव्य संरक्षण

राष्ट्रीय जीनबैंक में दीर्घकालीन संरक्षण हेतु विभिन्न फसलों की 31,935 प्राप्तियां प्राप्त हुई। इनको जीनबैंक निधारित मापदण्डों के अनुसार संशोधित किया गया। इनमें से 25,793 प्राप्तियों को आधार संग्रहों में शामिल किया गया। इसके फलस्वरूप राष्ट्रीय जीनबैंक के आधार संग्रहों की कुल संख्या बढ़कर 2,87,028 हो गयी है (तालिका-1)। इस दौरान जननद्रव्य संचालन यूनिट ने 12,103 प्राप्तियां प्राप्त की जिसमें से 7,281 प्राप्तियों को मध्यावधि भण्डार गृह से संदर्भ सामग्री के रूप में रखा गया। जीनबैंक में संरक्षित 2,733 प्राप्तियों का निरीक्षण किया गया तथा 2,909 प्राप्तियों की पासपोर्ट सूचना को पूर्ण किया गया।

तालिका 1: राष्ट्रीय जीनबैंक में दीर्घावधि हेतु संरक्षित जननद्रव्य का ब्यौरा (31.12.2004 तक)

फसल वर्ग	जनवरी से दिसम्बर 2004	वर्तमान (स्थिति योग)
धान	6890	71673
गेहूं	2019	34275
मक्का	597	5508
अन्य	922	9372
धान्य	**10428**	**120828**
ज्वार	1682	17483
बाजरा	1102	6737
मोटे अनाज	1178	16798
अन्य	1225	2176
मोटे अनाज तथा चारे की फसलें	**5187**	**43194**
रामदाना	364	3521
कुटू	43	293
अन्य	80	169
कूट धान्य	**487**	**3983**
चना	613	15644
अरहर	1344	7520
मूंग	154	2959
अन्य	832	16718
दलहन	**2943**	**42841**
मूँगफली	1496	11437
सरसों	68	7163
सूरजमुखी	184	6124
अन्य	2873	12172
तिलहन	**4621**	**36896**
कपास	41	4594
जूट	192	2585
अन्य	124	1426
रेशेदार फसलें	**357**	**8605**
बैगन	498	3032
मिर्च	2	1981
अन्य	852	11905
सब्जियाँ	**1352**	**16918**
सरीफा	.	57
पपीता	.	23
अन्य	.	92
फल	.	**172**
पोस्ता	1	293
तुलसी	3	194
तम्बाकू	1	937
अन्य	96	1181
औषधीय एवं सगंधी पौधे तथा अन्य	**101**	**2605**
धनिया	1	296
सोवा	.	59
अन्य	162	198
मसाले	**163**	**553**
पोंगम तेल वृक्ष	.	42
अन्य	154	42
कृषि वानिकी	**154**	**198**
मसूर	.	7712
अरहर	.	2523
द्वितीयक	.	**10235**
योग	**25793****	**287028***

* इसमें 1647 निर्मुक्त किस्में तथा 677 आनुवांशिक धरोहर शामिल हैं।

** इस संख्या में 252 निमुक्त किस्में तथा 207 आनुवांशिक धरोहर शामिल हैं।

अरण्डी, मूंगफली, अरहर, तोरई, कपास के बीजों को अति निम्न स्तर आर्द्रता (1 से 3 % नमी) तक सुखाने पर इनकी दीर्घ जीविता अधिक पाई गई। किगेलिया पिन्नाटा, सफेद मूसली, तथा *कय्यूरीगेहम स्पानोसा* (सभी औषधीय पौंधे) के बीजों में सुषुप्ता भंग करने की विधियाँ खोजी गई।

पादप उत्तक कल्चर एवं हिम-परिरक्षण

वानस्पतिक संवर्धन वाली फसलें जिनमें बीज नहीं बनता जैसे बागवानी, प्रकन्दीय, औषधीय तथा संकटापन्न प्रजातियों एवं नई औद्योगिक फसलों की 1579 प्राप्तियों का उत्तक संवर्धन विधि द्वारा कमरे के तापक्रम अथवा निम्न तापक्रम (4^0 सें.) पर संरक्षण किया गया। प्रजातियों के अनुसार उप-संवर्धन का अन्तराल 4 से 24 महीने रहा। विभिन्न प्रजातियों के संवर्धन हेतु नये प्रोटोकाल विकसित किए गए। *एलियम फिस्टूलासम* और *कुरकुलिगो, आर्कियोडिस* के पौध पुनर्उत्पादन के लिए प्रोटोकाल निर्धारित किए गए। अरबी के प्रयोगशाला में प्रकन्द तैयार किए गए। एलियम, ब्राह्मी, अरबी *कुरकुमा लोंगा, जेनशियाना* तथा *प्लम्बैगो* में मन्द विकास पर प्रयोगशाला में भिन्न-भिन्न परिणाम देखे गये। केले की 61 प्राप्तियां एवं ग्लेडियोलस (1) के उत्तक-कल्चर पौधे मांगकर्त्ताओं को भेजे गये। कुल 5242 प्राप्तियों (आर्थोडोक्स तथा रिकेल्सीट्रेंट बीजों) के परागकण तथा शहतूत की 20 प्राप्तियों की सुषुप्त कलिकोंप हिम-परिरक्षण में सफलतापूर्वक संरक्षित किए गए।

डी.एन.ए. फिंगर प्रिटिंग

वर्ष के दौरान कुल 778 फसलों की किस्मों तथा उन्नत प्रचलित प्रजातियों का डी.एन.ए. फिंगर प्रिटिंग किया गया। धान, गेहूं, मटर, सोयाबीन तथा कपास का माइक्रोसेटेलाइट विधि से तथा मसूर और अरहर की किस्मों का एफ.पी.एल. विधि द्वारा विश्लेषण किया गया।

अन्य गतिविधियां

- विभिन्न समितियों जैसे संस्थान प्रबन्धन समिति, अनुसंधान सलाहकार समिति, कर्मचारी परिषद् एवं संस्थान संयुक्त कर्मचारी परिषद् की समय-समय पर सभायें आयोजित कर पादप आनुवंशिक संस्थानों के उचित प्रबन्धन संबंधी सभी पहलुओं पर चर्चा कर आवश्यक सुझाव दिये गये।
- ब्यूरो के वैज्ञानिकों, अनुसंधान सहायकों, तकनीकि तथा प्रशासनिक कर्मचारियों ने कार्यशालाओं, सम्मेलनों एवं प्रशिक्षण कार्यक्रम में भाग लेकर ज्ञान का आदान-प्रदान किया।
- विशिष्ट वैज्ञानिकों, प्रशासकों, प्रगतिशील किसानों, नीति नियन्ताओं तथा विद्यार्थियों ने राष्ट्रीय जीनबैंक, डी.एन.ए. फिंगर प्रिंटिंग प्रयोगशाला, संगरोध प्रयोगशाला, राष्ट्रीय संगरोध शीशघर तथा उत्तक संवर्धनशाला आदि सुविधाओं को देखा और जानकारी प्राप्त की।
- 'भारतीय कृषि में ट्रान्सजैनिक' विषय पर 9 से 10 मार्च 2004 को नई दिल्ली में एक राष्ट्रीय सम्मेलन का आयोजन किया।

- पादप ब्यूरो के मुख्यालय तथा क्षेत्रीय केन्द्रों पर निम्नलिखित प्रशिक्षण कार्यक्रमों का आयोजन किया गया: ''फसलों की वन्य प्रजातियों'' पर नई दिल्ली में; ''फसल प्रजाति संरक्षण तथा किसानों के अधिकार'' पर हैदराबाद में; ''ट्रान्सजैनिक फसलों के मूल्यांकन हेतु जैवसुरक्षा'' पर नई दिल्ली में; ''बीज भण्डारण सिद्धान्त एवं विधियां तथा जीनबैंक प्रबन्धन'' नई दिल्ली में तथा ''बौद्धिक सम्पदा अधिकार एवं जननद्रव्य प्रबन्धन'' पर हैदराबाद में।

- प्रायोगिक प्रक्षेत्र, ईसापुर, नई दिल्ली, जोधपुर, हैदराबाद, शिमला तथा त्रिशूर केन्द्रों पर रबी एवं खरीफ फसलों पर खेत दिवस आयोजित किये गये जिनमें फसल विशेषज्ञों ने भाग लिया तथा फसल सुधार हेतु जननद्रव्यों का चयन किया।

- भारतीय कृषि अनुसंधान परिषद द्वारा गठित 'जननद्रव्य पंजीकरण समिति' के डा. जी. कल्लू, उपमहानिदेशक (उद्यान एवं फसल विज्ञान) की अध्यक्षता में चार सभायें की गई। कुल 247 प्रस्ताव अनुमोदन हेतु प्राप्त हुए जिनमें से 121 किस्मों को राष्ट्रीय जीनबैंक में पंजीयन किया गया।

- एक नई पहल के अन्तर्गत रा.पा.आ.सं. ब्यूरो ने स्नात्कोत्तर स्कूल, भारतीय कृषि अनुसंधान संस्थान, नई दिल्ली के माध्यम से पादप आनुवंशिक संसाधन में वाचस्पति (पी.एच.डी.) की उपाधि हेतु शिक्षा सत्र् 2004-2005 से अध्यापन कार्य प्रारम्भ किया है। इसमें भारतीय विद्यार्थियों के लिए तीन स्थान तथा विदेशी नागरिकों के लिए दो स्थान हैं। भारतीय प्रत्याशियों के चयन हेतु राष्ट्रीय स्तर पर प्रतियोगिता परीक्षा भा.कृ.अ. संस्थान द्वारा की जायेगी। इस अध्ययन का उद्देश्य पादप आनुवंशिक संसाधनों के आधारभूत एवं प्रयुक्त पहलुओं पर स्वतंत्र रूप से शोध करने की दक्षता एवं आत्मविश्वास को विकसित करना है। कृपया इस संबंध में विस्तृत जानकारी के लिए निदेशक, रा. पा.आ. संसाधन ब्यूरो, नई दिल्ली से सम्पर्क करें।

हिन्दी अनुवाद : डा. अर्जुन लाल
श्री के. डी. जोशी

Annexure I. Meteorological data (temperature in degree Celsius and rainfall in mm) of different stations during 2004

Station	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Akola	Max. temp	29.4	31.4	38.9	41.1	40.6	37.1	33.9	29.2	31.6	32.6	31.9	30.1
	Min. temp.	12.4	13.5	18.4	25.6	26.4	26.1	24.7	23.1	22.8	18.2	15.7	10.8
	Rainfall	4.8	3.4	0.0	3.3	8.0	51.1	84.8	111.0	111.7	49.6	41.0	0.0
Bhowali	Max. temp	14.4	16.2	24.7	26.6	27.9	25.5	25.7	20.2	34.0	20.3	18.2	17.1
	Min. temp.	4.0	0.7	7.4	10.6	14.1	15.6	16.3	17.5	14.7	8.0	3.9	1.1
	Rainfall	75.0	0.0	0.0	69.0	55.4	217.6	335.0	317.1	200.0	92.0	7.0	0.0
Cuttack	Max. temp	26.4	29.6	35.0	34.9	37.5	35.5	31.7	30.8	32.1	30.3	29.9	28.1
	Min. temp.	15.1	17.3	22.5	24.7	26.9	27.0	25.6	25.9	25.5	23.5	18.5	15.8
	Rainfall	8.2	17.8	0.4	77.8	9.5	105.4	340.7	322.7	156.8	231.6	0.0	0.0
Hyderabad	Max. temp	29.0	31.5	37.4	38.2	35.8	34.0	30.8	30.3	31.0	30.7	29.9	29.1
	Min. temp.	13.5	14.6	18.3	24.2	24.6	24.1	23.1	22.4	22.0	19.7	14.9	10.7
	Rainfall	7.3	0.0	9.4	35.6	114.8	56.2	287.6	53.8	126.8	76.7	0.6	0.0
Jodhpur	Max. temp	25.8	29.7	37.8	40.9	40.7	39.7	38.2	34.0	37.1	35.0	33.1	28.1
	Min. temp.	10.7	12.6	17.6	24.6	27.9	27.8	27.6	25.2	25.4	20.1	16.0	13.4
	Rainfall	0.0	0.0	0.0	0.2	0.0	31.5	35.1	139.5	11.1	2.8	0.0	0.2
Shillong	Max. temp	19.2	21.2	26.8	24.9	27.9	26.9	25.9	29.0	258.9	24.7	23.3	21.8
	Min. temp.	6.7	9.2	15.2	15.1	18.7	19.7	20.0	20.5	19.3	15.4	11.5	9.6
	Rainfall	0.0	13.1	31.7	306.5	210.0	432.2	747.3	189.8	263.4	584.5	59.6	2.9
Shimla	Max. temp	13.8	19.0	21.3	24.1	27.4	24.5	24.4	22.8	24.3	21.1	19.9	17.9
	Min. temp.	0.8	2.2	7.5	13.8	16.4	15.2	16.5	15.9	15.2	10.0	7.6	2.4
	Rainfall	39.7	113.5	108.9	51.4	39.9	113.7	352.2	588.8	17.6	0.0	9.5	10.49
Thrissur	Max. temp	33.4	35.2	36.5	34.8	30.4	29.6	29.3	28.5	30.8	31.4	30.1	32.1
	Min. temp.	22.3	22.5	24.2	25.2	23.6	22.3	22.9	23.1	23.6	23.4	23.7	22.6
	Rainfall	0.0	0.0	8.6	60.2	578.3	786.0	369.6	386.9	208.8	493.2	71.7	0.0