



वार्षिक प्रतिवेदन

# NBPGR

## ANNUAL REPORT 2003

**National Bureau of Plant Genetic Resources**  
New Delhi - 110 012



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This report includes unprocessed or semi-processed data, which would form the basis of scientific papers in due course. The material contained in the report therefore may not be made use without the written permission of the Director, National Bureau of Plant Genetic Resources, New Delhi except for quoting it for scientific reference.

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## ACRONYMS

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

## PREFACE

Since its establishment in 1976 as a nodal institution under the Indian Council of Agricultural Research (ICAR), National Bureau of Plant Genetic Resources (NBPGR) has played an important role in the sustainable management of plant genetic resources (PGR) in the country. Over these years Bureau has provided leadership to various stakeholders of PGR including ICAR institutes, state agricultural universities, state departments of agriculture, private organizations and farmers in the country. Today NBPGR is known globally for its national genebank, national networking system on PGR management and as a training center for human resource development in PGR management.

The Bureau has its main campus at New Delhi with a 100 acre experimental farm at Issapur (about 45 kms from main campus) and 11 regional stations/ base centers located in different agroclimatic/ phytogeographical regions of India. It has also developed close linkages with 57 national active germplasm sites (NAGS) and other cooperators across the country. In order to enhance the utilization of available germplasm in various crops, a new initiative was taken this year for joint evaluation involving crop-based institutes of ICAR, Project Directorates and National Research Centers.

During 2003, NBPGR has made significant progress in all the identified thrust areas of PGR management like plant exploration and collection of germplasm; targeted introductions for biotic, abiotic stress tolerance/resistance and quality traits; quarantine inspection of germplasm under exchange; characterization, evaluation, regeneration/ multiplication of germplasm; *ex situ* conservation of orthodox seeds; tissue culture and cryopreservation; molecular characterization of released varieties and promising genotypes and registration of indigenous germplasm. Several grass root level trainings and biodiversity fairs were organized for creating PGR awareness among farmers particularly tribal women. Significant achievements (activity-wise) are highlighted in executive summary and details are given in ensuing chapters.

It is a pleasure to place on record my sincere thanks and gratitude to Dr Mangala Rai, Secretary, Department of Agricultural Research & Education and Director General, Indian Council of Agricultural Research; Dr Gautam Kalloo, Deputy Director General (Horticulture & Crop Sciences), ICAR and Dr SL Mehta, National Director, National Agricultural Technology Project on Plant Biodiversity for their guidance, encouragement and support to NBPGR. I wish to express my sincere appreciation to all my colleagues in the NBPGR for their dedicated efforts and cooperation in carrying out the functions and activities of the Bureau. I congratulate Drs Arjun Lal, (Ms) Neeta Singh and (Ms) Ruchira Pandey for compiling and editing this report. I shall greatly appreciate specific suggestions from readers in improving and expanding our services.

September 2004  
New Delhi

**BS Dhillon**  
Director

# EXECUTIVE SUMMARY

During 2003, NBPGR made significant progress in all the identified thrust areas of plant genetic resources management like collection of indigenous germplasm and targeted introductions from abroad, quarantine inspection and release of healthy germplasm, characterization, evaluation and maintenance of germplasm, *ex situ* conservation, DNA fingerprinting, PGR policy and human resource development. A summary of accomplishments under these PGR activities is given below.

## PLANT EXPLORATION AND GERMPLASM COLLECTION

At the national level, a total of 197 explorations were undertaken across the country under NATP-PB project and 9571 accessions of various agri-horticultural crops and their wild relatives were collected in a mission mode. Out of these, 1509 collections were made by the Headquarter, New Delhi (Zone-VII under NATP-PB) through 35 explorations covering parts of UP, MP, HP, Gujarat, Rajasthan, J & K, Haryana, Punjab and Uttaranchal. Special emphasis was given on the collection of wild relatives of crop plants, vegetables, minor fruits and medicinal plants.

By **Regional Station Akola**, two explorations were undertaken for collection of germplasm of various crops from Yavatmal, Chandrapur and Gadchiroli districts and custard apple germplasm from Vidarbha and Marathawada region of Maharashtra. The material was collected from farmers threshing yards /fields and natural forests and a total of 152 accessions were assembled from nine districts of

Maharashtra. The accessions included cereals (7), millets (10), pulses (37), oilseeds (13), vegetables and tuber crops (32), horticultural crops (32), fibre crop (1), spices (8), wild relatives (10) and medicinal and aromatic plants (2). In case of custard apple variability was also observed pertaining to the physico-chemical characteristics including the total soluble salts (%).

**Regional Station, Bhowali** undertook seven (four multicrop and three crop specific) explorations from parts of Uttaranchal and 252 collections including landraces and primitive cultivars from remote areas of hills were collected. In addition, four explorations (2 multicrop and 2 crop/ region specific) were undertaken by cooperators in parts of Uttaranchal under NATP (PB) and 425 accessions comprising cereals (109), vegetables (107), oilseeds (17), pulses (2) and spices (2) were collected during 2003.

**Exploration Base Center, Cuttack** carried out five explorations for collection of M&AP and agri-horticultural crops from various parts of Orissa and West Bengal including one special mission to Sunderban and 421 accessions were collected. A rare collection of *Piper chaba* (locally called as gaccha mirch, a highly pungent type having plant height upto 210 cm and fruiting throughout the year) was made.

**Regional Station, Hyderabad** conducted 17 explorations and collected germplasm of paddy, pearl millet, small millets, pulses, niger, *Pongamia* sp., tuber crops, ginger, turmeric, grapes, medicinal and aromatic plants. During these

explorations, a total of 2,322 accessions of different crops and their wild relatives were collected. A total of 8,880 samples of different agri-horticultural crops were added to the medium-term storage module during 2003 making a total of 43,760 germplasm samples conserved as on 31.12.2003.

**Regional Station, Jodhpur** carried out seven multicrop explorations to various parts of Gujarat, Haryana and Rajasthan and collected 333 accessions comprising cereals (76), pseudocereals (18), millets (2), pulses (100), oilseeds (5), vegetables (23), fruits (12), spices (11), fibre (1), medicinal and aromatic plants (69), multi-purpose trees (8), forage grass (1) and ornamentals (7). The vegetatively propagated material (32) was also collected which is being maintained in the field.

**Exploration Base Center, Ranchi** collected 1,196 accessions of different agri-horticultural crops including the wild types during 10 explorations undertaken in parts of Orissa. *Flacourtia indica* and *Aristolochia oncocephalus* were collected for the first time and added to gene bank.

**Regional Station, Shillong** collected a total of 1,865 accessions of various crop plants and their wild relatives during eight explorations from the East and West Khasi hills and Ri-Bhoi districts of Meghalaya, Saikhul area of Senapati district of Manipur; Jharnapani, Dimapur, Nagaland, Mamit district of Mizoram and West Tripura. Two special exploration missions were also conducted, one in Brahmaputra Islands and another in Arunachal Pradesh. Good variability was collected in paddy, strawberry, wild banana, *Prunus*, *Pyrus*, *Curcuma* and *Cucumis*.

**Regional Station, Shimla** conducted ten

explorations and 979 accessions comprising cereals (153), pseudocereals (41), millets (17), pulses (91), oilseeds (89), vegetables (217), fruits (130), ornamentals (44), spices & condiments (36), M & AP (58), dye yielding (9), wild relatives (22) and other economic plants (72) were collected.

**Regional Station, Srinagar** undertook two explorations in different areas of Kashmir Valley and Ladakh (J&K) and Lahaul and Spiti region of Himachal Pradesh. A total of 192 collections comprising different agrihorticultural crops and their wild relatives were made along with 31 herbarium specimens sent to National Herbarium of Cultivated Plants (NHCP).

**Regional Station, Thrissur** collected a total of 484 accessions during ten explorations that included 311 accessions of cultivated plants, 142 of wild relatives and 35 of medicinal and aromatic plants. Another 1499 accessions were collected during the 75 explorations undertaken by the 18 cooperating centres. A total of 605 accessions were deposited to national gene bank for long-term storage, 67 accessions were added to *in vitro* repository at Thrissur and five were sent for cryopreservation. Fifty-five voucher specimens (herbaria) were provided to the national herbarium of cultivated plants at NBPGR (HQs).

## GERMPLASM EXCHANGE

During the period under report 33,326 accessions (1,07,202 samples) were imported from 41 countries that included germplasm (24,140 accessions; 34,968 samples) as well as trial material (9,180 entries; 72,234 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were



met by arranging material from different sources in India and 490 accessions (549 samples) including CIMMYT material (nurseries) were sent to 16 countries. Based on requests received from research workers in the country 15,289 samples of diverse crops maintained by active germplasm sites were obtained and supplied to them for utilization in the various crop improvement programmes in the country.

### **Promising introductions for biotic stress resistance**

- *Triticum aestivum* (EC 524892) tolerant to hessian fly (*Mayetiola destructor*); *T. aestivum* (EC 527045) tolerant to hessian fly, resistant to stripe rust and leaf rust; *T. aestivum* (EC 528127) resistant to powdery mildew, septoria leaf blotch, soil borne wheat mosaic virus and stripe rust; *T. aestivum* (EC 533525) resistant to powdery mildew, barley yellow leaf virus and glume blotch; *T. aestivum* (EC 533532) resistant to leaf rust, stem rust and wheat soil borne mosaic virus; *T. aestivum* (EC 533533) resistant to stem rust, leaf rust and hessian fly- all from USA.
- *Zea mays* (EC 520260) resistant to European corn borer (*Ostrinia nubilalis*); *Z. mays* (EC 523377) resistance to corn borer (*Diatrea grandiosetta*); *Z. mays* (EC 514655-60) mold resistant varieties- all from USA.
- *Hordeum vulgare* (EC 523339) resistant to common root rot and EC 532634 resistant to covered smut and intermediate reaction to barley leaf scald and net blotch- both from Canada; *H. vulgare* (EC 527044) resistant to barley stripe rust and EC 533523 resistant

to net blotch, spot blotch and stem rust- both from USA.

- *Helianthus annuus* (EC 524065-070) resistant to Alternaria blight and head rot lines from Bulgaria,
- *Carthamus tinctorius* (EC 523375) having high oil content (>40%) and resistance to Alternaria, Fusarium wilt and aphids from USA.
- *Sesamum indicum* (EC 519382) resistant to powdery mildew, wilt and bacterial blight from Bulgaria.
- *Phaseolus vulgaris* (EC 528616-618) resistant to curly top virus (CTV) and bean common mosaic virus (BCMV) from USA; *P. vulgaris* (EC 530832, EC 530891, EC 530898) resistant to angular leaf spot and rust from Bulgaria.
- *Pisum sativum* (EC 517107-111) resistant to powdery mildew from Bulgaria.
- *Capsicum annum* (EC 533896-901) resistant to southern root knot nematode from USA; *Capsicum* sp. (EC 532386-89) Cayenne type, resistant to CMV, bacterial wilt and poty virus group from Taiwan.
- *Lycopersicon esculentum* (EC 515140-41) resistant to *Tomato leaf curl virus*, bacterial wilt and *Tobacco mosaic virus* from Taiwan; *L. esculentum* (EC 528360-369) resistant to whitefly transmitted geminivirus, *Tomato yellow leaf curl virus*, Fusarium wilt and Stemphyllium grey leaf spot from Taiwan.
- *Nicotiana tabacum* (EC 516584-586) resistant to black shank, granville wilt, *Tobacco mosaic virus* and southern root knot nematode from USA.

Besides, several exotic collections having resistance to abiotic stresses and having potential for quality and agronomic traits were also introduced and made available to plant breeders in the country.

## **QUARANTINE OF GERmplasm UNDER EXCHANGE**

At New Delhi, a total of 33,320 exotic accessions (1,07,202 samples) nurseries/ trial breeding material (9180 entries, 72,234 samples) and germplasm (24,140 accessions, 34,968 samples) of various crops and 490 accessions (549 samples) 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 621 samples were infested with insects/mites including 134 samples with hidden infestation; 1,511 infected with nematodes; and 171 infected with fungi and bacteria. Of the 2,303-infested/infected-contaminated samples, 2,214 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip, ethyl alcohol wash and mechanical cleaning. Eighty-nine 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-seven Phytosanitary Certificates were issued for consignments meant for export. A total of 2,352 samples collected indigenously were processed for pest-free conservation. Of the 517 infested/-infected samples, 464 were salvaged and 2,299 samples were released for pest-free conservation. Twenty-three samples of transgenic crops viz., paddy and cotton, were processed for quarantine clearance. Extensive

studies were carried out on prevalence of seed-transmitted viruses of grain legumes in different pulse growing areas of the country, assessment of their seed transmission rates, techniques for their detection in group testing by Double Antibody Sandwich and Direct Antigen Coating Enzyme Linked Immunosorbent Assay (ELISA) and the role of epidemiological factors in their field spread.

At the Regional Station, Hyderabad, a total of 23,038 samples comprising 10,884 of import samples and 12,154 of export samples were processed for quarantine clearance and a total of 184 phytosanitary certificates were issued. Several important pests were intercepted. A total of 2,198 import samples were found infested/infected with pests/pathogens, and 2,012 samples could be salvaged. One hundred and eighty-six samples infected with pathogens could not be salvaged and hence rejected. In exports, 241 samples were rejected due to the detection of important pests/pathogens and lack of viability. The plant quarantine services were extended to 27 organizations in south India.

## **GERMPLASM CHARACTERIZATION, EVALUATION AND MAINTENANCE**

At the Experimental farm, Issapur and HQs, New Delhi, a total of 12,616 accessions of various agri-horticultural crops viz., cereals (6,992), legumes (1,289), oilseeds (1,257), vegetables (2,352), forages (149), under-utilized crops (239) and medicinal and aromatic plants (338) were grown during the reporting period for characterization, evaluation, multiplication and maintenance. Besides, a total of 3,500 accessions of various crops comprising cereals (1,821) pulses (388), oilseeds (326), vegetables (664), forages (28)

and medicinal and aromatic plants (273) 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. Germplasm evaluation of crops namely rapeseed-mustard (825), pulses (898) and wheat (152) for quality attributes/value added traits resulted in identification of promising accessions. Phytochemical study of various M&AP was also undertaken. A report on germplasm evaluation for kharif (2002), rabi (2002-03) and horticultural crops was compiled and distributed to the concerned PCs/ PDs.

Under the agroclimatic conditions of Regional Station, **Akola**, 1,521 accessions comprising cereals (206), millets (452), pulses (412) and oil seeds (451) were characterized and regenerated. Crop-wise accessions included maize (206), barnyardmillet (64), littlemillet (50), prosomillet (19), kodomillet (33), foxtailmillet (256), fingermillet (30), horsegram (163) and niger (211) during *kharif* season and chickpea (210), grasspea (39), linseed (239) and safflower (1) during *rabi* season. Promising accessions were identified for different yield attributing characters in all these crops germplasm. A total of 608 accessions were supplied to different research organizations for utilization in crop improvement programs and 46 accs. were supplied to regeneration sites and 608 for multi-location testing and evaluation purpose.

A total of 2061 accessions were grown at **Bhowali** station for regeneration, characterization and maintenance. A total of 335 accessions were supplied to user scientists in the country and 301 accessions deposited in National gene bank for conservation.

At **Cuttack**, 2,882 accessions comprising 2,712 accs. of cultivated rice and 170 accs. of turmeric were grown for preliminary characterization and seed multiplication. A total of 437 accs. of various crop (including 73 accs. received from OUAT) and 129 accs. of M&AP were deposited as voucher specimen in MTS and of 590 accs. were deposited in NGB. A set of 104 accs. of agri-horticultural crops was sent to regeneration sites for characterization and evaluation.

At **Hyderabad** 1,141 accessions of different agri- horticultural crops and wild species were sown/ maintained for evaluation/ rejuvenation/ multiplication. Promising accessions were identified in chilli for disease resistance.

At Regional Station, **Jodhpur**, 1219 accessions comprising wheat, barley, chickpea, brassica, safflower, coriander, cumin, fenugreek, isabgol and taramira were sown along with checks during rabi, 2003. Horticultural plants and plants of economic importance were maintained and data were recorded in kair, jamun, mulberry, *Salvadora* sp., *Aloe barbadensis*, *Andrographis paniculata*, *Jatropha curcas* and jojoba. In all, 8,877 accessions were processed and kept in the MTS facility and 262 accessions were sent for long-term storage in gene bank. Seed samples (8,072) were supplied to various indenters on request.

At Regional Station, **Shillong**, a total of 2545 accs. were characterized and promising genotypes for various attributes identified.

At Regional Station, **Shimla**, a total of 1,915 accessions of various agri-horticultural crops were characterized and multiplied for conservation, 1122 accessions were sent for

medium term storage as voucher specimens and 985 accessions for long-term storage.

At Regional Station, **Thrissur**, 997 annuals and 241 perennials were grown for characterization/evaluation and 1,324 annuals and 1,223 perennials for regeneration/ maintenance. Promising accessions were identified for yield and quality traits.

## **GERMPLASM CONSERVATION-EX SITU**

A total of 38,926 accessions of various crops were received at the conservation division for long-term conservation in the National Genebank. Of these 20,027 accessions were added to the base collections. In addition, a total of 8,035 accessions received at the Germplasm Handling Unit were stored in the medium term storage module as voucher specimen. Monitoring of the stored germplasm (2,486 accessions), physical verification and inventorization (1,56,980 accessions), and updating of passport information (1,334 accessions) were the other major achievements. Dormancy breaking protocols for six wild species of medicinal importance were developed. Studies on ultra-dried seeds to enhance the longevity of sesame, safflower, spongegourd, radish and neem were continued to develop cost effective conservation methods.

## **TISSUE CULTURE AND CRYOPRESERVATION OF GERMPLASM**

During the year, a total of 1396 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* multiplication and conservation protocols in different species. Plantlet regeneration protocols were developed in *Allium ramosum*, *Camellia sinensis*, *Centella asiatica* and somatic embryogenesis was induced in mango. Cryopreservation experiments yielded varying degree of success in *Dioscorea alata*, *Gentiana*, *Morus bombycis*, *Musa* cv. Williams (AAA) and *Simmondsia chinensis*. DNA isolation and purification protocols were standardized in *Allium tuberosum* and *Bacopa monnieri*. In *Colocasia esculenta*, RAPD analysis using 10 primers indicated that there was no difference in the banding pattern of two year-old *in vitro* conserved four accessions and that of their mother plants maintained in the polyhouse. A total of 61 accessions of *Musa*, were supplied as *in vitro* cultures to various indenters. A total of 5242 accessions of orthodox, intermediate and recalcitrant seed species were conserved in the cryobank.

## **DNA FINGERPRINTING**

A total of 753 varieties/ promising germplasm were fingerprinted during the year. AFLP analysis of blackgram, cowpea, greengram, mothbean, pigeonpea, ricebean, pea, lentil, chilli, saffron, brinjal and brassica was further carried out. STMS analysis of rice, sorghum, wheat and chickpea was taken up.

## **PGR POLICY ISSUES**

Country's progress report on the implementation of global plan of action (GPA) on all the twenty priority areas was prepared and submitted to Joint Secretary (Seeds), DAC and Asstt. Director General (Seeds), DARE. Suggestions were made for removal of objectionable phrases and inclusion of additional information on programs and policies of NBPGR in the draft document of national biodiversity, strategy and action plan (NBSAP). A document on material transfer agreement (MTA) was submitted to SAARC secretariat for its approval by member nations. Action on the recommendations of first meeting of the Functional Committee on PGRs was initiated and communicated to ICAR.

## **OTHER ACTIVITIES**

- Meetings of the Institute Management Committee, Research Advisory Committee, Staff Research Council, Institute Joint Staff Council and Crop Advisory Committee were held timely to review the progress of work related to various PGR activities and planning strategies to further strengthen various activities and infrastructure development both at the headquarters and regional stations.
- Several distinguished scientists, progressive farmers, administrators, teachers and students visited the National Genebank, DNA Fingerprinting Labs, plant quarantine greenhouses and

glasshouses, national herbarium of cultivated plants and tissue culture labs at Headquarters, New Delhi and field gene banks at Issapur, Akola, Bhowali, Hyderabad, Jodhpur, Ranchi, Shillong, Shimla and Thrissur.

- The scientists, research associates and technical staff from Headquarters and regional stations participated in various national training courses, workshops, seminars, symposia, group meetings and a few international conferences abroad in the field of plant genetic resources and related disciplines.
- For human resource development in PGR management several training programmes, group meetings, workshops and grassroot level trainings/ biodiversity fairs were organized throughout the country. Greater emphasis was given on creating PGR awareness among women farmers in remote villages / tribal areas.
- Field days were organized for rabi and kharif crops at Issapur Farm, New Delhi, Thrissur, Akola, Shimla, Jodhpur and Hyderabad in which several plant breeders from ICAR, SAUs and other organizations participated and observed the performance of germplasm in the field and indented accessions/ lines of desired traits for their utilization in crop improvement programs.

## COLLABORATIVE GERmplasm EVALUATION: A NEW INITIATIVE

A new initiative was taken for germplasm evaluation for qualitative traits and for agronomic performance in collaboration with relevant organization like ICAR crop based Institutes, Project Directorates, National Research Centers and All India Coordinated Projects. Collaborative germplasm evaluation was initiated for following crops: **rice** (100 accs) with Directorate of Rice Research, Hyderabad; **wheat** (2080 accs) with DWR, Karnal and 155 accs with VPKAS, Almora; **maize** (108 accs for 8 locations) with DMR, New Delhi, 54 accs with ICAR Research Complex for NE region Tadong, Sikkim and 54 accs with VPKAS, Almora; **barley** (28 accs) with VPKAS, Almora; **sorghum** (60 accs) with NRC, Sorghum, Hyderabad; **lentil** (50 accs) with IIPR, Kanpur; **rapeseed** and **mustard** (121 accs) with NRC on Rapeseed-mustard, Bharatpur; **sunflower** (98 accs) with DOR, Hyderabad; **crambe** (12 accs) with NRC on Rapeseed-mustard, Bharatpur; **brinjal** (200 accs) and **tomato** (300 accs) with IIVR, Varanasi; **garlic** (525 for maintenance & 50 for evaluation) with NRC for Onion & Garlic, Pune; **fenugreek** (52 accs) and **coriander** (30 accs) with NRC on Seed Spices, Ajmer.



Dr. J.L. Karihaloo, Project Director, NRC on DNA Finger printing receiving Rafi Ahmed Kidwai award from Shri Raj Nath Singh Ji, Union Minister of Agriculture

## 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 centers 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

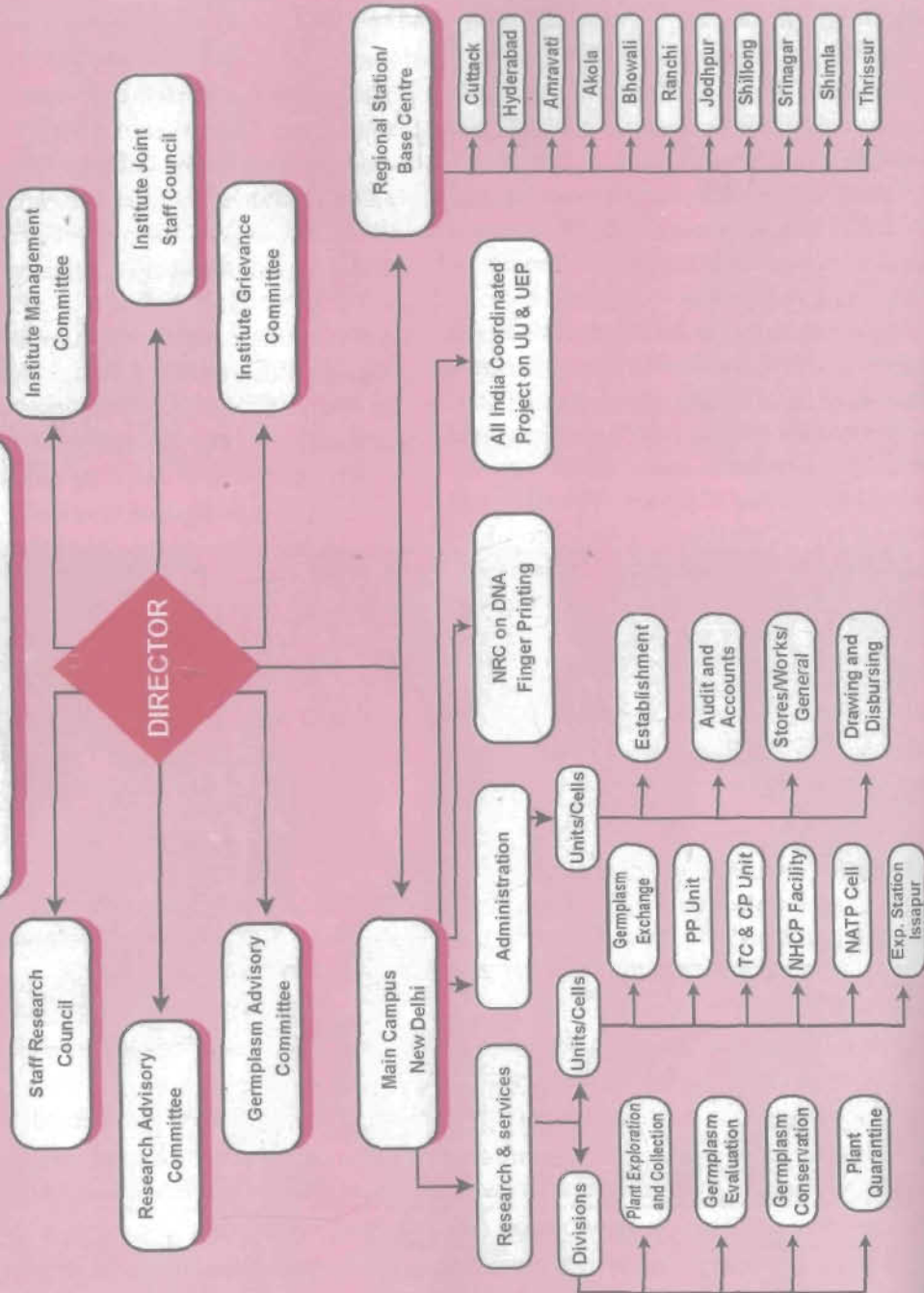
### MANDATE

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







Committee, Research Advisory Committee, Crop Germplasm Advisory Committees and the Staff 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), Agricultural Research Information System (ARIS) and Policy Planning and Monitoring (PPM).

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 Centers, headed by a principal scientist/senior scientist, are located at Shimla, Bhowali, Shillong, Jodhpur, Akola, Hyderabad, Amravati, 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<sup>3</sup> and two of 176 m<sup>3</sup> capacity) were installed for long-term storage of seeds of orthodox species kept in laminated aluminium foils at -20°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 57 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 Crop Germplasm Advisory Committees for different crops advise the Bureau regarding improving the capability, efficiency and effectiveness of its services for management of PGR in the country.

### **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, Plant Germplasm Reporter Minimal Descriptors of Agrihorticultural Crops, Training Courses Manuals etc. 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.

### **Extension services**

Bureau organizes Plant Biodiversity Fairs /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 197 explorations were undertaken across the country under NATP-PB project and 9,571 accessions of various agri-horticultural crops and their wild relatives were collected. Out of these, 1509 collections were made by the Headquarters, New Delhi through 35 explorations covering parts of UP, MP, HP, Gujarat, Rajasthan, J & K, Haryana, Punjab and Uttaranchal. Special emphasis was given on the collection of wild relatives of crop plants, vegetables, minor fruits and medicinal plants. A total of 864 samples were added to the National Herbarium of Cultivated Plants.

## 1.1 Exploration and Germplasm Collection

A total of 197 explorations were executed under the NATP Project on Plant Biodiversity and 9,571 accessions of different agri-

horticultural crops comprising 7,332 accessions of cultivated plants and 2,239 accessions of their wild types were collected. The zone wise details of the collected germplasm are given in table 1.

**Table 1. Explorations undertaken and germplasm collected in India**

| Zone         | Region  | No. of explorations undertaken | Accessions collected |
|--------------|---|--------------------------------|----------------------|
| 1.           | Arid region                                   | 15                             | 465                  |
| 2.           | South-West coastal region                     | 62                             | 1441                 |
| 3.           | Humid/moist tropical East coastal region      | 6                              | 294                  |
| 4.           | North-East hill region                        | 18                             | 1947                 |
| 5.           | Central Himalayan region                      | 4                              | 339                  |
| 6.           | North-West Himalayan and high altitude region | 13                             | 1257                 |
| 7.           | North-West plains                             | 35                             | 1509                 |
| 8.           | Sub-tropical/sub-humid region                 | 21                             | 1063                 |
| 9.           | Central Indian region                         | 6                              | 232                  |
| 10.          | South-East coastal region                     | 17                             | 1024                 |
| <b>Total</b> |   | <b>197</b>                     | <b>9,571</b>         |

Thirty five multi-crop and crop specific explorations were undertaken by the Headquarters from parts of UP, MP, HP, Gujarat, Rajasthan, J&K, Haryana, Punjab and Uttaranchal and a total of 1,509 collections of different agri-horticultural crops were assembled. Diversity in cultivated (1,249) and wild types (260) included cereals (971), pseudocereals (39), millets and minor millets (43), pulses (114), oilseeds (411), vegetables

(438), fiber and allied crops (6), horticultural and fruit crops (119), medicinal and aromatic plants, spices and condiments (107), trees/forestry species (54) and other crops (81). The details of crop diversity explored and germplasm collected during the explorations are given in table 2.

Crop diversity collected during the explorations conducted by zone VII (HQ) are briefly described hereunder.

**Table 2: Crop diversity collected from central India (Zone-VII)**

| Crop groups                    | Crop  | Areas  |
|--------------------------------|---|--|
| Cereals (97)                   | Rice (63), Barley (20), Wheat (131),<br>Maize (1)   | UP- Gorakhpur, Mirzapur, Basti, Deoria, Siddarth<br>Nagar<br>J & K- Baramulla, Kargil, Leh<br>HP- Lahaul Spiti, Mandi<br>T N- Nilgiri, Coimbatore<br>A & N- South , North and middle Andaman   |
| Pseudocereals                  | Amaranth (39)   | Gujarat- Mehsana, Banaskantha, Kheda,<br>Gandhi Nagar, Anand<br>A& N- South, North and middle Andaman  |
| Millets/ Minor<br>millets (37) | Foxtail millet (19) Kodo millet (6)<br>Finger millet (4) <i>Coix</i> (8)  | UP- Gorakhpur, Deoria, Basti, Siddarth Nagar,<br>Pilibhit, Shahjahanpur  |
| Pulses (114)                   | Garden bean (2) <i>Lathyrus</i><br>(39) Cowpea (16) Faba bean<br>(1) Blackgram (11) Green gram<br>(6) Pigeonpea (21) Peas (13)<br>Horsegram (1) Others (3)  | UP- Basti, Deoria, Ghazipur, Mau, Ballia,<br>Azamgarh, Maharajganj, Siddarth Nagar.<br>TN- Nilgiri , Coimbatore<br>Jharkhand- Gumla, Lohardaga, Katihar,<br>Hazaribagh<br>Chhattisgarh- Jagdalpur, Dantewara<br>A&N- South, North and middle Andaman   |
| Oilseeds (411)                 | <i>Jatropha</i> (79), Linseed (108) Mustard<br>(214), Sesame (7) Taramira (3)   | UP- Basti, Deoria, Siddarth Nagar, Gorakhpur,<br>Maharajganj, Kanpur<br>HP- Chamba, Kangra, Kullu, Mandi, Lahaul Spiti,<br>Una, Sirmour<br>Karnataka- Konark<br>J& K- Kargil , Leh, Baramulla, Udhampur<br>UA- Pauri, Dehradun, Nainital, Champawat, U.S.<br>Nagar<br>Harayana- Gurgaon<br>Jharkhand- Gumla, Lohardaga, Katihar,<br>Hazaribagh<br>Punjab- Gurdaspur, Ropar<br>A.& N- South , North and middle Andaman  |
| Vegetables (1509)              | Musk melon (104) Bitter gourd (14)<br>Pumpkin (10) Snake gourd (6)<br>Bottle gourd (10) Sponge gourd (8)<br><i>Colocasia</i> (2) Ash gourd (1)<br>Cauliflower (10) Cucumber (12)<br>Tomato (1) Radish (2) Chilli (50)<br>Onion (10) Methi (2) Yam (7)<br>Pea (6) Spinach (2) French bean (8)<br>Carrot (1) Brinjal (1) Snapmelon (70)<br>Okra (3) Watermelon (2)<br>Others (24) | UP- Bahraich, Jaunpur, Unnao, Pratapgarh,<br>Hardoi, Eta, Agra, Aligarh, Amroha,<br>Bulandshahr, Gaziabad, Meerut, Barabanki,<br>Sultanpur, Basti, Deoria, Jhansi, Hamirpur,<br>Ghazipur, Mau, Ballia, Azamgarh, Rai barielly,<br>Fatehpur<br>J& K- Jammu, Udhampur, Kargil, Leh, Bara mulla<br>HP- Lahaul Spiti , Mandi<br>TN- Nilgiri, Coimbatore<br>Punjab- Bhatinda, Abohar, Fazilka<br>Raj.- Hanumangarh, Ganganagar<br>Jharkhand- Gumla, Lohardaga, Lathar,<br>Hazaribagh<br>A & N- South , North & middle Andaman |

|                                     |   |   |
|-------------------------------------|---|---|
| Fibre & Allied crops (6)            | <i>Sesbania</i> (4)   | MP- Gwalior , Datia , Tikamgarh, Chattarpur, Panna  |
|                                     | Jute (2)  | UP- Jhansi, Deoria, Basti, Siddarth Nagar<br>A& N- South, North & middle Andaman  |
| Horticultural & Fruit crops (119)   | Citrus (79) Ber (22) Strawberry (2)<br>Jamun (1) Papaya (1) Others (14) | Rajasthan- Alwar, Bharatpur<br>UP- Agra, Mathura<br>J & K- Kargil, Leh, Baramulla<br>HP- Lahaul Spiti, Mandi, Sirmour, Kangra, Hamirpur |
| M & AP, Spices and Condiments (107) | Mehndi (16) Neem (27) Garlic (3)  | UP- Muzzafarnagar<br>Haryana - Karnal , Hisar, Mahendragarh, Rewari,  |
|                                     | <i>Coleus forskohlii</i> (10) <i>Asparagus</i> (1)                      | Rajasthan- Jaipur, Ajmer<br>TN- Kanyakumari   |
|                                     | <i>Piper</i> (2) Vanilla (1) Turmeric (1)                               | J & K- Kargil, Leh, Baramulla<br>HP- Lahaul Spiti, Mandi  |
|                                     | Others (46)   | Uttaranchal- Uttarkashi<br>A& N- South, North and middle Andaman  |
| Tree species(54)                    | Mahua (20) <i>Pongamia pinnata</i> (10)                                 | MP- Gwalior, Datia, Tikamgarh, Chattarpur, Panna  |
|                                     | Bakain (12) <i>Terminalia arjuna</i> (4)                                | UP- Jhansi, Kannauj, Kanpur, Lucknow, Muradabad   |
|                                     | Others (4)  | Jharkhand-Jahanabad, Ranchi<br>Karnataka-Kolar  |
| Miscellaneous- 81                   |   |   |

**1.1.1 Collection of pseudo-cereals from Gujarat:** A total of 36 accessions of grain amaranth were collected from Mehsana, Banaskantha, Kheda, Gandhinagar and Anand districts of Gujarat . Two accessions of *Jatropha* were also collected.

**1.1.2 Collection of oilseeds from UP:** A total of 51 accessions of mustard were collected from Basti, Siddarth nagar, Gorakhpur, Deoria, Kushinagar, and Maharajganj of U.P. Good variability was observed in mustard with regard to seed size and seed colour.

**1.1.3 Collection of forest trees from MP and UP:** A total of 18 accessions of mahua were collected from Gwalior, Datia , Tikamgarh, Chattarpur, Panna of M.P. and Jhansi of U.P. Two accessions of *Sesbania* were also collected.

**1.1.4 Collection of vegetables from UP:** A total of 72 accessions of musk melon were collected from Jhansi and Hamirpur of UP. Good variability was observed in muskmelon with regard to fruit colour and fruit size.

**1.1.5 Collection of horticultural crops from Rajasthan, UP and Haryana:** A total of 18 samples of ber were collected from Alwar and Bharatpur of Rajasthan; Agra and Mathura of U.P. and Faridabad of Haryana. Good variability was observed in ber with regard to fruit size and fruit colour.

**1.1.6 Collection of *Momordica dioca* from UP and MP:** A total of 64 samples of *Momordica dioca* having variability in fruit colour, fruit size and fruit shape were collected from Mirzapur, Sonbhadra, Banda, Mahoba,

Jhansi, Jalaun of U.P. and Rewa, Sidhi, Satna and Chattarpur of M.P.

#### **1.1.7 Collection of M & AP from**

**Uttaranchal:** A total of 57 accessions comprising *Celastrus paniculatus* (3) *Coleus forskohlii* (10) *Withania somnifera* (1), *Saussurea*, *Costus* (1), *Asparagus* (1), *Spilanthes acmella* (1) *Carum carvi* (1), *Polygonatum multiflorum* (4), *Corylus jacquemontii* (1), *Aconitum balfourii*, (4) *Picrorrhiza*, *Scrophularia* (2), *Valeriana*, jatamansi (1), *Allium* sp. (2), *Dactylorhiza* sp. (2), and others (19) were collected from high hills of Uttarkashi in Uttaranchal.

#### **1.1.8 Collection of millets and minor millets**

**from UP:** A total of 8 accessions of Job's tear and one of bittergourd were collected from Muzaffar Nagar, Pilibhit and Shahjahanpur of UP

**1.1.9 Collection of cereals from UP:** A total of 37 accessions of Boro rice were collected from Gorakhpur, Sant Kabir Nagar, Mirzapur, and Basti of U.P.. Diversity observed in the land races of Boro rice comprise wide range of grain size, shape and color, maturity period and drought tolerance.

#### **1.1.10 Collection of pulses from**

**Chhattisgarh:** A total of 20 samples comprising perennial pigeonpea (5), and wild pigeonpea (15) were collected from Jagdalpur and Dantewara of Chhattisgarh. Good variability was observed in pigeonpea with regard to seed size and colour.

#### **1.1.11 Collection of fruits from**

**Chhattisgarh:** A total of 87 samples comprising citrus (71), ber (4) *Acacia* (1), *Poncirus* (9), others (2) were collected from Sirmour, Kangra, and Hamirpur of H.P. and Hoshiarpur and

Abohar of Punjab. Good diversity was observed in *citrus* with regard to fruit size, shape and colour.

#### **1.1.12 Collection of multi-crops from**

**Andaman and Nicobar:** A total of 112 accessions comprising cereals (23), pseudocereals (3), pulses (23), oilseeds (3), fruits (3), vegetables (37), spices and condiments (5), fibers (2) and others (13) were collected from South Andaman, North Andaman and middle Andaman.

#### **1.1.13 Collection of oilseeds from HP:**

A total of 109 accessions of mustard were collected from Chamba, Kangra and Kullu of H.P. Good diversity was observed in mustard with regard to seed size and colour.

#### **1.1.14 Collection of M & AP from U.P.,**

**Rajasthan and Tamil Nadu:** A collection of 27 accessions of neem were collected from Lucknow of U.P., Jaipur and Ajmer of Rajasthan and Kanyakumari of Tamil Nadu.

#### **1.1.15 Collection of Allium sp. and Barley**

**from J & K:** A total of 46 accessions comprising *Allium* (10), barley (8) and others (28) were collected from Kargil, Leh and Baramulla of J & K and Lahul spiti and Mandi of H.P.

### **1.2 National Herbarium of Cultivated Plants**

A total of 864 samples were processed and included in the herbarium after authentication and indexing. These included 664 herbarium specimens, 164 seed samples and 36 economic products. The herbarium now holds 15,764 herbarium specimens. These are representative of 3,251 species belonging to 1,287 genera and 246 families. Some important additions are listed in the table below.

Some important materials added during the year were *Actinidia chinensis*, *Anthemis australis*, *A. tinctoria*, *Conium maculatum*, *Stachys tibetica*, *Braya* sp. from N.W. Himalayas and *Oxytropis* sp. from the cold arid tracts of Jammu and Kashmir.

*Aconitum balfourii*, *Chaerophyllum heterophyllum*, *Jurinea dolomoea* and *Polygonatum multiflorum* from Uttarkashi area of Uttaranchal; *Actinidia* sp., *Docynia hookeriana*, *Juglans regia*, *Crataegus* sp., *Gymnema sylvestre*, *Helicteres isora* and diversity in *Lawsonia inermis* and *Pongamia pinnata* were some of the useful and potentially useful plants from Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra and Arunachal Pradesh.

Spices and condiments from arid tracts of Rajasthan were *Acacia senegal*, *Capparis*

*decidua*, *Cordia dichotoma* and *Prosopis cineraria*. Tubers of *Solanum tuberosum*; rhizomes of *Curcuma caesia* and *Curcuma angustifolia*; fruits of *Terminalia cattapa* and *Cycas beddomei* were also added.

*Ipomoea dichroa*, *Kirganelia reticulata*, *Carica carandas*, *Baliospermum montanum*, *Bergia ammannioides*, *Chorisia speciosa*, *Zephyranthes flava*, *Origanum vulgare* and *Euphorbia clarkeana* were collected in Delhi and adjoining areas.

Over 110 aquatic plants such as *Blyxa*, *Hydrilla*, *Hydrocleis*, *Limnocharis*, *Limnophyton*, *Ottelia*, *Polygonum*, *Potamogeton* and *Vallisneria* were added from various parts of India.

Three-hundred and twenty-two specimens of plant material were checked for authenticity

#### Species added to the NHCP

| Family           | Botanical name  |
|------------------|---|
| Actinidiaceae    | <i>Actinidia chinensis</i> Planch.                          |
| Asteraceae       | <i>Anthemis australis</i> Willd.,<br><i>A. tinctoria</i> L. |
| Cornaceae        | <i>Benthamidia capitata</i> (Wall. ex Roxb.) Hara           |
| Apiaceae         | <i>Conium maculatum</i> L.                                  |
| Solanaceae       | <i>Datura suaveolens</i> Humb. & Bonpl.                     |
| Ginkgoaceae      | <i>Ginkgo biloba</i> L.                                     |
| Limnocharitaceae | <i>Hydrocleis martii</i> Seub.                              |
| Convolvulaceae   | <i>Ipomoea dichroa</i> Choisy                               |
| Euphorbiaceae    | <i>Kirganelia reticulata</i> (Poir) Baill.                  |
| Poaceae          | <i>Leptochloa panicea</i> (Retz.) Ohwi                      |
| Limnocharitaceae | <i>Limnocharis flava</i> (L.) Buchen.                       |
| Malvaceae        | <i>Malvaviscus conzattii</i> Greenm.                        |
| Lamiaceae        | <i>Melissa officinalis</i> L.                               |
| Hydrocharitaceae | <i>Ottelia alismoides</i> (L.) Pers.                        |
| Passifloraceae   | <i>Passiflora edulis</i> Sims                               |
| Geraniaceae      | <i>Pelargonium crispum</i> (P.J. Bergius) L'Her.            |



|                |  |
|----------------|--|
| Pinaceae       | <i>Picea smithiana</i> Boiss             |
| Plantaginaceae | <i>Plantago arenaria</i> Waldst. & Kit.  |
| Plantaginaceae | <i>Plantago hookeriana</i> Fisch. & Mey. |
| Rosaceae       | <i>Potentilla fulgens</i> Hk.            |
| Fabaceae       | <i>Sesbania cannabina</i> (Retz.) Pers.  |
| Lamiaceae      | <i>Stachys tibetica</i> Vatke            |
| Fabaceae       | <i>Wisteria floribunda</i> DC.           |



Variability in Citrus fruit collected from Garo hills of NEH region



*Vigna marina*—a medicinal plant collected from Andaman



Polyembryonic coconut trees from Andaman & Nicobar Islands

of botanical and common names. Thirty-two indentations were processed for identification, provided specimens and supporting information to students, researchers and others on useful

plants, weedy species of Asteraceae in India, and local flora. Macadamia nut from exotic sources, *Enicostemma verticillata*, *Capparis* spp. and *Spathodea* sp. were received for

identification. Consultation of specimens belonging to Solanaceae and Poaceae was done under Botanical Survey of India, Coimbatore -Flora of India project.

### Other Activities

1. Co-operator's training programme under HRD component on Plant Taxonomy and Wild Relatives of Crop Plants (27 Jan. to 1 Feb., 2003).
2. Dr. E. Roshini Nayar delivered a lecture at the National Workshop on Herbarium Techniques organized by the National Institute on Science Communication and Information Resources (NISCAIR), New Delhi.
3. Drs. Arjun Lal, Usha Dev and E. Roshini Nayar participated in the working group meeting on Biological Control for *Mikania micrantha* in India on 27-28 June, 2003.

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

PGR/PGC-BUR-DEL-01.00: Exploration for the collection of germplasm diversity in agricultural and horticultural crops, biosystematic and ethno-botanical studies, and maintenance of herbarium (S. S. Malik).

PGR/PGC-BUR-DEL-01.01: Exploration for the collection of genetic resources of cultivated crops and their wild relatives (S. K. Jain).

PGR/PGC-BUR-DEL-01.02: Analysis of genetic diversity and elucidation of species relationship in *Cucumis* species complex using morphological, biochemical and molecular markers to relate with collection/conservation strategies. (Umesh Srivastava; Gunjeet Kumar).

PGR/PGC-BUR-DEL-01.03: Exploration for collection of medicinal and aromatic plant diversity from different phyto-geographical regions. (K. C. Bhatt; N. Dixit, D. R. Pani).

PGR/PGC-BUR-DEL-01.04: National Herbarium of Cultivated Plants (NHCP) – establishment, maintenance, build up and taxonomic studies on Indian crop plants. (E. R. Nayar; Anjula Pandey).

## 2. DIVISION OF GERmplasm EVALUATION

**Summary:** A total of 12, 616 accessions of various agri-horticultural crops, viz. cereals (6, 992), legumes (1, 289), oilseeds (1, 257), vegetables (2, 352), forages (149), under-utilized crops (239) and medicinal and aromatic plants (338) were grown during the reporting period for characterization, evaluation, multiplication and maintenance. Besides, a total of 3,500 accessions of various crops comprising cereals (1,821) pulses (388), oilseeds (326), vegetables (664), forages (28) and medicinal and aromatic plants (273) 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. Germplasm evaluation of crops namely rapeseed-mustard (825), pulses (898) and wheat (152), for quality attributes/value added traits resulted in identification of promising accessions. Phyto-chemical study of various M&AP was also undertaken. A report on germplasm evaluation for *kharif* (2002), *rabi* (2002-03) and horticultural crops was compiled and distributed to the concerned PC/PD. Five germplasm field days were organized to promote interaction with plant breeders/user scientists. A total of 8,189 seed samples were supplied to different institutes for use in crop improvement programmes.

### 2.1 Evaluation for Agro-morphological Traits

A total of 12, 616 accessions of various agri-horticultural crops, namely, cereals (6,992), legumes (1,289), oilseeds (1, 257), vegetables (2, 352), forages (149), under-utilized crops (239) and medicinal and aromatic plants (338) were grown during the reporting period for characterization, evaluation, multiplication and maintenance. Besides, a total of 3,500 accessions of various crops, namely cereals (1,821) pulses (388), oilseeds (326), vegetables (664), forages (28) and medicinal and aromatic plants (273) were grown for regeneration and seed increase. 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 2003 is presented in Table 1.

Germplasm accessions of different crops were raised in one to three rowed plots in an Augmented Block Design along with suitable checks. The data were recorded on a set of

descriptors for characterization and preliminary evaluation.

### 2.2 Promising Accessions Identified in Different Crops

Based on characterization and preliminary evaluation, promising accessions for various attributes, viz. earliness, pod length, seeds per pod and high yield potential etc. have been identified. (table 2). A promising accession of pea, 'NBP-1' was considered by the Varietal Identification Committee of pulses and recommended for re-testing for one more year in the central zone.

### 2.3 Germplasm Enhancement in Sesame and Mungbean

A set of 20 enhanced progenies ( $F_6$ ) of sesame were distributed, through the Project Co-ordinator (sesame & niger), to four AICRP centres viz., TNAU, Coimbatore; OUAT, Bhubaneshwar; RAU, Mandor and JNKVV, Jabalpur for multi-location testing during *kharif*, 2003 and selection of promising types for use in crop improvement.

**Table 1 : Germplasm evaluated/ maintained during 2003**

| Crop group                  | Crop name                     | Botanical name                   | Accession (no.)                 |                           |    |
|-----------------------------|-------------------------------|----------------------------------|---------------------------------|---------------------------|----|
|                             |                               |                                  | Characterization and evaluation | Regeneration/ maintenance |    |
| Cereals                     | Wheat                         | <i>Triticum aestivum</i>         | 3344(IN*)                       | –                         |    |
|                             | Barley                        | <i>Hordeum vulgare</i>           | 1003(IN*)                       | –                         |    |
|                             | Triticale                     | <i>Triticale</i>                 | 223(IN*)                        | –                         |    |
|                             | Wheat                         | <i>Triticum aestivum</i>         | 1089                            | 1271                      |    |
|                             | Barley                        | <i>Hordeum vulgare</i>           | 618                             | 419                       |    |
|                             | Maize                         | <i>Zea mays</i>                  | 715                             | 131                       |    |
| Pulses                      | Cowpea                        | <i>Vigna unguiculata</i>         | 400                             | 200                       |    |
|                             | Urdbean                       | <i>Vigna mungo</i>               | 369                             | 188                       |    |
|                             | Pea                           | <i>Pisum sativum</i>             | 300                             | –                         |    |
|                             | Lentil                        | <i>Lens culinaris</i>            | 220                             | –                         |    |
| Oil seeds                   | Rapeseed mustard              | <i>Brassica spp.</i>             | 485                             | 297                       |    |
|                             | Crambe                        | <i>Crambe abyssinica</i>         | 62                              | 14                        |    |
|                             | Sunflower                     | <i>Helianthus annuus</i>         | 210                             | 15                        |    |
|                             | Safflower                     | <i>Carthamus tinctorius</i>      | 500                             | –                         |    |
| Vegetable crops             | Brinjal                       | <i>Solanum melongena</i>         | 1250                            | –                         |    |
|                             | Tomato                        | <i>Lycopersicon esculentum</i>   | 320                             | –                         |    |
|                             | Onion                         | <i>Allium cepa</i>               | 107                             | –                         |    |
|                             | Garlic                        | <i>Allium sativum</i>            | –                               | 664                       |    |
|                             | Palak                         | <i>Beta vulgaris</i>             | 35                              | –                         |    |
|                             | Bottle gourd                  | <i>Lagenaria siceraria</i>       | 65                              | –                         |    |
|                             | Radish                        | <i>Raphanus sativus</i>          | –                               | –                         |    |
|                             | Coriander                     | <i>Coriandrum sativum</i>        | 58                              | –                         |    |
|                             | Ridge gourd                   | <i>Luffa acutangula</i>          | 125                             | –                         |    |
|                             | Sponge gourd                  | <i>Luffa cylindrica</i>          | 316                             | –                         |    |
|                             | Fenugreek                     | <i>Trigonella foenum-graecum</i> | 76                              | –                         |    |
|                             | Perennial horticultural crops | Pomegranate                      | <i>Punica granatum</i>          | –                         | 49 |
|                             |                               | Citrus                           | <i>Citrus spp.</i>              | –                         | 17 |
|                             |                               | Guava                            | <i>Psidium spp.</i>             | –                         | 9  |
| Mulberry                    |                               | <i>Morus spp.</i>                | –                               | 4                         |    |
| Aonla                       |                               | <i>Embllica officinalis</i>      | –                               | 4                         |    |
| Karonda                     |                               | <i>Carissa spp.</i>              | –                               | 3                         |    |
| Lasora                      |                               | <i>Cordia myxa</i>               | –                               | 1                         |    |
| Pear                        |                               | <i>Pyrus spp.</i>                | –                               | 12                        |    |
| Plum                        |                               | <i>Prunus spp.</i>               | –                               | 4                         |    |
| Bael                        |                               | <i>Aegle marmelos</i>            | –                               | 10                        |    |
| Mango                       |                               | <i>Mangifera indica</i>          | –                               | 3                         |    |
| Ber                         |                               | <i>Zizyphus spp.</i>             | –                               | 11                        |    |
| Apple                       |                               | <i>Malus spp.</i>                | –                               | 2                         |    |
| Almond                      |                               | <i>Prunus spp.</i>               | –                               | 1                         |    |
| Forages                     |                               | Pearl millet                     | <i>Pennisetum typhoides</i>     | 149                       | 28 |
| Under-utilized crops        |                               | Faba bean                        | <i>Vicia faba</i>               | 239                       | –  |
| Medicinal & aromatic plants | Vetiver                       | <i>Vetiveria zizanioides</i>     | 131                             | 135                       |    |
|                             | Palmarosa                     | <i>Cymbopogon martini</i>        | –                               | 55                        |    |
|                             | Aloe                          | <i>Aloe vera</i>                 | 30                              | 38                        |    |
|                             | Giloe                         | <i>Tinospora cordifolia</i>      | 31                              | 20                        |    |
|                             | Urginea                       | <i>Urginea indica</i>            | –                               | 20                        |    |
|                             | Sataver                       | <i>Asparagus racemosus</i>       | –                               | 5                         |    |
|                             | Mucuna                        | <i>Mucuna pruriens</i>           | 55                              | –                         |    |
|                             | Ocimum                        | <i>Ocimum basilicum</i>          | 61                              | –                         |    |
|                             | Kalmegh                       | <i>Andrographis paniculata</i>   | 30                              | –                         |    |

IN\* - International Nurseries

**Table 2: Promising accessions identified for different traits**

| Crop          | Accession number      | Promising traits   |
|---------------|-----------------------|--|
| Pea           | EC 381866, EC 381864  | Early 50% flowering (<73 days) and maturity (< 117 days)                                 |
|               | EC 342007, EC 398588  | Long pods (>8 cm) with more seeds / pod (>6)   |
|               | IC 208375, IC 6620    | High pods / plants (>30) and high yield per plant (>38 g)                                |
| Cowpea        | EC 472766             | Grain type, with determinate plant type, high seeds /pod (>15) and high yield potential. |
|               | EC 472282             | Early (37 days)  |
|               | EC 472286             | Long pods (>33 cm)   |
|               | IC 202790             | Bold seeds (28.4 g)  |
| Sunflower     | EC 494400, EC 494409  | Bold seed (100 seed weight >8.0 g)   |
| Mustard       | IC 331819, IC 355342  | Early maturity (<130 days )  |
| Toria         | IC 331818 , IC 342993 | Early maturity ( <115 days)  |
| Yellow sarson | IC 332144 , IC 342784 | Early maturity ( <115 days)  |
| Brinjal       | EC 467277             | High primary branches  |
|               | IC 89929              | Profuse fruiting   |
| Bottle gourd  | EC 334300             | Early fruiting   |
|               | IC 333267             | Profuse fruiting   |
|               | IC 343154             | High fruit weight  |



Promising accession of Indian mustard bearing high number of pods in clusters

Over 80 enhanced progenies ( $F_5$ ) of sesame were grown at Delhi in replicated trials for further evaluation and selection of superior types during



EC 472766—a promising cowpea accession with determinate plant type

kharif, 2003. Progeny enhancement ( $F_3$ ) of five interspecific crosses involving four *Sesamum* spp. is in progress at NBPGR, RS, Thrissur.

Over 40 accessions of wild *Vigna* species in *mungo-radiata* complex were grown for evaluation and use in interspecific hybridisation at Delhi and entire wild species germplasm in *mungo-radiata* complex (more than 120 accs.) were grown at NBPGR, RS, Thrissur for evaluation and use in interspecific hybridisation.

Interspecific crosses were made between four mungbean varieties (CO-4, CO-5, CO-6 and VBNGg-2) and four wild related species (*V. radiata* var. *sublobata*, *V. radiata* var. *setulosa*, *V. mungo* var. *silvestris* and *V. hainiana*) at NBPGR RS, Thrissur. More than 2000 crosses were attempted. Success ranged from 0% (CO-5 X *V. hainiana*) to 40% (VBNGg-2 X *V. radiata* var. *sublobata*).

## 2.4 Evaluation for Quality/ Value Added Traits

### 2.4.1 Brassica collections

**Total oil and fatty acid profile:** A total of 825 *Brassica* accessions consisting *B. juncea* (503), *B. campestris* var. *toria* (64), *B. campestris* var. yellow sarson (45), *B. campestris* var. brown sarson (90), *B. napus* (38), *B. rapa* (17) and *Eruca sativa* (68) were analysed for total seed oil content. Among these, 175 collections were also studied for fatty acid profile. *B. campestris* lines identified with high oil content (>47%) were: IC 342993, 342763, 334289, 347947, 343277, 343125, 312462, 261683 and PS 507.

Other two lines, IC 312519 and EC 389916 belonging to *B. juncea* and *B. napus* respectively, were identified for their high oil content. Among thirty eight *B. napus* collections, nineteen were selected for low erucic acid content in the range of 2 to 20%. EC 400804, 400802, 394357 and 981675 were found promising for high oleic acid content in range of 62.87 to 66.91% and low erucic acid in range of 2 to 5.17%.

### 2.4.2 Quality traits of exotic *Crambe abyssinica* germplasm

Forty-five *Crambe abyssinica* germplasm introduced from USA and grown during *rabi* 2002-03 at IARI Farm were studied for fruit oil (%), seed (%) of the fruit, seed oil (%), seed protein (%), erucic and oleic acid percentage of the seed oil and thousand seed weight (g).

Erucic acid content ranged from 45.12 to 64.15% with a mean value of 60.20%. Three accessions namely, EC 499680, EC 499687 and EC 499726 with more than 61% erucic acid were found to be promising for industrial use.

### 2.4.3 Protein content of pulses

A total of 898 accessions of pulse crops were evaluated for their protein content (%N x 6.25). Protein content showed wide range and some of the accessions were found to possess high protein value (Table 3).

**Table 3 : Protein content (%) in pulse crops**

| Crop    | Accessions evaluated (no.) | Range         | Mean  | Promising accessions                    |
|---------|----------------------------|---------------|-------|---|
| Urdbean | 303                        | 21.73 - 27.48 | 24.31 | IP U - 99-60, N/3108, UH - 86-32 (>27%) |
| Pea     | 280                        | 21.45 - 28.78 | 24.42 | EC 384137, EC 384276, EC 398591 (>28%)  |
| Cowpea  | 315                        | 17.34 - 26.43 | 21.50 | C - 1099 (> 26%)                        |

## 2.4.4 Protein content in wheat

A total of 152 accessions of wheat germplasm and elite synthetic lines of wheat were evaluated for protein content (% N × 5.7). Protein content ranged from 9.0 – 16.12% in germplasm and 13.17 to 21.25% in elite lines. Elite lines were found to possess higher mean protein value (16.86%) than that of remaining germplasm (12.89%).

## 2.5 Phyto-chemical Evaluation of Medicinal and Aromatic plants

### 2.5.1 Aromatic plants

A total of 196 samples of aromatic plants were analysed for their essential oil content (table 4). The *Ocimum* accession MKSP-41 contained highest oil percent (0.87%) followed by EC 388887 (0.80%). The vetiver accession, IC

210756 contained highest oil content (1.34%) followed by IC 210615 (0.89%). Among the palmarosa samples analysed, IW 4492 contained maximum oil (1.00%).

Young inflorescence, young leaves and stems of ten accessions of *Ocimum* sp. were subjected to hydro-distillation for estimation of oil content on fresh weight basis. The oil percentage varied from 0.14% to 0.30% and 0.16% to 0.29% in young inflorescence and young leaves respectively. Only trace amount of oil was found in stems.

A total of twelve essential oils were analysed for various physico-chemical constants (Table –5).

### 2.5.2 Medicinal plants

A total of 96 samples of *Mucuna pruriens* (Kiwanch) were analysed for L-Dopa. (1, 3:4

Table-4. Essential oil content of aromatic plants on dry weight basis

| Common name | Botanical name               | Samples analysed (no.) | Essential oil content (%) |
|-------------|------------------------------|------------------------|---------------------------|
| Palmarosa   | <i>Cymbopogon martinii</i>   | 93                     | 0.28 – 1.21               |
| Vetiver     | <i>Vetiveria zizanioides</i> | 7                      | 0.39 – 1.34               |
| Basil       | <i>Ocimum</i> sp.            | 96                     | 0.15 – 0.87               |

Table 5 : Physico-chemical properties of some essential oils

| Plant                       | Refractive index | Optical rotation | Specific gravity | Acid value |
|-----------------------------|------------------|------------------|------------------|------------|
| <i>Artemisia nilagirica</i> | 1.4692           | (-)12° 89'       | 0.9032           | 2.46       |
| <i>Artemisia annua</i>      | 1.4748           | (-)16° 55'       | 0.9543           | 1.05       |
| <i>Curcuma zedoaria</i>     | 1.4955           | (+)5° 46'        | 0.9437           | 2.33       |
| <i>Citrus</i> sp.           | 1.4685           | (+)50° 96'       | 0.8428           | 6.67       |
| <i>Pistacia integerima</i>  | 1.4668           | (-)29° 88'       | 0.8810           | 1.45       |
| <i>Valeriana wallichii</i>  | 1.4945           | (-)36° 42'       | 0.8593           | 18.92      |
| <i>Zanthoxylum armatum</i>  | 1.4722           | (-)10° 98'       | 0.9624           | 3.03       |
| <i>Cymbopogon martinii</i>  | 1.4680           | (+)0° 05'        | 0.8789           | 9.18       |
| <i>Cymbopogon flexuosus</i> | -                | (-)22° 18'       | 0.8873           | 11.8       |
| <i>Eucalyptus globulus</i>  | 1.4685           | (-)16° 84'       | 0.8736           | 17.30      |
| Mentha                      | 1.4672           | -                | 0.8705           | 18.90      |
| Anise                       | -                | (+)12° 4'        | 0.9420           | -          |

Dihydroxy phenylalanine) content which ranged from 2.41% to 6.23%. The accession IC 25333 contained highest L-Dopa content (6.23% ) followed by IC 83195 (5.82%).

A total of 36 samples of three single petalled cultivars of *Polyanthes tuberosa* (tuberosa) viz. Mexican single, Prajwal and Srinagar harvested at two stages viz., fully mature and 1-2 days old open florets, were analysed for their concrete content. The cultivar Srinagar gave the highest recovery (0.13%) followed by cvs. Prajwal (0.08%) and Mexican single (0.060%), harvested at fully mature floret stage.

Fourteen samples of *Baliospermum montanum* (Danti) were analysed for the fixed oil content and various physico-chemical constants. The oil percentage varied from 27.0 to 33.13%.

## 2.6 Documentation of Plant Genetic Resources

Germplasm characterization and evaluation data on kharif (2002) and rabi crops (2002-03) and horticultural crops (2002-03) were compiled and distributed to concerned PCs/PDs for effective utilization of germplasm.

**Electronic form of catalogues :** The catalogues published by the Bureau since 1990-91 onwards have been brought out in an electronic form and CDs of electronic catalogues along with software package have been sent to concerned PCs/PDs.

Computerization and processing of data for bringing out crop catalogues on strawberry and sorghum have been completed.

**ARIS activities:** A modification was made in the passport information documentation

system along with incorporation of user friendly queries. The data entry in the system was completed with the information like collector details and mission details. Data sheets of old exotic records were standardized by including taxonomic codes and national/international addresses. A software that has been developed for on-line feeding, querying and retrieval of information for the Conservation Division was presented to the scientists. Passport information of about 35,000 accessions was put in the database and assigned IC numbers. The information for 19 crops assigned to the NBPGR for development of extant varieties (from 1987 till date) database has been completed. Software in this regard has been developed and also installed at the office of NSP, IARI.

## 2.7 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 1,468 seed samples of various crop groups; cereals (27), forages (22), legumes (194), oilseeds (141), vegetables (943), medicinal and aromatic plants (56) and under-utilized crops (85) were supplied to 70 research workers of ICAR Institutes, State Agricultural Universities and other research centers engaged in crop improvement programmes (Table 6). Besides, 6,721, seed samples of exotic wheat (5,720), barley (994) and triticale (7) were also supplied to 48 indentors.



**Table 6 : Germplasm Supplied**

| Crop group/Crop                        | No. of accessions | Indentors |
|--|-------------------|-----------|
| <b>Cereals</b>                         |                   |           |
| Wheat                                  | 26                | 2         |
| Maize                                  | 1                 | 1         |
| <b>Pulses &amp; legumes</b>            |                   |           |
| Cowpea                                 | 23                | 2         |
| Pea                                    | 81                | 7         |
| Urd bean                               | 51                | 2         |
| Lentil                                 | 37                | 4         |
| Chickpea                               | 1                 | 1         |
| <i>Lathyrus</i>                        | 1                 | 1         |
| <b>Oilseeds</b>                        |                   |           |
| Brassica                               | 117               | 6         |
| Sunflower                              | 12                | 2         |
| <i>Crambe</i>                          | 12                | 1         |
| <b>Vegetables</b>                      |                   |           |
| Tomato                                 | 230               | 12        |
| Bottle gourd                           | 10                | 1         |
| Sponge gourd                           | 10                | 1         |
| Ridge gourd                            | 10                | 1         |
| Bitter gourd                           | 5                 | 1         |
| Onion                                  | 2                 | 1         |
| Garlic                                 | 652               | 2         |
| Methi                                  | 1                 | 1         |
| Coriander                              | 1                 | 1         |
| Chinese cabbage                        | 22                | 1         |
| <b>Forages &amp; Grasses</b>           |                   |           |
| Oat                                    | 22                | 2         |
| <b>Under-utilized plants</b>           |                   |           |
| <i>Sesbania</i>                        | 42                | 5         |
| <i>Crotalaria</i>                      | 6                 | 3         |
| Faba bean                              | 37                | 3         |
| <b>Medicinal &amp; aromatic plants</b> |                   |           |
| <i>Ocimum</i>                          | 10                | 1         |
| <i>Mucuna</i>                          | 30                | 2         |
| <i>Andrographis</i>                    | 5                 | 1         |
| <i>Psoralea</i>                        | 8                 | 1         |
| <i>Hyocymus niger</i>                  | 3                 | 1         |
| <b>Grand total</b>                     | <b>1468</b>       | <b>70</b> |

## 2.8 Germplasm Holding in Medium Term Storage

A total of 15,473 accessions of various field crops comprising cereals (3,521), pulses (5,444), oilseeds (3,567), vegetables (2,261), medicinal and aromatic plants (160) and under-utilized crops (520) were maintained in medium-term storage (Table 7).

**Table 7: Germplasm holding in MTS at NBPGR (HQs), New Delhi**

| Crop group                    | Crop                           | Accession (no.) |
|-------------------------------|--------------------------------|-----------------|
| Cereals                       | Wheat                          | 1100            |
|                               | Maize                          | 1221            |
|                               | Barley                         | 1200            |
| Pulses                        | Pea                            | 550             |
|                               | Cowpea                         | 1160            |
|                               | Lentil                         | 389             |
|                               | Mung                           | 645             |
|                               | Urd                            | 300             |
|                               | Guar                           | 1150            |
|                               | Chickpea                       | 1250            |
| Oilseeds                      | Brassica                       | 2900            |
|                               | Sunflower                      | 95              |
|                               | Sesame                         | 550             |
| Vegetables                    | <i>Crambe</i>                  | 22              |
|                               | Brinjal                        | 850             |
|                               | Tomato                         | 700             |
|                               | Bottle gourd                   | 80              |
|                               | Sponge gourd                   | 25              |
|                               | Ridge gourd                    | 80              |
|                               | Bitter gourd                   | 05              |
|                               | Pumpkin                        | 06              |
|                               | Radish                         | 100             |
|                               | Methi                          | 250             |
|                               | Palak                          | 40              |
|                               | Coriander                      | 80              |
|                               | Chinese cabbage                | 45              |
| Under-utilized crops          | Faba bean                      | 275             |
|                               | Rice bean                      | 103             |
|                               | <i>Amaranthus</i>              | 32              |
|                               | <i>Sesbania</i>                | 100             |
|                               | <i>Crotalaria</i>              | 10              |
| Medicinal and Aromatic plants | <i>Ocimum</i>                  | 14              |
|                               | <i>Mucuna</i>                  | 40              |
|                               | Poppy                          | 53              |
|                               | <i>Psoralea</i>                | 19              |
|                               | <i>Andrographis paniculata</i> | 15              |
|                               | Periwinkle                     | 10              |
|                               | Ashwagandha                    | 04              |
| <i>Hyocymus niger</i>         | 05                             |                 |

## 2.9 Germplasm Field Day

To promote germplasm utilization, five field days were organised during 2003. Different *rabi* crops on 25<sup>th</sup> March, wheat, barley and triticale on 28<sup>th</sup> March, tomato and garlic on 26<sup>th</sup> April, different *kharif* crops on 08<sup>th</sup> October and brinjal on 21<sup>st</sup> November, 2003. A large number of scientists from different institutes/SAUs participated in the germplasm field days and selected the material of their choice for utilization in crop improvement programmes.

## 2.10 New Initiatives

### 2.10.1 Collaborative germplasm evaluation

A new initiative has been taken for germplasm evaluation for qualitative traits and for agronomic performance in collaboration with relevant organization like ICAR crop based Institutes, PDs, NRCs and ACRIPS. Collaborative germplasm evaluation has been started for rice, wheat, maize, barley, sorghum, lentil, rapeseed and mustard, sunflower, crambe, brinjal, tomato, garlic, fenugreek, coriander and spinach. The crops and collaborative centres are given in Table 8.

**2.10.2 Multi-location evaluation of germplasm through AICRP** A special programme for multi-location evaluation of germplasm of major crops, namely, rice, wheat, chickpea and pigeonpea has been initiated in collaboration with crop based institutes and AICRPS.

**Rice germplasm** : Two thousand accessions (2000) of rice germplasm were multiplied at the DRR, Hyderabad for further evaluation.

**Table 8 : Crop germplasm grown for collaborative evaluation**

| Crop             | Collaborative centres (accs. no.)  |
|------------------|--|
| Rice             | DRR, Hyderabad (100)   |
| Wheat            | DWR, Karnal (2080)<br>(153 in 5 sets)<br>VPKAS, Almora (155)   |
| Maize            | DMR, New Delhi<br>(108 for 8 locations)<br>ICAR Research Complex for N.E. region Tadong, Sikkim (54)<br>VPKAS, Almora (54) |
| Barley           | VPKAS, Almora (28)   |
| Sorghum          | NRC, Sorghum<br>Hyderabad (60)   |
| Lentil           | IIPR, Kanpur (50)  |
| Rapeseed-mustard | NRC on Rapeseed-mustard,<br>Bharatpur (121)  |
| Sunflower        | DOR, Hyderabad (98)  |
| Crambe           | NRC on Rapeseed-mustard,<br>Bharatpur (12)   |
| Brinjal          | IIVR, Varanasi (200)   |
| Tomato           | IIVR, Varanasi (300)   |
| Garlic           | NRC for Onion & Garlic, Pune<br>(525 for maintenance & 50 for evaluation)  |
| Fenugreek        | NRC on Seed Spices,<br>Ajmer (52)  |
| Coriander        | NRC on Seed Spices,<br>Ajmer (30)  |

**Wheat germplasm** : Fifteen hundred accession (1,500) of wheat germplasm were multiplied at NBPGR, New Delhi for further evaluation.

**Chickpea germplasm** : A total of 1,022 accessions were multiplied at 4 locations (IIPR, Kanpur; NBPGR Regional Station, Akola; JNKVV, Jabalpur, and RAU, Sriganaganagar) during 2002-03 and 565 accs. of chickpea are being multiplied at 5 locations (IARI, New Delhi, NBPGR Regional Station, Akola; JNKVV, Jabalpur; RAU, Sriganaganagar and Durgapura) during 2003-04.

**Pigeonpea germplasm** : A total of 1,019 accessions of pigeonpea germplasm were sent for multiplication during 2003 at two different locations (NDUAT Faizabad, UP and S.K.Nagar , Gujarat).

**Chickpea evaluation** : A total of 125 accessions are being evaluated during 2003–04 for biotic/abiotic stresses and protein content at 17 locations as shown below :

| Stresses          | Location  |
|-------------------|---|
| Wilt and root rot | Hisar, Ludhiana (NWPZ)<br>IIIPR (NEPZ)<br>Sehore, Rahuri (CZ)<br>Gulbarga, Bangalore (SZ) |
| Dry root rot      | Durgapura, Coimbatore   |

| Stresses          | Location                |
|-------------------|-------------------------|
| Collar rot        | Jabalpur                |
| Ashcochyta blight | Ludhiana                |
| BGM               | Pantnagar               |
| Heliothis         | Pantnagar, Gulbarga     |
| Cold tolerance    | Samba, Almora, Ludhiana |
| Protein content   | NBPGR, New Delhi        |

## 2.11 Germplasm Advisory Committee (GAC)

Germplasm Advisory Committee meetings on rice, wheat and barley, maize, pulses, oil seeds, fibre crops, millets and forages were organised to advise NBPGR in different activities and management of Plant Genetic Resources. The recommendations are being pursued.

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

PGR/GEV- BUR-DEL-01.00 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of various crops, (Mahendra Singh).

### Sub Projects

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, P.S. Mehta, KC Muneem and DC Bhandari).

PGR/GEV- BUR-DEL-01.02 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of maize (Ambrish Kumar Sharma, Dinesh Kumar, P.S. 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; N.K.Gautam, Babu Rah, DC Bhandari, 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, Y.S. Rathi, Neelam Bhatnagar, NK Dwivedi, N Sivraj).

PGR/GEV- BUR-DEL -01.05 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of tomato, spinach and palak, and cucurbits (V.K. Dobhal; K.K. Gangopadhyay, Gunjeet Kumar, B.L.Meena, KS Varapasrad and M. Abdul Nizar).

PGR/GEV- BUR-DEL -01.06 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of brinjal, carrot and radish, fruits and ornamentals (K.K. Gangopadhyay, Gunjeet Kumar; V.K. Dobhal, B.L.Meena and V. Shivraj).

- PGR/GEV- BUR-DEL -0l.07 : Characterization, evaluation, maintenance, régénération and documentation of germplasm resources of bottle-gourd, methi, chinese cabbage & coriander (Gunjeet Kumar, K.K. Gangopadhyay, V.K. Dobhal and B.L.Meena).
- PGR/GEV- BUR-DEL -0l.08 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of onion and garlic, and medicinal and aromatic plants. (Ashok Kumar; S. K. Pareek, Archana Raina, Jitendra Mohan, C.S. Raghav and Poonam Suneja).
- PGR/GEV- BUR-DEL -0l.09 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of forages and aonla, ber and bael (Vandana Joshi; Harinder Singh, and IP Singh).
- PGR/GEV- BUR-DEL -0l.10 : Biochemical evaluation of germplasm resources of various field crops (S Mandal; Sangita Yadav).
- PGR/GEV- BUR-DEL -0l.11 : Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under-utilized crops (B.S. Phogat; Hanuman Lal, R.S.Rathi, N Dixit, JB Tomar, K.S Negi and DK Hore).
- PGR/GEV- BUR-DEL -0l.12 : Studies on germplasm resources for biotic stress (P.L.Premi).
- PGR/GEV- BUR-DEL -0l.13 : Studies on statistical techniques for efficient management of PGR (R.K.Mahajan; R.C. Agrawal).
- PGR/GEV- BUR-DEL -0l.14 : Genetic resources information programme (R.C. Agrawal; R.K.Mahajan).
- PGR/GEV- BUR-DEL -0l.15 : Genetic enhancement of crop species with particular reference to sesame and mungbean (I S Bisht; Z Abraham and M Latha).

### 3. DIVISION OF GERMPLASM CONSERVATION

**Summary:** A total of 38,926 accessions of various crops were received at the conservation division for long-term conservation in the National Genebank. Of these 20,027 accessions were added to the base collections. In addition, a total of 8,035 accessions received at the Germplasm Handling Unit were stored in the medium term storage module as voucher specimens. Monitoring of the stored germplasm (2,486 accessions), physical verification and inventory (1,56,980 accessions), and updating of passport information (1,334 accessions) were the other major achievements. Dormancy breaking protocols for six wild species of medicinal importance were developed. Studies on ultra-dried seeds to enhance the longevity of sesame, safflower, sponge gourd, radish and neem were continued to develop cost-effective conservation methods.

#### 3.1 Germplasm Augmentation

A total of 38,926 accessions of various agricultural crops were received at the conservation division for long-term conservation at the National Genebank. These include 5,552 accessions restored from the International Crop Research Institute for the Semi Arid Tropics (ICRISAT) to NBPGR under the ICAR-ICRISAT collaborative project on "Restoration of ICRISAT mandate crop germplasm to NBPGR". A total of 20,027 accessions were processed for long-term conservation as per the genebank standards and were stored as base collections at  $-20^{\circ}\text{C}$ . These comprised cereals (7,593), pseudocereals (683), millets (1,163), oilseeds (3,023), pulses (2,909), vegetables (2,002), fibre crops (679), forages (1,134), fruit crops (45), agro-forestry species (42), medicinal and aromatic plants (319), narcotics (4), spices (24), released varieties (201) and genetic stocks (206).

The crop wise details of the various accessions received and added to the National Genebank are listed in table 1, with this the total germplasm holdings in the National Genebank has risen to 2,61,555. In addition, a total of 3,789 exotic accessions of different crops

imported/ introduced by germplasm exchange unit were kept as voucher samples in the medium-term storage (MTS) module for reference.

##### 3.1.1 Germplasm received at the GHU

The Germplasm Handling Unit (GHU) received a total of 11,531 seed accessions collected from 219 explorations conducted in the ten NATP zones. Of these 8,035 were kept in the MTS as voucher specimens to ensure multiplication, conservation and use and 174 were handed over for cryopreservation.

#### 3.2 Germplasm Registration

A total of 303 new and revised proposals were considered for registration in the two germplasm registration committee meetings held between January-December, 2003. Out of these, 100 genetic stocks of various agri-horticultural crops were approved for registration with Indian National Germplasm Registration (INGR) and national identity numbers and conserved in the LTS. The registered germplasm comprised cereals (42), pseudo-cereals (2), grain legumes (7), oilseeds (11), fibres (5), vegetables (9), fruits and nuts (10), medicinal and aromatic plants (5), ornamentals (3), spices (4) and sugar yielding plants (2).

### 3.3 Monitoring of Germplasm

Germplasm stored in the long-term storage module for 10 years or more was monitored for seed viability, seed quantity and seed health to identify accessions that may require regeneration as per the genebank standards. This included paddy (800), wheat (514), barley (99), maize (68), sesame (50), groundnut (100), safflower (50), soybean (50), okra (210), methi (30), pigeonpea (110), cowpea (55) and jute (250). All the accessions maintained seed viability conforming to the genebank standards.

### 3.4 Documentation and Database Management

Efforts continued to update passport data of germplasm conserved before the NATP. Passport data for 1,334 accessions belonging to various sources was updated. These comprised jute (279), cotton (48), brinjal (203), okra (245), tomato (486) and methi (73).

### 3.5 Physical Verification

A total of 1,56,980 accessions of various crops conserved in the base collections were verified to identify duplicates, missing or extra accessions and to prepare a validated inventory.

### 3.6 Germplasm Regeneration

A total of 1,351 germplasm samples of various crops were supplied for seed multiplication/evaluation/characterization. These comprise cowpea (415), pigeonpea (79), urd (484), cotton (50) and paddy (30). In addition, seed samples of exotic accessions stored as voucher specimens were also sent for multiplication. These comprised sunflower (73), safflower (9), brassica (111) and wheat (100).

### 3.7 Supportive Research

Dormancy breaking protocols were developed for six wild plant species of medicinal importance. In *Physachlaina praeatle*, *Sopbra macrophora* and *Cicer microphyllum*, acid scarification enhanced germination from 0-5% (control) to 95-100%, whereas in *Urtica hyperborea*, *Hippophae rhamnoides* sub sp. *turkestenica* and *Aconogonum tartiosum* cooling at 5°C resulted in 90-95% increase in germination.

Dry and ultra-dry (less than 5% moisture) seeds stored at different temperatures were monitored for germination to assess their longevity. Til seeds stored at 4.5% moisture content declined to 40 percent germination after 86 months of storage at ambient temperature. Whereas those at 2% moisture maintained 88% germination which is above the genebank standard. Similarly, in safflower, seeds at 3.8% moisture content declined to 81% germination after 80 months of storage at ambient temperature while seeds at 6% moisture had reached this level of germination much earlier (after 32 months) during storage. In sponge gourd, seeds with 10% moisture were dead after 18 months of ambient storage, but maintained high viability, at 4 and -20°C. Radish seeds with 10 and 7% moisture also lost their viability at ambient conditions. At 5 and 2.5 percent initial viability was maintained. Neem seeds dried to 2.75 percent moisture maintained good viability (70-90%) and vigour at ambient, 25°C and 4°C as well as ambient temperature after 76 months of storage.

### 3.8 Perma-frost Storage

A set of 130 accessions of various crops which were stored at 5-8% moisture level in the perma-

frost region of Leh were retrieved after two years of storage for monitoring of their viability. Results revealed that the viability of monitored accessions is maintained close to their initial

value. Another 142 accessions belonging to various crop groups were deposited at the FRL, Leh as well as Kardungla pass (permafrost).

**Status of Base Collections in National Genebank – (as on 31st December, 2003)**

| Crop group                 | Accessions       |               |
|----------------------------|------------------|---------------|
|                            | January          | Present       |
|                            | to December 2003 | Status        |
| <b>Cereals</b>             | <b>7772</b>      | <b>110447</b> |
| Paddy                      | 4886             | 64816         |
| Wheat                      | 1690             | 32252         |
| Maize                      | 847              | 4918          |
| Others                     | 349              | 8461          |
| <b>Millets and forages</b> | <b>2324</b>      | <b>38534</b>  |
| <i>Sorghum</i>             | 570              | 15801         |
| Pearl millet               | 81               | 5635          |
| Minor millet               | 532              | 15680         |
| Others                     | 1141             | 1418          |
| <b>Pseudo cereals</b>      | <b>686</b>       | <b>3496</b>   |
| Amaranth                   | 506              | 3157          |
| Buckwheat                  | 113              | 250           |
| Others                     | 67               | 89            |
| <b>Grain legumes</b>       | <b>2986</b>      | <b>39235</b>  |
| Chickpea                   | 557              | 14583         |
| Pigeonpea                  | 1159             | 6146          |
| Mung bean                  | 44               | 2803          |
| Others                     | 1226             | 15703         |
| <b>Oilseeds</b>            | <b>3069</b>      | <b>32769</b>  |
| Groundnut                  | 1135             | 9941          |
| <i>Brassica</i>            | 228              | 7046          |
| Safflower                  | 817              | 5970          |
| Others                     | 889              | 9812          |
| <b>Fibre crops</b>         | <b>689</b>       | <b>7991</b>   |
| Cotton                     | 583              | 4166          |
| Jute                       | 57               | 2494          |

| Crop group   | Accessions       |               |
|--|------------------|---------------|
|  | January          | Present       |
|  | to December 2003 | Status        |
| Others   | 49               | 1331          |
| <b>Vegetables</b>                                    | <b>2067</b>      | <b>15660</b>  |
| Brinjal  | 315              | 2475          |
| Chilli   | 140              | 1979          |
| <i>Others</i>  | 1612             | 11206         |
| <b>Fruits</b>  | <b>45</b>        | <b>172</b>    |
| Custard apple  | 0                | 57            |
| Papaya   | 0                | 23            |
| Others   | 45               | 92            |
| <b>Medicinal &amp; Aromatic Plants and Narcotics</b> | <b>323</b>       | <b>2487</b>   |
| Opium poppy  | 0                | 292           |
| <i>Ocimum</i>  | 0                | 189           |
| Tobacco  | 4                | 936           |
| Others   | 319              | 1070          |
| <b>Spices &amp; condiments</b>                       | <b>24</b>        | <b>387</b>    |
| Coriander  | 6                | 293           |
| Sowa   | 0                | 59            |
| Others   | 18               | 35            |
| <b>Agro-forestry</b>                                 | <b>42</b>        | <b>42</b>     |
| Pongam oil tree                                      | 42               | 42            |
| <b>Duplicate Safety Samples</b>                      | <b>0</b>         | <b>10235</b>  |
| Lentil   |                  | 7712          |
| Pigeonpea  |                  | 2523          |
| <b>Total</b>   | <b>20027</b>     | <b>261555</b> |

**Number of genetic stocks registered crop group-wise**

| S. No. | Crop Group                    | No. of accessions registered |
|--------|-------------------------------|------------------------------|
| 1.     | Cereal                        | 42                           |
| 2.     | Pseudo-cereals                | 2                            |
| 3.     | Grain legumes                 | 7                            |
| 4.     | Oilseeds                      | 11                           |
| 5.     | Fibres                        | 5                            |
| 6.     | Vegetables                    | 9                            |
| 7.     | Fruits and nuts               | 10                           |
| 8.     | Medicinal and aromatic plants | 5                            |
| 9.     | Ornamentals                   | 3                            |
| 10.    | Spices                        | 4                            |
| 11.    | Sugar yielding plants         | 2                            |
|        | <b>Total</b>                  | <b>100</b>                   |

## **Research projects (Code: Title, Project leader; Associate/s)**

PGR/GCN-BUR-DEL-01.00: *Ex-situ* conservation of plant genetic resources of agricultural and horticultural crops using conventional seed storage methods. (A.K. Singh)

## **Sub-projects**

PGR/GCN-BUR-DEL-01.01: Management of information and national germplasm conservation network (A.K. Singh; S. Saxena, Anjali Kak).

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 germplasm using conventional seed storage methods (Sanjeev Saxena and A.D. Sharma).

PGR/GCN-BUR-DEL-01.04: Conservation of oilseed germplasm using conventional seed storage methods (Ashok Kumar).

PGR/GCN-BUR-DEL-01.05: Conservation of cereal and pseudo-cereal germplasm, excluding paddy, using conventional seed storage methods (Kalyani Srinivasan and Manju Uprety).

PGR/GCN-BUR-DEL-01.06: Conservation of spices, medicinal and aromatic plant germplasm using conventional seed storage methods (Veena Gupta).

PGR/GCN-BUR-DEL-01.07: Conservation of fruit and agro-forestry tree species germplasm using conventional seed storage methods (A.K. Singh; and J. Radhamani).

PGR/GCN-BUR-DEL-01.08: Conservation of forage and fibre crop germplasm using conventional seed storage methods (Anjali Kak).

PGR/GCN-BUR-DEL-01.09: Conservation of millets and vegetables germplasm using conventional seed storage methods (Chitra Devi).

PGR/GCN-BUR-DEL-01.10: Investigating seed dormancy, seed storage behaviour and physiological and biochemical changes during storage (Kalyani Srinivasan; Neeta Singh, Sanjeev Saxena, J. Radhamani, Anjali Kak, Chitra Pandey, Manju Uprety and A. D. Sharma).



## 4. DIVISION OF PLANT QUARANTINE

**Summary:** A total of 33,320 exotic accessions (1,07, 202 samples), nurseries/ trial breeding material (9,180 entries, 72,234 samples) and germplasm (24,140 accessions, 34,968 samples) of various crops and 490 accessions (549 samples) 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 621 samples were infested with insects/ mites including 134 samples with hidden infestation; 1,511 infected with nematodes; and 171 infected with fungi and bacteria. Of the 2,303-infested/ infected/-contaminated samples, 2,214 were salvaged through fumigation, hot water treatment (HWT), x-ray radiography, pesticidal dip, ethyl alcohol wash and mechanical cleaning. Eighty-nine 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-seven Phytosanitary Certificates were issued for consignments meant for export. A total of 2,352 samples collected indigenously were processed for pest-free conservation. Of the 517 infested/-infected samples, 464 were salvaged and 2,299 samples were released for pest-free conservation. Twenty-three samples of transgenic crops viz., paddy and cotton, were processed for quarantine clearance. Extensive studies were carried out on prevalence of seed-transmitted viruses of grain legumes in different pulse growing areas of the country, assessment of their seed transmission rates; techniques for their detection in group testing by Double Antibody Sandwich and Direct Antigen Coating Enzyme Linked Immunosorbent Assay (ELISA) and the role of epidemiology in field spread.

### 4.1 Import Quarantine

**4.1.1 Quarantine examination:** A total of 33,320 exotic accessions (1,07, 202 samples), nurseries/ trial breeding material (9,180 entries, 72,234 samples) and germplasm (24,140 accessions, 34,968 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 pest detection techniques. Of the import samples, 2,435 samples were exposed to x-ray radiography for detection of hidden infestation of bruchids and chalcids. A total of 2,303 samples were found infested/ infected of which 621 samples were infested with insects/ mite including 134 samples with hidden infestation; 1,511 samples infected with nematodes and 171 with plant pathogens. A number of pests of major quarantine importance were intercepted (Table 1).

**4.1.2 Salvaging of infested/ infected/ contaminated germplasm:** Of the total 2,303-infested/ infected/contaminated samples, 2,214 were salvaged. A total of 621 samples infested with insects/ mites were salvaged by x-ray radiography (134), fumigation (472), and pesticidal dips (15); 416 samples infected with fungi/ bacteria were salvaged by hot water treatment (35), ethyl alcohol wash (12) and pesticidal treatment (124); and 1,151 samples infected with nematodes were salvaged by hot water and nematicidal dip treatments. Eighty-nine samples of soybean from USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India.

**4.1.3 Prophylactic treatments:** A total of 40,025 seed samples were given prophylactic fumigation, 1,511 samples of vegetative propagules were given prophylactic dip/spray treatment and 3,823 samples of paddy were

**Table 1: Pests intercepted in the exotic germplasm during the year 2003**

| Pest                             | Host  | Source             |
|----------------------------------|---|--------------------|
| <b>Insects</b>                   |   |                    |
| <i>*Acanthoscelides obtectus</i> | <i>Phaseolus vulgaris</i>                   | Colombia           |
| <i>Arecerus</i> sp.              | <i>Zea mays</i>                             | USA                |
| <i>Bruchidius</i> sp.            | <i>Trifolium alexandrinum</i>               | Egypt              |
| <i>*Bruchidius atrolineatus</i>  | <i>Vigna unguiculata</i>                    | Nigeria            |
| <i>Bruchus pisorum</i>           | <i>Pisum sativum</i>                        | Bulgaria, Eritrea  |
| <i>Callósobruchus chinensis</i>  | <i>Vicia faba</i>                           | Eritrea            |
| <i>Callosobruchus maculatus</i>  | <i>Vigna unguiculata</i>                    | Nigeria            |
| <i>Sitophilus zeamais</i>        | <i>Zea mays</i>                             | Thailand, USA      |
| <i>Sitotroga cerealella</i>      | <i>Oryza sativa</i>                         | Nepal              |
| Immature forms of insects        | <i>Vicia faba</i>                           | Russia             |
|                                  | <i>Triticum aestivum</i>                    | Australia          |
| Scale insects                    | Mango cuttings                              | Brazil             |
|                                  | Cherry                                      | USA                |
| Mealy bugs                       | Cherry                                      | USA                |
| Staphylinid beetle               | <i>Mentha</i> sp.                           | Japan              |
| Mites                            | <i>Salix alba</i>                           | Belgium            |
|                                  | <i>Corylus</i>                              | USA                |
| <b>Nematodes</b>                 |   |                    |
| <i>Aphelenchoides besseyi</i>    | <i>Oryza sativa</i>                         | Nepal, Philippines |
| <i>Ditylenchus</i> sp.           | Pear  |                    |
|                                  | <i>Cornus mas</i> , Cornelian cherry        | New Zealand        |
|                                  |   | USA                |
| <i>Helicotylenchus</i> sp.       | <i>Cydonia oblonga</i>                      | New Zealand        |
|                                  | <i>Prunus</i> sp.                           | France             |
|                                  | <i>Corylus</i> sp., <i>Mespilus</i> sp.,    | USA                |
|                                  | <i>Cydonia</i> sp.                          |                    |
| <i>Hoplolaimus</i> sp.           | Pear  | New Zealand        |
| <i>Meloidogyne</i> sp.           | <i>Corylus</i> sp., <i>Mespilus</i> sp.,    |                    |
|                                  | <i>Cydonia</i> sp.                          | USA                |
| <i>M. incognita</i>              | <i>Malus</i> , <i>Pyrus</i> , <i>Prunus</i> | USA                |
| <i>Pratylenchus</i> sp.          | Pear  | New Zealand        |
|                                  | <i>Malus</i> , <i>Pyrus</i> , <i>Prunus</i> | USA                |
| <i>P. penetrans</i>              | <i>Mentha arvensis</i>                      | Japan              |
| <i>Trichodorus</i> sp.           | Pear  | New Zealand        |
| <i>Tylenchorhynchus</i> sp.      | <i>Cydonia oblonga</i>                      | New Zealand        |
|                                  | <i>Juglans regia</i>                        | France             |
|                                  | <i>Pistacia vera</i>                        | USA                |
| <b>Pathogens</b>                 |   |                    |
| <i>Alternaria brassicicola</i>   | <i>Brassica</i> sp.                         | USA                |
|                                  | Cauliflower seed                            | Netherlands        |
| <i>Alternaria sesami</i>         | <i>Sesamum indicum</i>                      | Brazil             |
| <i>Botrytis cinerea</i>          | <i>Malus</i> sp.                            | USA                |
| <i>Colletotrichum dematium</i>   | <i>Beta vulgaris</i>                        | Belgium            |
| <i>Corynespora</i> sp.           | <i>Corchorus</i>                            | Bangladesh         |
| <i>Curvularia lunata</i>         | <i>Oryza sativa</i>                         | Vietnam            |

|                                 |                           |                       |
|---------------------------------|---------------------------|-----------------------|
| <i>Drechslera oryzae</i>        | <i>O. sativa</i>          | Vietnam               |
| <i>D. sorghicola</i>            | <i>Zea mays</i>           | USA                   |
| <i>D. sorokiniana</i>           | <i>Triticum aestivum</i>  | Bangladesh            |
| <i>D. setariae</i>              | <i>Eleusine</i> sp.       | USA                   |
| <i>Fusarium equiseti</i>        | <i>Beta vulgaris</i>      | Belgium               |
| <i>F. monilliforme</i>          | <i>Zea mays</i>           | South Africa, USA     |
| <i>F. semitectum</i>            | <i>Oryza sativa</i>       | Vietnam               |
| <i>Nigrospora oryzae</i>        | <i>O. sativa</i>          | Vietnam               |
| * <i>Peronospora manshurica</i> | <i>Glycine max</i>        | USA                   |
| <i>Puccinia carthami</i>        | <i>Carthamus</i>          | USA                   |
| <i>Puccinia helianthi</i>       | Sunflower                 | Bulgaria              |
| <i>Phoma</i> sp.                | <i>Pennisetum glaucum</i> | Eritrea               |
|                                 | <i>Eleusine</i> sp.       | USA                   |
|                                 | <i>Oryza sativa</i>       | Vietnam               |
| <i>Rhizoctonia</i> sp.          | <i>Brassica napus</i>     | USA                   |
| <i>Tilletia foetida</i>         | <i>Triticum aestivum</i>  | Syria                 |
| <i>Verticillium albo-atrum</i>  | <i>Beta vulgaris</i>      | Belgium               |
| <i>V. cinnabarinum</i>          | <i>Oryza sativa</i>       | Vietnam               |
| <b>Viruses</b>                  |                           |                       |
| SMV, CABMV, *AMV, BCMV          | <i>Glycine max</i>        | Taiwan                |
| PSbMV                           | <i>Pisum sativum</i>      | Bulgaria, Taiwan, USA |
| CABMV                           | <i>Vigna radiata</i>      | Taiwan                |
| CABMV, PSbMV                    |                           |                       |
| CABMV, *AMV, *TBRV, CMV         | <i>V. unguiculata</i>     | Eritrea,<br>Nigeria   |

AMV= alfalfa mosaic virus; BCMV= bean common mosaic virus; CABMV= cowpea aphid-borne mosaic virus; CMV= cucumber mosaic cucumovirus; PSbMV= pea seed-borne mosaic virus; SMV =soybean mosaic potyvirus; TBRV= tomato black ring virus.

\* Pest not yet reported from India on these hosts

given hot water treatment. In order to prevent the introduction of new strains of tobamoviruses through seeds, all the introduced germplasm samples of chilli (140), and tomato (467) 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 (4,861) comprising, wheat (3,671 entries), barley (976) and triticale (214) from CIMMYT, Mexico were grown in PEQN. Loose smut of wheat (*Ustilago segetum* var. *tritici*) was intercepted in 7 entries (IDTN-04-87, 91, EC 514389, EC 519508, IC 128237, IC

246923 and 7<sup>th</sup> EGPSN-89). Infected plants were uprooted and destroyed.

A total of 1,116 samples of exotic germplasm viz., *Glycine max* (25), *Phaseolus* spp. (968), *Pisum sativum* (18), *Vicia faba* (16), *V. sativa* (5), *V. villosa* (3), *Vigna radiata* (35) and *V. unguiculata* (46) were grown in green house. The plants showing viral symptoms were tested by using specific antisera to various seed transmitted viruses in Enzyme Linked Immunosorbent Assay. Seeds harvested from virus-free plants only were released to the indenters. The interceptions made are presented in table-1.

## 4.2 Export Quarantine

497

A total of 490 accessions (509 samples) of various crops intended for export to various countries were processed for detection of associated pests. Of these, 77 samples were found infested with insect pests. All the infested samples were salvaged through fumigation (76) and x-ray (1). A total of 214 samples was given prophylactic treatments viz., fumigation (171) and pesticidal dip/spray (43). Important insects intercepted were *Rhizopertha dominica* on rice and wheat; *Sitotroga cerealella* on rice; *Sternochaetus mangiferae* in mango stones; lepidopteran larvae and pupae on guava. Twenty-seven Phytosanitary Certificates were issued.

## 4.3 Supportive Research

*Clerodendron* sp. and *Vitex* sp. extracts for the control of insect pests - Preliminary experiments on the insecticidal properties of *Clerodendron* sp. and *Vitex* sp. extracts (aqueous and alcoholic in two concentrations) were tested against four stored insects viz. pulse beetle (*C. maculatus*), lesser grain borer (*Rhizopertha dominica*), rice weevil (*Sitophilus oryzae*) and red flour beetle (*Tribolium castaneum*) by the direct contact method and seed treatment with crude powder. All the insects were susceptible to both the extracts but to different extents and the concentration was directly related to the adult mortality. Further experiments on the effectiveness of these extracts against different stages of these insects are in progress.

Preliminary studies on the feasibility of electron beam (EB) for disinfestation of seeds against insect-pests were conducted by assessing the effect of various doses of EB on the germination

and vigour of seeds various crops. The seeds of 22 crops comprising cereals and millets, legumes/ pulses, oilseeds, vegetables, fibre crop were irradiated with the EB doses viz., 100Gy, 200Gy, 300Gy, 400Gy and 500Gy (Beam energy 480Kev, Beam current= 12mA and speed of conveyor belt= 10m/min.) by using the EB facility at the Centre of Advanced Technology, Department of Atomic Energy, Indore. The effect on percent germination and seedling vigour as per international standards of seed testing was studied.

## 4.4 Seed Health Testing for Pest-free Conservation

A total of 2,352 samples collected under NATP-PB were processed for seed health testing and salvaging for pest-free conservation. All the samples were examined by using different techniques. Of these, 1,569 samples were exposed to x-ray radiography to detect hidden infestation and 243 samples were found infested. A total of 517 samples were found infested/ infected viz., 476 samples with insects including 243 with hidden infestation and 94 with fungal pathogens. Of the total infested/ infected, 464 samples were salvaged while 53 samples highly infested with insects, were rejected. A total of 2,299 samples were released for pest-free conservation. Important interceptions were-

**Insects-***Bruchidius* sp., *Bruchidius angustifrons* and *Bruchophagus mellipes* in *Sesbania*; *Bruchus* spp. in *Pisum* spp.; *Callosobruchus analis* in *Vigna mungo* and *V. radiata*; *C. cajani* in *Cajanus cajan*, *V. mungo* and *V. radiata*; *C. chinensis* in *Cicer arietinum*, *Macrotyloma uniflorum*, *V. radiata* and *V. unguiculata*; *C. maculatus* in *Vigna mungo*; *C. phaseoli* in *Lablab*

*purpureus*; *Caryedon serratus* in *Acacia senegal*; *Conicobruchus albopubens* in *Cyamopsis tetragonoloba*; *Rhizopertha dominica* in *Hordeum vulgare*; *Sitophilus oryzae* in *H. vulgare*, *Oryza sativa* and *Zea mays*; *Specularius* sp. in *V. unguiculata*; *Spermophagus pygopubens* in *Abelmoschus* sp.; *Systole* sp. in *Coriandrum sativum*; *Tribolium castaneum* in *Sesamum indicum* and *Triticum aestivum*; *Zabrotes subfasciatus* in *Phaseolus vulgaris*.

**Fungi:** *Botryodiplodia theobromae* on *Zea mays*; *Colletotrichum dematium* on *Vigna unguiculata*; *Drechslera oryzae* and *D. sorghicola* on *Oryza sativa* and *Triticum aestivum*; *D. setariae* on *Vigna* spp., *D. sorokiniana* in *Triticum aestivum*; *Fusarium equiseti* on *Cucumis* spp; *F. moniliforme* on *Phaseolus vulgaris* and *Sesbania*; *F. semitectum* on *Phaseolus vulgaris* and *Vigna unguiculata*; *F. solani* on Okra, *Pisum sativum* and *Vigna mungo*; *Macrophomina phaseoli* on *Vigna mungo*; *Rhizoctonia solani* on loquat, *Phaseolus vulgaris* and *Vigna* spp. and *Zea mays*; *R. bataticola* on *Psophocarpus tetragonolobus* and *Ustilaginoidea virens* on *Oryza sativa*.

#### 4.5 National Containment/ Quarantine Facility for Transgenic Planting Material

One-hundred-and-five samples of imported transgenic planting material comprising cotton (4) from USA; maize (1) from South Africa; rice (19) from Vietnam; and wheat (43) and rice (38) from Germany containing diverse genes were received for quarantine clearance. Of these, 23 samples comprising 4 samples of cotton

from USA including 2 with *cry 1F*, *cry 1Ac* genes encoding insecticidal proteins and 2 samples with *vip-3* gene for imparting insect resistance; 19 samples of rice from Vietnam containing three genes namely plant phytoene synthase (*psy*), bacterial phytoene desaturase (*crtl*) and lycopene  $\beta$ -cyclase (*lcy*), responsible for the synthesis of  $\beta$ -carotene in rice endosperm were processed for quarantine clearance. The quarantine processing included visual inspection and incubation test of all the samples, x-ray radiography of cotton and soaking and washing tests of paddy for detection of various pests viz., insects, nematodes, fungi and bacteria. Important interceptions included, *Fusarium moniliforme* in maize and *Nigrospora oryzae*, *Drechslera oryzae* and *Curvularia lunata* in paddy. Infected material was salvaged by giving hot water treatment at 52°C for 30 minutes. Post-entry quarantine inspection of transgenic maize imported from South Africa was done and it was found to be free from stalk rot, leaf spot and downy mildew.

#### 4.6 Human Resource Development

An orientation course, fourth in the series, on “**Biosafety Considerations for Evaluation of Transgenic Crops**” was organized from November 10-18, 2003 at NBPGR, New Delhi under the ICAR-DBT project entitled “National Containment/ Quarantine Facility for Transgenic Planting Material, Phase-II”.

The objective of the course was to develop a critical mass of scientists at national level who can comprehend and participate in tackling various issues related to biosafety for evaluation of transgenics. Seventeen participants engaged in research in biotechnology, botany, cyto-

genetics, plant breeding, plant protection and seed technology at various ICAR institutes, a CSIR institute and different agricultural/ other universities attended the course. Training comprised of lectures by eminent biotechnologists, plant breeders, plant protection specialists, policy makers, representatives of private sectors, covering different aspects of genetic engineering, provisions of International Biosafety Protocol, quarantine strategies and regulatory mechanism for safe import/ evaluation of transgenics, impact of transgenics on environment and human health. Interactive sessions were arranged to share the viewpoints and experiences. Participants were also exposed to the experiences of private sector engaged in research and field trials of transgenics through a presentation on a case study of Bt cotton (from lab to fields) and a field visit. The training was concluded with panel discussion and a plenary session.

#### **4.7 Diagnostics and Development of Seed Certification Protocols for Management of Transmitted Viral Diseases of Grain Legumes**

- Field surveys were undertaken to assess the prevalence of Bean Common Mosaic Virus (BCMV) in mungbean and urdbean, Pea Seed-borne Mosaic Virus (PSbMV) in pea and Soybean Mosaic Virus (SMV) in soybean in Haryana, Madhya Pradesh (MP), Uttaranchal and Uttar Pradesh (UP). Leaf samples of mungbean, pea, soybean and urdbean showing virus-like symptoms were tested by variants of Enzyme Linked Immunosorbent Assay (ELISA). Mungbean and urdbean showed the presence of BCMV, pea and soybean

showed the presence of PSbMV and SMV, respectively.

- A total of 212 seed samples comprising mungbean (13), pea (72), soybean (79) and urdbean (48) belonging to different varieties were collected from Assam, Arunachal Pradesh, Gujarat, Haryana, MP, Manipur, Meghalaya, Mizoram, Rajasthan, Sikkim, Tripura, UP and Uttaranchal to determine the status of mandated seed-transmitted viruses.
- A total of 104 seed samples comprising mungbean (25), soybean (54) and urdbean (25) belonging to different varieties collected from diverse sources were subjected to growing-on test under green house conditions to assess the seed transmission rate of SMV in soybean and BCMV in mungbean and urdbean. Studies revealed 1.4-16.34 % and 1.28-27.11% of BCMV in mungbean and urdbean, respectively, and 1.26-35.8% of SMV in soybean.
- A total of 604 seed samples comprising mungbean (49), pea (303), soybean (187) and urdbean (65) collected from diverse sources belonging to different varieties were tested by group testing of seedlings, testae and embryos against SMV and PSbMV by Double Antibody Sandwich-ELISA and BCMV by Direct Antigen Coating-ELISA. Out of the 284 seed samples tested, 207 showed presence of PSbMV in testae; out of 175 tested, 58 samples in seedlings; 5 out of 169 tested showed presence of SMV in testae 57 out of 161 tested in seedlings; 31 showed the presence of BCMV in testae and none in embryos of mungbean. In urdbean 62

showed the presence of BCMV in testae and 22 in embryos.

- Immunoglobulins to cowpea aphid-borne mosaic virus and SMV were conjugated with alkaline phosphatase for further use in standardizing ELISA protocol for detection of these viruses.
- Field experiments on epidemiology of SMV on soybean and PSbMV on pea were carried out.

### **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. Plants of different species are being 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) (R.K. Khetarpal)

PGR/PQR-BUR-DEL-01.01: Quarantine clearance of germplasm under exchange. Joint inspection and prophylactic treatments (P.C. 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, P.C. Agarwal, Baleshwar Singh, Dinesh Chand, K. D. Joshi).

PGR/PQR- BUR-DEL-01.05: Quarantine clearance of germplasm under exchange and supportive research: Virological aspects (Shamsher Singh, D. B. 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.).

Seed health testing of germplasm of different agri-horticultural crops for pest-free conservation of germplasm (NATP) (Arjun Lal, R.K.Khetarpal, Shamsher Singh, P.C. Agarwal, B.Lal, Usha Dev, Manju Lata Kapur, Rajan, Baleshwar Singh, D.B. Parakh, Shashi Bhalla, V.Celia Chalam, Kavita Gupta, Charan Singh, A.K. Maurya, Dinesh Chand, K.D. Joshi).

National containment/quarantine facility for transgenic planting material (DBT)(R.K. Khetarpal, Gurinder Jit Randhawa).

Diagnostics and development of seed certification protocols for management of seed-transmitted viral diseases of grain legumes (NATP) (R.K. Khetarpal, Celia Chalam V).

ICAR-CABI Classical biological control of *Mikania micrantha* with *Puccinia spegazzinii* (DFID) (Usha Dev – Co-PI)

## 5. GERmplasm EXCHANGE UNIT

**Summary:** During the period under report 33,320 accessions (1,07,202 samples) were imported from 41 countries and these included germplasm (24,140 accessions; 34,968 samples) as well as trial material (9180 entries; 72, 234 samples) of different agricultural and horticultural crops. Requirement for germplasm from abroad was met by arranging material from different sources from India and these (490 accessions; 549 samples) including CIMMYT material (nurseries) were sent to 16 countries. Based on requests received from research workers in the country, 15,289 samples of diverse crops were supplied to users for crop improvement programmes in the country.

### 5.1 Import of Plant Genetic Resources

PGR introduction 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 and seed/ plant propagules during the year, were as follows:

|  |                                       |
|--|---------------------------------------|
| Accessions procured and processed      | 33,320<br>(1,07,202 samples)          |
| (a) Germplasm                          | 24,140 accessions<br>(34,968 samples) |
| (b) Trials                             | 9180 entries<br>(72,234 samples)      |
| Number of transgenic material imported | 23                                    |
| Number of countries involved           | 41                                    |
| Number of import permits issued        | 1109                                  |

**Cereals and millets:** *Aegilops biuncialis* (130), *A. columanaris* (190), *A. comosa* var. *comosa* (1), *A. comosa* var. *subventricosa* (1), *A. crassa* (130), *A. cylindrica* (78), *A. geniculata* (125), *A. juvenalis* (2), *A. kotschy* (11), *A. longissima* (36), *A. markgraffi* (44), *A. neglecta* (102), *A. peregrina* (56), *A. peregrina* var. *brachyathera* (3), *A. peregrina* var. *peregrina* (1), *A. searsii* (50), *A.*

*sharonensis* (78), *A. speltoides* (33), *A. speltoides varligustica* (22), *A. tauschii* (83), *A. triuncialis* (251), *A. umbellata* (55), *A. uniaristata* (4), *A. ventricosa* (2) all from USA; *Avena abyssinica* (7), *A. barbata* ssp. *barbata* (3), *A. brevis* (6), *A. eriantha* (2), *A. fatua* (6), *A. longiglumis* (2), *A. macrocana* (2), all from USA; *A. floccifolia* (149) from Sweden and USA; *Eleusine coracana* (3) from Eritrea and USA; *E sativa* (1), *E. indica* (5), *E. jaegeri* (1), *E. multiflora* (1), *E. tristachya* (4) all from USA; *Hordeum vulgare* (34) from Canada, Eritrea, Syria and USA; *Oryza australiensis* (5), *O. barthii* (17), *O. brachyantha* (4), *O. eichingeri* (2), *O. glaberrima* (466), *O. glumaepatula* (7), *O. latifolia* (7), *O. longistaminata* (17), *O. longiglumis* (4), *O. meridionalis* (4), *O. minuta* (4), *O. officinalis* (4), *O. punctata* (4), *O. rhizomatis* (5), *O. ridleyi* (5), *O. rufipogon* (67) all from Philippines; *O. sativa* (2842) from Japan, Nepal, Srilanka, Switzerland, Philippines, USA and Vietnam; *Pennisetum glaucum* (429) from Eritrea, UK, Canada and USA; *Sorghum bicolor* (321) from Australia, Canada, Kenya, Srilanka and USA; *Triticum aestivum* (816) from Australia, China, Bangladesh, Germany, Nepal and USA; *T. aestivum* spp. *aestivum* (5) from USA; *T. durum* (30) from Russia, *T. monococcum* spp. *aegilopoides* (763) and *T.*



*monococcum*, spp. *monococcum* (2) from USA; *T. timopheevii* spp. *armeniaceum* (253) from USA; *T. timopheevii* spp. *timopheevii* (24) from USA; *T. turidum* spp. *durum* (25) from Syria; *T. urartu* (198) from USA; *Zea mays* (5273) from Argentina, Belgium, Brazil, Bulgaria, Eritrea, Mexico, Philippines, South Africa, Thailand and USA; Trials/nurseries-Paddy (916 entries; 9103 samples)-18<sup>th</sup> IRBBN, 16<sup>th</sup> IRGMN, 9<sup>th</sup> IRHON, 24<sup>th</sup> IRBPHN, 30<sup>th</sup> IIRON, 19<sup>th</sup> IRSBN, 24<sup>th</sup> IRCTN, 26<sup>th</sup> IDRON, 26<sup>th</sup> IRLON, 4<sup>th</sup> IRTON; *Zea mays* (2885 entries; 14,933 samples) ILYHO 314-CHTYNQ, IEYVO 310-EVT 14A, IEYVO 316-CHTTEY, IYQO 339-CHTSYO, IEYO 352-EVTI7 EY, IYHO 33T-CHTSY, IPTT-45, IPTT-33, IPTT-501, IPTT-502, TTWCEY, EVTYQ-03, TSCLWQ 03-03, TSCLW 03-015, TSCLY-03-17, EVTWQ, TCLWQ-03-02, TCLWQ-03-01, TCLYQ-03-07, EVT 13 Prep IDILPOP 03, Prep IDEPOP 03, Prep IDEIHY B 03, Prep IDQHYB 03, IEWVOEVT 14 B, IEYV 035-2, EVT 17 EY, CHTH-TZZY, TCLW03-16, TSCL 03-18, TSCL W03-19, TTWC WQ03-04, DST, IPTT-45, IPTT446; *Triticum aestivum* (4320 entries; 42,228 samples) 12<sup>th</sup> FAWWON, 6<sup>th</sup> WON-SA, 6<sup>th</sup> WON-IIRR, ME 1Q-02, 35<sup>th</sup> IDYT, 24<sup>th</sup> ESWYT, 36<sup>th</sup> IBWSN, 11<sup>th</sup> SAWYT, 33<sup>rd</sup> EDUYT, 35<sup>th</sup> ISDN, 11<sup>th</sup> HTWYT, 21<sup>st</sup> SAWSN, PBW 343 INQYT, IDTN-04, 5<sup>th</sup> EGPVT, 7<sup>th</sup> EGPSN, 12<sup>th</sup> HMN, 3<sup>rd</sup> CWA-RTA, WON-D, IDON-CA, 21<sup>st</sup> SAWSN, 1<sup>st</sup> ISWSN, 15<sup>th</sup> ASWSN, 14<sup>th</sup> HRWSN, 11<sup>th</sup> HRWYT, 24<sup>th</sup> ESWYT, 4<sup>th</sup> IAT, 3<sup>rd</sup> HLWSN, 5<sup>th</sup> FEFWSN, 3<sup>rd</sup> WKL-CWA 04, 3<sup>rd</sup> RWGP-CWA04, 4<sup>th</sup> RWYT-LR/CA; *Hordeum vulgare* (279 entries; 1649 samples) 13<sup>th</sup> HBSN, 31<sup>st</sup> IBON, IBON-L-RAM, ISEBON, IBON-MRA,

IHTBON, ISABON, 26<sup>th</sup> IBYT, IBCB-S, IEBON-04, ISABON, IHTBON, IBRWAGP, IBYT-NRA, IBYT-LR-A, IBYT-LRA-M, IBLSGP, IBPMGP, IBCSGP, ISABON; *Triticale* (211 entries; 1006 samples), 35<sup>th</sup> ITSN, 12<sup>th</sup> FWTCL, 35<sup>th</sup> ITYN.

**Grain legumes:** *Cicer arietinum* (456) from Australia and Eritrea, *Cyamopsis senegalensis* (1) and *C. serata* (1) both from USA; *Glycine max* (378) from Nigeria, Taiwan and USA; *Lathyrus sativus* (1) from Eritrea; *Lens culinaris* (220) from Eritrea, *L. ervoides* (3), *L. lamottei* (3), *L. nigricans* (3) from Syria; *L. odomensis* (22), *L. orientalis* (91), *L. tomentosus* (9) all from Syria; *Phaseolus vulgaris* (441) from Columbia, Eritrea and Taiwan; *Pisum sativum* (18) from Bulgaria, Eritrea, Taiwan and USA; *Vicia faba* (2) from Eritrea; *V. sativa* (5) from Russia; *V. villosa* (3) from Russia and USA, *Vigna aconitifolia* (1), *V. ambacensis* var. *ambacensis* (3), *V. ambacensis* var. *pubigera* (1), *V. angivensis* (1), *V. angularis* var. *angularis* (1), *V. angularis* var. *nipponensis* (1), *V. biennis* (1), *V. comosa* ssp. *comosa* var. *comosa* (1), *V. filicaulis* var. *filicaulis* (1), *V. filicaulis* var. *pseudovenulosa* (1), *V. friesorum* var. *friesorum* (1) *V. frutescens* ssp. *frutescens* var. *frutescens* (1), *V. frutescens* ssp. *incana* (1), *V. gracilis* var. *gracilis* (2), *V. grandiflora* (1), *V. heterophylla* (1), *V. hirtella* (1), *V. hosei* var. *hosei* (1), *V. hosei* var. *pubescens* (1), *V. luteola* (1), *V. macrohyncha* (1), *V. multinervis* (1), *V. mungo* (2) and *V. mungo* var. *sylvestris* (2) all from Belgium; *V. nakashimae* (1), *V. nepalensis* (1), *V. nigrizia* (1), *V. nyangensis* (1), *V. oblongifolia* var. *oblongifolia* (3), *V. oblongifolia* var. *parviflora* (3), *V. parkeri* ssp. *maranguensis* (2), *V. racemosa* (1), *V.*

*racemosa* var. *racemosa* (3) all from Belgium, *V. radiata* (66) from Japan, Taiwan and USA; *V. radiata* var. *radiata* (10) from Belgium and USA; *V. radiata* var. *sublobata* (2) from Belgium; *V. radicans* (1), *V. reflexo-pilosa* var. *glabra* (1), *V. reticulata* (2), *V. riukuensis* (1), *V. schimperii* (1), *V. stipulacea* (2), *V. subramaniana* (1), *V. trilobata* (2), *V. trinerva* var. *trinerva* (1), *V. triphylla* (1), *V. umbellata* (1), *V. umbellata* var. *gracilis* (1), *V. umbellata* var. *umbellata* (1) all from Belgium; *V. unguiculata* (118) from Eritrea, Nigeria and USA; *V. unguiculata* ssp. *alba* (2), *V. unguiculata* ssp. *baoulensis* (2), *V. unguiculata* ssp. *burundiensis* (1), *V. unguiculata* ssp. *leutuzei* (1), *V. unguiculata* ssp. *pawekaiiae* (1), *V. unguiculata* ssp. *pubescens* (1), *V. unguiculata* ssp. *stenophylla* (2), *V. unguiculata* ssp. *tenuis* (3), *V. unguiculata* ssp. *unguiculata* var. *spontanea* (8), *V. unguiculata* ssp. *sesquipedalis* (1), *V. unguiculata* ssp. *unguiculata* var. *unguiculata* (1) all from Belgium; *V. venulosa* (1), *V. vexillata* var. *angustifolia* (1), *V. vexillata* var. *lobatifolia* (1), *V. vexillata* var. *macrosperma* (2), *V. vexillata* var. *ovata* (1), *V. vexillata* var. *vexillata* (3) all from Belgium. Trials/nurseries of *Cicer arietinum* (261 entries, 1748 samples) CIABN-04, CIFWN-04, CIEN-SL-2-04, CIF3W SL-04, CIEN SLI-04, CIDTN-04; *Lens culinaris* (308 entries, 1567 samples) LIEN-E-04, LIEN-L-04, LIEN-S-04, LIFWM-04, LIF3N-E-04, LIF3N-S-04, LIDTN-04, LIRN-04, LIABN-04, LIF3B-L-04.

**Oilseeds:** *Arachis hypogaea* (175) from Nigeria and USA; *Brassica rapa* (2) from Canada; *B. rapa* ssp. *chinensis* (1) from USA;

*B. napus* (1), *B. napus* var. *napus* (9) both from USA; *Carthamus arborescens* (1), *C. boissieri* (1), *C. dentatus* (1), *C. glaucus* (1) all from Germany; *C. lanatus* (7) from Denmark and Germany; *C. palestinus* (1) from USA; *C. tinctorium* (4) from Germany and USA; *Guizotia abyssinica* (14) from USA; *Helianthus annuus* (310) from Australia, Bulgaria, France and USA; *H. anomalus* (1), *H. ciliaris* (1), *H. decapetus* (1), *H. deserticola* (10), *H. paradoxus* (1), *H. pumilis* (1), *H. subcanascens* (1), *H. scaberimus* (1) all from USA; *Linum usitatissimum* (5) from Eritrea and Canada; *Sesamum indicum* (18) from Brazil, Bulgaria, Denmark, Eritrea, Sri Lanka and USA.

**Vegetables:** *Abelmoschus esculentus* (274) from Eritrea and USA; *Allium fistulosum* (1) from Denmark; *Brassica oleracea* var. *botrytis* (123) from Netherlands; *B. oleracea* var. *capitata* (1) from USA; *Capsicum annum* (425) from Bulgaria, Taiwan and USA; *C. chinense* (5) from USA; *Capsicum* sp. (130) from Taiwan; *Cucumis africanus* (1), *C. anguria* (2), *C. anguria* var. *anguria* (1) *C. anguria* var. *longaculeatus*, *C. dispsaceus* (2), *C. meeuoei* (1), *C. melo* (8) *C. melo* ssp. *agrestio* (3), *C. melo* var. *cantalupensis* (2), *C. melo* var. *conomon* (2), *C. melo* var. *flexuosus* (1), *C. melo* var. *inodorus* (2), *C. melo* ssp. *melo* (83) *C. metuliferus* (2), *C. myriocarpus* (2), *C. myriocarpus* ssp. *leptodermis*, (2), *C. myriocarpus* ssp. *myriocarpus* (1); *C. prophetarum* (1), *C. pustulatus* (2), *C. sagittatus* (3), *C. sativus* (11), *C. sativus* var. *sativus* (22), *C. sativus* var. *sikkimensis* (1), *C. sativus* var. *xishuangbannanensis* (1), *Cucumis* sp. (1), *C.*

*zeyheri* (1) all from USA; *Cucurbita maxima* (16), *C. moschata* (4) both from USA; *C. pepo* (37), *C. pepo* var. *fraterna* (2), *C. pepo* var. *pepo* (1), *C. pepo* var. *texana* (2) all from USA; *Cucurbita* sp. (21) from Sweden; *Citrullus colocynthis* (12), *C. lanatus* (12) both from Iran and USA; *C. lanatus* var. *citroides* (151) from USA; *C. lanatus* var. *lanatus* (221) from USA; *C. rehmeii* (1) all from USA; *Daucus carota* (26) from USA; *Lagenaria siciraria* (20) from USA; *Luffa acutangula* (17) from USA; *Lycopersicon cheesmanii* (8) from Taiwan and USA; *L. chilense* (6) from USA; *L. chimielewskii* (8) from Taiwan and USA; *L. hirsutum* (34) from Taiwan and USA; *L. lycopersicoices* (2) from USA; *L. parviflorum* (9) *L. pennellii* (7), *L. peruvianum* (11), *L. pimpinellifolium* all from Taiwan and USA; *L. sitiens* (2) from USA; *Lycopersicon* sp. (54) from Taiwan and USA *Lycopersicon esculentum* (662) from Taiwan and USA; *L. esculentum* var. *cerasiforme* (32) from USA; *L. esculentum* var. *glandulosum* (1), *L. esculentum* var. *humifusum* (1), *L. esculentum* var. *peruvianum* (2) all from USA; *Momordica charantia* (1) from USA; *Praecitrullis fistulosus* (1) from USA, *Solanum melongena* (316) from USA; *Trigonella foenum graecum* (2) from Eritrea.

**Fruits:** *Asimina triloba* (2) from USA; *Carica papaya* (2) from Taiwan; *Cornus mas* (1) from USA; *Corylus avellana* (26) from USA; *Citrus unshui* (2) from USA; *Citrus* sp. (150) Australia; *Cydonia oblonga* (2) from Newzealand; *Irvingia gabonensis* (5) from Nigeria; *Juglans regia* (3) from France; *Macadamia integrifolia* (5) from Spain; *Malus domestica* (22) from Newzealand and

USA; *Malus* sp. (5) from Australia and Newzealand; *Malus sylvestris* (23) from Australia; *Mangifera indica* (2) from Brazil; *Mangifera zeylanica* (3) from Sri Lanka; *Mespilus canascens* (1), *M. germanica* (2), *M. macrocarpa* (1) all from USA; *Opuntia ficus indica* (1) from Mexico, *Passiflora edulis* (1) from Australia; *Persea americana* (3) from Australia; *Phoenix dactylifera* (1) from Iran; *Pistacea vera* (1) from USA; *Prunus armeniaca* (2) from USA; *P. domestica* (8) from Australia; *P. persica* (27) from Australia and USA; *Prunus* sp. (10) from Australia and USA; *Pyrus communis* (30) from Australia, Canada and Newzealand; *Pyrus* sp. (1) from Australia; *Vitis vinifera* (2) from Ukraine.

**Fibres:** *Corchorus aestuans* (2), *C. capsularis* (2), *C. fascicularis* (2), *C. olitorius* (2), *C. pseudocapsularis* (2), *C. pseudoolitorius* (2), *C. trilocularis* (2), *C. tridens* (2) all from Bangladesh; *Corchorus* sp. (12) from China; *Crotolaria goreensis* (1), *C. incana* (3), *C. pilosa* (8), *C. retusa* (4), *C. zanzibarica* (1) all from Columbia; *Gossypium hirsutum* (354) from Spain and USA; *G. tomentosum* (1) from USA; *Hibiscus cannabinus* (19) from USA; *H. sabderiffa* (18) from Bangladesh and China.

**Medicinal and aromatic plants:** *Abrus precatorius* (2) from Denmark and UK; *A. lycoctonum* (1), *A. napellus* (1) both from Denmark; *Adonis annua* (1) from Denmark; *Antirrhinum majus* (1) from UK; *Atropa belladonna* (2) from Denmark and UK; *Cassia angustifolia* (1) from UK; *C. crocodylium* (1), *C. cyanus* (1), *C. diluta* (1), *C. eriophora* (1), *C. solstitialis* (1) all from

Denmark; *Datura stramonium* (2) from Denmark; *D. stramonium* var. *stramonium* (1) both from Denmark; *Dianthus fruticosus* (1) from UK; *Ginkgo biloba* (1) from USA; *Hypericum foliosum* (1), *H. perforatum* (2) both from Denmark; *Hyoscyamus albus* (2) from Denmark; *H. niger* (16) from Denmark and USA; *Hyoscyamus niger* var. *annuus* (3), *H. niger* var. *niger* (2), *H. niger* var. *pallidus* (3) all from Germany; *H. pusillus* (1) from Denmark; *Hyssopus officinalis* (2) from Denmark; *Lavandula angustifolia* (2) *L. officinalis* (1), *L. intermedia* (1) all from UK; *Limonium* sp. (3) from UK; *Melissa officinalis* (1) from Denmark; *Mentha arvensis* (1) from Japan; *M. longifolia* (1), *M. rotundifolia* (1), *M. spicata* (1) all from Denmark; *Origanum vulgare* (1) from Denmark; *Papaver argemone* (1), *P. dubium* (2), *P. fugax* (1), *P. hybridum* (1), *P. lateritum* (1), *P. rhoeas* (2), *P. somniferum* (2) all from Denmark; *Pelargonium odoratissimum* (1) from UK; *Plantago afra* (1), *P. amplexicaulis* (2), *P. arenaria* (1), *P. aristata* (1), *P. atrata* (1), *P. debilis* (1), *P. hookeriano* (1) *P. lagopus* (1), *P. lanceolata* (1), *P. major* (1), *P. media* (1), *P. orbignyana* (1), *P. palagonica* (1), *P. subspatulata* (1) all from Denmark, *Podophyllum hexandrum* (1) from UK; *Silybum marianum* (2) from Denmark; *Stevia* sp. (1) from Canada.

**Forages:** *Chaetocalyx brasiliensis* (1) from Columbia; *Corymbia citriodora* ssp. *citriodora* (1) from Australia; *Eragrostis teff* (2) from Eritrea; *Macropitulum atropurpureum* (1) from Australia; *Medicago ciliaris* (1), *M. coronata* (1), *M. intertexta* (1), *M. laciniata* (1), *M. littorales* (1), *M. lupulina* (1), *M. minima* (1),

*M. orbicularis* (1), *M. polymorpha* (2), *M. radiata* (1), *M. rigidula* (1), *M. rugosa* (1), *M. scutellata* (1), *M. torinata* (1), *M. truncatula* (1), *M. turbinata* (3) all from Denmark; *Melilotus indicus* (1), *M. messanensis* (1), *M. segetalis* (1), *M. sulcatus* (1) all from Denmark; *Stylosanthes guianensis* (8) from Columbia; *Trifolium alexandrinum* (14) from Denmark and USA; *T. alpestre* (1), *T. angustifolium* (1) both from Denmark; *T. arvense* (3) from Denmark and USA; *T. aureum* (1) from Denmark; *T. baccarinii* (1) from USA; *T. billardieri* (1) from Denmark; *T. campestre* (3) from USA; *T. clypeatum* (1), *T. dasyurum* (1), *T. diffusum* (1), *T. fragiferum* (1), *T. grandiflorum* (1), *T. incarnatum* (1), *T. lappaaceum* (1), *T. leucanthum* (1), *T. ligusticum* (1), *T. michelranium* (1), *T. nigriscens* (1), *T. pilulare* (1), *T. scabrum* (1), *T. squamosum* (3), *T. striatum* (1), *T. tomentosum* (1) all from Denmark.

**Tubers:** *Ipomoea batatas* (94) from Peru; *Manihot esculenta* (37) from Nigeria; *Solanum acuate* f. *acaule* (14); *S. acroscopicum* (1), *S. alandiae* (1), *S. albicans* (6), *S. albornozii* (1), *S. ambosinum* (3), *S. andreanum* (3), *S. berthaultii* (11), *S. boliviense* (3), *S. brachistortichum* (5), *S. brachycarpum* (10), *S. bukasovii* (16), *S. bukasovii* f. *multidissectum* (8), *S. bulbocastnum* (15), *S. candolleianum* ssp. *cardiophyllum* (1), *S. cardiophyllum* ssp. *cardiophyllum* (3), *S. cardiophyllum* ssp. *ehrenbergii* (7), *S. chacoense* (8), *S. chancayense* (2), *S. chomatophyllum* (10), *S. circaefolium* var. *capscibaccatum* (5), *S. colombianum* (1), *S. commersonii* ssp.

*commersonii* (6), *S. commersonii* ssp. *malmeanum* (1), *S. demissum* (20), *S. dolichocremastrum* (1), *S. fendleri* ssp. *fendleri* (8), *S. fernanderianum* (1), *S. gandarillasii* (2), *S. gourlayi* ssp. *gourlargi* (10), *S. guerreroense* (2); *S. hjertingii* (7), *S. hougasii* (4), *S. huancambense* (1), *S. incamayoense* (1), *S. infundibuliforme* (10), *S. iopetalum* (3), *S. jamesii* (5), *S. kurtzianum* (5), *S. leptophyes* (2), *S. lignicaule* (2), *S. longiconicum* (1), *S. marinasense* (9), *S. medians* (5), *S. megistracrolobum* (10), *S. megistracrolobum* ssp. *toralapanum* (3), *S. microdontum* (10), *S. multinterruptum* (2), *S. neocardensaii* (1), *S. oplocense* (6), *S. oxycarpum* (3), *S. palustre* (3), *S. pampasense* (2), *S. papita* (3), *S. paucissectum* (1), *S. phureja* ssp. *phureja* (15), *S. pinnatisectum* (5), *S. piurea* (1), *S. polyadenium* (5), *S. polytrichion* (5), *S. raphanifolium* (8), *S. sanctae-rosae* (2), *S. scabrifolium* (1), *S. schenckii* (1), *S. sogarandinum* (3), *Solanum* sp. (4), *S. sparsipilum* (4), *S. spegazzinii* (15), *S. stenotomum* ssp. *stenotomum* (2), *S. stoloniferum* ssp. *stoloniferum* (11), *S. tariense* (5), *S. trifodum* (6), *S. tuberosum* ssp. *andigenum* (15), *S. verrucosum* (4), *S. violaceimarmoratum* (1), *S. blancogaldosii* (3), *S. sucrensis* (1) all from USA; *Solanum tuberosum* (69) from Germany, Peru and USA.

**Spices and condiments:** *Carum carvi* (2) from Denmark; *Coriandrum sativum* (1) from Denmark.

**Underutilized plants:** *Amaranthus* sp. (60), from Russia.

**Narcotics and beverages:** *Nicotiana calyciflora* (1), *N. gossei* (1), *N. heterantha* (1), *Nicotiana* sp. all from Australia; *N. tabacum* (20) from Brazil, USA and Zimbabwe; *Theobroma cacao* (24) from UK.

**Sugar-yielding plants:** *Beta vulgaris* (5) from Belgium; *Saccharum officinarum* (6) from Mauritius.

**Agroforestry species:** *Eucalyptus arqophloa* (5), *E. camaldulensis* var. *obtusata* (1), *E. camaldulensis* var. *simulata* (1), *E. camaldulensis* var. *tereteornis* (17) all from Australia; *Salix alba* (15) from Belgium, Croatia and Hungary; *S. alba* ssp. *coerulea* (14) from Germany; *S. alba* ssp. *vitellina* (6) from Germany; *S. americana* (1), *S. purpurea* (1), *S. purpurea* var. *gracilis* (1), *S. triandra* (1), *S. viminalis* ssp. *longifolia* (3), *S. rubens* (1), *Salix* sp. (4), *S. matsudana* (1) all from Germany.

**Plantation crops:** *Hevea camarguana* (1), *H. colina* (1), *H. fousiflora* (1), *H. gyanensis* (1) all from Indonesia.

**Ornamentals:** *Calendula arvensis* (2), *C. madarensis* (1), *C. officinalis* (1), *C. stellata* (1), *C. suffruticosa* (1) all from Denmark.

Accessions received from the Head, Germplasm Conservation Division for assigning national accession numbers were as follows: *Arachis hypogaea* (307), *Cajanus cajan* (46), *Citoria terneatea* (3), *Eleusine coracana* (152), *Nicotiana tabacum* (361), *Panicum maximum* (5), *Panicum purpureum* (54), *Phaseolus vulgaris* (11), *Sorghum bicolor* (1234) and *Triticum aestivum* (217).

## Promising introductions during 2003

| Crop                                  | Country | Salient features   | Distribution  |
|---------------------------------------|---------|--|---|
| <b>Biotic stress resistant</b>        |         |  |   |
| <i>Triticum aestivum</i><br>EC-524892 | USA     | Tolerant to hessian fly ( <i>Mayetiola destructor</i> )  | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticum aestivum</i><br>EC-527045 | USA     | Tolerant to hessian fly, resistant to stripe rust and leaf rust                                  | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticum aestivum</i><br>EC-528127 | USA     | Resistant to powdery mildew, septoria leaf blotch, soil-borne wheat mosaic virus and stripe rust | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticum aestivum</i><br>EC-533525 | USA     | Resistant to powdery mildew, barley yellow leaf virus and glume blotch                           | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticum aestivum</i><br>EC-533532 | USA     | Resistant to leaf rust, stem rust and wheat soil borne mosaic virus                              | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticum aestivum</i><br>EC-533533 | USA     | Resistant to stem rust, leaf rust and Hessian fly  | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Zea mays</i><br>EC-520260          | USA     | Resistant to European corn borer ( <i>Ostrinia nubilalis</i> )                                   | <ul style="list-style-type: none"> <li>• PD, DMR, IARI</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>   |
| <i>Zea mays</i><br>EC-523377          | USA     | Resistant to corn borer ( <i>Diatrea grandiosetta</i> )  | <ul style="list-style-type: none"> <li>• PD, DMR, IARI</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>   |
| <i>Zea mays</i><br>EC-514655-60       | USA     | Mould resistant varieties  | <ul style="list-style-type: none"> <li>• BARC, Mumbai</li> <li>• PD, DMR, IARI</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Hordeum vulgare</i><br>EC-532339   | Canada  | Resistant to common root rot   | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Hordeum vulgare</i><br>EC-527044   | USA     | Resistant to barley stripe rust  | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Hordeum vulgare</i><br>EC-532634   | Canada  | Resistant to covered smut and intermediate reaction to barley leaf scald and net blotch          | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Hordeum vulgare</i><br>EC-533523   | USA     | Resistant to net blotch, spot blotch and stem rust   | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Hordeum vulgare</i><br>EC-533524   | USA     | Resistant to <i>Fusarium</i> head blight   | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul> |

|   |          |   |  |
|---|----------|---|--|
| <i>Triticale</i><br>EC-537921-22                | Mexico   | Resistant to stem rust, yellow rust, <i>Fusarium</i> head blight, <i>Septoria</i> and tolerant to low PH  | <ul style="list-style-type: none"> <li>• GFRI, Jhansi</li> <li>• GCD, NBPGR</li> </ul>   |
| <i>Triticale</i><br>EC- 534274                  | USA      | Resistant to prevalent races of stem rust, leaf rust, wheat streak mosaic virus and ergot   | <ul style="list-style-type: none"> <li>• IGfRI, Jhansi</li> <li>• GCD, NBPGR</li> </ul>  |
| <i>Helianthus annuus</i><br>EC-524065-070       | Bulgaria | Alternaria blight and head rot resistant lines  | <ul style="list-style-type: none"> <li>• DOR, Hyderabad</li> </ul>   |
| <i>Glycine max</i><br>EC-528619-629             | Taiwan   | Rust resistant lines  | <ul style="list-style-type: none"> <li>• NARDF, Jalgaon</li> </ul>   |
| <i>Carthamus tinctorius</i><br>EC-523375        | USA      | High oil type (>40%) resistant to <i>Alternaria</i> , <i>Fusarium</i> wilt and aphid  | <ul style="list-style-type: none"> <li>• PD, DOR, Hyderabad</li> <li>• NBPGR RS. Akola,</li> <li>• GCD, NBPGR</li> </ul>             |
| <i>Sesamum indicum</i><br>EC-519382             | Bulgaria | Resistant to <i>Antigastra</i> powdery mildew, wilt and bacterial blight  | <ul style="list-style-type: none"> <li>• PC (S &amp; N), JNKVV, Jabalpur</li> <li>• NBPGR, RS Akola</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Phaseolus vulgaris</i><br>EC-528616-618      | USA      | Resistant to curly top virus (CTV); bean common mosaic virus (BCMV)   | <ul style="list-style-type: none"> <li>• PEQN (Seed for: HAFRP, Ranchi)</li> </ul>   |
| <i>Phaseolus vulgaris</i><br>EC-528359          | Taiwan   | Rust resistant lines  | <ul style="list-style-type: none"> <li>• PEQN (Seed for: HAFRP, Ranchi)</li> </ul>   |
| <i>Phaseolus vulgaris</i><br>EC- 530832         | Columbia | Resistant to angular leaf spot  | <ul style="list-style-type: none"> <li>• GBPUAT, Pantnagar</li> </ul>  |
| EC-530891                                       | Columbia | Resistant to rust   |  |
| EC-530898                                       | Columbia | Common bacterial blight   |  |
| <i>Pisum sativum</i><br>EC-517107-111           | Bulgaria | Resistant to powdery mildew   | <ul style="list-style-type: none"> <li>• PEQN (Seed for: IIPR, Kanpur)</li> </ul>  |
| <i>Capsicum annum</i><br>EC-533896-901          | USA      | Resistant to southern root knot nematode.   | <ul style="list-style-type: none"> <li>• IIVR, Varanasi</li> <li>• GCD, NBPGR</li> </ul>   |
| <i>Capsicum sp.</i><br>EC-532386-89             | Taiwan   | Cayenne type, resistant to CMV bacterial wilt, poty virus group   | <ul style="list-style-type: none"> <li>• PAU, Ludhiana,</li> <li>• IIVR, Varanasi</li> <li>• GCD, NBPGR</li> </ul>                   |
| <i>Citrullus sp.</i><br>EC-531947               | USA      | Resistant to anthracnose race II, mosaic virus, powdery mildew and downey mildew  | <ul style="list-style-type: none"> <li>• Pradham Biotech Pvt. Ltd, Hyderabad</li> </ul>  |
| EC-532028                                       |          |   |  |
| <i>Lycopersicon esculentum</i><br>EC-515140-41  | Taiwan   | Resistant to tomato leaf curl virus (TLCV), bacterial wilt (BW) and tobacco mosaic virus (TMV)  | <ul style="list-style-type: none"> <li>• M/s Manjushree Plantation Ltd, TN</li> <li>• IIVR, Varanasi</li> </ul>                      |
| EC-515144-55                                    |          |   |  |
| <i>Lycopersicon esculentum</i><br>EC-526511-13  | Taiwan   | Resistant to tomato spotted wilt virus  | <ul style="list-style-type: none"> <li>• ANGRAU, Hyderabad</li> </ul>  |
| <i>Lycopersicon esculentum</i><br>EC-528360-369 | Taiwan   | Resistant to whitefly-transmitted geminivirus (WTG); tomato yellow leaf curl virus (TYLCV), <i>Fusarium</i> wilt and <i>Stemphyllium</i> grey leaf spot | <ul style="list-style-type: none"> <li>• SKUAST, Srinagar</li> <li>• IIVR, Varanasi</li> <li>• GCD, NBPGR</li> </ul>                 |
| <i>Lycopersicon esculentum</i><br>EC-528375-378 | Taiwan   | Resistant to fruit borer  | <ul style="list-style-type: none"> <li>• SKUAST, Srinagar</li> <li>• IIVR, Varanasi</li> <li>• GCD, NBPGR</li> </ul>                 |

|   |             |  |  |
|---|-------------|--|--|
| <i>Lycopersicon peruvianum</i><br>EC-532633 | USA         | Resistant to tomato leaf curl virus  | <ul style="list-style-type: none"> <li>● IHR, Bangalore</li> <li>● IIVR, Varanasi</li> <li>● GCD, NBPGR</li> </ul>   |
| <i>Nicotiana tabacum</i><br>EC-516584-586   | USA         | Resistant to black shank root knot nematode, granville wilt, tobacco mosaic virus (TMV), southern root knot nematode | <ul style="list-style-type: none"> <li>● CTRI, Rajamundry</li> <li>● GCD, NBPGR</li> </ul>   |
| <b>Abiotic stress resistant</b>             |             |  |  |
| <i>Oryza sativa</i><br>EC-517348-401        | Philippines | Salinity tolerant lines  | <ul style="list-style-type: none"> <li>● Pt. JNC of Ag. &amp; R. Instt., Karikal</li> </ul>  |
| <i>Oryza sativa</i><br>EC-526554-561        | Philippines | Submergence tolerant   | <ul style="list-style-type: none"> <li>● NDUAT, Faizabad</li> </ul>  |
| <i>Oryza sativa</i><br>EC-526562-614        | Philippines | Salt tolerant  | <ul style="list-style-type: none"> <li>● NDUAT, Faizabad</li> </ul>  |
| <i>Oryza sativa</i><br>EC-526615-6620       | Philippines | Zinc deficiency tolerant   | <ul style="list-style-type: none"> <li>● NDUAT, Faizabad</li> </ul>  |
| <i>Triticum aestivum</i><br>EC-528127       | USA         | Good winter hardiness  | <ul style="list-style-type: none"> <li>● PD, DWR, Karnal</li> <li>● GED, NBPGR</li> <li>● GCD, NBPGR</li> </ul>  |
| <i>Triticum aestivum</i><br>EC-533526-531   | Mexico      | Drought resistant  | <ul style="list-style-type: none"> <li>● BAU, Ranchi</li> <li>● BHU, Varanasi</li> <li>● PD, DWR, Karnal</li> <li>● GCD, NBPGR</li> </ul>                  |
| <i>Zea mays</i><br>EC-517303                | USA         | Lodging resistant  | <ul style="list-style-type: none"> <li>● SKUAST (K), J&amp;K</li> <li>● PD, DMR, IARI</li> <li>● GCD, NBPGR</li> </ul>                                     |
| <i>Hordeum vulgare</i><br>EC-523339         | Canada      | Lodging tolerant   | <ul style="list-style-type: none"> <li>● PD, DWR, Karnal</li> <li>● GED, NBPGR</li> <li>● GCD, NBPGR</li> </ul>  |
| <i>Hordeum vulgare</i><br>EC-527044         | USA         | Lodging tolerant   | <ul style="list-style-type: none"> <li>● PD, DWR, Karnal</li> <li>● GED, NBPGR</li> <li>● GCD, NBPGR</li> </ul>  |
| <i>Triticale</i><br>EC-537921-22            | Mexico      | Tolerant to low pH   | <ul style="list-style-type: none"> <li>● IGFRI, Jhansi</li> <li>● GCD, NBPGR</li> </ul>  |
| <i>Brassica napus</i><br>EC-520224          | USA         | Widely adapted, with canola oil quality,   | <ul style="list-style-type: none"> <li>● NRC for Rapeseed and Mustard, Bharatpur, GED</li> <li>● GCD, NBPGR</li> </ul>                                     |
| <i>Sesamum indicum</i><br>EC-520261-62      | Sri Lanka   | Excessive moisture tolerant types  | <ul style="list-style-type: none"> <li>● PC (S &amp; N), JNKVV, Jabalpur,</li> <li>● NBPGR RS Akola</li> <li>● GED, NBPGR</li> <li>● GCD, NBPGR</li> </ul> |
| <i>Cicer arietinum</i><br>EC-530806-808     | Australia   | Chilling tolerant lines  | <ul style="list-style-type: none"> <li>● PAU, Ludhaina,</li> <li>● IIPR, Kanpur</li> <li>● GCD, NBPGR</li> </ul>   |
| <i>Phaseolus vulgaris</i><br>EC-530828      | Columbia    | Higher iron content  | <ul style="list-style-type: none"> <li>● GBPUAT, Pantnagar</li> </ul>  |
| <i>Phaseolus vulgaris</i><br>EC-530819      | Columbia    | Heat tolerant  |  |
| <i>Phaseolus vulgaris</i><br>EC-530819      | Columbia    | Drought resistant  |  |



|                                     |             |  |                                    |
|-------------------------------------|-------------|--|------------------------------------|
| EC-530858                           |             |  |                                    |
| <i>Pisum sativum</i>                | USA         | Heat tolerant lines                                | • HAFRP, Ranchi                    |
| EC-530809-819                       |             |  |                                    |
| <i>Salix alba</i>                   | Hungary     | Flood tolerant                                     | • YSPUH & F, Solan                 |
| EC-515105                           |             |  |                                    |
| <b>Agronomic and quality traits</b> |             |  |                                    |
| <i>Oryza sativa</i>                 | Philippines | New plant types                                    | • TNAU, Coimbatore                 |
| EC-512353-361                       |             | (less tillering, all tillers bearing panicle, more | • PD, DRR, Hyderabad               |
| EC-513198-237                       |             | number of grains per panicle and high harvest      |                                    |
|                                     |             | index)   |                                    |
| <i>Oryza sativa</i>                 | Philippines | CMS, maintainers and restorer lines                | • Vibha Agrotech Ltd,<br>Hyderabad |
| EC-516192-6235                      |             |  |                                    |
| <i>Oryza sativa</i>                 | Philippines | CMS and maintainer lines                           | • Pt. Jawaharlal Nehru             |
| EC-523464-476                       |             | Restorers lines                                    | College of Agriculture and         |
| EC-523479-86                        |             | Wide compatibility genes                           | Research Institute,<br>Karaikal    |
| EC-523490-91                        |             |  |                                    |
| <i>Triticum aestivum</i>            | USA         | Soft red winter wheat, high yielding               | • PD, DWR, Karnal                  |
| EC-533525                           |             |  | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | Winter wheat, high yielding, good bread            | • PD, DWR, Karnal                  |
| EC-533532                           |             | making quality                                     | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | Hard red winter wheat, good milling and baking     | • PD, DWR, Karnal                  |
| EC-533533                           |             | quality  | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | Hard white spring wheat, high protein and          | • PD, DWR, Karnal                  |
| EC-523376                           |             | excellent baking quality                           | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | High grain yield, semi-dwarf superior quality      | • PD, DWR, Karnal                  |
| EC-524892                           |             |  | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | Hard red spring wheat, high grain yield,           | • PD, DWR, Karnal                  |
| EC-527045                           |             | superior quality                                   | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Triticum aestivum</i>            | USA         | Red winter wheat, excellent straw strength and     | • PD, DWR, Karnal                  |
| EC-528127                           |             | yield potential                                    | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Zea mays</i>                     | Mexico      | Germplasm lines having high amylose, high          | • PD, DMR, IARI                    |
| EC-531818-30                        |             | oil content  | • GED, NBPGR                       |
| EC-531831-834                       |             | Quality protein maize (QPM)                        | • GCD, NBPGR                       |
| <i>Zea mays</i>                     | Bulgaria    | High protein and high oil content                  | • PD, DMR, IARI                    |
| EC-517102-106                       |             |  | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |
| <i>Hordeum vulgare</i>              | Canada      | Six rowed spring feed barely, high-yielding,       | • PD, DWR, Karnal                  |
| EC-532634                           |             | pump kernels                                       | • GED, NBPGR                       |
|                                     |             |  | • GCD, NBPGR                       |

|  |           |  |   |
|--|-----------|--|---|
| <i>Hordeum vulgare</i><br>EC-533523            | USA       | Superior malting quality, plump kernels  | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>                   |
| <i>Hordeum vulgare</i><br>EC-527044            | USA       | Semi-dwarf, two rowed, spring barley, plump kernels, good malting quality, grain protein (11% av.) | <ul style="list-style-type: none"> <li>• PD, DWR, Karnal</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>                   |
| <i>Pennisetum glaucum</i><br>EC-516577-83      | USA       | CMS and restorer lines   | <ul style="list-style-type: none"> <li>• AICRP, Pearl millet, Mandor</li> <li>• NBPGRRS, Jodhpur</li> <li>• GCD, NBPGR</li> </ul> |
| <i>Triticale</i><br>EC-537921                  | Mexico    | Hexaploid winter triticale, good forage quality  | <ul style="list-style-type: none"> <li>• IGFRI, Jhansi</li> </ul>   |
| EC-537922                                      | Mexico    | Hexaploid intermediate triticale, good forage quality  | <ul style="list-style-type: none"> <li>• GCD, NBPGR</li> </ul>  |
| <i>Triticale</i><br>EC-534274                  | USA       | High yielding, superior forage quality   | <ul style="list-style-type: none"> <li>• IGFRI, Jhansi</li> <li>• GCD, NBPGR</li> </ul>   |
| <i>Carthamus tinctorius</i><br>EC-523375       | USA       | High oil type (>40%)   | <ul style="list-style-type: none"> <li>• PD, DOR, Hyderabad</li> <li>• NBPGR RS, Akola,</li> <li>• GCD, NBPGR</li> </ul>          |
| <i>Helianthus annuus</i><br>EC-517095-96       | Bulgaria  | High oil content   | <ul style="list-style-type: none"> <li>• PD, DOR, Hyderabad</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>                |
| <i>Helianthus annuus</i><br>EC-524065-070      | Bulgaria  | High oil type (>48-50%),   | <ul style="list-style-type: none"> <li>• PD, DOR, Hyderabad</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>                |
| <i>Linum usitatissimum</i><br>EC-537910        |           | Low linolenic acid   | <ul style="list-style-type: none"> <li>• PAU, Ludhiana</li> </ul>   |
| EC-537911-12                                   | Canada    | High linolenic acid  | <ul style="list-style-type: none"> <li>• PC linsed, CSA, Kanpur</li> <li>• NBPGR RS, Akola,</li> <li>• GCD, NBPGR</li> </ul>      |
| <i>Phaseolus vulgaris</i><br>EC-530828         | Columbia  | High iron content  | <ul style="list-style-type: none"> <li>• GBPUAT, Pantnagar</li> <li>• GCD, NBPGR</li> </ul>                                       |
| <i>Pisum sativum</i><br>EC-517107-111          | Bulgaria  | Sweet sugar types  | <ul style="list-style-type: none"> <li>• PEQN (Seed for: IIPR, Kanpur)</li> </ul>   |
| <i>Macroptilium atropurpureum</i><br>EC-533895 | Australia | Forage type  | <ul style="list-style-type: none"> <li>• IGFRI, Jhansi</li> <li>• NBPGR RS, Jodhpur</li> <li>• GCD, NBPGR</li> </ul>              |
| <i>Vicia villosa</i><br>EC-517311              | USA       | Early flowering and high yielding  | <ul style="list-style-type: none"> <li>• PEQN (Seed for: NBPGR)</li> </ul>  |
| <i>Gossypium hirsutum</i><br>EC-516301-02      | USA       | Good fiber quality   | <ul style="list-style-type: none"> <li>• Pars Extra Growth, Hyderabad</li> </ul>  |
| <i>Hibiscus cannabinus</i><br>EC-532034-52     | USA       | Good fiber quality   | <ul style="list-style-type: none"> <li>• CRIJAF, Barackpore,</li> <li>• GCD, NBPGR</li> </ul>                                     |
| <i>Lycopersicon esculentum</i><br>EC-515142-43 | Taiwan    | Contains ten times more beta carotene than a red fruited tomato                                    | <ul style="list-style-type: none"> <li>• IIVR, Manjushree Plantation, Hossur</li> <li>• GCD, NBPGR</li> </ul>                     |
| <i>Lycopersicon</i> sp.<br>EC-531800-806       | Taiwan    | High beta carotene and determinate type  | <ul style="list-style-type: none"> <li>• IIVR, Varanasi</li> <li>• GED, NBPGR</li> <li>• GCD, NBPGR</li> </ul>                    |

|   |          |   |  |
|---|----------|---|--|
| <i>Cactus opuntia</i><br>EC-527043          | Mexico   | Edible cactus   | • CIAH, Bikaner  |
| <i>Irvingia gabonensis</i><br>EC-534351-355 | Nigeria  | African wild mango source of Dikka butter, used as food in Africa | • CISH, Lucknow, IHR, Bangalore<br>• NBPGR, RS, Thrissur<br>• CTRI, Rajamundry |
| <i>Nicotiana tabacum</i><br>EC-517324-25    | USA      | Flue cured variety  | • CTRI, Rajamundry   |
| <i>Nicotiana tabacum</i><br>EC-519004-06    | Zimbabwe | Hybrid burley type  | • CTRI, Rajamundry   |
| <i>Salix alba</i><br>EC-515100-105          | Hungary  | Fast growing, good stem girth                                     | • YSPUH & F, Solan   |

## 5.2 Export of Plant Genetic Resources

The seed and plant material of agricultural and horticultural crops were exported on the basis of (i) request received by the Bureau/ICAR headquarters (ii) request received from the scientist working in ICAR institutes/agricultural universities in India under various protocols/workplans/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/planting materials during 2003 is indicated below.

|  |                                       |
|--|---------------------------------------|
| Number of requests registered                  | : 38                                  |
| Number of countries to which material exported | : 16                                  |
| Number of accessions exported                  | : 387 accessions (446 samples)        |
| CIMMYT Transit material                        | : 103 accessions (103 samples)        |
| <b>Total</b>                                   | <b>: 490 accessions (549 Samples)</b> |

**Cereals, pseudocereals and millets:** *Triticum aestivum* to Philippines (1), Switzerland (178) and Australia (13); *Oryza sativa* to Philippines (78); *Zea mays* to Philippines (20), Vietnam (20), Cambodia (9), Argentina (20), Srilanka (4),

Mexico (7) and to East Timor (27); Sorghum to Srilanka (3).

**Vegetable crops:** *Capsicum* sp. (27) to Taiwan

**Fruit crops:** *Psidium guajava* (1); *Acharas sapota* (1) and *Mangifera indica* (2) to Oman; *Carica papaya* (1) to Eritrea

**Sugar yielding crops:** *Saccharum officinarum* (1) to Mauritius

**Plantation crops:** *Hevea spruceana* (1) and *H. benthamiana* (1) to Srilanka

**Tuber crops:** *Solanum tuberosum* (1) to Russia

**Weeds:** *Phalaris minor* (74) to USA

### Country-wise export of PGRs from India:

The relevant information on the nature of Indian Genetic Stocks exported to 16 countries during 2003 is as follows: *Zea mays* (20), Argentina\*; *Triticum aestivum* (13), Australia; *Zea mays* (9), Cambodia\*; *Zea mays* (27), East Timor\*; *Carica papaya* (1), Eritrea; *Saccharum officinarum* (1), Mauritius; *Zea mays* (T), Mexico\*; *Mangifera indica* (2), *Achras sapota* (1), *Psidium guajava* (1), Oman; *Zea mays* (20)\*, *Triticum aestivum* (1), *Oryza sativa* (70), Philippines; *Solanum tuberosum* (1), Russia; *Zea mays* (4), *Hevea* sp. (2), *Sorghum bicolor* (3), Srilanka; *Triticum aestivum* (178), Switzerland; *Capsicum* sp. (2), Taiwan; *Phalaris minor* (74), USA; *Zea mays* (20), Vietnam\*;

\*CIMMYT material

### 5.3 Inland supply of Plant Genetic Resources

| Crop                                   | Germplasm Samples | States/Union Territories  |
|--|-------------------|---|
| <b>Cereals Millets</b>                 |                   |   |
| <i>Oryza Sativa</i>                    | 222               | Tamilnadu, New Delhi, UP, Meghalaya, Orissa, Chattisgarh                |
| <i>Hordeum vulgare</i>                 | 02(G)             | Haryana, Rajasthan  |
| <i>Triticum aestivum</i>               | 226 (G), 455 (T)  | Maharashtra, Punjab, Haryana, UP, Karnataka, Rajasthan                  |
| <i>Avena sp.</i>                       | 21                | Rajasthan   |
| <i>Zea mays</i>                        | 44                | Karnataka, Punjab, Bihar, New Delhi                                     |
| <i>Sorghum sp.</i>                     | 218               | Kerala, AP  |
| <i>Secale cereale</i>                  | 13                | Mumbai  |
| <i>Aegilops sp.</i>                    | 14                | Delhi, Haryana  |
| <i>Pennisetum glaucum</i>              | 23                | Kerala, Maharashtra   |
| <i>Eleusine coracana</i>               | 5                 | Kerala, Maharashtra   |
| <i>Panicum sp.</i>                     | 4                 | Kerala, Maharashtra   |
| <i>Echinochloa crusgalli</i>           | 4                 | Kerala, Maharashtra   |
| <i>Paspalum scorbiculatum</i>          | 5                 | Maharashtra   |
| <i>Setaria italica</i>                 | 1                 | Maharashtra   |
| Proso millet                           | 2                 | Himachal Pradesh  |
| <b>Grain Legumes</b>                   |                   |   |
| <i>Pisum sativum</i>                   | 126               | UP, Maharashtra, Jammu & Kashmir, New Delhi, Uttaranchal, Rajasthan, HP |
| <i>Vigna unguiculata</i>               | 356               | Raipur, Kerala, Thrissur, West Bengal, Rajasthan                        |
| <i>Macrotyloma sp.</i>                 | 49                | Uttaranchal, Rajasthan, Thrissur, Maharashtra                           |
| <i>Vigna radiata</i>                   | 1015              | West Bengal, New Delhi, Haryana, Tamilnadu, Jammu & Kashmir, Karnataka  |
| <i>Cyamopsis tetragonoloba</i>         | 133               | Haryana, Maharashtra  |
| <i>Vigna aconitifolia</i>              | 156               | Haryana, Punjab, Rajasthan  |
| <i>Vigna mungo</i>                     | 522               | Punjab, Rajasthan, Thrissur, AP   |
| <i>Phaseolus vulgaris</i>              | 32                | Delhi, Kerala, HP   |
| <i>Cicer sp.</i>                       | 44                | Delhi, Rajasthan  |
| <i>Glycine max</i>                     | 15                | Maharashtra   |
| <i>Lens culinaris</i>                  | 62                | New Delhi, Uttaranchal, Rajasthan, UP                                   |
| <i>Vicia faba</i>                      | 1                 | New Delhi   |
| <i>Cajanus cajan</i>                   | 2043              | Rajasthan, UP, Gujarat, Akola   |
| <i>Lathyrus sp.</i>                    | 2                 | Delhi, Maharashtra  |
| <b>Vegetables</b>                      |                   |   |
| <i>Brassica oleracea var. botrytis</i> | 12                | Uttaranchal   |
| <i>Brassica oleracea var. capitata</i> | 3                 | Jammu & Kashmir   |
| <i>Lycopersicon esculentum</i>         | 361               | West Bengal, AP, Delhi, Jammu & Kashmir, UP, Assam, Uttaranchal, Punjab |
| <i>Momordica charantia</i>             | 47                | Karnataka, UP, Haryana  |
| <i>Allium sp.</i>                      | 6                 | West Bengal, Jammu & Kashmir  |
| <i>Allium sativum</i>                  | 602               | Delhi, Maharashtra, Punjab, Assam, Gujarat                              |
| <i>Solanum melongena</i>               | 121               | HP, Maharashtra, AP, UP   |
| <i>Cucumis melo</i>                    | 35                | Karnataka   |

| Crop                                   | Germplasm Samples | States/Union Territories  |
|--|-------------------|---|
| <i>Solanum</i> sp.                     | 7                 | Kerala  |
| <i>Abelmoschus esculentus</i>          | 51                | Assam, Kerala, Maharashtra  |
| <i>Capsicum</i> sp.                    | 154               | AP, Srinagar, UP, West Bengal   |
| <i>Brassica chinensis</i>              | 22                | Rajasthan   |
| <i>Asparagus</i>                       | 1                 | West Bengal   |
| <i>Phaseolus vulgaris</i>              | 9                 | Maharashtra   |
| <i>Trichosanthes anguina</i>           | 32                | Kerala  |
| <b>Oilseeds</b>                        |                   |   |
| <i>Brassica</i> sp.                    | 735               | Delhi, UP, MP, Rajasthan, Haryana, Punjab,  |
| <i>Helianthus annuus</i>               | 16                | UP, Delhi, Rajasthan, AP  |
| <i>Linum usitatissimum</i>             | 188               | Punjab, Maharashtra   |
| <i>Sesamum indicum</i>                 | 13                | Tamilnadu, Kerala, Maharashtra  |
| <i>Crambe abyssinica</i>               | 12                | Rajasthan   |
| <i>Eruca sativa</i>                    | 1                 | Rajasthan   |
| <i>Ricinus communis</i>                | 55                | Maharashtra, Rajasthan  |
| <b>Under-Utilized Plants</b>           |                   |   |
| <i>Vigna umbellata</i>                 | 40                | Tamilnadu   |
| <i>Cyamopsis tetragonoloba</i>         | 2                 | Maharashtra   |
| <i>Amaranthus</i> sp.                  | 205               | Haryana, Gujarat, Kerala, Uttaranchal, UP, Jharkhand, Orissa, Karnataka, Maharashtra, Chhattisgarh, Rajasthan, Punjab |
| <i>Simmondensia chinensis</i>          | 12                | Jharkhand, Maharashtra, Haryana   |
| <i>Sesbania</i>                        | 28                | UP, New Delhi, Rajasthan, Karnataka   |
| <i>Atriplex</i>                        | 2                 | Rajasthan   |
| <i>Coix</i> sp.                        | 3                 | Meghalaya   |
| <b>Fodder Crops</b>                    |                   |   |
| <i>Lucerne</i> sp.                     | 1                 | Rajasthan   |
| <b>Ornamentals</b>                     | 51                | HP, Delhi   |
| <b>Fruits</b>                          |                   |   |
| <i>Musa</i> sp.                        | 285               | Tamilnadu, Kerala   |
| <i>Pyrus malus</i>                     | 37                | Jammu & Kashmir   |
| <i>Prunus persica</i>                  | 14                | Jammu & Kashmir   |
| <i>Actinidia chinensis</i>             | 6                 | Jammu & Kashmir   |
| <b>Spices</b>                          |                   |   |
| <i>Trigonella foenum graecum</i>       | 2                 | Delhi, Rajasthan  |
| <i>Coriandrum sativum</i>              | 1                 | Rajasthan   |
| <b>Medicinal &amp; Aromatic Plants</b> |                   |   |
| <i>Ocimum</i> sp.                      | 10                | Jammu & Kashmir   |
| <i>Andrographis</i>                    | 5                 | MP  |
| <i>Psoralea</i> sp.                    | 8                 | MP  |
| <i>Mucuna</i> sp.                      | 38                | MP, Haryana, Kerala   |
| <i>Zingiber officinale</i>             | 1                 | Kerala  |
| <b>Fibre Crops</b>                     |                   |   |
| <i>Crotalaria juncea</i>               | 6                 | Karnataka, Haryana, Delhi   |
| <i>Gossypium hirsutum</i>              | 51                | Tamilnadu   |

G = Germplasm, T = Trial

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

- PGR/GEX-BUR-DEL-01.00: Exchange of plant genetic resources with foreign countries and inland supplies of the resources and related information to the scientists and other users in the country. (R.V. Singh)
- PGR/GEX-BUR-DEL-01.01: Import ,export and inland (national) supply of plant genetic resources and exchange of related information to the scientists/ users in the country (Deep Chand,Vandana Tyagi, Nidhi Verma, A.K.Singh, S.P.Singh, S.S.Ranga)
- PGR/GEX-BUR-DEL-01.02: Documentation and dissemination of information on germplasm both imported and collected in the form of plant germplasm reporter (Vandana Tyagi, Deep Chand, Nidhi Verma, A.K.Singh, S.P.Singh, S.S.Ranga)
- PGR/GEX-BUR-DEL-01.03: Preparation of bibliography on plant genetic resources (Nidhi Verma, Deep Chand,Vandana Tyagi, A.K.Singh, S.P.Singh, S.S.Ranga)
- PGR/GEX-BUR-DEL-01.04: Assembly of literature and preparation of inventories on plant genetic resources. (Vandana Tyagi, Deep Chand, Nidhi Verma, A.K.Singh, S.P.Singh, S.S.Ranga)

## 6. TISSUE CULTURE AND CRYOPRESERVATION UNIT

**Summary:** During the year, a total of 1396 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* multiplication and conservation protocols in different species. Plantlet regeneration protocols were developed in *Allium ramosum*, *Camellia sinensis* and *Centella asiatica*, and somatic embryogenesis was induced in mango. Cryopreservation experiments yielded varying degree of success in *Dioscorea alata*, *Gentiana*, sp. *Morus bombycis*, *Musa* cv. Williams (AAA) and *Simmondsia chinensis*. DNA isolation and purification protocols were standardized in *A. tuberosum* and *Bacopa monnieri*. In *Colocasia esculenta*, RAPD analysis using 10 primers indicated that there was no difference in the banding pattern of two year-old *in vitro*-conserved four accessions and that of their mother plants maintained in the polyhouse. A total of 61 accessions of *Musa*, were supplied as *in vitro* cultures to various indentors. A total of 5242 accessions of orthodox, intermediate and recalcitrant seed species were conserved in the cryobank.

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, 159 new accessions were added to the *in vitro* repository which included *Allium sativum* (10), *Colocasia esculenta* (15), *Curcuma* spp. (25), *Dioscorea* spp. (5), *Fragaria* (20), *Ipomoea batatas* (20), *Morus* spp. (20), medicinal and aromatic plants (19), *Musa* (24) and *Vitis vinifera* (1). A total of 1396 accessions belonging to different crop plants were maintained *in vitro* and subcultured at periodic intervals (Table 1).

**6.1.1 Tropical fruits:** A total of 341 accessions of *Musa* (in the form of ~ 4100 cultures) were conserved at 25°C under 8/16 h photoperiod. The average subculture period varied from 6-12 months, depending on the genotype.

Suckers of banana germplasm (106 accessions) were procured from NRC on Banana (NRCB), Trichy, Tamilnadu. Of these, 24 accessions were

added to the *in vitro* repository during the year. In addition, one accession of grape was also established *in vitro*.

To enhance the rate of shoot multiplication in nine cultivars of *Musa* (belonging to AAA, ABB, AAB subgroups), effect of thidiazuron (TDZ) at 1 or 2 µM was tested and an average of one or two shoots were obtained, after six weeks of culture. This was not significantly different from the results obtained on the regular multiplication medium with 6-benzylaminopurine (BAP, at 10µM). Thus, TDZ at 1 or 2 µM was unsuitable for enhancing the multiplication rate in the cultivars tested.

To determine the optimum protocol for cryopreservation of banana meristems, three techniques were compared in one genotype (*Musa* cv Williams, AAA). Highly proliferating meristems were subjected to a simple freezing, vitrification and fast-freeze/fast-thaw methods of cryopreservation. Highest recovery (38.5%)

Table-1. Status of *in vitro* conserved germplasm in TCCU (as on December 31, 2003)

| Crop groups                          | Storage temp. (°C) | Optimum subculture interval (months) | Accessions in culture (no.) |
|--------------------------------------|--------------------|--------------------------------------|-----------------------------|
| <b>Fruits</b>                        |                    |                                      |                             |
| <i>Musa</i> spp.                     | 25                 | 8-12                                 | 341                         |
| <i>Actinidia chinensis</i>           | 25                 | 8                                    | 3                           |
| <i>Aegle marmelos</i>                | 25                 | 12                                   | 1                           |
| <i>Fragaria</i> spp.                 | 25                 | 8-10                                 | 47                          |
| <i>Prunus</i> spp.                   | 25                 | 4-6                                  | 2                           |
| <i>Rubus</i> spp.                    | 25                 | 8-10                                 | 5                           |
| <i>Malus</i> sp.                     | 25                 | 3-4                                  | 4                           |
| <i>Morus</i> spp.                    | 25                 | 6-8                                  | 42                          |
| <i>Vitis vinifera</i>                |                    |                                      | 1                           |
| <b>Bulbous Crops</b>                 |                    |                                      |                             |
| <i>Allium sativum</i>                | 25,4               | 6-12                                 | 117                         |
| <i>Allium</i> spp.                   | 25, 4              | 4-23                                 | 14                          |
| <b>Tuber Crops</b>                   |                    |                                      |                             |
| <i>Alocasia</i> spp.                 | 25                 | 10                                   | 3                           |
| <i>Colocasia esculenta</i>           | 25                 | 8-10                                 | 93                          |
| <i>Dioscorea</i> spp.                | 25                 | 8-12                                 | 48                          |
| <i>Ipomoea batatas</i>               | 25                 | 8-12                                 | 250                         |
| <i>Xanthosoma sagittifolium</i>      | 25                 | 10                                   | 3                           |
| <b>Medicinal and Aromatic Plants</b> |                    |                                      | 397                         |
| <i>Aconitum violaceum</i>            | 25                 | 8                                    | 1                           |
| <i>Aristolochia indica</i>           | 25                 |                                      | 1                           |
| <i>Bacopa monnieri</i>               | 25                 | 6                                    | 12                          |
| <i>Centella asiatica</i>             | -                  | -                                    | 3                           |
| <i>Coleus aromaticus</i>             | -                  | -                                    | 1                           |
| <i>Coleus forskohlii</i>             | 25                 | 12                                   | 12                          |
| <i>Chlorophytum</i> sp.              | -                  | -                                    | 1                           |
| <i>Curculigo orchioides</i>          | -                  | -                                    | 1                           |
| <i>Digitalis</i> spp.                | 4                  | 11                                   | 6                           |
| <i>Eremostachys superba</i>          | 25                 | 6                                    | 2                           |
| <i>Gentiana kurroo</i>               | 4                  | 12                                   | 1                           |
| <i>Kaempferia</i> spp.               | -                  | -                                    | 7                           |
| <i>Mentha</i> sp.                    | 25,4               | 12                                   | 24                          |
| <i>Picrorhiza kurroa</i>             | 4                  | 12                                   | 6                           |
| <i>Plumbago zeylanica</i>            | 25                 | 6-10                                 | 5                           |
| <i>Pogostemon patchouli</i>          | 25                 | 12                                   | 2                           |
| <i>Pycnanthemum</i> spp.             | 25, 4              | 8-12                                 | 4                           |
| <i>Rauvolfia</i> spp.                | 25                 | 22                                   | 10                          |
| <i>Rheum</i> spp.                    | 25, 4              | 12                                   | 3                           |
| <i>Saussurea lappa</i>               | 4                  | 12                                   | 3                           |
| <i>Swertia chirayta</i>              | 4                  | 6                                    | 3                           |
| <i>Tylophora indica</i>              | 25                 | 12                                   | 6                           |



|                             |    |       |              |
|-----------------------------|----|-------|--------------|
| <i>Valeriana wallichii</i>  | 4  | 12    | 6            |
| <b>Spices</b>               |    |       |              |
| <i>Curcuma</i> spp.         | 25 | 6-10  | 91           |
| <i>Elettaria</i> spp.       | 25 | 15    | 5            |
| <i>Piper</i> spp.           | 25 | 10-22 | 7            |
| <i>Zingiber</i> spp.        | 25 | 8-24  | 173          |
| <i>Vanilla planifolia</i>   | 25 | 6     | 4            |
| <b>Industrial Plants</b>    |    |       |              |
| <i>Humulus lupulus</i>      | 25 | -     | 8            |
| <i>Simmondsia chinensis</i> | 25 | 6     | 12           |
| <b>Others</b>               |    |       |              |
| <i>Cicer microphyllum</i>   | -  | -     | 1            |
| <i>Gladiolous</i> cv.       | -  | -     | 1            |
| <b>Total</b>                |    |       | <b>1,396</b> |

Total no. of species : 124

was obtained in the vitrification method. Experiments were designed to further increase the recovery percentage.

**6.1.2 Bulbous crops:** A total of 132 accessions belonging to 16 species (*Allium* spp. and *Gladiolous* cultivar) were conserved as *in vitro* cultures under culture room conditions and/or at low temperature (4°C) with the average subculture period varying from 4-23 months, depending on the species.

A total of 24 accessions of *A. sativum* belonging to diverse agro-climatic regions (Haryana, UP, Jharkhand, MP, Rajasthan, Manipur and Khasi Hills) of India, were received. During the period under report, 10 new accessions were established *in vitro*. In 72 accessions of *A. sativum*, heavy antibiotic treatment to remove bacterial contamination reduced the number of cultures to one or two per accession. The bacterial contamination appeared following transfer of *in vitro* conserved (at low temperature) cultures to fresh medium, for rejuvenation under culture room conditions.

In *A. fistulosum*, procured from regional station

Bhowali, shoots exhibited rapid proliferation on cytokinin- supplemented medium. In *A. ramosum*, root induction was observed on basal medium as well as on half-strength basal medium though roots were healthier in the latter. Plantlets thus obtained were subjected to hardening for establishment in the net house. In another *Allium* species, tree onion (*Allium cepa* var. *proliferum*), received from Srinagar regional station, bulbous bases as explants were subjected to sterilant treatment for establishment of contamination-free cultures.

Conservation experiments initiated in *A. ramosum* revealed that under culture room conditions, shoots could be maintained only for 8-12 weeks on multiplication medium with cotton plugs as closures and survival declined afterwards. Maintenance of cultures on sucrose-free medium was not beneficial in prolonging the subculture duration. Experiments are continued to increase the subculture duration. *In vitro* cultures of *A. hookeri* could be maintained for 5 months under culture room conditions following use of polypropylene caps as closures for culture tubes and with increased

storage duration from 5 to 8 months, cultures exhibited a decline in per cent survival.

For standardizing cryopreservation protocol in *A. sativum* using vitrification technique, shoot buds (isolated from dormant cloves) cryoprotected with PVS2 failed to tolerate LN freezing whereas non-frozen controls could tolerate PVS2 up to 30 minutes. Preconditioning of cloves at low temperature had little influence on survivability of explants subjected to LN freezing

### **6.1.3 Medicinal, aromatic and rare / endangered plants:**

*In vitro* maintenance of existing cultures of 120 accessions belonging to 22 genera and 29 species was achieved through periodic subculture (4-24 months) either under culture room conditions and/or at low temperature. A total of 10 accessions comprising 4 genera were augmented from different regions for introduction *in vitro* (*Centella*-6, *Picrorrhiza*-1, *Plumbago*-2 and *Tylophora*-1).

A total of 19 accessions belonging to 10 genera added during the period were: *Bacopa monnieri* (5), *Centella asiatica* (3), *Coleus aromaticus* (1), *Curculigo orchoides* (1), *Kaempferia galanga*, (1) *Mentha* spp. (2), *Picrorrhiza kurroa* (1), *Plumbago zeylanica* (2), *Rauvolfia* spp. (2) and *Tylophora indica* (1). These include three new species viz., *Centella asiatica*, *Coleus aromaticus* and *Curculigo orchoides*.

In *Plumbago zeylanica*, plantlets were established in the net house. In *Coleus aromaticus*, 2-3 shoots were obtained on MS containing Kn and IAA using nodal segments as explants. In *Curculigo orchoides*, cultures

were established from sprouting shoot buds on MS medium containing BAP. Experiments are underway to induce multiple shoots by media manipulation.

Regarding short to medium-term conservation, in *Bacopa* and *Plumbago*, replacement of cotton plugs with polypropylene caps as closures was beneficial in prolonging subculture duration up to 48 weeks, normal subculture duration being 3-6 weeks. In the former, shoot tips remained viable up to six months following mineral oil overlay of explants. In *Coleus*, cultures could be maintained for 10 months on a medium containing lower (than that in the multiplication medium) concentration of growth regulators. The average subculture duration in this species is four weeks.

Cryopreservation experiments continued in *Bacopa*, *Gentiana* and *Picrorrhiza*. Employing the encapsulation-dehydration technique, 20% shoot tips could survive LN freezing in *Gentiana* whereas in *Bacopa* shoots are yet to be recovered from cryopreserved shoot tips. In *Bacopa* and *Gentiana*, encapsulated shoot tips could survive air drying for 5 and 6 hrs, respectively

### **6.1.4 Spices, plantation and new industrial crops:**

A total of 300 accessions (in the form of ~ 3600 cultures) comprising 173 of *Zingiber* species, 66 of *Curcuma*, 7 species of *Piper*, 5 of *Elettaria*, 4 of *Vanilla planifolia*, 12 of *Simmondsia chinensis* (6 each of male and female) and 8 of *Humulus lupulus* were maintained under short- to medium-term storage. The average subculture period is 8 and 24 months for *Zingiber* species (for shoots and *in vitro* rhizomes, respectively), 6-10 months for

*Curcuma* species, 12-24 months for *Piper* species, 14-15 months for *Elettaria* species, 18-22 months for *Vanilla planifolia*, 8-15 months for *Simmondsia chinensis* and 12 months for *Humulus lupulus*.

During the period under report, 59 accessions of turmeric and 7 accessions of ginger were received in the form of rhizomes. These comprised primitive cultivars, landraces and released varieties. All the rhizomes were planted in pots for subsequent processing for their *in vitro* establishment. Amongst these, 25 accessions of *Curcuma* species were added to the *in vitro* repository.

*In vitro* conservation protocol using high sucrose (9%) was applied to 104 accessions of ginger. In *Humulus lupulus*, 8 accessions stored at 4°C in dark, exhibited an average survival of 72% following storage up to 10 months as compared to that after 3 months at 25°C. Regeneration from the stored cultures of *H. lupulus* was 100%.

Several experiments were carried out for developing cryopreservation in jojoba using three techniques - encapsulation-dehydration, vitrification and a combination of the two, on shoot tips isolated from *in vitro* cultures. Results showed that 90% shoot tips survived dehydration by sucrose, but only 10-30% tolerated air dehydration as well as exposure to vitrification solution. Very low post-thaw explant survival (5-10%) was observed but these failed to regenerate into shoots. Further experiments have been designed to increase the dehydration tolerance of the explants to achieve a workable protocol for jojoba cryopreservation.

**6.1.5 Temperate and minor fruit crops:** A total of 104 accessions (in the form of ~ 1300 cultures) comprising 47 of *Fragaria* spp., 42 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 period varied from 4 -12 months in the aforementioned crops.

A total of 40 new accessions comprising *Morus* spp. (20) and *Fragaria* (20) were added in the *in vitro* repository during the period under report.

*In vitro* conservation protocol was refined for *Fragaria* species. Cultures of 8 accessions of *Fragaria* stored at low temperature (4°C, dark) exhibited survival up to 12 months as compared to that up to 8 months at 25°C. However, in *Morus* spp. (8 accessions), cultures could effectively be conserved for 6-8 months with polypropylene caps as culture tube closures in place of cotton plugs on MS + BAP. In *Aegle marmelos*, cultures could be conserved for 12 months on MS + BAP at 25°C. *In vitro* conserved cultures of *A. marmelos*, *Fragaria* and *Morus* exhibited 100% regrowth.

Experiments were initiated to standardize cryopreservation protocol for long-term conservation of mulberry (*Morus* spp.), using encapsulation-dehydration technique. Following cryopreservation, axillary buds exhibited 20% regeneration in *Morus bombycis* and 10% in *M. indica*.

**6.1.6 Tuber crops:** A total of 90 accessions of tuber crops were obtained from three regional stations of NBPGR. These include 76 accessions of taro (*Colocasia esculenta*) from Ranchi (30), Thrissur (26) and Shillong (20), 8 of elephant foot yam (*Amorphophalus* sp.)

from Thrissur and 6 of tannia (*Xanthosoma sagittifolium*) from Shillong. All these materials have been planted and maintained in net house for their subsequent establishment in tissue culture.

A total of 40 accessions of tubers crops were added to existing cultures of the *in vitro* repository. These include sweet potato (20), taro (15) and *Dioscorea* (5). Thus, a total of 397 accessions of various tuber crops have been maintained *in vitro* by periodic subculture.

To standardize *in vitro* conservation protocol in taro, *in vitro* cormlets were induced in one accession using higher sucrose (8%) in MS medium. The storage period of the *in vitro* cormlets is under study.

Under *in vitro* cryopreservation of germplasm, standardization of cryopreservation techniques for *Dioscorea alata* continued. Although survival of shoot tips after LN exposure was high (up to 75 %), the regeneration rate could not be increased beyond 20% because *D. alata* produces phenols in cultures. Incorporation of ascorbic acid in regrowth media promoted regeneration of cryopreserved shoot tips.

**6.1.7 Other crops:** Using the nodal segments as explants, germplasm of a new crop i.e. tea (*Camellia sinensis*) was established in tissue culture. In mango, somatic embryogenesis was induced from nucellar tissue and this was to test its amenability to cryopreservation

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 Monitoring Genetic Stability of *In Vitro* - Conserved Germplasm

For genetic stability studies, morphological data were recorded for plant height, plant span, predominant position (shape) of leaf lamina surface, leaf blade margin, leaf blade colour variegation, corm size and shape in 30 accessions of taro (*Colocasia esculenta*), grown in polyhouse and subsequently introduced in tissue culture. The material was obtained from NBPGR regional station, Ranchi.

DNA isolation, purification and quantification of 18 accessions of taro germplasm, maintained in polyhouse, was completed by modified CTAB method. DNA of these accessions was stored at -20°C for further use in genetic stability studies alongwith their *in vitro*-conserved clones. DNA isolation and purification protocols were standardized in *A. tuberosum* and *B. monnieri*.

Using a total of 10 primers, genetic stability studies were carried out in four, *in vitro*-conserved accessions of taro, employing Random Amplified Polymorphic DNA (RAPD) analysis. No differences were observed in the band pattern of 2-year-old *in vitro*-conserved accessions and their mother plants, grown in polyhouse.

## 6.3 *In Vitro* Germplasm Supply

Banana germplasm (51 exotic accessions) was supplied to NRCB for field evaluation studies. These comprised germplasm procured from International Network for Improvement of Banana and Plantain (INIBAP) Transit Centre, Belgium, and multiplied and subsequently conserved in the *in vitro* repository at NBPGR, New Delhi. The accessions consisted of germplasm to be evaluated under the

International Musa Testing Programme (IMTP), Phase III, of the INIBAP. Additionally, germplasm of 10 accessions of banana was supplied to Kerala Agricultural University and Banana Research Station, Kannara, Thrissur, for field evaluation purpose.

#### 6.4 Seed Cryopreservation

During the period under report a total of 700 accessions belonging to diverse crop groups were received of which 565 accessions were successfully cryostored. Seven exploration trips were undertaken during the year to collect difficult-to-store germplasm (intermediate and recalcitrant seeded species) from different parts of India in the form of fruits and seeds and 388 accessions belonging to *Citrus* spp., minor fruits and *Garcinia* spp. were collected. To undertake cryopreservation of pollen of recalcitrant seed species, mango was taken up as a priority crop. During the year, a trip was undertaken to CISTH, Lucknow and 30 pollen samples of mango were collected from field genebank.

Cryopreservation of various crops has been undertaken using seeds, embryos and embryonic axes (Table 2). Germplasm cryostored comprised accessions of fruits and nuts (331), agroforestry species (65), legumes (50), vegetables (23), medicinal and aromatic plants (22), and others (74). These included 122 varietal material belonging to orthodox group, 46 wild accessions and 12 exotic accessions mainly belonging to fruits and nuts and, medicinal and aromatic plants. In addition, pollen of mango cultivars (30) and *Citrus indica* (1) were also cryostored.

Basic studies on seed storage behavior, desiccation and freezing sensitivity, critical moisture content and shelf-life were carried out

**Table-2. Status of cryopreserved germplasm in TCCU (as on December 31, 2003)**

| Categories                             | Accessions (no.) |
|--|------------------|
| <b>Recalcitrant &amp; Intermediate</b> |                  |
| Fruits & Nuts                          | 1,071            |
| Spices & Condiments                    | 56               |
| Plantation Crops                       | 19               |
| Agroforestry plants                    | 1,710            |
| <b>Orthodox</b>                        |                  |
| Cereals                                | 191              |
| Millet and Forages                     | 245              |
| Pseudo-cereals                         | 63               |
| Grain Legumes                          | 552              |
| Oilseeds                               | 271              |
| Fibre Crops                            | 40               |
| Vegetables                             | 389              |
| Medicinal & Aromatic Plants            | 602              |
| Narcotics & Dyes                       | 33               |
| <b>Total</b>                           | <b>5,242</b>     |
| Wild species*                          | 275              |
| Varieties*                             | 353              |
| Endangered species*                    | 28               |
| Registered germplasm*                  | 10               |

\*- Included in respective crop groups.

Total no. of species: 502

in uninvestigated tree species like *Madhuca indica*, *Murraya koiengii*, *Salvadora oleoides*, *Syzygium cuminii*, *Jatropha curcas*, *Citrus grandis*, *C. karna* and *C. indica*. Air - desiccation freezing, vitrification and encapsulation-dehydration techniques were applied on these species in order to develop suitable protocol for their cryoconservation. Successful cryopreservation of embryos and embryonic axes was achieved in *J. curcas*, *C. grandis*, *C. karna* and *C. indica* using these techniques. Only limited survival could be achieved after cryopreservation of embryonic axes and embryos in *Murraya koiengii* and *Madhuca indica*. Short-term storage

experiments were carried out in seeds and embryonic axes of highly recalcitrant species of *Artocarpus heterophyllus* and *Syzygium cumini*.

Studies were also undertaken to standardize the germination requirements and cryopreservation of dormant buds of different mulberry species. Initial success was achieved in cryopreservation of dormant buds in selected accessions.

Retesting of 45 accessions belonging to oilseeds, pulses and fruits cryostored for

various periods was conducted to monitor the viability during storage. Initial viability was retained in all the accessions. More than 35 accessions of neem collected from diverse agro-climatic zones after storage at different temperatures (room temperature, 5°C, -20°C and -180°C) were retested for viability. Highest viability was achieved in samples stored at -180°C and deterioration of cotyledons of samples stored at other temperatures was recorded.

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

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

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

PGR/TCCU-BUR-DEL-01.02: *In vitro* conservation of spices, plantation and industrial crops. (R.K. Tyagi; Anuradha Agrawal, R.P. Yadav)

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

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

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

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

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

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

PGR/TCCU-BUR-DEL-02.01: Cryopreservation of orthodox and intermediate seed species in various forms using standard protocols (Rekha Chaudhury; S. K. Malik)

PGR/TCCU-BUR-DEL-02.02: Investigating desiccation and freezing tolerance in sub-orthodox seed species for cryopreservation (S. K. Malik; Rekha Chaudhury)

## 7. NRC ON DNA FINGERPRINTING

**Summary:** A total of 753 varieties/ promising germplasm were fingerprinted during the year. AFLP analysis of blackgram, cowpea, greengram, mothbean, pigeonpea, ricebean, pea, lentil, chilli, saffron, brinjal and *Brassica* was further carried out. STMS analysis of rice, sorghum, wheat and chickpea was taken up.

### 7.1 DNA Fingerprinting

**7.1.1 Rice:** Seventy-six cultivars of rice were finger printed employing 28 microsatellite markers, revealing 73 alleles. Out of these 28 markers, 24 were polymorphic and four were monomorphic. The number of alleles per locus varied in the range of 1 to 8 with an average of 3.0. Cluster analysis, on the basis of dendrogram generated using Jaccard's similarity ratio, revealed that all the rice cultivars could be grouped into eight main clusters. The Polymorphism Information Content (PIC) values ranged from 0 to 0.927. High gene diversity has been observed, demonstrating the diverse nature of the materials included in the present investigation.

**7.1.2 Wheat:** DNA was extracted, purified and quantified from 43 released varieties of wheat. Protocol was standardized for STMS analysis with ten unlabelled primer pairs.

**7.1.3 Brassica:** DNA was isolated and purified from 89 accessions including released varieties of *Brassica* species. A representative set of four accessions was screened against forty-five AFLP primer pairs to select suitable combinations for fingerprinting these accessions. Seven primer-pairs have been identified for subsequent fingerprinting of these accessions.

**7.1.4 Sorghum:** In continuation of earlier work done on STMS analysis of sorghum, 12 more primer pairs were used to fingerprint 65 sorghum cultivars including released varieties,

hybrids and their parental lines. Data scoring was done for 10 primer pairs, the number of alleles produced per primer ranged from 5 to 13 with an average of 7.8 alleles per primer. This allelic data was used to calculate diversity index with respect to each primer pair. Diversity Index (DI) ranged from 0.326-0.760.

**7.1.5 Chickpea:** Twenty-five STMS markers were employed for fingerprinting 21 chickpea cultivars, amplifying 1-5 loci per primer pair. High degree of polymorphism was observed as 69 out of 73 alleles (94.5 %) were polymorphic. PIC value varied from 0.57 to 1.00 for each polymorphic primer. All twenty-one cultivars were grouped in two major clusters at 40% similarity level and all the cultivars can be distinguished from each other. In Principal Coordinate Analysis, first three components explained 54.55, 9.66 and 5.57 % of genetic variability, respectively.

**7.1.6 Pigeonpea:** Analysis of 56 pigeonpea varieties revealed low differences among them, as a result no distinct groupings were identifiable. However, perusal of the AFLP patterns indicated that all the varieties analyzed could be distinguished. The closest similarity between any two varieties was 96% for Selection 8239 - Pusa 945 and Pusa 605 - B 92212. DSLR 55 was the most diverse in comparison to others.

**7.1.7 Blackgram and greengram:** AFLP profiles of 54 blackgram and 75 greengram varieties also revealed presence of high genetic

similarities within the group. The Jaccard's similarity coefficients ranged from 0.89 to 0.98 for blackgram and 0.88 to 0.98 for greengram. Further, among the varieties analyzed, five close groups in blackgram and four groups in greengram were identified. The within group similarity in both the crops was very high. Such high genetic similarities indicated that although AFLP markers can distinguish all the varieties analyzed, there is a need to use more sensitive microsatellite markers for cultivar identification.

**7.1.8 Ricebean and mothbean:** The analyses of two underutilized pulse crops, namely, ricebean (*Vigna umbellata*, 47 varieties) and mothbean (*Vigna aconitifolia*, 10 varieties) indicated that the differences among the varieties in these two crops were greater in comparison to others from the *Vigna* group. In fact, one of the released ricebean varieties, PRR-IA was more diverse than some of the elite landraces under cultivation. In ricebean, the elite landraces (30) were also analyzed, as most of the area under this crop is occupied by these cultivars and they are the source of variability for the variety improvement programmes.

**7.1.9 Pea:** AFLP fingerprinting work was initiated in pea. DNA extraction was completed in 44 pea cultivars including some germplasm lines and two sub-species of *P. sativum* i.e. *P. sativum* sp. *fulvum* and *P. sativum* sp. *arvense*. Sixty-four AFLP primer combinations in four pea cultivars were screened for their suitability in fingerprinting. Twelve primer pairs were finally selected. Data on 38 pea cultivars with four primer combinations were analyzed. A total of 217 bands were polymorphic which resulted in 96.9% polymorphism. Pair-wise Jaccard's similarity estimates between 38 cultivars were

calculated. Substantial genetic diversity was observed in the material. All the cultivars included in the study could be discriminated based on combined AFLP profiles of four primer combinations.

**7.1.10 Lentil:** DNA extraction, purification and quantification were completed in 40 lentil cultivars and landraces. Further fingerprinting using AFLP marker is under progress.

**7.1.11 Chilli:** Thirty-four accessions of chilli have been fingerprinted using AFLP, ISSR and RAPD primers. With the availability of information on STMS primer sequences, the conditions for amplification were optimized and seven primer pairs were employed for generating STMS markers in these accessions.

**7.1.12 Saffron:** Thirteen accessions of saffron collected from different locations in Jammu & Kashmir have been fingerprinted using nine AFLP primer pairs. Each of the primer pairs could distinguish all the accessions. All but two of the 156 markers generated were polymorphic with a PIC of 0.32. Though saffron is vegetatively propagated, no two accessions used in the study were identical using the AFLP markers. The data are being subjected to further analysis.

**7.1.13 Brinjal:** A representative set of four accessions was screened against forty-five primer pairs to select suitable combinations for fingerprinting brinjal accessions using AFLP markers. Twelve primer pairs have been identified and will be subsequently used for AFLP of these accessions.

**7.1.14 Citrus:** In continuation of the work reported earlier, thirty-four accessions of citrus have been fingerprinted using six anchored ISSR



primers. Optimization of reaction and amplification conditions with more primers is under progress.

**7.1.15 Plantago:** Forty-eight accessions of *Plantago* were fingerprinted with different molecular markers *i.e.* RAPD, ISSR and AFLP. Out of 59 random primers used, only 10 were polymorphic. Out of 14 ISSR primers, only one *viz.* UBC 866 was polymorphic. AFLP of 48 *Plantago* accessions was carried out using 16 AFLP primers (4 *MseI* and 12 *EcoRI* ). The results showed moderate diversity in the accessions.

## 7.2 Crop DNA fingerprint database and statistical analysis package

Interactive software to retrieve information according to the choice from the database and perform data analysis has been developed, with different modules such as average number of bands per cultivar, probability of chance identity, per cent polymorphism, per cent monomorphism, polymorphic information content and resolving power to perform statistical analysis.

**Table 1. Number of varieties/ accessions fingerprinted in crops using different profiling techniques during 2003**

| Crop         | Varieties /accessions fingerprinted | Techniques used        |
|--------------|-------------------------------------|------------------------|
| Rice         | 76                                  | STMS, AFLP, RAPD       |
| Wheat        | 43                                  | STMS, AFLP, RAPD       |
| Brassica     | 89                                  | STMS, RAPD             |
| Sorghum      | 65                                  | STMS, AFLP, RAPD       |
| Chickpea     | 21                                  | STMS, AFLP, ISSR, RAPD |
| Pigeon pea   | 56                                  | AFLP, RAPD             |
| Black gram   | 54                                  | AFLP                   |
| Green gram   | 75                                  | AFLP                   |
| Ricebean     | 47                                  | AFLP                   |
| Mothbean     | 10                                  | AFLP                   |
| Peas         | 44                                  | AFLP                   |
| Lentil       | 40                                  | AFLP                   |
| Chillies     | 34                                  | ISSR, AFLP, RAPD       |
| Brinjal      | 4                                   | ISSR, RAPD             |
| Citrus       | 34                                  | AFLP, ISSR             |
| Saffron      | 13                                  | AFLP                   |
| Plantago     | 48                                  | ISSR, AFLP, RAPD       |
| <b>Total</b> | <b>753</b>                          |                        |

- RAPD : Random Amplified Polymorphic DNA  
 AFLP : Amplified Fragment Length Polymorphism  
 ISSR : Inter Simple Sequence Repeats  
 STMS : Sequence Tagged Microsatellites  
 RFLP : Restriction Fragment Length Polymorphism

### WEBPAGE

Webpage for NRC on DNA fingerprinting has been developed and linked with NBPGR Website.

### 7.3 Analysis of Genetic Diversity

A total of 162 seed samples were collected, comprising cultivated *Solanum melongena* (121 samples), *S. insanum* and intermediate forms (40 samples) and *S. macrocarpon* (1 sample) covering eastern and western coastal regions of Kerala, Karnataka, Andhra Pradesh, Goa and Orissa to study the phylogenetic relationships.

Sixty collections of *S. melongena* and related wild and weedy forms were grown at NBPGR, Hyderabad and Thrissur farms. Characterization data have been so far recorded in 44 accessions grown at Hyderabad. Selected collections of *S. melongena* and related taxa were characterized using AFLP based markers. To select primer-pair combinations that give robust, polymorphic products, primer screening was carried out using forty-five primer pair combinations. The *EcoRI* primers were labelled with fluorescent dyes which allowed detection of amplification products that were resolved by an ABI Prism 310 Genetic Analyzer. Fragment sizes were determined in relation to the GenScan - 500 ROX size standard. Twelve primer pair combinations have been selected for multiplexing of the AFLP reactions for characterization of the selected accessions using AFLP markers.

### 7.4 Validation of Core Collection in Sesame

The nucleotide base polymorphism in *ITS1*, *ITS2* and *trn* loci was studied in seven *Sesamum* species occurring in India. The PCR-RFLP technique was used to analyze *S. indicum*, *S. malabaricum*, *S. mulayanum*, *S. laciniatum*, *S. prostratum*, *S. radiatum* and *S. alatum*

species. The results indicated species-specific RFLP patterns in the loci analyzed. The cultivated species *S. indicum* and its wild relatives *S. malabaricum* and *S. mulayanum* were placed in the same cluster, while the African species, *S. radiatum* and *S. alatum* were observed to be widely separated from the three Indian species. The Pan-Asiatic species, namely, *S. laciniatum* and *S. prostratum* also grouped separately but were placed intermediate to the Indian and African species. The results provide supportive evidence that *S. malabaricum* is the progenitor of the cultivated *S. indicum*.

### 7.5 Molecular Detection of Transgenes

For molecular detection, transgenic samples of maize with *cp4epsps* gene, cotton with *vip3* gene and *cryIF/cryIA(c)* genes and golden rice with *psy<sub>1</sub>*, *crt1* and *icy* genes have been taken up.

For the detection of transgenes, primers have been designed for scorable/ selectable markers, regulatory sequences and *cre* sequence of terminator gene. In addition, primers corresponding to different regions as well as different sequences of transgenes such as *cp4epsps*, *vip3*, *Aox* and *cryIA(c)* have also been designed, as some modifications including truncations as well as alterations have been observed in the transgene sequences used by different indenters for the development of transgenics in their respective crops.

DNA was isolated and quantified from the seedlings of the transgenic lines received and were tested for the terminator gene using designed primers for *cre* sequence. All these lines tested negative for the terminator gene.

In transgenic maize *cp4epsps* gene has been detected.

## 7.6 Development of PCR-based Methods

The PCR detection of transgenes was carried out in transgenic cotton with *cry IA(c)* gene for insect resistance, mustard with *barnase* and *barstar* genes for male sterility and restoration of fertility and soybean with EPS synthase gene for herbicide tolerance. Promoters/ terminators such as 35S, *nos* and

selectable markers viz., *npt II* and *hpt II* were also detected in transgenic cotton, mustard and soybean.

CaMV 35S promoter has been detected in cotton and brassica; *npt II* gene in brassica and soybean; *cry IA(c)* in cotton; *barnase* and *barstar* genes in mustard and *cp4epsps* in soybean. As expected an amplification product of 195 bp was observed for CaMV 35S promoter, 475 bp for *npt II*, 1350 bp for *cryIA(c)*, 370 bp for *barnase*, 294 bp for *barstar* and 320 bp for EPS synthase.

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

PGR/DFP-BUR-DEL-01.00: Technology development for DNA fingerprinting of cereals and millet crops. (Lalit Arya, Gurinder Jit Randhawa, Rakesh Singh, Sunil Archak)

PGR/DFP-BUR-DEL-02.00: Technology development for DNA fingerprinting of pulses, oilseeds and fibres. (K.V. Bhat, M.K. Rana, Gurinder Jit Randhawa, Rakesh Singh)

PGR/DFP-BUR-DEL-03.00: Technology development for DNA fingerprinting of horticultural crops. (J.L. Karihaloo, Ambika B. Gaikwad, Sunil Archak)

PGR/DFP-BUR-DEL-04.00: Technology development for DNA fingerprinting of medicinal and aromatic plants. (Gurinder Jit Randhawa, Rakesh Singh)

PGR/DFP-BUR-DEL-05.00: Crop DNA fingerprint database and statistical analysis package. (Madhu Bala)

## 8. PGR POLICY PLANNING UNIT

The PGR Policy Planning unit has been functioning at NBPGR since 1996 with the following objectives

- To document and collect literature on concurrent international and national developments concerning plant genetic resources and related fields such as biosafety, germplasm utilization, exchange, and quarantine.
- To provide analytical input 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 Global Plan of Action

Progress report on the implementation of Global Plan of Action (GPA), on all the twenty priority activities, was prepared and sent to Department of Agriculture and Cooperation (DAC). The report was presented by J.S. (seeds) at the first meeting of the participant countries in the Japanese Govt. Funded Project on Implementation of GPA, at Bangkok, Thailand, in October 2003.

The report along with additional information on underutilized crops was also sent to ADG (seeds). The national report for the technical workshop on integrating information gathering on plant genetic resources for food and agriculture, and the monitoring of the implementation of GPA was presented by ADG (seeds) at FAO, Rome during November 2003.

### 8.2 National Biodiversity Strategy and Action Plan (NBSAP)

For the finalization of the draft National Biodiversity Strategy and Action Plan (NBSAP) a meeting alongwith, select expert group from various Departments and Ministries, dealing with biodiversity, was attended on 28.5.03 at Ministry of Environment and Forests.

Suggestions given by NBPGR regarding removal of objectional phrases pertaining to negative projection of the agriculture research system of India, and inclusion of additional information on programmes and policies of NBPGR in the draft document, have been well taken by the group. Suggestions were included in the draft being finalized by the MoEF.

Under the NBSAP process and in continuation with the obligations under CBD regarding documentation of country's biodiversity, a Regional awareness-cum-training workshop for preparation of People's Biodiversity Registers (PBRs) was attended during 19-21 May, 2003. A presentation regarding documentation of plant varieties and farmers varieties was made for the purpose of consideration in the formats for documentation of agro-biodiversity in the People's Biodiversity Registers. The format developed by NBPGR for documentation of farmers varieties, was considered to be included in the PBRs, by the expert group.

### 8.3 SAARC Material Transfer Agreement (MTA)

A meeting regarding finalization of MTA for exchange of germplasm among SAARC countries was held at NBPGR on 23.1.2003. The

draft document was sent to ICAR for approval and the approved MTA was sent to SAARC secretariat for approval of other SAARC member countries.

#### **8.4 Functional Committee on Plant Genetic Resources**

Action on the recommendations of the first meeting of the Functional Committee held in May 2002 was initiated. The action taken report was communicated to ICAR. A summary of the report is presented below:

##### **Agenda I: International Treaty on Plant Genetic Resources for Food and Agriculture**

a) It was recommended that the single window system of exchange of PGRFA should be strengthened. Wherever the National Active Germplasm Sites (NAGS) do not exist, at least one institute/centre should be designated for each crop under the multilateral system.

After the recommendation, the NAGS have been identified in all crops. For the crops covered under the International Treaty, 16 of the 19 NAGS responded for identification of nodal scientists and, of these, sixteen have been received.

It was recommended that NBPGR should seek blanket permission for export of released varieties of crops covered under multilateral system of exchange, envisaged under the treaty.

A committee to formulate guidelines for exchange of germplasm was constituted by ICAR, with DDG (CS) as Chairman. The draft report has been submitted to ICAR on 9<sup>th</sup> July 2003. Provision for permission to NBPGR has been proposed in these draft

guidelines. NBPGR was advised to procure PGR available with International Agricultural Research Centres (IARCs) under Material Transfer Agreement.

Efforts to procure elite germplasm and germplasm of Indian origin, available with IARCs have been going on. Seeds of groundnut (1071), French bean core collection (889), barley and *Aegilops* (285), have been received from ICRISAT, CIAT and ICARDA, respectively.

##### **Agenda II: Protection of Plant Varieties and Farmers' Rights**

a) It was recommended to undertake documentation of extant varieties in a phased manner and proposals for varieties released during last 14 years be obtained from DAC, for documentation.

As recommended, a project proposal for documentation of plant varieties was sent to DAC for approval. The project has started in March 2002 after due approval from DAC. The data on release proposals of notified varieties has been procured from DAC. For the documentation and cataloguing of the released and notified varieties, a software has been developed and data related to 35 crops has been entered using the above software at NBPGR and NSP (IARI). Database designing for the detailed documentation of characterization for DUS and comparisons among varieties etc. is being developed.

b) It was also decided to seek guidance from DAC on documentation of farmer's varieties.

DAC was approached for providing guidance on how to document farmers' varieties, and the response from DAC is awaited. The proforma developed by NBPGR was sent to ICAR. This has also been communicated to all Directors/PDs/PCs to collect data on farmers, varieties.

- c) It was advised to pursue provision of support from 'National Gene Fund' under the rules and regulations of the Act.

DAC has been requested for support on *ex situ* conservation.

### **Agenda III: Biological Diversity Act**

- a) NBPGR to review and put up a suitable proposal to ICAR/MoEF for access to biological diversity for commercial utilization, the section 7 of the Act was deliberated. Also, a blanket authorization may be sought from MoEF by ICAR/DARE, for export of PGR as per mandate of NBPGR (Section 3). The sub-committee to deal with agro-biodiversity proposed in the Act should have ICAR/DARE as the nodal agency.

Comments on the Biological Diversity Bill (Act) and draft Rules and Regulations include all these suggestions. The Director DARE has also approached Secretary MoEF on 27.8.03 to include these suggestions/ modifications in the relevant rules and regulations or sub-ordinate legislation.

- b) A need was felt for considering the appropriate provision in bills/Act related to environment, biological diversity, PPVFR, DIP etc. with respect to PGR-related issues.

Provision of DIP Act with Seed Act; with Biological Diversity and with Protection of Plant Varieties and Farmers' Right have been studied respectively, and draft document is being compiled.

### **8.5 Review Workshop on Plant Quarantine**

The Review Workshop on Plant Quarantine Policies and Procedures was organized on January 21, 2003 at NBPGR, New Delhi. The objective of the workshop was to review the national policies and procedures of plant quarantine in the wake of International Agreements and Protocols in order to streamline the National Plant Quarantine System to facilitate international trade of planting material/commodities.

The subject was discussed in two technical sessions:

**Technical Session I :** National Regulatory Mechanism in relation to International Agreements and Protocols (Issues related to PFS order – DIP Act, WTO- SPS Agreement, International Protocols on Biosafety- CBD, etc.)

**Technical Session II :** Procedures (issues related to import procedures, sampling, detection techniques, salvaging treatments and pest risk analysis.)

The participants included senior officials from the Ministry of Agriculture, Directorate of Plant Protection, Quarantine and Storage, IARI, other Designated Inspection Authorities from SAUs and staff of Plant Quarantine Division at NBPGR.

## 8.6 SAARC Workshop

A paper entitled “Plant Quarantine Set-up in India and Scope for Collaboration in SAARC Region” was presented in the SAARC Workshop on Setting up Regional Network on Sanitary and Phytosanitary Measures and Quality Control at Islamabad, Pakistan from March 18-19. The Workshop provided an opportunity to member countries to exchange views, share experience and make recommendations on setting up of a SPS network for the benefit of the member countries in the region.

## Research Projects (Code: Title, Project leader; Associates)

PGR/PPU-BUR-DEL-01.00: PGR policy planning and back-up research. (R. P. Dua)

PGR/PPU-BUR-DEL-01.01: PGR management and related policy issues. (Pratibha Brahmi, Sanjeev Saxena, Gurinder Jit Randhawa)

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

## 8.7 Policy Issues Related to Plant Quarantine

Comments on Supplement to International Standards for Phytosanitary Measures (ISPM) were provided which include stacks that - LMO's should be subjected to a separate risk analysis – Gene Risk Analysis (GRA); the definitions of PRA need to be revised to suit new situation; Cartagena Protocol on Biosafety is stringent enough to check the ill effects of LMO's on environment; invasiveness of LMO's can not be studied in a short period.

## 9. REGIONAL STATION, AKOLA

**Summary:** Two explorations were undertaken for collection of germplasm for multi-crops from Yavatmal, Chandrapur and Gadchiroli districts and for custard apple germplasm from Vidarbha and Marathawada region of Maharashtra. A total of 152 accessions were assembled from nine districts of Maharashtra State. A total of 1521 accessions comprising cereals (206), millets (452), pulses (412) and oilseeds (451) were characterized and regenerated. Crop-wise accessions include maize (206), barnyard millet (64), littlemillet (50), prosomillet (19), kodo millet (33), fox-tail millet (256), finger millet (30), horsegram (163), niger (211) during kharif and chickpea (210), grasspea (39), linseed (239) and safflower (1) during rabi. Promising accessions were identified for different yield attributing characters in different crops germplasm. A total of 608 accessions were supplied to different research organizations for utilization in crop improvement programmes, 46 accessions were supplied to regeneration sites and 608 for multi-location testing and evaluation purpose.

### 9.1 Exploration and Collection

Two exploration trips were undertaken and a total of 152 accessions were collected that included cereals and pseudocereals (7), millets (10), pulses (37), oilseeds (13), vegetables and tuber crops (32), horticultural crops (32), fibre crops (1), spices (8), wild relatives (10) and medicinal plants (2). The areas surveyed include Vidarbha and Marathawada regions of Maharashtra for germplasm collection of multi-crops including minor millets and custard apple. Most of the collections were made from farmers threshing yards/ fields and natural forests. Variability was observed in custard apple pertaining to physicochemical characteristics including TSS content in morpho-agronomic characters of germplasm of cultivated crops.

**9.1.1 Multi-crop exploration and collection from Gadchiroli district of Maharashtra:** During the multi-crop exploration to Yavatmal, Chandrapur and Gadchiroli districts of Maharashtra, a total of 112 accessions comprising paddy (5), maize (2), prosomillet (3), pearl millet (1), sorghum (6), chickpea (5), pigeonpea (3), greengram (10), horsegram (3), cowpea (6), grasspea (3),

blackgram (7), sesame (9), linseed (2), black mustard (2), okra (1), pumpkin (3), pea (1), bottlegourd (3), eggplant (2), ridgegourd (2), spongegourd (2), cucumber (3), lablab bean (5), yam (2), *Amaranthus* species (2), chillies (1), bittergourd (3), onion (1), snakegourd (1), custard apple (31), ber (1), roselle (1), coriander (4), *Cuminum cyminum* (1), *Cuminum* sp. (1), fenugreek (2), *Abelmoschus ficulneus* (2), *A. tuberculatus* (1), *Cucumis callosus* (1), *Cucurbita* spp. (3), *Trichosanthes cucumeriana* (1), *Coccinia cordifolia* (1), *Cucumis hardwickii* (1), medicinal plant (1), *Bryonopsis laciniosa* (1) and others (1) were collected.

**9.1.2 Exploration and collection of custard apple germplasm:** Five districts of Vidarbha and one district of Marathwada region were explored for collection of custard apple germplasm during 23–31 October, 2003. The districts explored were Akola, Buldhana, Amravati, Yavatmal, Washim (Vidarbha) and Nanded (Marathawada) of Maharashtra. The predominant custard apple growing areas are Wadgaon (forest area) near Paratwada, Barlinga near Chikhaldhara, Pala near Shirasgaon, Karanja Bairam near Paratwada,



Varha near Chandur Rly., Karajgaon near Yavatmal, Mahur, Varud near Pusad and Manora, Akola, Buldhana, Amravati, Yavatmal Dongaon, Janephal areas near Mehkar and Nanded district of Maharashtra.

Physico-chemical characteristics were recorded for the following traits viz., average fruit weight (90.8-346.6 g), fruit height (5.1-8.8 cm), fruit width (6.0-8.5 cm), fruit girth (18.3-27.7 cm), no. of seeds/fruit (21-63), weight of seeds/fruit (8.3-19.4), weight of 100 seeds (22.97-54.55 g), weight of rind/fruit (30.68-137.70 g), weight of pulp/fruit (44-88 g), fruit to pulp ratio (37.06 to 54.24) and total soluble sugar (19-26%).

The germplasm included *Annona squamosa* (28), *Bryonopsis laciniosa* (1), *Trichosanthes cucumeriana* (1), *Abelmoschus ficulneus* (2), *A. tuberculatus* (1), *Cucumis hardwickii* (1), *C. callosus* (1), *Luffa acutangula* (1), *Momordica charantia* (1), *Cucurbita* sp. (1), *Ziziphus jujube* (1) and *Vigna unguiculata* (1).

During the exploration one accession having different plant type locally called as 'Nar' (male) was collected from Wadgaon forest areas near Paratwada. Its leaves are dark green and small and, fruits remain green even after maturity.

## 9.2 Characterization of Germplasm

A total of 1521 accessions comprising cereals (206), millets (452), pulses (412) and oilseeds (451) were characterized. Crop-wise accessions include: maize (206), barnyardmillet (64), littlemillet (50), prosomillet (19), kodomillet (33), foxtail millet (256), fingermillet (30), horsegram (163), niger (211) during *kharif* season and

chickpea (210), grasspea (39), linseed (239) and safflower (1) during *rabi* season. The germplasm was grown at the experimental farm of NBPGR regional station, Akola and standard plant protection measures were practised.

Morphological and quantitative characters were recorded on five random plants and post harvest observations were recorded on the samples in the laboratory. Promising accessions identified for rare economic traits are given in Table 1.

### Observations on morphotypes in millet germplasm

|  |  |
|--|--|
| (i) Barnyard millet ( <i>Echinochloa crusgalli</i> ) |  |
| Purple panicle type-                                 | IC-325944, IC-340240, IC-340228, IC-40191  |
| Compact panicle -                                    | IC-340224  |
| Tall plant type -                                    | IC-372607, IC-325966.  |
| Dwarf plant type-                                    | IC- 340220, IC-340195, IC-340187, IC-340167, IC-340163, IC-340155, IC-340124, IC-340103. |
| Open panicle -                                       | IC-340238, IC-340203, IC-340210, IC-340134 IC-340106                                     |
| Purple panicle-                                      | IC-325968, IC-326031.  |
| Tall & Purple-                                       | IC-344224  |
| Dwarf & Purple-                                      | IC- 340225   |
| Dwarf-   | IC-372606, IC-326012   |
| Tall-  | IC-325968  |
| (ii) Prosomillet ( <i>P. miliaceum</i> )             |  |
| Late-  | IC-344135, IC-344144, IC-344164, IC-344177, IC-344181, IC-344183, IC-344186, IC-344200   |

**Table-1. Promising germplasm lines in different crops**

| Crop            | Accession no.  |
|-----------------|--|
| Maize           | EC-477305, EC-477325, IC-262537, IC-332178, IC-332070, IC-338816.<br>Early: EC-477365, EC-497581, IC-337073, IC-347133   |
| Barnyard millet | IC-372607  |
| Littlemillet    | IC-340166, IC-340117, IC-340111  |
| Proso millet    | IC-344200, IC-344160   |
| Kodomillet      | IC-340154  |
| Foxtailmillet   | IC-340232  |
| Fingermillet    | IC-344207  |
| Horsegram       | IC-341278, IC-341261, IC-268212, IC-283412, IC-341291, IC-341293   |
| Grasspea        | Early (<80 days) IC-345392, IC-345404, IC-345429<br>Prolific bearing (>40 pods) IC-345454, IC-345488, IC-345428<br>High yielding IC-345392, IC-345488, IC-345429 |
| Chickpea        | VK-SK-000117, VKG 19/118, KC/GK/OP-53  |
| Niger           | High yielding IC-320933, IC-340123, IC-340200, IC-340244, IC-320979, IC-341315, IC-341319  |
| Linseed         | IC-34543, IC-345426 (high yielding), IC-345460, IC-345466,<br>Early (<95) days) IC-283450, IC-267679, IC-26743   |

Very late- IC-344191, IC-344202, IC-344218

Dark purple - IC-344152, IC-344160, IC-344206

High yielding - IC-344156, IC-344204, IC-344206, IC-344112.

(iii) Fingermillet (*Eleusine coracana*)

Late - IC-340219, IC-344213, IC-344199, IC-344210, IC-344203, IC-344205

Early - IC-344172, IC-344133, IC-344158

Long, open & straight panicle- IC-340142

Tall - IC-344138

### 9.3 Maintenance of Germplasm

A total of 1779 accessions comprising millets (245), pulses (667), oilseeds (710), vegetables

(138), fiber crops (1), and wild relatives (18) either collected or received under NATP (PB) were maintained at the center during the period. Crop-wise accessions includes: barnyardmillet (64), finger millet (40), littlemillet (68), kodomillet (32), fox-tailmillet (41), pigeonpea (216), chickpea (210), soybean (30), grasspea (39), horsegram (171), winged bean (1), groundnut (23), safflower (5), niger (210), linseed (239), castor (3), sesame (230), okra (117), amaranth (27), roselle (1) and *Abelmoschus* spp. (18).

### 9.4 Conservation of Germplasm

A total of 152 accessions of collected material were supplied to NBPGR as voucher samples for conservation in the MTS and 2207 accessions were deposited in LTS at NBPGR. These included sesame (cultivated) 1772 accs., sesame (core), 311 accs. and sesame (wild) 124 accessions.

## 9.5 Supply of Germplasm

A total of 46 accessions comprising paddy (2), wheat (1), barley (1), mustard (1), sorghum (25), pearl millet (6), mothbean (1), mungbean (2), cowpea (1), swordbean (1), lentil (1), sunflower (1), pea (1) and cotton (2) were supplied to different NAGS.

For multi-location trial sesame (230), okra (78) and amaranth (100) germplasm were sent to three sites. A total of 658 accs. were supplied to different research organizations for utilization in crop improvement programmes.

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

PGR/GEV-BUR-AKO-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources in the Central Indian plains (I. P. Singh, N. Dikshit)

PGR/GEV-BUR-AKO-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of pulse (pigeon pea, chick pea), vegetables (winged bean, amaranth, okra) and underutilized crops (I. P. Singh, N. Dikshit)

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

# 10. REGIONAL STATION, BHOWALI

**Summary:** Seven (four multi-crop and three crop-specific) explorations were undertaken from parts of Uttaranchal and 252 collections including landraces and primitive cultivars from remote areas of hills were collected. In addition, four explorations (2 multicrops and 2 crop/ region/ specific) were undertaken by cooperators in parts of Uttaranchal under NATP (PB) and 425 accessions comprising cereals (109), vegetables (107), oilseeds (17), pulses (2) and spices (2) were collected during 2003. A total of 2061 accessions were received for regeneration, characterization and maintenance. A total of 335 accessions were supplied to user scientists in the country and 301 accessions deposited in National genebank for conservation.

## 10.1. Exploration and Collection of Germplasm

A total of 252 germplasm accessions were collected during seven explorations (4 multicrop and 3 crop-specific) from parts of Uttaranchal under NATP (PB). Emphasis was on the collection of germplasm of landraces/ primitive cultivars of various crops from the inaccessible and remote areas of mid hill regions. The germplasm comprised cereals (71), minor millets (15), pulses (44), oilseeds (25), vegetables (17), spices (39), horticultural crops (28), M&APs (5) and others (8) (Table 1). Three crop-specific explorations were especially undertaken for the collection of *Zizyphus* spp. and pomegranate from districts of US Nagar, Haridwar, Dehradun, Chamoli, Nainital and Almora. In addition, 4 explorations (2 multicrops and 2 crop/ region/ specific) were undertaken by cooperators in parts of Uttaranchal under NATP (PB) and 425 accessions comprising cereals (109), vegetables (107), oilseeds (17), pulses (2) and spices (2) were collected during 2003.

## 10.2 Augmentation of Germplasm

A total of 2061 accessions comprising *Aegilops* spp. (28), amaranth (300), barley (100), buckwheat (300), chilli (156), *Citrus* spp. (5), cowpea (1), cucumber (2), eggplant (7),

Frenchbean (958), kiwi (1), litchi (3), mango (9), M & APs (34), methi (2), okra (4), onion (1), pea (1), plum (2), pumpkin (2), strawberry (12), *Triticum* spp. (4), urdbean (1), wheat (127) and ginger (1) were received from NBPGR, New Delhi; NBPGR R/S, Hyderabad and NBPGR R/S Phagli, Shimla; YSPUH&F, Nauni, Solan; IHR, Bangalore; PAU, Ludhiana, Fruit Research Station, Hoshiarpur, Punjab; NIDHI, Pithoragarh; KAU, Kerala and CAZRI, Jodhpur, Rajasthan for evaluation and maintenance of germplasm.

## 10.3 Germplasm Evaluation and Maintenance

**10.3.1 Germplasm characterization/ initial seed increase/ multiplication:** 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 2002-2003 (Tables 2 - 4).

**10.3.2 Horticultural plants:** A total of 517 accessions of fruit crops, 903 of vegetables (chilli and others), 91 of ornamentals and 75 of other horticultural plants were maintained. The range of variation for some of the important traits is given in Table 5.

**Table-1. Explorations undertaken during 2003 by NBPGR regional station, Bhowali**

| Period           | Areas explored  | Germplasm collected | Cereals   | Minor millets | Pulses    | Vegetables | Hort. crops | M & AP    | Spices    | Oil seeds | Others    |
|------------------|---|---------------------|-----------|---------------|-----------|------------|-------------|-----------|-----------|-----------|-----------|
| Feb. 12-22       | US Nagar, Haridwar & Dehradun district                | 10                  | —         | —             | —         | —          | 10          | —         | —         | —         | —         |
| May 13-22        | Rudraprayag, Tehri & Uttarkashi districts             | 60                  | 24        | 06            | 08        | 06         | —           | 03        | 08        | 05        | —         |
| June 16-21       | Nainital, Lohaghat, Champawat & Pithoragarh districts | 49                  | 23        | —             | 15        | 02         | —           | —         | 09        | —         | —         |
| July 31 - Aug. 6 | US Nagar, Haridwar & Dehradun district                | 04                  | —         | —             | —         | —          | 04          | —         | —         | —         | —         |
| Sep. 27- Oct. 2  | Nainital, Almorā & Chamoli                            | 14                  | —         | —             | —         | 14         | —           | —         | —         | —         | —         |
| Oct. 7-15        | Rudraprayag, Tehri & Uttarakashi                      | 47                  | 18        | 09            | 09        | —          | —           | —         | 01        | 08        | 02        |
| Oct. 15-23       | Champawat, Lohaghat, Pithoragarh districts            | 68                  | 06        | —             | 12        | 09         | —           | 02        | 21        | 12        | 06        |
| <b>Total</b>     |   | <b>252</b>          | <b>71</b> | <b>15</b>     | <b>44</b> | <b>17</b>  | <b>28</b>   | <b>05</b> | <b>39</b> | <b>25</b> | <b>08</b> |

**Table-2. Germplasm characterization during kharif 2003**

| Crop (accessions)   | Checks  | Main attributes   |
|---------------------|---|---|
| Maize (85)          | VL - 16<br>HIM - 129  | Plant height (157 -307 cm), kernels rows/cobs (8-18 Nos.), grain / rows (9 - 48 Nos.), grain yield / plant (5 -148.95 g), yield / row (50-1191.67 g), 100 - seed weight (10.95 - 30.92 g) |
| Amaranth (55)       | Annapurna,<br>Swarna  | Plant height (100-242 cm), inflorescence length (20-80 cm), seed yield/row (25-290 g), yield / plant (3.25 - 37.25 g), 1000 - seed weight (0.41 - 0.86 g)                                 |
| French bean (397)   | VL- 63, PLB - 10-1,<br>PLB - 14 - 1,<br>Champawat local,<br>Bhowali local | Days to maturity (84 - 115), no. of pods/plant (4 -24), 100 - grain weight (14.75 - 54.70 g), grains/plant (3.07 -32.03 g)  |
| Cowpea (51)         | FTC - 27, NS 24-82  | Days to maturity (96 - 125), no. of pods/plant (4 - 22), 100 - grain weight (5.92 - 16.36 g), yield/plant (4.60 - 27.0 g)   |
| Soyabean (115)      | VLS - 21,<br>VLS - 54   | Plant height (40.0-290.0 cm), yield/plant (5 - 121.67 g), yield/row (25 - 468.33 g), 100 - seed weight (4.33 - 25.61 g)   |
| Horsegram (62)      | Local   | Plant height (39.0-120.0 cm), yield/row (3 - 30 g), 100 - seed weight (1.98 - 3.31 g)   |
| Blackgram (25)      | Local   | Plant height (60-200 cm), seed yield/plant (0.87 - 8.68 g), seed yield/row (2.91 - 46.82 g), 100 - seed weight (2.80 - 4.30 g)  |
| Medicago spp. (141) | Local   | Plant height (9-110 cm), stem diameter (0.19 - 4.0 mm), fresh weight/plant (5 - 180 g)  |
| Trifolium spp. (39) | Local   | Plant height (15-55 cm), Fresh weight/plant (990-1500 g)  |

**Table-3. Multiplicaion/ seed increase during kharif 2003**

| Crop               | Accs. | Purpose |
|--------------------|-------|---------|
| Groundnut          | 23    | LTS     |
| Ricebean           | 23    | LTS     |
| Sem                | 08    | LTS     |
| Greengram          | 02    | LTS     |
| Pigeonpea          | 04    | LTS     |
| <i>Mucuna</i> spp. | 04    | LTS     |

**Table-4. Germplasm characterization during rabi 2003**

| Crop                        | Accs. | Checks                                      |
|-----------------------------|-------|---|
| Wheat                       | 457   | UP- 2425, UP-2382, HS-240, HB-208           |
| <i>Triticum</i> spp. (wild) | 68    | —   |
| <i>Aegilops</i> spp. (wild) | 61    | —   |
| Barley                      | 267   | VLB-1, VLB-60, VLB-64                       |
| <i>Avena</i> spp. (wild)    | 19    | —   |
| Pea                         | 29    | Lincon, Harbhajan, Selection - 18           |
| Lentil                      | 144   | VL-1,VL-105, VL-108, PL-406, PL-639, PL-830 |
| Faba bean                   | 14    | —   |
| <i>Brassica</i> spp.        | 177   | Kiran , Kranti, PI-303                      |
| Radish                      | 13    | Govind safed                                |
| Coriander                   | 45    | Pant harit, Bhowali local                   |
| Fenugreek                   | 22    | PEB, Kasuri methi                           |
| Garlic                      | 110   | Lohit, Local                                |
| <i>Lepidium sativum</i>     | 119   | —   |

**Table-5. Characterization of horticultural germplasm during 2003**

| Crop                            | Accs. | Checks | Main attributes   |
|---------------------------------|-------|--------|---|
| <b>Germplasm of fruit crops</b> |       |        |   |
| Peach                           | 09    | —      | Days to bud break (69-79), flower diameter (2.14 – 4.56 cm), petal length (1.22-1.58 cm), leaf length (6.5-15.43 cm), leaf width (2.29-3.68 cm), petiole length (0.62-0.94 cm), stem thickness (0.68-11.13 cm), fruit length (4.72 – 4.78 cm.), fruit width (4.45 – 4.74 cm.), fruit volume (11.7-22.7cc), 10 fruit weight (350.0 – 616.70 g), fruits/ plant (15.25-528.5), TSS (11.6 – 14.13 brix) |
| Plum                            | 08    | —      | Days to bud break (67.4-69), flower diameter (2.19-2.25 cm), petal length (1.10-1.19 cm), leaf length (3.42-8.37 cm), leaf width (1.62-3.54 cm), petiole length (0.61-1.52 cm), stem thickness (1.12-10.48 cm), fruit length (3.88-4.41 cm), fruit width (3.74-4.23 cm), fruit weight (20.0-43.4 g) and TSS (14.9-15.4 brix)  |
| <i>Rubus</i> spp.               | 21    | —      | Days to 50% flowering (64-134.66), flower diameter (0.74 – 2.93 cm.), petal length (0.23-1.02 cm.), No. of trusses / plant (5.0-330.5), No. of flowers/trusses (1.6-15.86), No. of fruit vesicles/ fruit (1.6-69.3), TSS (9.0-15.33 brix), fruit  |

|                             |     |  |   |
|-----------------------------|-----|--|---|
| Almond                      | 05  |  | length (0.5 – 1.34 cm.), Fruit width (0.56 – 1.35 cm), 10 fruit weight (1.19 – 9.33 g), terminal leaf length (3.35-10.78 cm), terminal leaf width (2.48-9.76 cm.), petiole length (2.87-10.93 cm)   |
| Apple                       | 23  |  | Days to bloom (68-73), flower size (4.63-4.88 cm), petal length (2.08-2.16 cm), petal width (0.45-1.35 cm), leaf length (11.37-14 cm), leaf width (3.54-4.27 cm), petiole length (2.01-2.32 cm.), stem thickness (5.96-7.15 cm).  |
| <b>Vegetable germplasm</b>  |     |  |   |
| Chilli                      | 199 | Pant C – 1,<br>JCA – 263,<br>LCF – 206 | Days to 50% flowering (137-163), plant height (37-93 cm), Number of flowers/ axil (1-6), plant canopy (560-3140 cm <sup>2</sup> ), Fruit length (2.76-13.32 cm), fruit width (0.69-5.16 cm) No. of fruits / plant (5.2-76.2) and 10 fruit weight/ plant (15 – 650 g)  |
| <b>Ornamental germplasm</b> |     |  |   |
| Gladiolus                   | 31  | Red double and Butterfly               | Days to germination (68-122), plant height (10.4 - 122 cm), No. of leaves/ plant (6.8-9.4), leaf length (35.2-48.8 cm), leaf width (2.06-3.5 cm), No. of florets/ spike (7-19), floret length (6.7-12.5 cm), floret width (4.5-7.6 cm), diameter of corm (3.9-6.3 cm), corm weight (34-75 g), cormels (4-15), cormel weight (4-13 g), days to spike emergence (132-203), days to first flower emergence (142-209), days to first flower bud opening (147-211), days to last flower bud opening (159-221), days to last flower bud existence (133-223), length of spikes (3.9 – 76.4 cm), rachis length (25.2-59.2 cm) |



*Stevia rebaudiana* in flowering at Bhowali station

## 10.4 PCPGR UTDASP- Bhowali Unit

### 10.4.1. Import of planting material (rooted plants): Amongst the accessions of apple and

pear received, one plant of each accession was planted in field gene bank, and one each was also maintained in pots for quarantine observations. For regeneration, the material was grafted on pre-established rootstocks.

**Apple** (*Malus domestica*)- EC-528097, EC-528098, EC-528099, EC528100, EC-528102, EC-528103, EC-528104 and EC-528105 were established and preliminary observations with respect to plant height (170-210 cm), stem girth (14.3-28.4 mm), branches /plant (7-20), leaf length (5.32-10.9 mm) and leaf width (2.56-5.8 mm) were recorded. Jonagold (EC-528100) was susceptible to powdery mildew.



Pod variability observed in germplasm of Frenchbean maintained at Bhowali

**Apple rootstocks (*Malus* spp.)-** EC-528106 and EC-528107 were collected.

**Pear (*Pyrus communis*)-** EC-528108, ECC-528109, EC-528110, EC-528111, EC-528112, EC-528113, EC-528114, EC-528115 and EC-528116 were established in the field.

**Pear rootstocks (*Cydonia oblonga*)-** EC-528117 and EC-528118 were established in the field.

***Ribes* sp.:** Among 19 accessions the range of variation for characters plant height (18.2-44.5cm), stem girth (3.62- 17.03 mm) and number of branches/ plant (1 -7) was recorded. Only one accessions EC- 453291 showed fruiting (fruit weight-0.4 g, fruit length-4.69 mm, fruit width-4.09 mm with TSS 13 brix).

**Walnut :** The material imported from France showed a wide range of variation in plant height (1.7- 3.5 m), stem girth (32.76- 70.20 mm), number of branches/ plant (5- 12), leaf length (11.77- 18.73 cm) and leaf width (4.93- 8.94 cm).

**Regeneration of promising accessions:** Plants/ seeds of kagazi (IC-319045), santra (IC-319065), malta (IC-319066), chakotra (IC-319044), pahadi nimbu (IC-319067), Kiwi (EC-

64093, EC-24672, EC-64094, EC-64090, EC-137263, EC-64092), *Zinia* (IC-318926, IC-318927, IC-318928), *Glargia* (IC-320219, IC-320220), tuberose (IC-319156), *Tagetes* (IC-318939), *Phlox* (IC-319010, IC-319011, IC-319012) accessions were regenerated through cuttings, other vegetative means, and also through seeds.

#### 10.4.2. Nursery management

**Kiwi and *Citrus* at NBPGR regional station, Bhowali:** Grafting of Hayward and Allision scion was completed under field conditions in nursery. Cuttings were also maintained. About 50 plants of male Tomuri and 100 plants of Allision and Hayward were ready for supply to farmers for popularization in hills.

**Kiwi and *Citrus* spp. at farmers' field :** UTDASP staff of NBPGR regional station, Bhowali provided technical know how to selected progressive farmers' of district Nainital, Uttaranchal.



Soyabean germplasm being characterized at Bhowali station

### 10.5 Wild Economically Useful Plants

**10.5.1. Preliminary evaluation of *Allium* spp.:** A total of 35 accessions of *Allium* spp.



(wild only) were maintained and evaluated in field genebank. *Allium auriculatum*, *A. consanguineum*, *A. carolinianum*, *A. griffithianum* and *A. royleii* were multiplied for seed increase.

**10.5.2. Maintenance of wild economically useful plants:** A total of 110 accessions of wild related species of *Abelmoschus*, *Brynnopsis*, *Crotalaria*, Cucumber, *Dioscorea*, *Myrsine*, *Macrotyloma*, *Parthenocissus*, *Ribes*, *Solanum*, and raspberry etc. were maintained in the field genebank.

**10.5.3. Maintenance of arborescent plants:** A total of 190 accessions of arborescent plants comprising 150 species (92 genera belonging



Ramtil (*Guizotia abyssinica*) collected from kitchen garden in Uttarkashi

to 50 families of both exotic and indigenous origin) were maintained in the Biodiversity Botanical Garden of the station.

**10.5.4. Maintenance of bamboosetum:** A total of 35 accessions comprising 18 species belonging to six genera were maintained.

**10.5.5. Maintenance of forage legumes and grasses:** A total of 141 accessions (*Medicago* sp.) were maintained and evaluated.

**Trifolium sp.:** A total of 39 accessions were maintained.

**Temperate Grasses:** A total of 54 accessions of temperate grasses were maintained in field genebank.

**10.5.6. Medicinal and aromatic plants:** A total of 320 accessions (vegetatively propagated-100; seed producing- 220) comprising 205 species belonging to 115 genera of 37 families were conserved in field genebank/ herbal garden of the station. Nearly 30 species of the promising and high-prized aromatic plants such as *Aloe*, *Alpinia*, *Artemisia*, *Asparagus*, *Bunium*, *Carum*, *Centella*, *Chrysanthemum*, *Cymbopogon*, *Hedychium*, *Lavendula*, *Matricaria*, *Marjorana*, *Melissa*, *Mentha*, *Ocimum*, *Oreganum*, *Pelargonium*, *Plantago*, *Pyrethrum*, *Rosa*, *Rosmarinus*, *Salvia*, *Spilenthus*, *Stevia*, *Tagetes*, *Thymus*, *Valeriana*, *Withania* and *Zanthoxylum* were multiplied for supply to the indentors. Steam distillation unit was being operated in different seasons for extracting essential oil from aromatic plants including scented rose geranium, rosemary, lemon grass, timoor and others.

**Determination of percentage of essential oil:** A total of 14 accessions of aromatic plants were extracted for determining the percentage



Wild cucumber (*Cucumis hardwickii*) collected from Shiwalik hills

of essential oil during different seasons through steam distillation. A part of the oil was also sent to chemistry unit, NBPGR, New Delhi for further chemical analysis. The range of oil percentage in different species is as follows: *Artemisia* sp. (0.14- 0.21), *Curcuma* sp. (0.03), *Cryptomeria* sp. (0.18-0.20), *Cymbopogon* sp. (0.16- 0.29), *Hedychium* sp. (0.03), *Marjorana* sp. (0.18- 0.21), *Pelargonium* sp. (0.05-0.10), *Pistacia* sp. (0.03-0.04), *Rosmarinus* sp. (0.11- 0.13), *Tagetes* sp. ((0.10- 0.12) and *Zanthoxylum* sp. (0.05- 0.07). Essential oil of *Artemisia* sp. (610 g), *Curcuma zedoaria* (80 g), geranium (2468 g), Lemon grass (5145 g), *Tagetes* sp. (205 g) and *Valeriana* sp. (240 g) was sold to the users.

### 10.6 Germplasm Conservation

A total of 301 accessions of different crops *viz.* barley (130), lentil (110) and wheat (61) were

supplied for LTS whereas *Fragaria* spp. (25) were supplied for *in vitro* conservation.

### 10.7 Germplasm Supply

A total of 335 accessions of different crops were supplied to various research organisations/indentors under MTA. *Aegilops* sp. (1), barley (13), *Citrus* spp. (96), chilli (27), French bean (8), *Hordeum* sp. (2), rye (14), strawberry (61), *Tagetes* spp. (36), *Triticum* spp. (2), M&APs (*Artemisia* sp., *Coleus* sp., *Curcuma* sp., *Valeriana* sp.), *Solanum* sp. (58) and wheat (17). Seed samples and live rooted plant material *viz.* *Achillea* sp. (5), *Acorus* sp. (10), *Aloe* sp. (24), *Allium* sp. (15), *Artemisia* sp. (35 g), *Asparagus* sp., (10 g + 88), *Bergenia* sp. (01), *Chammomile* sp. (20), Caraway (430 g), Clarysage (255 g + 124), *Conium* sp. (5), *Curculigo* sp. (15), *Cynura* sp. (5), garden sage (52), geranium (4440), *Ginkgo* sp. (11), grasses (41 Kg), *Heracleum* sp. (5), lavender (150 g + 3322), lemon grass (5110), *Malaxis* sp. (1), *Melissa* sp. (5), *Pelargonium tomentosum* (10), *Pyrethrum* sp. (200 g + 80), Rosemary (2100), *Spilenthus* sp. (10), *Marjorana* (10), *Tagetes* sp. (10), *Thymus* sp. (20), *Valeriana* sp. (35), *Viola* sp. (10), *Withania* sp. (110 g); apple (5), flowering annuals (300), Kiwi (390 Kg + 215), *Citrus* sp. (116), *Cryptomeria japonica* (6), peach (6 Kg + 30), plum (14 Kg), strawberry (1.750 Kg + 231) and *Tagetes* spp. (36) were supplied to different farmers / indentors.

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

PGR/PGC-BUR-BHO-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of the Northern Himalayas and adjoining Plains. (D C Bhandari upto May 24, 2003; K S Negi w.e.f. May 24, 2003).

- PGR/PGC-BUR-BHO-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of field crops with emphasis on ethno-botanical aspects (D.C.Bhandari, upto May 24, 2003; K. S. Negi ,wef May 24, 2003; K.C. Muneem, wef June 5, 2003)
- PGR/PGC-BUR-BHO-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of temperate horticultural crops (S.K.Verma)
- PGR/PGC-BUR-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 (K.S.Negi)

## 11. EXPLORATION BASE CENTER, CUTTACK

**SUMMARY:** Five explorations were undertaken for collection of M&APs and agri-horticultural crops from various parts of Orissa and West Bengal including one special mission to Sunderban and 421 accessions were collected. A rare collection of *Piper chaba* (locally called as gaccha mircha, highly pungent, plant height upto 210 cm, fruiting throughout the year) was made. A total of 2882 accessions comprising 2,712 accessions of cultivated rice and 170 accessions of turmeric were grown for preliminary characterization and seed multiplication. A total of 437 accessions of various crops (73 accessions received from OUAT) and 129 accessions of M&APs were deposited as voucher specimen in MTS whereas 590 accessions were deposited in NGB. A set of 104 accessions of agri-horticultural crops were sent to regeneration sites for characterization and evaluation. Under Human Resource Development Programme (HRD), two grassroot level trainings were conducted.

### 11.1 Germplasm Exploration and Collection

During the year 2003, five explorations were undertaken for collection of agri-horticultural crops including chillies, medicinal plants and other wild relatives of crops plants from various parts of Orissa and West Bengal including a special mission for collection of germplasm from Sunderban area of WB. The exploration programmes were conducted under Jai Vigyan National Science & Technology Mission on conservation of agro-biodiversity (NATP on Plant Biodiversity) in collaboration with SARC (NGO), Cuttack. A total of 421 accessions including cereals (34), pulses (3), plantation crop (1), vegetables (35), oilseeds (1), horticultural crop (1), fibre crops (20), spices & condiments (111), tuber crops (14), M&APs(169), forest plants



*Abrus precatorius* - a medicinal plant collected from Gandhmardan hills of Orissa

(2) and wild relatives (30) were collected during the exploration. The major collections were hot chillies, cultivated rice, M&APs, tuber crops, jute and allied fibres and some wild relatives of crop plants. A rare collection included gaccha mircha (highly pungent, plant height upto 210 cm and

**Table-1. Details of explorations conducted during 2003.**

| Period of collection   | Crops collected | Areas explored        | No. of accs. |
|------------------------|-----------------|-----------------------|--------------|
| February 20 – 25, 03   | M&APs           | Gandhamardhan         | 46           |
| March 15 – 19, 03      | M&APs           | Mayurbhanj            | 39           |
| March 28 – April 2, 03 | M&APs           | Keonjhar              | 60           |
| November 11 – 16, 03   | Chillies        | Sambalpur, Sundergarh | 99           |
| December 3 – 9, 03     | Multi crop      | Sunderban (WB)*       | 177          |
| <b>Total</b>           |                 |                       | <b>421</b>   |

\* Special collection mission to Sunderban area of W.B.



A medicinal plant belonging to Bignoniaceae collected from western ghats of Orissa

fruiting throughout the year) was made. Other collections include *Porteresia coarctata*, *Asparagus racemosus*, *Raulvolfia serpentina*, *Terminalia* spp., *Withania somnifera*, *Curculigo orchioides*, *Pueraria tuberosa* etc. During special exploration mission, landraces of different crops having salinity tolerance were collected. The exploration-wise details with period of collection, region/areas covered, crop diversity and number of accessions collected are given in Table 1.

#### **11.1.1 Collection of medicinal & aromatic plants from Gandhamardan hills of Orissa:** A



*Wagatea spicata* a medicinal plant collected from Western Ghats

total of 46 accessions of M & APs (44 accessions of seeds and 2 accessions of live plants), comprising 27 species belonging to 26 genera were collected. Wide range of morphological variability was observed for seed colour (white, red and black) in *Abrus precatorius*. Besides information on ethno-medicinal uses of collected germplasm was recorded.

#### **11.1.2 Collection of medicinal & Aromatic Plants from Mayurbhanj district of Orissa:**

The germplasm was collected along with ethno-botanical information by contacting several tribes of different ethnic groups of the district. A total of 39 accessions comprising 26 species belonging 24 genera were collected from 13 collection sites. The germplasm includes 33 accessions of seeds and 6 accessions of live plants. Wide range of morphological variability was observed for seed colour in *Abrus precatorius*.

#### **11.1.3 Collection of Medicinal and Aromatic plants from Keonjhar district of Orissa:**

Exploration was undertaken in collaboration with SARC to collect potential medicinal plants and the information related to traditional herbal remedies. A total of 60 accessions comprising 31 species belonging to 30 genera were collected

from 15 collection sites and these include 54 accessions of seeds and 6 accessions of live plants. Besides ethno-medicinal uses *Rauvolfia tetrapylla*, *Terminalia ballerica*, *T. chebula*, *Abrus precatorius*, *Martynia annua*, etc. information was also recorded for their unique use in healing some chronic and dreadful diseases by the rural healers.

Wide range of morphological variability was observed for seed colour in *Abrus precatorius* (white, red and pink) and *Mucuna pruriens* (black and light brown).

**11.1.4 Collection of chilli from Sambalpur and Sundergarh district of Orissa:** The exploration was planned for collection of a unique type material locally called as **Bismircha** from Bonai area of Sundergarh, Bamra and Kuchinda area of Sambalpur. A total of 99 accessions of chilli were collected from 25 collection sites. The original collection has been deposited in the National genebank (MTS).

**11.1.5 Special collection mission in Sunderban area of WB:** A total of 177 accessions of different

crops viz. cereals (34), pulses (3), vegetables (35), oilseed (1), fibre crops (20), horticultural plant (1), spices and condiments (12), tuber crops (14), medicinal plants (24), plantation crop (1), forest plant (2) and wild relatives (30) were collected from 17 different sites. Some of the accessions collected were rare and these included *Piper chaba* (SBC-1/15), wild *Solanum* (SBC-1/3, 55) and two kernel rice (SBC-1/53).

## 11.2 Germplasm Conservation

**11.2.1. Medium Term Storage (MTS):** A total of 437 accessions including M&APs, cultivated rice and other agri-horticultural crops (364 accessions collected by NBPGR Base Center, Cuttack and 73 accessions of multi-crop received from OUAT, Bhubaneswar) deposited as voucher specimen in MTS at NBPGR, New Delhi.

**11.2.2. Long Term Storage (LTS):** A total of 590 accessions comprising cultivated rice (450), wild rice (85), pigeon pea (12), minor millets (8), mustard (13), horsegram (4), sesame (1), linseed (1), finger millet (2), cowpea (1), great millet (2), maize (8), pearl millet (1) and

**Table-2: Range of variability in collected germplasm of cultivated rice**

| Characters               | Mean  | Range   |         |
|--------------------------|-------|---------|---------|
|                          |       | Minimum | Maximum |
| Plant ht. (cm)           | 50.80 | 159.22  | 88.50   |
| Leaf length (cm)         | 18.80 | 59.00   | 35.97   |
| Leaf width (Cm)          | 0.60  | 1.30    | 1.06    |
| No. of effective tillers | 2.00  | 23.0    | 8.65    |
| Panicle length (cm)      | 14.42 | 31.92   | 21.63   |
| Days to 50% flowering    | 53    | 91      | 71.15   |
| Days to maturity         | 84    | 124     | 112.16  |
| Grain length (mm)        | 4.00  | 7.10    | 5.72    |
| Grain width (mm)         | 1.50  | 2.80    | 2.21    |
| L/W ratio                | 1.45  | 3.93    | 2.62    |
| 100 grain wt. (g)        | 1.01  | 3.15    | 2.15    |

ginger (2) were deposited for LTS in the National genebank at NBPGR, New Delhi.

### **11.3 Germplasm Maintenance**

A total of 3393 accessions comprising 2784 accs. of cultivated rice, 41 accessions of pulses, 153 accessions of wild rice , 198 accessions of

M&APs, 150 accessions of spices, 17 accessions of banana, 2 accessions of vegetable crops, 2 accessions of root and tuber crops, 19 accessions of betel vine, 2 accessions of horticultural crops, 1 accessions of plantation crop and 24 accessions of economic plants are maintained at NBPGR Base Center, Cuttack.

#### **Research Project (Code: Title, Project Leader; Associate)**

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

## 12. REGIONAL STATION, HYDERABAD

**Summary:** A total of 23,038 samples comprising 10,884 of import samples and 12,154 of export samples were processed for quarantine clearance and 184 phytosanitary certificates were issued. Several important pests were intercepted. A total of 2,198 import samples were infested/infected with pests/pathogens, and 2,012 samples could be salvaged. One hundred and eighty-six samples infected with pathogens could not be salvaged and hence rejected. In exports, 241 samples were rejected due to the detection of important pests/pathogens and lack of viability. Quarantine service was extended to 27 organizations in south India. During the period about 1,141 accessions of different agri-horticultural crops and wild species were sown/ maintained for evaluation/ rejuvenation/ multiplication. A total of 17 explorations were conducted to collect germplasm of paddy pearl millet, small millets, pulses, niger, *Pongamia* sp., tuber crops, ginger, turmeric, grapes and, medicinal and aromatic plants. During these explorations, a total of 2,322 accessions of different crops and their wild relatives were collected. A total of 8,880 samples of different agri-horticultural crops were added to the medium-term storage module during 2003 making a total of 43,760 germplasm samples conserved as on 31.12.2003.

### 12.1 Quarantine

A total of 23,038 samples of different crops were received and processed for quarantine clearance. Out of these, 10,884 samples (paddy- 4,024; maize-2,135; sorghum-209; pearl millet-420; chickpea-435; groundnut-165; soybean-517; sunflower-235; cotton-300; brinjal-422; tomato-633; okra-318; chilli-467; *Cucumis melo*- 225; *Citrullus* spp.-292; tobacco-52 and others-35) were imported from different countries and 12,154 (sorghum-1,981; pearl millet-1,244; minor millets-94; chickpea-5,424; pigeonpea-537 and groundnut-2,874) were meant for export to different countries.

**12.1.1 Import quarantine:** Particulars of import germplasm received from different CG centers / IARC's or others are given as under:

| Source                          | No. of accs.* |
|---------------------------------|---------------|
| CG centers (IRRI/ICARDA/CIMMYT) | 4240          |
| IARC's (AVRDC)                  | 33            |
| Others                          | 6611          |
| <b>Total</b>                    | <b>10884</b>  |

\* Each sample represented an accession

**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 pathogens intercepted during the reporting period are as given in Table 1.



Groundnut accession (ICG 8200) showing resistance to pod bud necrosis virus and TVS on sap inoculations

**Imports processed and released:** A total of 10,617 import accessions (including previous consignments) of paddy (4,024), maize (1,756), sorghum (209), pearl millet (129), *Eragrostis*



**Table-1.** Important pathogens intercepted

| Crop                  | Pathogen   | Country        |
|-----------------------|--|----------------|
| Maize                 | <i>Fusarium solani</i> , <i>F. oxysporum</i> and bacteria  | Argentina, USA |
| Sorghum               | <i>Drechslera sorghicola</i>   | USA            |
| Pearl millet          | <i>Cercospora</i> sp.  | USA            |
|                       | <i>Pyricularia setariae</i>  | Eritrea        |
| Chickpea              | <i>Botrytis cinerea</i>  | USA            |
| Groundnut             | <i>Burkholderia solanacearum</i>   | Niger          |
| Soybean               | <i>Peronospora manshurica</i>  | USA            |
| Sunflower             | <i>Alternaria helianthi</i>  | France         |
| Wild safflower        | <i>Botrytis</i> sp.  | Germany        |
| Cotton                | <i>Rhizoctonia solani</i> and <i>Fusarium solani</i>   | USA            |
| Brinjal               | Unidentified bacteria  | USA            |
| Tomato                | <i>Rhizoctonia solani</i>  | USA            |
| Abelmoschus sp.       | <i>Fusarium solani</i>   | USA            |
| Chilli                | <i>Rhizoctonia solani</i> , <i>Colletotrichum capsici</i> and unidentified bacteria                      | USA            |
| <i>Citrullus</i> spp. | <i>Fusarium solani</i> , <i>Rhizoctonia solani</i> , <i>Colletotrichum</i> sp. and unidentified bacteria | USA            |

(365), chickpea (493), cowpea (18), *Brassica* spp. (11), soybean (507), sunflower (239), castor (3), safflower (1), cotton (300), brinjal (446), tomato (668), okra (318), chilli (456), *Cucumis melo* (228), *Citrullus* sp. (291), tobacco (135) and others (20) were released to the consignees after giving the mandatory treatments.

Total number of samples infested/ infected in imports - 2198

Samples infected with pathogens - 1288

Insects - 23  
 Nematodes - 887  
 Number of samples salvaged - 2012  
 Number of samples detained/rejected - 186

The following germplasm accessions were detained/rejected due to the reasons given below:

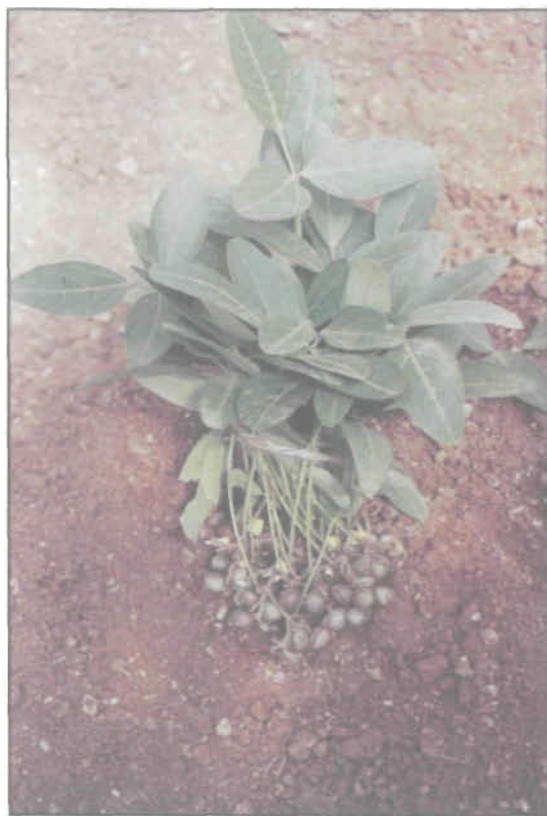
Two accessions of bambara groundnut from UK, sent by NRCG, Junagadh, were grown in the quarantine greenhouse and no seed-born virus was detected. Harvested accessions were released.

| Crop                 | No. of samples | Country   | Reason for rejection/detention              |
|----------------------|----------------|-----------|---|
| Maize                | 3              | Argentina | <i>Fusarium solani</i> ; <i>F.oxysporum</i> |
| Pearl millet         | 1              | Eritrea   | <i>Pyricularia setariae</i>                 |
| Groundnut            | 164            | Niger     | <i>Burkholderia solanacearum</i>            |
| Soybean              | 10             | USA       | <i>Peronospora manshurica</i>               |
| Chilli               | 7              | USA       | <i>Colletotrichum capsici</i>               |
| <i>Citrullus</i> sp. | 1              | USA       | <i>Colletotrichum</i> sp.                   |
| <b>Total</b>         | <b>186</b>     |           |   |

**Post-entry quarantine observations :** No exotic pest was detected during post-entry quarantine inspections held at ICRISAT and other private organizations. However, the following important pathogens were detected and necessary precautions were taken to restrict the spread of the same. The details are given as under:

PEQ inspection of pearl millet accessions (29) from Eritrea was carried out at weekly intervals at ICRISAT, Hyderabad. Severe rust (*Puccinia penniseti*) infection was noticed in all the accessions except in two the severity was very meager. The panicles of harvested pearl millet accessions were inspected and six out of 29 accessions were infected with smut (*Tolyposporium penicillariae*). Yellow mosaic and sterility mosaic symptoms were noticed in some accessions of the pigeonpea germplasm. The affected plants were removed and burnt. Downy mildew (*Peronosclerospora sorghi*), zonate leaf spot (*Gloeocercospora sorghi*), leaf blight (*Exserohilum turcicum*) and maize stripe virus symptoms were recorded on some sorghum accessions from Columbia, grown in PEQIA of ICRISAT. The downy mildew and maize stripe virus affected plants were incinerated. PEQ inspections of crop germplasm (1055 accessions) meant for different private organizations were carried out at the active crop growth stage by pathologists from this Regional Station during the period.

**12.1.2 Export Quarantine:** Out of 12,154 samples meant for export to various countries, 241 samples were rejected due to the association



Bambara groundnut (imported from UK) bearing pods under quarantine glasshouse

of various pests and pathogens. In all, 184 phytosanitary certificates were issued. The details are given as under:

| Crop          | No. of Samples*      |                  |                      |
|---------------|----------------------|------------------|----------------------|
|               | Received             | Rejected         | Released             |
| Sorghum       | 1981 (1821)          | 23(23)           | 1958(1798)           |
| Pearl millet  | 1244 (1184)          | 19(19)           | 1225 (1165)          |
| Small millets | 94 (94)              |                  | 94 (94)              |
| Chickpea      | 5424 (2801)          | 114 (87)         | 5310 (2714)          |
| Pigeonpea     | 537 (529)            | 18(18)           | 519(511)             |
| Groundnut     | 2874 (2481)          | 67(49)           | 2807 (2432)          |
| <b>Total</b>  | <b>12,154 (8910)</b> | <b>241 (196)</b> | <b>11,913 (8714)</b> |

\* Figures in parentheses indicate number of accessions

**Export interceptions:** Majority of chickpea accessions were infected with gram-negative bacteria and fungal pathogens, viz., *Rhizoctonia bataticola* and *Fusarium oxysporum*. The rejections in the export germplasm of ICRISAT mandate crops were mainly due to lack of viability, bacteria, *F. oxysporum*, *F. poae*, *F. solani*, *R. bataticola*, *R. solani*, *Sclerotium rolfsii*, *Botrytis cinerea*, *Colletotrichum* sp. and *Acremonium strictum*, *Cercospora* sp., *Pyricularia oryzae*, *Botryodiplodia theobromae* etc. on various crops. Some samples were rejected due to lack of necessary documents like DARE certificate, back history and FAO trust.

Organisations that received quarantine service from NBPGR, Hyderabad

**CGIAR institute-ICRISAT-** Patancheru, Hyderabad

**ICAR institutes-** Directorate of Rice Research, Directorate of Oilseeds Research and National Research Centre for Sorghum, Hyderabad; Central Tobacco Research Institute, Rajahmundry; Indian Institute of Horticultural Research, Bangalore.

**Universities/ State Government Organizations-** Acharya NG Ranga Agricultural University, Hyderabad; Tamil Nadu Agricultural University, Coimbatore; Kerala Agricultural University, Palghat; University of Agricultural Sciences, Bangalore; Regional Research Station, Mandya; Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal.

### **Private Industries**

**Hyderabad:** Vibha Agrotech India Ltd.; PHS Agritech Pvt.Ltd.; MAHYCO Ltd., Medak ; Pioneer Overseas Corporation Pvt.

Ltd.; Bioseed Research India Ltd.; Nusun Genetic Research Ltd.; Paras Extra Growth Seed Ltd.; JK Agri Genetics, and Pradhama Biotech Ltd.

**Bangalore:** Advanta India Pvt. Ltd., ; Monsanto Technology India Ltd.; Metahelix Life Sciences; Pioneer Overseas Corporation Pvt. Ltd and Greentech Seeds Pvt. Ltd.

**Salem:** Rasi seeds Pvt. Ltd.,

## **12.2 Plant Genetic Resources Activities**

### **12.2.1 Exploration and germplasm collection:**

During the period under report, 17 explorations were conducted and a total of 2,322 accessions of crop germplasm including medicinal and wild plant species were collected from the South East Coastal Zone and the details of which are given below.

**Paddy:** The survey for paddy germplasm was undertaken in collaboration with ANGRAU/OUAT/IGKV in the high altitude tribal pockets in eastern ghat areas in the deccan peninsula, mainly in the districts of East Godavari, Visakhapatnam and Vizianagaram of north coastal Andhra Pradesh and Koraput of Orissa and Bastar, Kanker and Dantewada of Chattisgarh. A total of 220 accessions of paddy germplasm and 62 accessions of other crops were collected. The landraces collected include among others **Atia, Badshah Bhog, Baghthado, Barangi Chudi, Basua Bhog, Bata Mokdo, Batta Dhan, Bayagunda, Bhus Katia, Botta Dhan, Budama, Chipti, Chudi Dhan, Ekhlo, Gada Khuta, Goyandhi Dhan, Haldi Ghati, Jadanga, Chudi, Kakdo, Kanai, Kursu Bhog, Lal Hazari, Lal Mhokudo,**

**Lalu, Limalosiri, Mach Kanta, Meraka Vari, Mettu Sundari, Mokhdo, Nalla Budama, Neem Chudi, Pārbhat Jera, Samudro Chila, Sofiri, Sunasheri and Umer Chudi.** Significant variability was observed for plant height (short/ medium/ tall/ very tall), panicle length, size, no. of panicle branches, grains/panicle, glume colour (black, brown, dark brown, purple) seed length, grain type, kernel colour (white, red, brown), maturity (very early; early, middle, late, very late), tolerance/resistance to different biotic (blast, loose smut) and abiotic (moisture, drought) stresses etc..

**Pearl millet:** A survey was conducted to collect pearl millet germplasm from southern coastal and Rayalaseema regions of Andhra Pradesh. A total of 40 accessions, comprising pearl millet (35) and other crops (5) were collected. Important landraces collected from this region were **Pedda Sodda, Kammi Sodda, Edagaru Sodda/Budda Sodda/Pichhuka Sodda** and **Natu Sodda**.

**Small millets:** An exploration was undertaken for collection of small millet germplasm in the Srikakulam and Vizianagaram districts of Andhra Pradesh. Two hundred and fifty accessions of small millets along with pulses were collected. Variability was noticed in seed colour in finger millet, little millet, barnyard millet, Italian millet and sorghum.

**Pulses:** One survey was undertaken in Rayalaseema and South Coastal regions of Andhra Pradesh. In all, 80 accessions consisting of rice bean (7), cowpea (20), blackgram (11), greengram (4), pillipesara (11), pigeonpea (10), beans (9) and chickpea (6), paddy (1) and sorghum (1) were collected. Twenty one mandals and 31 villages in four districts of

Prakasham, Nellore, Cuddapah and Chittoor were surveyed for the variability.

Another survey was conducted in the Telangana region of Andhra Pradesh (Fig.3). This resulted in collection of 404 accessions, which include blackgram (110), greengram (111), cowpea (39), and chickpea (18). Paddy (27), sorghum (40), minor millets (18), Sesame (17) and vegetables (24) were also collected. Important collections were yellow-seeded greengram, red-seeded blackgram, black-seeded greengram, paccha jonna, konda jonna and *Oryza rufipogon*.

**Niger:** The survey for collection of niger germplasm was conducted in collaboration with All India Coordinated Research Project (Sesame & Niger), JNKVV, Jabalpur in parts of Telangana and Rayalaseema regions comprising Medak, Ranga Reddy, Mahaboobnagar and Chittoor districts of Andhra Pradesh during November 2003. A total of 287 accessions of germplasm consisting of niger (103), sesame (81), and other crops including wild, medicinal plant species (103) were collected.

**Tuber crops:** An exploration was conducted in the coastal districts of Andhra Pradesh for the collection of tuber crops. In all, 86 accessions belonging to *Amorphophallus* (18), *Alocasia* (6), *Colocasia* (21), *Dioscorea* (26), sweet potato (9) and others (6) were collected.

**Grape:** An exploration survey was undertaken for the identification of variability in grape germplasm in the Telangana region of Andhra Pradesh during second fortnight of February 2003. About 46 grape growing gardens in Rangareddy, Mahboobnagar and Medak districts of Andhra Pradesh were visited and 12 varieties were identified, which are being cultivated in the region. Out of these, two varieties, viz.,

Thompson Seedless and Taj-eh-Ganesh are occupying >95% of the area. Only nine accessions were collected and are being maintained.

**Medicinal and aromatic plants:** Two special missions were conducted in this region during the period under report for the collection of medicinal and wild plant species in Nallamalai hills of eastern ghats during first fortnight of January 2003 in which a total of 252 accessions of medicinal plants germplasm and other crops were collected. The important medicinal and wild plant species collected are *Gymnema sylvestre*, *Ceropegia* sp., *Pueraria tuberosa*, *Abrus precatorius*, *Asparagus racemosus*, *Chlorophytum arundinaceum*, *Entada pursaetha*, *Piper* sp., *Scilla indica*, *Centella asiatica*, *Andrographis paniculata*, *Gardenia* sp., *Oryza* sp., *Rhynchosia* sp., *Crotalaria* sp., *Luffa acutangula* var. *amara*, *Phyllanthus* sp., *Strychnos nux-vomica*, *Strychnos potatorum*, *Hemidesmus indicus*, *Zingiber roseum*, *Viscum* sp., *Hibiscus radiata* etc.

Another special mission for the collection of medicinal plant germplasm was undertaken in the Tirumala hill range of eastern ghats, Andhra Pradesh. A total number of 205 accessions of medicinal, endangered and endemic plants were collected. The important species collected were *Cycas beddomei*, *Boswellia ovalifoliata*, *Rhynchosia beddomei*, *Strychnos potatorum*, *S.nux-vomica*, *Euphorbia fusiformis*, *Cissus* sp., *Kalanchoe pinnata* etc.

**Henna (Mehendi):** The survey for *Mehendi* germplasm was undertaken during November, 2003 in Visakhapatnam district of Andhra Pradesh. A total of 61 accessions including *Mehendi* (50), sorghum (1), pulse crops (8),

cotton (1), and medicinal plants (1) were collected during the survey. Variation was observed in leaf shape, fruit shape and seed shape in the collected germplasm.

**Pongamia:** During the period under report five exploration missions were undertaken in parts of Andhra Pradesh covering Adilabad, Mahaboobnagar, Chittoor, Kurnool Srikakulam, Vizianagaram and Visakhapatnam districts. These explorations resulted in the identification of 161 plus trees with rich variability with regard to the number of kernels per pod, pod size, leaflet number etc. Oil extracted from the seeds of pongamia trees is used as a diesel substitute, i.e., "Biofuel". Thirty-seven accessions of medicinal and wild plant species were also collected in one of the surveys undertaken for the *Pongamia* germplasm.

**Ginger and Turmeric:** An exploration was undertaken during February 2003 in collaboration with ANGRAU in the North Telangana districts comprising Rangareddy, Medak, Nizamabad, Adilabad, Karimnagar and Warangal districts of Andhra Pradesh for collection of endemic diversity in ginger and turmeric germplasm. In all, 193 accessions consisting of ginger (25), turmeric (83) and 85 accessions of different agri-horticultural/ medicinal/wild species were collected in the above survey. Important local types collected in ginger include **Kohir, Pattanbi, Deshi allamu and Manchiallamu and Armoor, Barrepasupu, Jatipasupu, Mydukuru, Deshawali and Duggirala** in turmeric. Diversity was observed in turmeric with regard to size and shape of mother rhizomes, branching, size and length of gingers, internodal distances and inside and outside colour. In ginger,

variability was mainly observed for rhizome size, branching and compactness, fibrousness and frequency.

### 12.2.2 Germplasm Evaluation

**Maize:** Two hundred accessions of maize were characterized and evaluated. Several accessions were affected with downy mildew and these were uprooted and incinerated to avoid further spread. Range of variation recorded for different quantitative traits included: no. of tassel branches (6-29), plant height (106-279 cm), ears/plant (1-2), days to tasselling (36-72), days to silking (40-82) and days to maturity (78-111). IC-332069 was the early accession (36 days) to tassel, while IC-332070 was recorded for early silking (40 days).

**Blackgram:** Three hundred accessions were characterized and evaluated during kharif 2003. Some accessions performed better over checks for different traits.

NATP collections of blackgram germplasm (165 accessions), received from NBPGR, New Delhi, were sown for initial multiplication prior to evaluation. Out of the 94 accessions that germinated, several did not flower. A total of 470 accessions of blackgram germplasm received from NBPGR New Delhi were sown along with three checks T-9, LBG-20, PU-19 for characterisation and evaluation in rabi 2003-04.

**Brinjal:** Thirty-seven accessions of brinjal were characterized and evaluated. Range of variability was observed for traits as plant height (15-73 cm), plant spread (29-105 cm), no. of primary branches (1-7), fruit length (1.8 – 23 cm), fruit width (2-24 cm), no. of clusters/plant (1.8-12), fruits/plant (3.1-20) and days to 50% flowering (85-145). Eighty-two accs. of new



IC 261008 collected from Khammam district of AP, to yield higher number of fruits per plant.

NATP collections have been transplanted in ABD with Bhagyamati and Syamala as check varieties for characterization, evaluation and multiplication. Data is being recorded for 40 descriptors consisting of plant, flower and fruit characters.

**Tomato:** Twenty-one accessions of tomato germplasm lines were transplanted for characterization and evaluation during rabi 2003-04.

**Chillies:** Two hundred and six accessions of chillies were characterized and evaluated. Good range of variation was observed for various quantitative traits as stem length, stem diameter, plant height, plant canopy width, no. of branches, days to 50% flowering and days to maturity. Another set of 143 accessions sown for evaluation during kharif 2003. In addition, nineteen accessions of released chilli varieties are also being characterized and evaluated to generate information for supplementing the molecular finger printing work.

**12.2.3. Germplasm conservation:** A total of 8,880 samples of different agri- horticultural

crops were added to medium term module at the station during the year 2003 making a total

of 43,760 samples, the details of which are given as under:

| Crop / Category                          | Number of samples added during 2003 | Total samples in MTM* |
|--|-------------------------------------|-----------------------|
| Blackgram                                | -                                   | 710                   |
| Brinjal                                  | 355                                 | 6116                  |
| Tomato                                   | -                                   | 304                   |
| Chillies                                 | 370                                 | 3021                  |
| Voucher samples                          | 6637                                | 30848                 |
| <b>Restoration from ICRISAT</b>          |                                     |                       |
| Sorghum                                  | -                                   | 244                   |
| Chickpea                                 | 660                                 | 1168                  |
| Pigeonpea                                | 846                                 | 846                   |
| <b>Collaborating Institutes Material</b> |                                     |                       |
| ANGRAU – paddy, vegetables, sunflower    | 12                                  | 32                    |
| DOR – Sunflower                          | -                                   | 74                    |
| DRR – Paddy                              | -                                   | 258                   |
| CTRI-Rajahmundry (Tobacco)               | -                                   | 139                   |
| <b>Grand Total</b>                       | <b>8880</b>                         | <b>43760</b>          |

\* (Indicates number of samples including duplicates)

Paddy samples (6,484), belonging to Directorate of Rice Research, which had been stored in the MTS, have been returned to them on their request. A set of 4,193 accessions of pearl millet was sent to NBPGR RS, Jodhpur for medium term conservation and utilization in the region.

A total of 1,530 samples of different agri-horticultural crops collected under NATP and 1,787 samples of pre-NATP material were sent for conservation to National genebank, New Delhi.

### Restoration of ICRISAT Germplasm

A total of 7,440 accessions of different ICRISAT mandate crop germplasm was restored and sent to NGB, NBPGR, New Delhi under the “Restoration of germplasm of ICRISAT mandate crops to NBPGR” Project. The details are given as below.

| Crop          | Restored to NBPGR |
|---------------|-------------------|
| Sorghum       | 1680              |
| Pearl millet  | 190               |
| Small millets | 1328              |
| Chickpea      | 204               |
| Pigeonpea     | 1731              |
| Groundnut     | 2307              |
| <b>Total</b>  | <b>7,440</b>      |

### 12.2.4 Germplasm Distribution

Supplied to Indentors for crop improvement

- A total of 1,078 germplasm accessions consisting of pigeonpea (472), groundnut (371) and pearl millet (235) were sent to 11 plant breeders in the country.
- Sixteen accessions of brinjal germplasm were supplied to Allahabad Agricultural Institute (AAI), Allahabad (10) and Fruit Research Station, Aurangabad (6).

- Thirty-three accessions of tomato were supplied to ANGRAU (25) and AAI (8).
- Twenty-one accessions of chillies were supplied to AAI (6), MLK (PG) College Balrampur (12) and Central Institute of Tropical Horticulture (3).

**Supplied to cooperators for multiplication and conservation:** A total of 2860 accessions of various crops were distributed to different organizations for multiplication and conservation.

**Germplasm distributed to NAGS:** A total of 2211 accessions of different agri-horticultural crops, collected in the SEC zone under NATP (PB) was distributed to different NAG sites for multiplication and conservation.

**Phenological calendar** of 175 tree taxa and 560 herbaceous taxa of Eastern Ghats was compiled.

**Unique accessions of germplasm Information** collected under NATP (PB) from the SEC zone has been compiled.

## 12.3 Supportive Research

**12.3.1 First report of Cyst nematode on castor:** Soil and root samples, collected from castor fields of Boddupalli village of Nalgonda district yielded the presence of *Heterodera* cyst nematode. This is the first report of occurrence of cyst nematode on castor. Host range studies revealed that blackgram, castor and pigeonpea are good hosts of this nematode while cluster bean, chillies, tomato and potato are non-hosts. In the screening of 27 castor lines against castor cyst nematode, all lines were susceptible. Sunflower and maize found were to be non-hosts for the castor cyst nematode. In a recent survey, reniform nematode problem on cotton was

recorded from Gumdampadu and Gangavaram villages of Kurnool district in Andhra Pradesh. Soil and root samples (4), collected from *Chlorophytum* fields in Zahirabad village yielded the presence of root-knot nematode (*Meloidogyne javanica*).

**12.3.2 Biotic stresses: Screening and identification of sources for resistance against powdery mildew (*Leveillula taurica*) in chilli germplasm:** Field screening of chilli germplasm was done against powdery mildew for two consecutive seasons (153 accessions in 2001-02 & 209 [153+56] in 2002-03) at this station. Three promising accessions viz., IC-276569, IC-276574 and IC-257814 without manifesting any disease symptoms consecutively for two seasons when compared with other germplasm accessions and the check varieties viz. *Arka Abhir*, *CA-235*,



*Capsicum baccatum* accession (IC-276569) showing resistance to powdery mildew.

*CA-930*, *G-4* and *Pusa Jwala* during 2001-02 and 2002-03 were identified. Another accession, *IN-57* was also promising against the disease while on evaluation during 2002-03.



On artificial inoculation, out of the four accessions, two accessions viz. IC-276569 and IN-57 were completely free from the disease (presence of only the initial inoculum noted) apparently by their ability to inhibit the intake and multiplication of the powdery mildew spores on the leaf surface.

- First observation on anthracnose disease was recorded on 143 accessions of chilli (sown during rabi 2003) that are being grown in the field for characterization and evaluation.
- Seven sunflower lines out of 95 were field promising to TSV and they were sown for laboratory screening.
- Incidence of anthracnose and leaf spot was recorded on 112 beans accessions. Out of 112 accessions, resistance source was found in 34 accessions for aphids and fungal diseases.

**12.3.3 Treatment Schedules: Seed to seed transmission of *Rhizoctonia bataticola* infecting groundnut:** Harvested groundnut seeds of 10 accessions were plated in PCA medium to test transmission of *R. bataticola* to next generation. A total of five accessions showed infection ranging from 5 to 36% indicating seed to seed transmission in groundnut. Root bits of all 10 accessions were also tested positive.

**Eradication of *R. bataticola* from groundnut seeds:** Six treatments were tried viz., thiram, benomyl, carbendazim, captan, benomyl + thiram and carbendazim + thiram. The dose was 2g a.i. / kg of seeds. The combination of carbendazim + thiram was the best showing nil infection in lab test and no pre- and post-

emergence damping off in glass house without affecting seed germination.

**Longevity of *Rhizoctonia bataticola* infected groundnut seed in storage:** Longevity studies on ten groundnut samples infected with *R. bataticola*, stored at 20°C revealed that there was no change in the infection percentage.

**Detection and identification of seed rotting bacteria in chickpea:** Five detained chickpea samples of export germplasm that were heavily infected (60-80%) with seed rotting bacteria were selected to detect and identify the causal bacteria responsible for rotting. Two methods, viz., direct seeding on the nutrient agar medium and seed soak method, were employed to isolate bacteria from the infected seed. Seed soak method could not be proved successful in recovering bacteria. The bacterial cultures from seeds were purified and gram staining revealed the presence of gram negative bacteria in two cultures and gram positive bacteria in the remaining cultures. The two gram negative bacteria were identified as *Pseudomonas* spp. It was observed that the germination was not hampered when the seeds were associated with gram negative bacteria.

**Seedling blackening and rot in sunflower:** Sunflower accessions from USA have shown symptoms of seedling blackening and severe rot in the blotter test. Bacterium was isolated from the infected portions and was identified as *Burkholderia cepacia* based on the cultural, physiological and biochemical tests.

**NATP-IMV: Integrated virus disease management in urdbean and mungbean**

On farm trials on integrated virus disease

management in urdbean were undertaken in three fields at Wanaparthy, one field each in Singarajupalli, Pedamaduru and NBPGR experimental fields. The crop was good in one field at Wanaparthy. PBNV incidence in these fields in IPM and sole crop (farmer's practice), 30 days after sowing was 3.4% and 15.7%, respectively. Yield data were taken on on farm trial conducted at Wanaparthy. Integrated virus management field yielded 419.6 kg/ha whereas sole crop yielded 300 kg/ha. The PBNV incidence in NBPGR field in IPM and sole crop was 11.8% and 5.2%, respectively. Observations on PBNV incidence at Pedamaduru showed 6.22% incidence of PBNV in integrated virus management field and 8.16% in the sole crop field (farmer's practice). Fifteen each of mungbean and urdbean cultivars were screened against PBNV and none of them were resistant.

In an on-farm trial on mungbean organised at Jonnalagadda village of Guntur district, the disease incidence was much lower in IMV fields when compared to the control field. Incidence of ULCV was nil in all the fields. the on-farm trials organised in two fields at Wanaparthy, Warangal there were no significant differences in PBNV incidence between IMV and the control (sole crop) plots. The NATP-IMV trial, conducted at this Regional Station, the IMV plot showed superiority in recording less disease incidence (25.06% PBNV & 0.7% MYMV) than the control plot (35.9% PBNV & 2.09% MYMV). Incidence of ULCV was nil in both the fields.

Blackgram germplasm (345 accessions) being evaluated in the field showed PBNV incidence

of 40.5% (LBG-20) to 81.3% (SKN-67). Greengram germplasm (92 accessions) showed PBNV incidence of 6.2% (CN 8073) to 75.0% (CN 9018). None of the blackgram or greengram accessions was resistant. However, 26 accessions of greengram accessions exhibited good stand in the field despite PBNV infection.

#### **NATP-PSND: An integrated approach to the control of stem necrosis of groundnut**

Seeds of Early Ramshorn (168) and sunflower (238) collected from TSV infected plants were tested for seed transmission. None of the germinated plants showed visible symptoms or positive for TSV in ELISA test. The three isolates of TSV from groundnut, sunflower and marigold were sap inoculated onto a set of differential hosts. The groundnut isolates showed differences in the severity in the host reaction. *Parthenium* samples collected from surrounding areas of irrigated fields (350) and growing under rainfed condition (256) showed TSV infection percentage of 43.14 and 35.93, respectively.

Screening of 25 ICGV lines against tobacco streak virus (TSV) and 20 ICGS lines against both peanut bud necrosis virus (PBNV) and tobacco streak virus (TSV) by sap inoculation was done under greenhouse conditions. All ICGV lines were susceptible to TSV. ELISA and indicator plant testing against TSV and PBNV were done for 12-suspected groundnut samples brought from Kadiri, Anantapur. Of the 12 samples, seven were positive for TSV and one for PBNV. *Parthenium* plants (90) at NBPGR farm were indexed for TSV in ELISA, assayed

onto indicator hosts and 15 plants were identified for TSV seed transmission in *Parthenium*.

All 69 advanced groundnut-breeding lines screened against PSND by sap inoculation, were susceptible.

**Screening of 31 wild *Arachis* spp.** against peanut bud necrosis virus (PBNV) and tobacco streak virus (TSV) by inoculation was done under greenhouse conditions. Of the 20 accessions, ICG-8200, ICG-8186 and ICG-11564 were found to be resistant to PBNV while none of the accessions was resistant to TSV.

### **Research Projects (Code: Title, 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: Augmentation, 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: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of agricultural crops (cereals, millets, pulses, oilseeds etc.) and their wild relatives. (Kamla Venkatesh Waran)

PGR/PQR-BUR-HYD-02.02: Augmentation, 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:** Seven multi-crop exploration trips were undertaken to various parts of Gujarat, Haryana and Rajasthan. In all, 333 collections were made. These collections comprised cereals (76), psuedocereals (18), millets (2), pulses (100), oilseeds (5), vegetables (23), fruits (12), spices (11), fibre (1), medicinal and aromatic plants (69), multi-purpose trees (8), forage grass (1), and ornamentals (7). Vegetatively propagated material (32) was also collected which is being maintained in the field. Observations were recorded on the rabi crops (832 accessions) and the kharif crops (3117 accessions). A set of 1219 accessions comprising wheat, barley, chickpea, brassica, *Carthamus*, coriander, cumin, fenugreek, Isabgol and taramira were sown along with checks during rabi 2003. Horticultural plants and plants of economic importance were maintained and data were recorded in *Capparis deciduous*, jamun, mulberry, *Salvadora* sp., *Aloe barbadensis*, *Andrographis paniculata*, *Jatropha curcas* and jojoba. In all, 8877 accessions were processed and kept in the MTS facility and 262 accessions were sent to the LTS. Seed samples (8072) have been supplied to various indentors on request.

### 13.1 Exploration and Collection

Seven exploration trips were undertaken to various parts of Gujarat, Haryana and Rajasthan (Table 1). All seven trips were multi-crop. In all, 333 collections comprising cereals (76), pseudocereals (18), millets (2), pulses and legumes (100), oilseeds (5), vegetables (23), fruits (12), spices (11), fibre (1), medicinal and aromatic plants (69), multi-purpose trees (8), forage grasses (1) and ornamentals (7) were made. Vegetatively propagated material (32) was also collected and these are being maintained in the field (Table 2).



A unique collection of *Solanum melongena* collected from Kharachia region (salt affected area)

#### 13.1.1 Exploration and collection of *Amaranthus* (grain type), barley, chickpea (drought/tolerant from Nagour) and isabgol from parts of Gujarat and Rajasthan

In all, 101 collections comprising *Amaranthus paniculatus* (16), *Lawsonia inermis* (6) and *Plantago ovata* (18) were made from areas of Banaskantha, Kheda, Mehsana, Sabarkantha districts of Gujarat and Ajmer, Banswara, Baran, Barmer, Bhilwara, Bundi, Chittaurgarh, Dausa, Dungarpur, Jalor, Kauroli, Kota, Nagour, Rajsamand, Swaimadhpor, Sirohi, Tonk and Udaipur districts Rajasthan, during April 9 to 22, 2003. A wide range of variability in grain amaranth, barley, chickpea and isabgol was observed. In grain amaranth variability was observed in plant height, hairy/ non-hairy stem; panicle shape, size; colour; seed size and colour. Variability was found in panicle length, seed shape, size, husk colour and thickness in barley. Chickpea showed variability in plant height, pod shape, size and colour, seed coat colour and seed size. Variability was also found in plant height, stem colour dried plant appearance,

**Table-1. Plant exploration and collection undertaken during 2003**

| Areas surveyed (period)  | Crops/ plants collected   | No. of samples |
|--|---|----------------|
| Parts of Gujarat & Rajasthan (Banaskantha, Kheda, Mahsana, Sambarkantha districts of Gujarat and Ajmer, Banswara Baran, Barmer, Bhilwada, Bundi, Chittaurgarh, Dausa, Dungarpur, Jalore, Kauroli, Kota, Nagour, Rajasamand, Sawai madhopur, Sirohi, Tonk, Udaipur districts of Rajasthan (April 19-22, 2003) | <i>Amaranthus paniculatus</i> (16), <i>Brassica campestris</i> (1), <i>Cicer arietinum</i> (8), <i>Hordeum vulgare</i> (52), <i>Lawsonia inermis</i> (16), <i>Plantago ovata</i> (18)   | 101            |
| Kharchia and Sojat area of Pali district of Rajasthan (April 13-15, 2003)  | <i>Allium sativum</i> (1), <i>Anethum sowa</i> (1), <i>Brassica campestris</i> (1), <i>Cassia auriculata</i> (1), <i>Chenopodium album</i> (1), <i>Cicer arietinum</i> (4), <i>Coriandrum sativum</i> (2), <i>Cuminum cyaminum</i> (4), <i>Hordeum</i> (1), <i>Solanum melongena</i> (2), <i>S. surrattense</i> (1), <i>Spinacia oleracea</i> (2), <i>Plantago ovata</i> (1), <i>Trigonella foenum graecum</i> (3), <i>Triticum aestivum</i> l(9)   | 60             |
| Parts of Pali district of Rajasthan (May 2-3, 2003)  | <i>Cicer arietinum</i> (2), <i>Hordeum vulgare</i> (5) and <i>Triticum aestivum</i>   | 13             |
| NW & NE parts and western Rajasthan & parts of Haryana (Bhiwani, Mahendragarh, Hisar districts of Haryana and Ajmer, Alwar, Bikaner, Churu, Dausa, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagour, Sikar districts of Rajasthan). (October 14-16 & 19-23, 2003)   | <i>Bracharia ramosa</i> (1), <i>Citrullus colocynthis</i> (2), <i>Cucumis callosus</i> (1), <i>Cyamopsis tetragonoloba</i> (25), <i>Tribulus pentandrus</i> (2), <i>Vigna aconitifolia</i> (21), <i>V. radiata</i> (5)  | 67             |
| S. K. Nagar district of Gujarat & Barmer district of Rajasthan (November 4-7, 2003)  | <i>Citrullus colocynthis</i> (2), <i>Cyamopsis tetragonoloba</i> (10) and <i>Vigna aconitifolia</i> (10)  | 22             |
| Parts of Udaipur district of Rajasthan (October 17-20, 2003)   | <i>Abelmoschus esculentus</i> (3), <i>Acacia senegal</i> (1), <i>Amaranthus amara</i> (2), <i>Annona squamosa</i> (2), <i>Brassica campestris</i> (1), <i>Capparis deciduas</i> (1), <i>Cucumis melo</i> var. <i>momordica</i> (5), <i>Cucurbita moschata</i> (1), <i>Dolichos lablab</i> (1), <i>Eleusine coracana</i> (1), <i>Lawsonia inermis</i> (1), <i>Luffa acutangula</i> (4), <i>Raphanus sativus</i> (1), <i>Santalum album</i> (1), <i>Sorghum bicolor</i> (1), <i>Sesamum indicum</i> (2), <i>Tamarindus indicum</i> (1), <i>Vigna mungo</i> (1), <i>V. radiata</i> (1), <i>V. unguiculata</i> (2) and <i>Ziziphus nummularia</i> (1) | 37             |
| Parts of Jodhpur (October 10 - November 21, 2003)  | <i>Asacia senegal</i> (3), <i>Aloe barbadensis</i> (3), <i>Catharanghus roseus</i> (4), <i>Cissus quadrangularis</i> (3), <i>Cordia myxa</i> (3), <i>Commiphora wightii</i> (5), <i>Cyamopsis tetragonoloba</i> (1), <i>Delonix regia</i> (1), <i>Jasminum sambac</i> (1), <i>Nerium odorum</i> (5), <i>Prosopis cineraria</i> (3), <i>Saraca indica</i> (1), <i>Tamarindus indica</i> (3), <i>Tylophora indica</i> (1)   | 44             |
| <b>Total</b>   |   | <b>333</b>     |

**Table-2. Vegetatively propagated crops being maintained in the field**

| Plant material               | No. of collections |
|------------------------------|--------------------|
| <i>Acacia Senegal</i>        | 3                  |
| <i>Aloe barbadensis</i>      | 3                  |
| <i>Catharanthus roseus</i>   | 4                  |
| <i>Cissus quadrangularis</i> | 3                  |
| <i>Cordia myxa</i>           | 3                  |
| <i>Commiphora wightii</i>    | 1                  |
| <i>Delonix regia</i>         | 1                  |
| <i>Jasminum sambac</i>       | 1                  |
| <i>Lawsonia inermis</i>      | 5                  |
| <i>Nerium odorum</i>         | 5                  |
| <i>Prosopis cineraria</i>    | 3                  |
| <i>Saraca indica</i>         | 1                  |
| <i>Tamarindus indica</i>     | 3                  |
| <i>Tylophora indica</i>      | 1                  |

inflorescence length, colour and diameter of seed, size and colour in isbagol.

### 13.1.2. Exploration and collection of henna and other species from Kharchia and Sojat area of Rajasthan

In all, 60 samples comprising *Allium sativum* (1), *Anethum sowa* (11), *Brassica campestris* (1), *Cassia auriculata* (1), *Chenopodium album* (2), *Cicer arietinum* (4), *Coriandrum sativum* (2), *Cuminum cyminum* (4), *Hordeum vulgare* (4), *Lawsonia inermis* (22), *Raphanus sativus* var. *mougrii* (1), *Solanum melongena* (2), *S. surrattense* (1), *Spinacia oleracea* (2), *Plantago ovata* (1), *Trigonella foenum-graecum* (3) and *Triticum aestivum* (9) were collected from Kharchia and Sojat area of Pali district of Rajasthan during April 13 to 15, 2003. Variability in plant height, shape and size of leaf, fruit and seed, presence and absence of spine, stem, leaf, fruit and seed colour was observed in henna.



Seed variability in henna collected from Sojat region, Rajasthan

### 13.1.3. Exploration and collection of germplasm from Pali district of Rajasthan

An exploration was undertaken in various parts of Pali district of Rajasthan in collaboration with IHR, Bangalore. In all, 13 accessions comprising *Cicer arietinum* (2), *Hordeum vulgare* (5) and *Triticum aestivum* (6) were collected. Variability in barley was observed in plant height, internodal distance, tillers, panicle length and seed size and shape, colour and husk content. In chickpea, variability in plant height, branching habit, pod shape, size, colour, seed shape, size and seed coat colour and in wheat variability in plant height, tillers, panicle length, seed shape, size and colour was observed.

### 13.1.4. Exploration and collections of cluster bean and mothbean from parts of Haryana and Rajasthan

In all, 67 collections comprising *Cyamopsis tetragonoloba* (35), *Vigna aconitifolia* (21), *V. radiata* (5), *Citrullus colocynthis* (2), *Brachiaria ramosa* (1), *Cucumis callosus* (1) and *Tribullus pentandrus* (2) were collected from Bhiwani, Mahendragarh and Hisar districts of Haryana and Ajmer, Alwar, Bikaner, Churu, Dausa, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagour and Sikar districts of Rajasthan during an exploration trip during October 14-16 and 19-

23, 2003. In cluster bean there was variability in plant height, hairy/ non hairy stem and pods, seed size and colour, pod size and length, plant habit (single stem/ branched) and in mothbean it was variable in plant habit (spreading/ straight), seed and pod colour, number of pods in a bunch and pod size.

### 13.1.5 Exploration and collection of cluster bean, mothbean and tumba from Gujarat and Rajasthan

A total of 22 collections were made which comprised *Citrullus colocynthis* (2), *Cyamopsis tetragonoloba* (10) and *Vigna aconitifolia* (10). Tumba collected from Gujarat was small and found rarely due to over grazing. Cluster bean showed variability in plant height, hairy/ non hairy stem or pods, seed size and colour, pod size and length, plant habit (single stem or branched). Mothbean exhibited variability in plant habit (spreading/ straight), seed and pod colour, number of pods in a bunch and pod size.

### 13.1.6. Collection of multi-crop germplasm from Udaipur district of Rajasthan

The 37 accessions collected during October 2003 comprised *Abelmoschus esculentus* (3), *Acacia senegal* (1), *Amaranthus amara* (2), *Annona*

*squamosa* (2), *Brassica campestris* (1), *Capparis deciduas* (1), *Capsicum annum* (1), *Carica papaya* (1), *Crotalaria juncea* (1), *Cucumis melo* var. *momordica* (5), *Cucurbita moschata* (1), *Dolichos lablab* (1), *Eleusine coracana* (1), *Lawsonia inermis* (1), *Luffa acutangula* (4), *Raphanus sativus* (1), *Santalum* sp. (1), *Sesamum indicum* (2), *Sorghum bicolor* (1), *Tamarindus indicum* (1), *Vigna mungo* (1), *V. radiata* (1), *V. unguiculata* (2) and *Zizyphus nummularia* (1) from Udaipur, Rajasthan during October 17 to 20, 2003.

### 13.1.7. Exploration and collection of multi-crop germplasm from parts of Jodhpur district of Rajasthan

Local exploration trips were undertaken during October 10 to November 21, 2003 in parts of Jodhpur. In all, 33 accessions comprising *Acacia senegal* (3), *Aloe barbadensis* (3), *Catharanthus roseus* (4), *Cissus quadrangularis* (3), *Cordia myxa* (3), *Commiphora wightii* (1), *Cyamopsis tetragonoloba* (1), *Delonix regia* (1), *Jasminum sambac* (1), *Nerium*



Farmers and scientists observing Kharif crops germplasm



Shri Raj Nath Singh Ji Hon'ble Union Minister of Agriculture accompanied by Dr Mangala Rai, Secretary, DARE and DG, ICAR inaugurating office-cum laboratory complex of NBPGR Regional Station, Jodhpur on 1 October 2003

*odorum* (5), *Prosopis cineraria* (3), *Saraca indica* (1), *Tamarindus indica* (3), *Tylophora indica* (1). Seeds were also collected from a 15 feet tall plant of *Cyamopsis tetragonoloba*.

## 13.2 Germplasm Characterisation and Evaluation

### 13.2.1 Agricultural crops in Rabi 2002:

Data were recorded on the following crops sown in rabi, 2002 for various morphological and agronomic parameters as per the descriptor list: *Carthamus oxycantha* (31), Chickpea (8), Coriander (22), Cumin (1), Fenugreek (15), Isabgol (1), Lucerne (1), Taramira (38), Wheat (601) and *Brassica* (1). 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 Kharif 2003:** During Kharif 2003, a total of 3117 accessions comprising bajra (190), castor (155), cowpea (490), guar (603), mung (882), moth (287), til (380) and tumba (130) were sown for characterisation, multiplication and evaluation. Besides, Jodhpur the multi-location trial was carried out in Delhi (for bajra, cowpea and mung) and Akola for castor and til. The crop stand was very good and data as per the descriptor lists were recorded for the crops.

### 13.2.3 Germplasm evaluation during Rabi

**2003:** A total of 1219 accessions comprising wheat (695), barley (257), chickpea (65), *Brassica campestris* (39), *Eruca sativa* (39), coriander (26), cumin (27), fenugreek (21), isabgol (19) and *Carthamus oxycantha* (31)



Women participating in GRLT programme at Udaipur

were sown along with checks during rabi, 2003. Out of these, 610 accessions of wheat and 189 accessions of barley were received from NBPGR, New Delhi for multi-location evaluation. The data are being recorded as per the descriptor list.

**13.2.4 Horticultural plants :** Cuttings of ornamental plants like bougainvillea (160) and others (100) were planted in polybags for multiplication. Cuttings of pomegranate (Jalore seedless) and West Indian cherry were planted for supply. Saplings of mulberry (6), West Indian cherry (1), ornamental plants, *Agave* sp. (3 accessions) and jamun (5 accessions) were also transplanted in the field.

Fruit weight in amla, ber, karonda and lemon were recorded. Plant height, number of branches, canopy, seed size, shape and growth parameters were recorded for jamun (7 accessions), mulberry (13 accessions) and *Salvadora* sp. (6), and 100 seed weight of *Capparis deciduas* was recorded. Plants of the entire ber germplasm were pruned.

**13.2.6 Economically important plants:** In mehendi (henna), seeds of 26 accessions and



**Table-3. Promising accessions identified in various crops during rabi, 2002 and kharif, 2003**

| Crop   | Main attributes            | Accessions identified for specific/ desired traits                 |
|--|----------------------------|--|
| <b>Wheat (695)</b>   |                            |  |
| Checks<br>PBW 383, Raj 3765<br>HD:2733, C-306                        | Plant height < 90 cm       | IC-104563, IC-104614, IC-104626, R-65, W-16, W-28, W-32            |
|  | Yield per plant > 50g      | IC-73491, IC-28875, IC-47451, Hind-62, W-18                        |
|  | 1000 grain weight > 50g    | IC-42403, IC-47535, IC-73575, IC-82402, IC-104573, H-3, H-16, W-49 |
| <b>Pearl millet (221)</b>  |                            |  |
| Checks<br>ICMH-356, CZP-923<br>CZP-9802, HHB-67<br>Pusa-23, Pusa-605 | Plant height > 180.4 cm    | IC-325177, IC-329070, IC-329054, IC-329029, IC-329073, IC-369858   |
|  | Yield/ plant > 25.3 g      | IC-17774, IC-17762, IC-325794, IC-329043, IC-333121, IC-369854     |
|  | 1000 grain weight > 11.3 g | IC-333121, IC- 373564, IC-325760, IC-325825, IC-325831, IC-333179  |
| <b>Cowpea</b>  |                            |  |
| V-240, V-585<br>GC-3   | Plant height (cm)          | C-947, C-1165, C-1219  |
|  | Yield/ palnt (g)           | C-1323, C-1228, C-1229   |
|  | 1000 seed wt. (g)          | C-915, C-921, C-1287   |
| <b>Guar</b>  |                            |  |
| Jadiya, Jwala<br>Maru, RM-40   | Plant height (cm) > 68.2   | IC-325832, IC-369838, IC-324007                                    |
|  | Yield/ plant > 15.0 (g)    | IC-370516, IC-323996, IC-324008                                    |
|  | 1000 seed wt. >2.80 (g)    | IC-326831, IC-325846, ND-135                                       |
|  | Plant height (cm.) >50 cm  | IC-333138, IC-370533, IC-373546, MD-97                             |
|  | Yield/ plant (gm) > 14g    | IC-311415, IC-311427, IC-311396                                    |
|  | 100 seed weight (g) >3.40  | MD-131, IC-311427, IC-311415                                       |
| <b>Mung bean</b>   |                            |  |
|  | Plant height (cm) >55 cm   | IP-01 377, IC-324005, IC-325791                                    |
|  | Seed yield > 16g           | IN-45, VR-22, VA-92  |
|  | 100 seed wt (g) > 5 g      | PNB-5, IN-84, IN-147   |

cuttings of 7 accessions were planted. Sowing of *Jatropha curcas* (33 accessions) and *Andrographis paniculata* (7 accessions), *Balanites aegyptiaca* (7 accessions) and transplanting of *Aloe barbadensis* (4 accessions), *Datura metel* (1 accessions) and *Tinospora cordifolia* (1 accessions) was carried out. Grass tussocks of 19 collections were also transplanted in the field for characterization and 32 samples of *Aloe barbadensis* (8 accessions) were transplanted for multiplication. Cuttings of

*Commiphora wightii* (3 accessions) were planted for gap filling.

Observations were made in *Aloe barbadensis* (12 accessions), *Andrographis paniculata* (7 accessions), *Commiphora wightii* (15 accessions), *Jatropha curcas* and *jojoba* (74 accessions) for various morphological characters. Fruits were harvested from the *Andrographis paniculata* (2), *Commiphora wightii* (15) and *Moringa oleifera* (1) plants established in the field.

### 13.3 Conservation and Maintenance of Germplasm

A total of 8,877 accessions of different crops/plant species were processed and kept in the MTS facility. This included bajra (5458), cowpea (88), ber (2), mung (843), moth (20), guar (203), NATP collections (696), pre-NATP collections (5), *Sesamum mulayanum* (59), *Atriplex* spp. (39), khejri (402), jeera (24), rayda (1), isabgol (1), dhania (23), chickpea (2), methi (16), castor (948), lemon (1), kinnu (1) *Andrographis paniculata* (5) and others (3).

### 13.4 Supply of germplasm

A total of 4,953 accessions (4916- seeds; 37-cuttings/ plants) of the following germplasm were supplied to the various indentors.

**Seed material:** Pearl millet (3192), cowpea (2), guar (170), mothbean (120), mungbean (1,255), castor (102), jojoba (11), kachari (20), *Jatropha* (2), *Lawsonia inermis* (22) and tumba (20).

**Cuttings/ plants:** *Aloe barbadensis* (16), *Commiphora wightii* (15) and *Lawsonia inermis* (6).

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

PGR/GEV-BUR-JOD-01.00: Augumentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources in arid and semi-arid regions (N. K. Dwivedi, K. C. Muneem, N. Bhatnagar).

PGR/GEV-BUR-JOD-01.01: Augumentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of cereals, pearl millet and minor millets in arid and semi-arid regions (K. C. Muneem, N. K. Dwivedi).

PGR/GEV-BUR-JOD-01.02: Augumentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of legumes (cowpea, guar, moth and mung) and oil seed (castor, jojoba, til and tumba) (N. K. Dwivedi, N. Bhatnagar).

PGR/GEV-BUR-JOD-01.03: Augumentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of fodder, forest, fuel, fibre, M&APs and horticultural crops (fruits, ornamentals and vegetables) (N. Bhatnagar, N. K. Dwivedi).

# 14. EXPLORATION BASE CENTER, RANCHI

**Summary:** Two new additions to the National Gene Bank were *Flacourtia indica* and *Aristolochia oncocephalous*. A total of 1,196 samples of different agri-horticultural crops including the wild types were collected during ten explorations.

## 14.1 Exploration and Collection of Germplasm

During the year, ten explorations were undertaken and 1,196 samples of different agri-horticultural crops including wild types were collected. The details of explorations, and accessions collected are given in table 1.

**Table 1: Germplasm of crop plants and their wild relatives collected during 2003**

| Area explored and duration   | Crops  | Coll. |
|--|--|-------|
| Dumka and Jamtara Jharkhand<br>18.2.03 to 25.02.03   | Paddy (36), Maize (9), Ragi (4), Kodo (1), Gundali (1), <i>Sorghum</i> (1), Arhar (7), Kulthi (8), Cowpea (3), Kudrum (6), Sarson (6), Til (2), Niger (1), Cotton (1), Sanai (1), Sponge gourd (2), Ridge gourd (3), Tomato (2), Bitter gourd (1), Bottle gourd (1), Pumpkin (1), Sem (1), Turmeric (1), <i>Mucuna</i> (2) Cucumber (1) & Ber (2)  | 104   |
| Bokaro & Dhanbad district of Jharkhand<br>18.2.03 to 24.02.03  | Paddy (26), Maize (27), Ragi (6), Arhar (16), Urid (4), Mung (1), Kulthi (1), Sponge gourd (6), Ridge gourd (3), Sem (7), Cowpea (1), Okra (1), Bara sem (1), Bottle gourd (1), Sarson (2), Til (1), Cotton (1), Tulsi (1), <i>Datura aiba</i> (1), Imli (1) & Garlic (1)  | 115   |
| Dhanbad and Bokaro dist. of Jharkhand<br>25.2.03 to 3.03.03  | Paddy (7), Maize (7), <i>Sorghum</i> (3), Okra (1), Ratti (1), <i>Amaranthus</i> (2), Poi (1), Ash gourd (1), <i>Brassica</i> sp. (14), Arhar (7), Bora bean (3), Chilli (1), <i>Chenopodium</i> (1), Gram (3), Coriander (2), <i>Costus</i> (1), Cucumber (1), Ragi (1), Cotton (2), Niger (1), Kudrum (2), Sweet potato (1), Bottle gourd (3), <i>Lathyrus</i> (4), Lentil (5), Dhurpi sag (1), Linseed (4), Sponge gourd (3), Horse gram (7), <i>Mucuna</i> (4), Misrikand (1), Small pea (2), Patal kohara (1), Castor (1), Bhelwa (1), Til (2), Spinach (1), <i>Thespesia</i> (1), Black gram (2), Mung (1), Rice bean (2), Cowpea (3)                        | 109   |
| Ranchi, Latehar and Gumla in Jharkhand<br>13.04.03 to 9.04.03  | <i>Lawsonia</i> sp. (35)   | 35    |
| Jehanabad, Gaya, Nawada, Jamui, Nalanda, Luckesarai, Shekhpura districts of Bihar<br>29.04.03 to 4.05.03 | Bottle gourd (23), Bitter gourd (11), Cucumber (8), Amaranth (31), Faba bean (19), Sponge gourd (29), Ridge gourd (13), Satputia (11), Coriander (3), Long melon (6), Cowpea (3), Pea (3), Long bean (2), Sem (2), <i>Hibiscus</i> sp. (1), Snap melon (4), Papaya (1), Sowa (1)   | 171   |
| West Singhbhum of Jharkhand  | Jackfruit (11), Jamun (4), <i>Cordia myxa</i> (1), <i>Madhuca indica</i> (1), <i>Schleichera oleosa</i> (1)  | 18    |
| Jamtara and Deoghar districts of Jharkhand<br>5.08.03 to 12.08.03<br>16.12.03 to 5.12.03                 | <i>Abelmoschus</i> sp. (2), <i>Allium sativum</i> (1), <i>Amaranthus tricolor</i> (1), <i>Brassica</i> sp. (3), <i>Cajanus cajan</i> (4), <i>Capsicum annuum</i> (4), <i>Cicer arietinum</i> (2), <i>Cucurbita maxima</i> (3), <i>Eleusine coracana</i> (3), <i>Hibiscus</i> sp. (1), <i>Luffa acutangula</i> (2), <i>Luffa cylindrica</i> (3), <i>Macrotyloma uniflorum</i> (8), <i>Ocimum</i> sp. (1), <i>Oryza sativa</i> (21), <i>Panicum sumatrense</i> (1), <i>Pisum sativum</i> (1), <i>sesamum indicum</i> (1), <i>Vigna radiata</i> (1), <i>Vigna unguiculata</i> (1), <i>Zea mays</i> (14), <i>Artocarpus heterophyllus</i> (9), <i>Eugenia javanica</i> | 110   |

| Area explored and duration  | Crops   | Coll. |
|---|---|-------|
| Ranchi, Lohardaga, Gumla & part of Simdega district of Jharkhand<br>20.11.03 to 7.11.03 | (2), <i>Syzygium cuminii</i> (1), <i>Aloe</i> sp. (1), <i>Hibiscus</i> sp. ( <i>Lalita sag</i> ) (1), <i>Buchanania lanzan</i> (1), <i>Celastrus paniculatus</i> (1), <i>Cinnamomum zeylanicum</i> (1), <i>Citrus</i> sp. (2), <i>Amorphophallus</i> sp. (1), <i>Marore phalli</i> (1), <i>Khathbel</i> (1), <i>Tephrosia purpurea</i> (1), <i>Kala jeera</i> (1), <i>Shehara</i> (1), <i>Cawalia (mota)</i> (1), <i>Kamraj</i> (1), <i>Tar mujri</i> (1), <i>Kari jhar</i> (1), <i>Bhui chap</i> (1), <i>Mada Kachur</i> (1), <i>Kapoor kachari</i> (1)  | 185   |
| Ranchi and Purulia districts of Jharkhand & West Bengal<br>20.11.03 to 27.11.03         | Maize (7), Rice (36), Little millet (1), Finger millet (7), Sorghum (2), Cowpea (4), Urd bean (16), Mung bean (3), Pigeon pea (5), <i>Lathyrus sativus</i> (3), Chickpea (1), Lentil (1), Rapeseed mustard (6), Sesame (3), Linseed (1), <i>Hibiscus</i> sp. (5), Jute (3), Ground nut (1), Horse gram (2), <i>Vicia faba</i> (1), Niger (1), Ridge gourd (4), Sponge gourd (2), Bottle gourd (2), <i>Basa alba</i> (1), Ash gourd (1), <i>Dioscorea</i> sp. (2), Amaranth (4), Radish (1), Spinach (1), Pumpkin (1), <i>Colocasia</i> sp. (3), French bean (2), Garlic (1), Turmeric (1), Brinjal (1), <i>Datura</i> sp. (2), <i>Sivlingi</i> (1), <i>Zingiber</i> sp. (1) <i>Panela</i> (1)   | 143   |
| Gärhwa district of Jharkhand<br>16.12.03 to 5.12.03                                     | <i>Abelmoschus esculentus</i> (1), <i>Allium sativum</i> (1), <i>Arachis hypogaea</i> (2), <i>Brassica</i> sp. (7), <i>Cajanus cajan</i> (2), <i>Cicer arietinum</i> (4), <i>Curcuma domestica</i> (1), <i>Datura alba</i> (1), <i>Dioscorea</i> sp. (2), <i>Dolichos biflorus</i> (10), <i>Dolichos lablab</i> (2), <i>Echinochloa frumentacea</i> (9), <i>Eleusine coracana</i> (7), <i>Guizotia abyssinica</i> (2), <i>Hibiscus</i> sp. (5), <i>Hordeum vulgare</i> (6), <i>Lagenaria siceraria</i> (1), <i>Lathyrus sativus</i> (3), <i>Lens esculenta</i> (3), <i>Linum usitatissimum</i> (9), <i>Luffa acutangula</i> (6), <i>Luffa cylindrica</i> (4), <i>Luffa hermaphrodita</i> (2), <i>Martynia diandra</i> (2), <i>Ocimum basilicum</i> (2), <i>Oryza sativa</i> (34), <i>Paspalum scrobiculatum</i> (5), <i>Pisum arvense</i> (2), <i>Pisum sativum</i> (1), <i>Ricinus communis</i> (1), <i>Sesamum indicum</i> (16), <i>Sorghum vulgare</i> (6), <i>Vicia faba</i> (1), <i>Vigna mungo</i> (4), <i>Vigna radiata</i> (9), <i>Vigna unguiculata</i> (2), <i>Zea mays</i> (20), <i>Zingiber officinale</i> (1), <i>Pueraria tuberosa</i> (1), <i>Asparagus racemosus</i> (1), <i>Chlorophytum borivilium</i> (1), <i>Chlorophytum tuberosum</i> (1), <i>Curcuma</i> sp. (1), <i>Urgenia indica</i> (2), <i>Zingiber</i> sp. (1), <i>Khajoor (wild)</i> (1) & wild grape (1) | 206   |

**Crop group-wise collection:** The accessions collected were classified crop group-wise as follows: cereals-312, medicinal plants-39, vegetables-205, spices & condiments- 24, pulses-240, oil seed- 103, minor millets-75, tuber crops-22, minor fruits-39, fiber crops-30, fruits-1, minor vegetables-2, *Lawsonia* sp.-35, millets-

17, pseudo cereals- 38, other-11, wild-3, total-1196.

## 14.2 Germplasm Characterisation and Maintenance

**Field gene bank:** A total of 436 accessions of various horticultural species were maintained in

## Flow of germplasm (exploration wise)

| Exploration code | Collections | Sent to MTS | Field gene bank | NAGS |
|------------------|-------------|-------------|-----------------|------|
| JBT-33/-         | 104         | 104         | 1               | 103  |
| VKG-24/-         | 115         | 114         | 1               | 114  |
| JBT-34/-         | 109         | 109         | 1               | 108  |
| VKG-25/-         | 35          | 0           | 35              | 0    |
| KG-3/-           | 171         | 171         | 1               | 170  |
| VKG-26/-         | 110         | 78          | 32              | 78   |
| JBT-35/-         | 18          | 0           | 18              | 0    |
| JBT-36/-         | 143         | 137         | 8               | 135  |
| VKG-27/-         | 185         | 177         | 8               | 176  |
| JBT-37/-         | 206         | 193         | 14              | 192  |

the field gene bank. These comprise jackfruit (136), barhal (14), jamun (46) bael (53), tamarind (51), Aonla (19), custard apple (37), mango (45), *Lawsonia* sp. (35).

### List of Medicinal Plants collected and maintained at Ranchi

*Abronia 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 orchoides*- 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, *Rauwolfia serpentina*- 5, *Holarrhena antidysenterica*- 1, *Rauwolfia tetraphylla*- 3, *Indigofera tinctoria*- 2, *Semecarpus anacardium*- 2, *Jatropha curcas*- 1, *Smilax* sp.- 4, *Jatropha gossypifolium*- 1, *Sohrea 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 lampus*- 2, *Vanda tasselata*- 3, *Tinospora cordifolia*- 9, *Withania somnifera*- 4, *Typhonium trilobatum*- 3, *Zingiber* sp.- 5, *Cinnamomum zeylanica*- 2. (Total - 291).

**Material deposited in LTS:** A total of 107 germplasm accessions of different crops were deposited in the National Gene Bank. These comprised paddy (78), cowpea (1), green gram

(2), horsegram (2), pea (1), finger millet (18), little millet (1), sorghum (2) and lablab bean (2).

**Material sent to National Active Germplasm Sites (NAGS):** The collected samples were sent to the different National Active Germplasm Sites. The perennial vegetatively propagated material and medicinal and aromatic plants were maintained and multiplied at the NBPGR base centre, Ranchi. The material collected during the year was sent to following organization/ scientists.

Head, Evaluation Division, NBPGR New Delhi, (416 accs.); UUC, NBPGR New Delhi, (65 accs.); Indian Institute of Pulses Research, Kanpur, (161 accs.); Central Rice Research Institute, Cuttack (18 accs.); NBPGR Regional Station, Jodhpur, (3 accs.); AICSMIP, Bangalore (75 accs.); NBPGR Regional Station, Akola (82 accs.); Central Institute of Cotton Research, Nagpur, (4 accs.); Central Research Institute for Jute & Allied Fibers, Barrackpore (26 accs.); Directorate of Oil seed Research, Hyderabad (3 accs.); National Research Institute for Groundnut, Junagarh (5 accs.); National Research Centre on Onion & Garlic, Pune (2 accs.); National Research Centre on Sorghum, Hyderabad, (17 accs.) and NBPGR Plant

Quarantine Station, Hyderabad, (10 accs.).

**The following germplasm is being maintained at the NBPGR base centre, Ranchi:** *Asparagus racemosus* (1), *Abrus precatorius* (1), *Aloe* sp. (1), *Amorphophallus* sp. (1), Angoor wild (1), *Artocarpus heterophyllus* (20), Bhui chap (1), *Buchanania lanzan* (1), *Celastrus paniculatus* (1), Chawlia (mota) (1), *Cinnamomum zeylanica* (1), *Citrus* sp. (2), *Chenopodium album* (1), *Costus speciosus* (1), *Chlorophytum borviliun*(White musali) (1), *Chlorophytum tuberosa*(Black musali) (1), *Cordia myxa* (1), *Colocasia esculentum* (9), *Curcuma* sp. (wild) (1), *Curcuma domestica* (3), *Dioscorea* sp. (6), *Eugenica javanica rosea* (1), *Eugenica javanica alba* (1), *Zingiber* sp. (2), Khajoor wild (1), Kala jeera (1), Kamraj (1), Kapoor kachari (1), Karijhar (1), Khathbel (1), *Lawsonia* sp. (35), Madakachur (1), Marorephalli (1), *Madhuca indica* (1), *Ocimum* sp. (1), *Flacourtia indica* (1), *Pueraria tuberosa* (1), *Schleichera oleosa* (1), Shehara (1), *Semecarpus anacardium* (1), *Syzygium cuminii* (5), *Tamarindus indica* (1), *Tephrosia purpuria* (1), Tar muri (1), *Urgenia indica* (2) & *Zingiber officinale* (1).

### **Research Projects (Project 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. (J. B. Tomar; V.K. 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. (J. B. Tomar; V. K. Gupta)

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

## 15. REGIONAL STATION, SHILLONG

**Summary:** A total of 1,865 accessions of various crop plants and their wild relatives were collected during eight explorations from NEH region. Two special exploration missions Brahmaputra Islands and in Arunachal Pradesh were also conducted. Good variability was collected in paddy, strawberry, wild banana, *Prunus*, *Pyrus*, *Curcuma* and *Cucumis*. A total of 2,545 accessions were characterized and promising genotypes for various attributes identified. Five grassroot level trainings were organized for PGR awareness in NEH region.

### 15.1 Exploration and Collection of Germplasm

Eight exploration trips were conducted and a total of 1,865 accessions collected from the East and West Khasi hills and Ri-Bhoi districts of Meghalaya; Saikhul area of Senapati district, Manipur; Jharnapani, Dimapur, Nagaland; Mamit district of Mizoram and West Tripura. Besides, two special missions were executed in the Brahmaputra river Islands and East, West, and Upper Siang districts of Arunachal Pradesh. Out of these collections, 1,438 accessions were sent to the National Gene Bank for conservation and 427 were retained at the station for seed multiplication in the field gene bank. The Foundation for Development Integration, Guwahati; NRC on Orchids, Sikkim and ICAR NEH, Barapani collaborated in successful execution of different trips. Crop diversity collected during various explorations is given in table 1. Details of the exploration trips and status of collected accessions are as follows:

The first exploration trip was a special mission to Brahmaputra river islands and riverbanks, collaborated by FDI (NGO), Guwahati. During the 58 days (11/02/2003 to 09/04/2003) entire stretch of river Brahmaputra i.e. from Sadiya to Dhubri (27°48.223' N/S to 25°45' N/S & 95°36.095' E/W to 89°60' E/W) was covered. Brahmaputra, one of the longest river systems

in the world covers 981 kms in India and is fed by 90 major tributaries in Assam. Most of the villages adjacent to the river remain inundated at least for 2-3 months during the rainy season. Deuri, Mishing, Sonowal Kachari and Ahoms are the dominant tribes in the course of the river in upper Assam districts. During the trip, 14 districts of Assam were covered and a total of 878 germplasm accessions were collected. Out of these, 767 accessions were deposited to the NGB for conservation and the remaining 111 accessions are maintained in the field gene bank for multiplication. Besides, 150 herbarium specimens and 22 Indigenous Technical Knowledge were documented. During the tour four grassroot level training (GRLT) programmes were conducted.

### Significant collections

- Small-fruited tomato landraces were collected from Lahowal, Dibrugarh.
- Morphological variation was observed in paddy for colour, degree of pubescence in husk, aroma etc.
- Variability in potato was collected.
- *Luffa aegyptiaca* was collected from Kobu Chapori area of Dhemaji district.
- *Macrotyloma uniflorum* and *Spilanthes paniculata* were collected.
- An indigenous leafy vegetable (*Rumex vesicarius*) was collected.

- Traditional weather forecasting system and insect pest management methods among the Mishing tribe of upper Assam and Muslim communities in Dhubri district of lower Assam were recorded
- Seed storage and conservation methods among the inhabitants of Majuli Island and preparation of alcoholic beverages from the wild plants by Ahom, Deuri, Sonowal, Kachari and Mishing tribes of upper Assam were documented.

**Table 1. Crop group-wise germplasm collected from NEH region during 2003**

| Crop Group                       | Crop(s)  | Total accs  |
|----------------------------------|--|-------------|
| <b>Cereals</b>                   | Paddy (474), Maize (76), Wheat (5), <i>Hordeum</i> (1)   | 556         |
| <b>Pseudo-cereals</b>            | Buckwheat (8), Amaranth (13), Finger millet (14), Foxtail millet (6), <i>Digitaria</i> (3), <i>Panicum</i> (3), <i>Sorghum</i> (3), Chenopods (1), <i>Coix</i> (3)   | 54          |
| <b>Grain legumes/<br/>Pulses</b> | Sem bean (26), Mung (12), French bean (40), Rice bean (19), Cowpea (78), <i>Lathyrus</i> (5), Pea (6), Lentil (7), Horse gram (2), Faba bean (6), <i>Cicer</i> (3), <i>Cajanus</i> (5), <i>Parkia</i> (1), Jack bean (1), Soybean (6), Bean (15), Adzuki bean (1), Black gram (32)   | 2           |
| <b>Vegetables</b>                | Ridge gourd (32), Sponge gourd (20), Ash gourd (23), Radish (13), <i>Malva</i> (6), Brinjal (51), Bottle gourd (25), Tomato (8), Bitter melon (18), <i>Rumex</i> (1), <i>Momordica</i> (3), Okra (24), Cucumber (52), Wild cucumber (1), Pumpkin (72), Musk melon (8), Ivy gourd (1), Snake gourd (7), Winged bean (1), <i>Cucumis trigonus</i> (1), <i>Zanonia</i> (1), <i>Sechium edule</i> (3), <i>Cyclanthera</i> (1), Solanum tree tomato (1), <i>S. gilfo</i> (4), <i>S. indicum</i> (1), <i>Solanum spirale</i> (1), <i>Lycopersicon pimpinellifolium</i> (1), Water melon (13), Cabbage (1), Spinach (2) | 396         |
| <b>Oilseeds</b>                  | <i>Brassica</i> (73), Sesame (15), Niger (3), Linseed (3), Castor (2), <i>Linum</i> (1), <i>Perilla</i> (1)  | 98          |
| <b>Spices</b>                    | Coriander (17), Chillil (101), Cumin (1), Black Pepper (2), Anise (1), Ginger (30), Black cumin (6), Azowan (3), Garlic (10), Onion (5), Turmeric (26), Fennel (1), Dill (5), Garden celery (1), <i>Spilanthes</i> (1), <i>Celosia</i> (1), <i>Allium</i> (2), Cardamom (2), <i>Zanthoxylum</i> (1), <i>Allium schoenoprasum</i> (1), <i>Illicium griffithii</i> (1), <i>Curcuma amada</i> (1)   | 219         |
| <b>Tuber crops</b>               | Potato (10), <i>Colocasia</i> (62), <i>Dioscorea</i> (22), <i>Ammomum</i> (1), Sweet potato (5), <i>Pachyrrhizus</i> (2)   | 102         |
| <b>Fruits</b>                    | <i>Citrus</i> (30), Mulberry (1), Papaya (7), <i>Zizyphus</i> (2), <i>Anona</i> (2), <i>Baccaruea</i> _1 (1), "Poniol" (1), Banana (33), Guava (4), Jackfruit (2), Minor Fruit (2), Wild pear (3), Strawberry (7), Tamarind (2), <i>Malus</i> (1), <i>Citrus volkamariana</i>  | 107         |
|                                  | (1), Kinnow (2), Trifoliolate orange (1), <i>Citrus latipes</i> (1), <i>Garcinia lanceaeifolia</i> (2), Pummelo (2)  | 107         |
| <b>Fibre crops</b>               | Tree Cotton (15), Jute (6), Sun hemp (2), <i>Hibiscus</i> (6)  | 29          |
| <b>Misc./ Unidentified</b>       | Kath Badam (1), Sausur (1), <i>Ocimum</i> (2), <i>Sesbania</i> (1), Unidentified (2), Tobacco (3), <i>Cordia myxa</i> (1) Orchids (5), Piper (1), betelnut (1), Ornamental capsicum (1), <i>Lycopodium</i> sp. (1), <i>Amorphophallus</i> sp. (1), Tea (3), <i>Coptis teeta</i> (1), <i>Hedychium</i> (1) <i>Livistonia</i> (1), <i>Dracaena</i> (1), Bamboo (1), <i>Cassia</i> (1), <i>Hodgsonia</i> (1), <i>Celosia</i> (8)  | 39          |
| <b>Total</b>                     |  | <b>1865</b> |





Wild *Fragaria* in natural habitat at Myodia Pass, Arunachal Pradesh



Filed visit of Dr. Mangala Rai, the Director General, ICAR at NBPGR, Barapani, Meghalaya



Wonder rice of Nagaland

The second exploration trip was executed in collaboration with NRC on Orchids, Sikkim during 19<sup>th</sup> April to 3<sup>rd</sup> May 2003. two-member team explored the major areas of upper and lower Dibang Valley district of Arunachal Pradesh, i.e. Anini, Alyne, Gipullin, Dembuen, Mippi, Amboli, Eron, Punli, Etulin, Arzu Railee, Daishalee, Hunli, Myudia, Roing, Jia-1&2, Balek, Rukmo for the first time. A total of 87 collections were made, out of which 51 accessions were sent to the NGB and remaining 36 germplasm retained by this station. The orchids (75 accessions) are being maintained by NRC on Orchids at Sikkim.

### Significant collections

- Wide variability in wild strawberry (*Fragaria* spp.) and wild banana (*Musa* spp.), which was found en-route to Myodiya Pass area of Dibang valley district.
- *Coptis teeta*, an endemic medicinal plant species was collected from the high altitude area of Dibang valley district.

The third exploration trip was undertaken for collection of multi-crop germplasm from East,

West Khasi hills and Ri-Bhoi district of Meghalaya. During the 11 days (16-26 May 2003) exploration trip Mawphlang, Thyrasad, Weloi, Mawsynram, Balat, Sohra, Mawsmat forest and other forest areas in West Khasi Hills, Mawkerwat, Nongstoin, Ranikor and in Ri-Bhoi District Umshning, Umran, Sonidon, Byrni and Nongpoh areas were covered. The trip yielded a total of 194 crop germplasm accessions. Out of this, 105 were sent to the NGB and 89 retained at the station.

**Significant collections included:** *Pyrus pashia*, *Prunus nepaulensis* and *Momordica cochinchinensis*.

An 8 days exploration was executed in Senapati district of Manipur. The FDI (NGO), Guwahati collaborated in this exploration programme. The area of collection was mainly in the Saikhul tribal development block, inhabited by Kuki and Thangkhu Nagas. The villagers are dependent mostly on wild vegetables, which are collected from jungles and sold in the local market. A total of 63 accessions were collected out of which 48 accessions have been sent to the NGB and 15 were maintained in the field gene bank of the station.

**Significant collections included:** *Zanonia* sp. and *Cucumis trigonus*.

FDI (NGO), Guwahati accompanied the team from NBPGR. During the 9 days trip Gulaghati, Kamalghat, Senapatipara, Lembucherra, Nagichera, Dayarampara, Rammikpara, Gopinagar, Bishalgarh and Ambasa areas were surveyed and 161 germplasm accessions belonging to various crop groups were collected. Out of this, 141 accessions were sent to the NGB.

Sixth exploration trip was executed in East, West and Upper Siang districts of Arunachal Pradesh.

The exploration was undertaken as part of a special mission proposed under the technical programme for the year 2003-2004. During the 17 days exploration trip, inaccessible areas like Garu, Dali, Kaying, Kabo, Wak, Roing, Mollo, Thumbin, Along and Basar (West Siang dist.); Berung, Padi (East Siang dist.); Jcngging, Karko, Tuting, Kapu, Wak, Mosing, Migging (Upper Siang dist.) were surveyed. Most of the areas are not approachable by vehicle. Due to the remoteness of the area the places are less influenced by human interference. Adi and Monpas are the dominant tribes in these areas. Variability in *Colocasia*, *Dioscorea*, ginger, *Coix*, chilli, rice bean, French bean and maize was collected for the first time from these areas.

**Significant collections included:** *Lycopersicon pimpinellifolium*, *Allium schoenoprasum*, *Illicium griffithii*, *Solanum spirale* and wild banana (*Musa* spp.).

NBPGR in collaboration with ICAR NEH, Barapani undertook a special exploration trip to Chumukdema village of Nagaland for collection of wonder rice landrace. The average height of tillers was found to be 2.60 m with 175 tillers/plant and 400-450 grains in each ear (panicle). Fifteen germplasm accessions belonging to other crop groups were also collected, out of which 2 were sent to the NGB and 13 others retained at the station. *Capsicum grossum*, *Malus baccata* and *Elatostema platyphylla* were assembled during this trip. Another joint exploration trip to the Mamit district of Mizoram was undertaken during 16<sup>th</sup> to 24<sup>th</sup> January, 2004 and a total of 282 collections were made. Out of this 193 accessions were sent to the NGB for conservation and the remaining 89 accessions are being maintained by NBPGR, Barapani.

**Table 2-Germ.plasm characterized at NBPGR Regional Station, Umiam, Meghalaya**

| <b>Crop</b>      | <b>No. of accessions</b> | <b>Superior genotypes identified<br/>(Single location)</b> |
|------------------|--------------------------|--|
| Upland paddy     | 173                      | IC 326137  |
| Lowland paddy    | 308                      | IC 274392  |
| Maize            | 222                      | AKON-39  |
| Ricebean         | 850                      | LRB-10   |
| Buckwheat        | 74                       | IC 310104  |
| Job's tear       | 45                       | H 2287   |
| <i>Perilla</i>   | 17                       | H 1099   |
| Ginger           | 170                      | IC 23564   |
| Turmeric         | 130                      | IC 319396  |
| <i>Colocasia</i> | 263                      | IC 264506  |
| Chillies         | 195                      | NIC-10399  |
| <i>Dioscorea</i> | 98                       |  |
| <b>Total</b>     | <b>2545</b>              |  |

**Significant collections included:** *Cassia occidentalis*, *Hodgsonia macrocarpa*, *Curcuma amada* and *Celosia argentea*.

## **15.2 Germplasm Characterization and Maintenance**

Germplasm of different agri-horticultural crops collected from this region was grown for preliminary evaluation. After screening of germplasm continuously for three successive years, the material was sent to the National Gene Bank for conservation. In addition to this, mandate crop germplasm was also received from outside the region for characterization under the prevailing rainfed agronomic conditions of Barapani. Based on yield and resistance against stress parameters, the promising genotypes were identified.

**15.2.1 Characterization of germplasm:** The following crops were characterized during the year 2003-2004.

**15.2.2 Maintenance of fruit germplasm:** The fruit plants being maintained at the station

included banana (80), *Citrus* (74), Passion fruit (4) and Kiwi fruit (2). Besides, some minor fruit plants (*Myrica*, *Vangeria*, *Elaeocarpus*, *Elaeagnus*, *Embllica* and *Zizyphus* species were introduced. Exotic guava accessions performed well for few years after which the plants were attacked by the borer. However, nine accs. were rejuvenated through cuttings. One wild relative of guava (*Psidium guanensis*) is being maintained.

Transplanted accs. of *Citrus* spp. (sweet and acid group) are now in vegetative growth stage. The growth of various accs. of banana is stunted due to attack of weevil $\delta$  like *Odioporus longicollis* and *Cosmopolites sordidus* and thus these are always under stress conditions. Bunchy top and *Cercospora* leaf spot disease in banana are prevalent in some of the accessions.

**15.2.3 Maintenance of miscellaneous germplasm:** The germplasm of following crops and wild relatives is being maintained at the station.

|                                      |  |
|--------------------------------------|--|
| <b>Pseudocereals</b>                 | Teosinte   |
| <b>Solanum spp.</b>                  | <i>Solanum gillo</i> , <i>S. spirale</i> , <i>S. mammosum</i> , <i>S. torvum</i> , <i>S. indicum</i>   |
| <b>Bulbs and rhizomes</b>            | <i>Heliconia dasyantha</i> , <i>Elletaria</i> sp., <i>Hedychium</i> sp.  |
| <b>Grain legumes</b>                 | <i>Parkia roxburghii</i> , <i>Mucuna utilis</i>  |
| <b>Fruits</b>                        | Dwarf mango ( <i>Mangifera</i> ), Jackfruit, <i>Simarouba glauca</i> ,   |
| <b>Ornamentals</b>                   | Various Orchids, <i>Gladiolus</i> , <i>Rosa</i> , <i>Nerium</i> , <i>Dombia</i> , <i>Callistemon</i> , <i>Plumeria</i> , <i>Dahlia</i> , <i>Thunbergia</i> , <i>Hibiscus</i> , <i>Caladium</i> , <i>Hydrangia</i> , <i>Cuphea</i> , <i>Canna</i> ,   |
| <b>Wild relatives of crop plants</b> | <i>Zizania</i> , <i>Psidium guanensis</i>  |
| <b>Medicinal plants</b>              | <i>Alpinia</i> , <i>Kaempferia</i> , <i>Cryptolepis</i> , <i>Leonotis</i> , <i>Embelica</i> , <i>Cymbopogon</i> , <i>Elaeocarpus</i> , <i>Clerodendron</i> , <i>Rauvolfia</i> , <i>Coptis</i> , <i>Potentilla</i> , <i>Curcuma</i> spp., <i>Zingiber</i> spp., <i>Murraya</i> , <i>Tupistra</i> , <i>Pogostemon</i> , <i>Andrographis</i> , <i>Withania</i> , <i>Melia</i> |

Besides the above-mentioned crops, under-utilized crops such as *Perilla*, buckwheat and *Coix* were also characterized and the relevant report sent to the Project Coordinator, AICRP on under-utilized crop plants.

Under the G-15 project on medicinal and aromatic plants, an exploration and collection trip was conducted in the district of Darjeeling, West Bengal. Areas surveyed during the tour include Sonada Range, Sukna Range and Bhuttabari Range all under Silvicultural Hills Division, Darjeeling and Darjeeling Range and Tonglu Range, both under Darjeeling Forest Division. A total of 34 accessions of medicinal plants were collected during the entire exploration trip. The materials have been introduced in the field gene bank of the station. So far, no accession has been sent for conservation in MTS/LTS.

### 15.3 Germplasm Distribution

Active germplasm collections of different crops namely paddy- 20, chilli-10, eice bean- 67, *Colocasia*- 20, *Xanthosoma*- 6, potato- 7, buckwheat- 6, exotic guava- 6, Passion fruit -1, bamboo-10, *Alpinia* spp- 3, *Curcuma caesia* - 2, *Cryptolepis buchmanii*- 1, *Kaempferia galanga*- 1, *Leonotis nepetaefolia*- 1, *Musa* spp-3 and *Coix*-1 maintained at the station were supplied to various research workers in this country.

### 15.4 Germplasm Conservation

A total of 323 accessions were deposited in the National Genebank for long term conservation. The details are given below.

| Crop           | No. of Accessions |
|----------------|-------------------|
| Maize          | 93                |
| Upland paddy   | 46                |
| <i>Perilla</i> | 52                |
| <i>Coix</i>    | 39                |
| Lowland Paddy  | 93                |
| Total          | 323               |

### 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 North Eastern India (D. K. 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 (D. K. Hore).

PGR/PGC-BUR-SHL-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, and documentation of genetic resources of indigenous and exotic lines of chillies, 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 10/01/2003 National gene bank for medicinal and aromatic plants (G-15).

## 16. REGIONAL STATION, SHIMLA

**Summary:** Ten explorations were conducted and 979 accessions comprising cereals (153), pseudocereals (41), millets (17), pulses (91), oilseeds (89), vegetables (217), fruits (130), ornamentals (44), spices & condiments (36), M & AP (58), dye yielding (9), wild relatives (22) and other economic plants (72) were collected. A total of 198 accessions of various crops viz. amaranth (60), French bean (37), *Trifolium* (28), *Medicago* (32), lotus (3), *Cornus max* (1), apple (4), peach (2), *Corylus* (25), *Mespilus* (4) were introduced from several countries. A total of 1915 accessions of various agri-horticultural crops were characterized and multiplied for conservation, 1122 accessions were sent for medium term storage as voucher specimens and 985 accessions for long-term storage in the National Gene Bank, 940 accessions of fruit crops, medicinal plants and ornamentals were conserved and maintained in field gene bank, 338 seed samples of grain crops, 187 rooted plants and 410 bud sticks were supplied to various researchers.

### 16.1. Germplasm Exploration and Collection

A total of ten explorations including two local trips of one day each were undertaken during the period and 979 germplasm accessions were collected from different parts of Himachal Pradesh, Jammu & Kashmir and Uttaranchal (Table 1).

This year major emphasis was to collect vegetables and as a result 217 germplasm accessions were collected. Other important

collections included landraces and wild relatives of ten local types of *Vigna mungo* and eight types of *V. unguiculata* from Changer and Kandi area of Bilaspur and Una districts and wild relatives of crops plants such as *Momordica dioica*, *Cucumis hardwickii*, *Trichosanthes lobata*, *T. bracteata*, *Solanum virum*, *Linum perenne*, *Cicer microphyllum*, *Chenopodium foliosum*, *Malus baccata* and *Diospyros lotus*. Crop group-wise diversity collected is shown in Fig. 1.

**Table-1 Germplasm explorations undertaken from January to December, 2003**

| Plants explored   | Areas explored        | Accessions collected |
|---|-----------------------|----------------------|
| Walnut  | Chakrata              | 38                   |
| Walnut  | Simour, Solan         | 24                   |
| Multi-crop  | Srinagar              | 20                   |
| Multi-crop  | Una and Bilaspur      | 340                  |
| Multi-crop with emphasis on wild relatives  | Lahual & Spiti        | 79                   |
| Medicinal & Aromatic Plants   | Shimla                | 27                   |
| Multi-crop  | Shimla, Kinnaur       | 199                  |
| Vegetables  | Kullu                 | 102                  |
| Multi-crop with emphasis on vegetables  | Una, Hamirpur, Kangra | 88                   |
| One day trips for the collection of <i>Dahlia</i> , <i>Didonaea viscosa</i> and <i>Lawsonia inermis</i> | Shimla                | 62                   |
|   | <b>Total</b>          | <b>979</b>           |



Variability for fruit (shape, size and colour) in apple germplasm



Husk tomato (*Physalis ixocarpa*) established successfully at Shimla station



Wild gram (*Cicer microphyllum*) collected from Tabo valley of Spiti (HP)



Pecan nut cv Mahan (EC-24558) in fruiting at Shimla station

**Introduction of exotic material:** A total of 198 accessions of various agri-horticultural plants viz., *Amaranthus* spp. (60) from Russia, *Phaseolus vulgaris* (37) from USA, *Trifolium* spp. (28), *Medicago* spp. (32), *Lotus* spp. (3) from Denmark and *Pyrus communis* (2) from Canada, *Cornus mas* (1), *Malus pumila* (4), *Prunus persica* (2), *Corylus avellana* (25), *Mespilus* sp. (4) and *Cydonia oblonga* (1) from USA were introduced. All the introduced germplasm

have been planted for characterization at the experimental farm.

## 16.2. Germplasm Characterization and Evaluation

**Pea:** Eighty accessions were characterized for 27 descriptors in the Augmented Block Design with 3 checks. The mean, range and coefficient of variation is given in Table-2. The coefficient of variation was high for no. of pods per plant (21.28%) followed by seed yield per plant (18.64%).

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

| Character                | Range     | Mean $\pm$ SE    | CV%   |
|--------------------------|-----------|------------------|-------|
| Days to maturity         | 155-178   | 164.5 $\pm$ 2.45 | 10.65 |
| Pod length (cm)          | 4.5-9.2   | 6.7 $\pm$ 0.89   | 9.69  |
| No. of pods per plant    | 15.0-60.0 | 32.0 $\pm$ 2.98  | 21.28 |
| No. of seeds per pod     | 3.0-9.0   | 5.98 $\pm$ 1.08  | 12.26 |
| 100 seed weight (g)      | 12.5-28.1 | 22.78 $\pm$ 1.99 | 14.55 |
| Seed yield per plant (g) | 6.2-58.9  | 26.5 $\pm$ 3.10  | 18.64 |

**Agricultural crops:** The following germplasm was sown for characterization, evaluation and multiplication in *kharif*.

| Crop        | No. of accession | Remark  |
|-------------|------------------|---|
| Amaranth    | 298              | 143 acc- characterization, 28 acc.- evaluation, 113 acc.- multiplication, 14 acc-coordinated varietal trial |
| Buckwheat   | 138              | 38 acc-evaluation, 100 acc.- characterization   |
| Chenopod    | 26               | 14 acc-evaluations, 12 acc-co-ordinated varietal trial.   |
| French bean | 1037             | Characterization  |
| Rice bean   | 14               | Co-ordinated varietal trial   |
| Adzuki bean | 15               | Co-ordinated varietal trial   |
| Cowpea      | 20               | Characterization  |
| Millets     | 50               | Characterization  |

The data were recorded as per the descriptors developed by NBPGR. The data for all the crops grown in the the Augmented Block Design were also analyzed for mean, range and co-efficient of variation (Table 3). The data recorded were only for one year; hence promising accessions were not marked. However, overall promising accessions were observed in different crops. These were EC 500964, EC 500885, EC 500910, EC 900957, EC 900901, EC 900958, EC 900883, EC 500462, EC 500766, EC 500765, EC 500320, EC 500729, EC 500787 in Frenchbean; IC 38151, IC 38108, IC 21944, IC 381205, IC 361608, IC 329587, IC 382750, IC 381185, IC 381100, IC

35449, IC 21935, IC 38180 in amaranth; IC 381077, IC 382731, IC 382734, IC 382263, IC 341592, IC 341582, IC 361636, IC 274439, IC 274425, IC 341586, IC 341593, IC 274425, IC 381177, IC 381204, IC 382734, IC 382243 in buckwheat and IC 329185, IC 107296, IC 329470, IC 329184, IC 107296, IC 381106, IC 107295, IC 329494 and IC 341706 in chenopod.

### Genetic divergence and inter-relationship analysis in grain amaranth (*Amaranthus hypochondriacus*)

**germplasm:** One hundred (50 from India and 50 from exotic sources) accessions of grain amaranth germplasm were grown in Complete Randomised Block Design. Data were recorded on six quantitative and two qualitative characters. All the genotypes irrespective of their place of collection were grouped into 10 different clusters. Clusters I, VII, VIII, IX and X had greater genetic distance from all other clusters and therefore, genotypes from these clusters can be chosen for breeding amaranth. This showed that genetic diversity is more important for selecting parents for hybridization than eco-geographical isolation. Beside seed yield, inflorescence length, no. of leaves and plant height were found important characters for selecting better yielding genotypes. Genotypes rich in protein content (EC 289389, EC



**Table 3: Range, mean and coefficient of variation**

| Crop        | Character                 | Range         | Mean $\pm$ SE | CV%   |
|-------------|---------------------------|---------------|---------------|-------|
| French bean | No. of pods/plant         | 11.50-32.00   | 23.52+2.30    | 14.89 |
|             | Pod length (cm)           | 9.75-18.80    | 14.20+1.62    | 18.26 |
|             | No. of seeds/pod          | 4.00-8.00     | 5.96+0.24     | 10.23 |
|             | Days to maturity          | 108.00-135.00 | 120.00+4.50   | 25.23 |
| Amaranth    | 100 Seed weight (g)       | 10.00-55.00   | 32.98+3.28    | 32.71 |
|             | Plant height (cm)         | 104.20-357.50 | 205.98+14.26  | 41.98 |
|             | Inflorescence length (cm) | 35.20-84.30   | 45.69+4.98    | 18.33 |
|             | Leaf length (cm)          | 12.50-28.30   | 21.36+2.64    | 11.79 |
| Buckwheat   | Days to maturity          | 147.00-174.00 | 158.00+6.67   | 9.56  |
|             | 100 Seed weight (g)       | 0.50-0.80     | 0.65+0.09     | 10.04 |
|             | Plant height (cm)         | 33.10-120.70  | 67.25+5.18    | 54.63 |
|             | No. of cyme /plant        | 7.00-31.00    | 20.33+2.80    | 24.32 |
| Chenopod    | Leaf length (cm)          | 4.80-11.80    | 7.10+1.94     | 12.35 |
|             | No. of primary branches   | 1.00-7.50     | 5.04+1.07     | 15.04 |
|             | Days to maturity          | 86.00-113.00  | 100.62+4.19   | 19.69 |
|             | 1000 seed weight          | 12.80-28.40   | 19.67+3.04    | 15.44 |
| Chenopod    | Plant height (cm)         | 60.10-312.70  | 215.39+12.26  | 45.09 |
|             | Inflorescence length (cm) | 21.60-76.70   | 45.02+6.66    | 24.31 |
|             | Leaf length (cm)          | 3.10-17.70    | 9.88+2.07     | 18.69 |
|             | Leaf width (cm)           | 2.60-17.30    | 8.14+1.99     | 17.08 |
|             | Days to maturity          | 131.00-166.00 | 141.00+7.02   | 21.01 |
|             | 1000 Seed weight (g)      | 0.10-0.90     | 0.65+0.08     | 10.08 |

289412, EC 170317, EC 322032, NIC 22541, IC 42302, IC 16636 and IC 17926) and oil content (IC 42316, IC 35415, NIC 22561, NIC 22541, EC 321558, EC 328889 and EC 359442) can be selected for quality breeding programs as both the characters showed high heritability. In general, the amaranth grain contains 6-10% oil which is mostly found

within the germ, but in the germplasm studied it ranged from 9.65-12.71 which is higher than the commonly available gene pool. Correlation and path analysis revealed the significance of inflorescence length, no. of leaves and plant height for selecting better yielding genotypes. The data were analyzed for frequency distribution, and range and promising accessions identified.

### Horticultural crop germplasm characterized

| Crop  | Accessions | Descriptors | Crop        | Accessions | Descriptors |
|-------|------------|-------------|-------------|------------|-------------|
| Apple | 85         | 14          | Walnut      | 20         | 33          |
| Pear  | 16         | 24          | Pecan nut   | 11         | 35          |
| Plum  | 19         | 24          | Husk tomato | 29         | 27          |
| Peach | 30         | 25          | Strawberry  | 17         | 15          |

In apple, early maturing accessions were 31, intermediate 27 and late 25 and the average fruit weight ranged from 25 to 226g of which 35 accessions have low fruit weight (25-75g); 35 medium (75-125 g) and 13 high (175-226 g). Thirtyfour accessions were found to have very good fruit quality where TSS ranged from 5 to 20%. In pear, fruit weight ranged from 25 to 250 g and 9 accessions had good eating quality. In plum, fruit weight ranged from 9 to 81g. In peach, average fruit weight ranged from 14-168 g and 12 accessions had good fruit quality. In apricot fruit weight ranged from 12-55 g and TSS from 13.3%-18.0%. In walnut, variation was observed for nut shape (round, long trapezoid, broad elliptic, ovate, short trapezoid and elliptic), nut diameter from 17.92-34.23 mm,

nut length from 19.41-39.85mm, nut weight from 3.6-9.65 g and kernel from 16.6-49.3%.

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. In case of quantitative characters viz. days to flower variation ranged from 24-78, plant height 57-150 cm, no. of berries/plant 15-135, berry length 4.54 to 35.34 mm, berry diameter 8.9 to 40.23 mm, berry weight 1.0 to 52.07 g, TSS 4 to 17%, and fruit yield 40 to 3392 g.

Promising accessions were also recorded for some important characters in fruit crops (Table 4).

**Table 4. Promising accessions in different fruit crops**

| Crop        | Character                   | Promising accessions                               |
|-------------|-----------------------------|--|
| Apple       | Earliness                   | EC 114699, EC 349919, EC 144039                    |
|             | Fruit weight (>200g)        | EC 115746, EC 145094, Tropical Beauty              |
|             | Eating quality              | Jono, EC 278716, EC 38372, EC 38689                |
|             | TSS (>20%)                  | IC 349912, EC 43638, EC 43637, EC 127110           |
| Pear        | Earliness                   | EC 27809, EC 27810, EC 38739                       |
|             | Fruit weight (>175g)        | Kieffer - B, Leconte, Flemish Beauty               |
|             | Eating quality              | Manning Elizabeth, Maxred Bartlett, Flemish Beauty |
|             | TSS (>15%)                  | Kieffer - B, Chinese Sandy, Flemish Beauty         |
| Plum        | Earliness                   | Fortune, Santa Rosa, EC 119775, Satsuma            |
|             | Fruit weight (>70g)         | EC 34052, Fortune, EC 22796, Santa Rosa            |
|             | Eating quality              | Settler, Santa Rosa, Yellow Plum, Fortune          |
|             | TSS (19%)                   | Kohinoor, EC 119775, Santa Rosa, Satsuma           |
| Peach       | Earliness                   | Flora Bella, May Fire, Duke, Florida Sun           |
|             | Fruit weight (>150g)        | EC 110858, Kanto 5, Co smith, July Alberta         |
|             | Eating quality              | Sun Red, Kanto 5, Snow Queen, Summer Glo           |
|             | TSS (15%)                   | Snow Queen, Sun Red, EC 280766, Kanto 5            |
| Apricot     | Earliness                   | EC-25730, Nugget                                   |
|             | Fruit weight (>35g)         | Nugget, St. Ambroise, EC-144316, Triumph severngii |
|             | Eating quality              | St. Ambroise, EC-168421, Canninos, EC-144316       |
|             | TSS (15%)                   | EC-168419, St. Ambroise, EC-25730, Canninos        |
| Walnut      | Nut weight (>8g)            | EC- 38836, EC-38837, Ogden                         |
|             | Kernel weight (>3g)         | EC-24507, EC-26891, EC-24582                       |
|             | Kernel per cent (>50%)      | EC-32384, EC-24582                                 |
|             |                             |  |
| Husk tomato | Earliness (<30 days)        | EC- 467434, EC- 467435, EC-467436, EC-467437       |
|             | Berry weight (>40g)         | EC-467434, 467460, 467461                          |
|             | Berries/plant (>75)         | EC-467440, 467451                                  |
|             | TSS (15%)                   | EC-467437, 467439, 467440                          |
|             | Fruit yield/ plant (>2.5kg) | EC-467437, 467439, 467440                          |

**Table 5. Status of germplasm holdings as active collections in MTS (as on 31/12/03)**

| Crop        | Active collection | MTS  | Crop          | Active collection | MTS |
|-------------|-------------------|------|---------------|-------------------|-----|
| Amaranth    | 2612              | 1511 | Horse gram    | 32                | 19  |
| Buckwheat   | 690               | 628  | Pea           | 110               | 74  |
| Chenopod    | 92                | 87   | Lentil        | 54                | 3   |
| French bean | 2380              | 1819 | <i>Cuphea</i> | 16                | 16  |
| Rice bean   | 225               | 192  | Meetha karela | 25                | 24  |
| Adzuki bean | 158               | 143  | Husk tomato   | 29                | 29  |

**Table 6. Status of germplasm holdings in the field gene bank (as on 31/12/03)**

| Crop    | Accession | Crop      | Accession | Crop                | Accession |
|---------|-----------|-----------|-----------|---------------------|-----------|
| Apple   | 160       | Plum      | 31        | <i>Rubus</i> spp.   | 27        |
| Pear    | 56        | Pecan nut | 13        | <i>Ribes</i> spp.   | 5         |
| Apricot | 42        | Walnut    | 180       | Persimmon           | 4         |
| Cherry  | 11        | Hazelnut  | 30        | Pomegranate         | 156       |
| Almond  | 14        | Kiwi      | 7         | Wild & minor fruits | 36        |
| Peach   | 55        | Grape     | 9         | M & AP              | 75        |

## 16.3. Germplasm Conservation

### 16.3.1 Germplasm conserved in the MTS:

A total of 1122 germplasm accessions were conserved in the NGB as voucher specimens. Besides, 3,258 germplasm accessions were also kept in the MTS at Shimla.

### 16.3.2 Germplasm conserved in the LTS:

Nine hundred and eighty-five germplasm



*Cuphea viscosissima*—a potential crop for Soap industry at Shimla

accessions of various crops were conserved in the NGB for long term storage.

Besides, germplasm is also maintained as active collections in the MTS and in the field genebank. The crop-wise details are given in table 5 and 6.

### 16.3.3 Conservation of wild relatives of crop plants:

A special emphasis was given on the conservation of wild relatives in the



Wild relative of *Thichosanthes bracteata* collected from foot hills of the Himalayas

field genebank. The important wild relatives that are being maintained at the station are given in table 7.

## 16.4 Germplasm Supply

Germplasm of following crops was supplied to various indentors.

**Seeds:** Amaranth (200), buckwheat (128), French bean (10).

**Rooted plants:** Apple (24), pear (24), peach (10), apricot (13), persimmon (23), Chinese ber (2), almond (2), kiwi (70), plum (1), strawberry (6), garlic (5) and M & AP (7).

**Bud sticks:** Pecan nut (50), apple (170), kiwi (60), pear (70), plum (60).

Besides, 933 recently collected germplasm accessions were supplied to NAGS for characterization and evaluation.

**Table 7. Status of wild relatives of agri-horticultural crops and some important medicinal plants conserved in the field genebank/ MTS**

| Crops                      | Crop species  |
|----------------------------|---|
| Amaranth                   | <i>Amaranthus hybridus</i> , <i>A. retroflexus</i> , <i>A. lividus</i> , <i>A. viridis</i> , <i>A. graecizans</i> , <i>A. dubius</i> , <i>A. spinosus</i> , and <i>A. tricolor</i>  |
| Buckwheat                  | <i>Fagopyrum emarginatum</i> , <i>F. tataricum</i> var. <i>himalayacum</i> and <i>F. gigataenium</i>  |
| Chenopod                   | <i>Chenopodium amaranticolor</i> , <i>C. botrys</i> , <i>C. murale</i> and <i>C. ambrasoides</i> .  |
| French bean                | <i>Phaseolus lunatus</i> and <i>P. coccineus</i> .  |
| Faba bean                  | <i>Vicia hirsuta</i> , <i>V. tetrasperma</i> .  |
| Apple                      | <i>Malus baccata</i> , <i>M. baccata</i> var. <i>himalaica</i> , <i>M. baccata</i> var. <i>dirangensis</i> and <i>M. sikkimensis</i>  |
| Pear                       | <i>Pyrus pyrifolia</i> , <i>P. pyrifolia</i> var. <i>kumaonii</i> , <i>P. polycarpa</i> , <i>P. jacquemontii</i> , <i>P. pashia</i> , <i>P. serotina</i>  |
| Prunes                     | <i>Prunus nepaulensis</i> , <i>P. armeniaca</i> , <i>P. cerasoides</i> , <i>P. cerasifera</i> , <i>Prunus</i> sp. (behmi)   |
| Walnut                     | <i>Juglans nigra</i> , <i>J. mandshurica</i> , <i>J. atlantifolia</i>   |
| Hazelnut                   | <i>Corylus colurna</i> , <i>C. ferox</i>  |
| Kiwi                       | <i>Actinidia purpurea</i> , <i>A. arguta</i>  |
| Grapes                     | <i>Vitis himalayana</i> , <i>V. ficifolia</i> , <i>V. arizonica</i> , <i>V. riparia</i> , <i>V. acerifolia</i> , <i>V. girdina</i> , <i>V. aestivalis</i> , <i>V. amurensis</i> , <i>V. cinerea</i>   |
| Pistachio                  | <i>Pistachio atlantica</i> <i>P. terebinthus</i> , <i>P. chinensis</i>  |
| <i>Rubus</i> sp.           | <i>Rubus ellipticus</i> , <i>R. niveus</i> , <i>R. biflorus</i> , <i>R. fruticosus</i> , <i>R. lasiocarpus</i> , <i>R. paniculatus</i> , <i>R. calycinus</i> , <i>R. opulifolius</i> , <i>R. hexagynus</i>  |
| <i>Ribes</i> sp.           | <i>Ribes nigrum</i> , <i>R. rubrum</i>  |
| Minor fruits               | <i>Punica granatum</i> , <i>Sorbus lanata</i> , <i>Cotoneaster acuminata</i> , <i>C. frigida</i> ; <i>Crataegus crenulata</i> , <i>C. oxyacantha</i> , <i>Feijoa sellowiana</i> , <i>Cydonia oblonga</i> ; <i>Docynia hookeriana</i> ; <i>Viburnum continifolium</i> , <i>V. lanata</i> , <i>Cornus capitata</i> , <i>Elaeagnus umbellata</i> , <i>Castanea crenata</i> , <i>Olea cuspidata</i> , <i>Ziziphus jujuba</i> , <i>Diospyros lotus</i> , <i>Hippophae rhamnoides</i> , <i>Pinus gerardiana</i> , <i>Ficus palmata</i>  |
| Important medicinal plants | <i>Tinospora cordifolia</i> , <i>Centratherum anthelminticum</i> , <i>Vitex negundo</i> , <i>Celastrus paniculatus</i> , <i>Withania somnifera</i> , <i>Melia azedarach</i> , <i>Bacopa monnieri</i> , <i>Roylea elegans</i> , <i>Acorus calamus</i> , <i>Asparagus adscendens</i> , <i>Habenaria intermedia</i> , <i>Hebenaria edgeworthii</i> , <i>Viola serpens</i> , <i>Viola odorata</i> , <i>Hedychium spicatum</i> , <i>Taxus baccata</i> , <i>Heracleum candicans</i> , <i>Thymus serpyllum</i> , <i>Dioscorea deltoidea</i> , <i>Angelica glauca</i> , <i>Podophyllum hexandrum</i> , <i>Polygonatum cirrhifolium</i> , <i>P. verticillatum</i> , <i>Valeriana wallichii</i> , <i>Asparagus filicinus</i> , <i>Roscoeia procera</i> , <i>R. alpine</i> , <i>Achillea millefolium</i> , <i>Aconitum heterophyllum</i> , <i>Bunium persicum</i> , <i>Betula utilis</i> , <i>Ephedra gerardiana</i> |

## 16.5 Externally Funded Projects

### 16.5.1 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 integration of data for GIS mapping. The data is being generated on plant species richness, classification of flora at species level, genetic erosion, cropping intensity, weed intensity and bio-prospecting potential. During the period under report 10 surveys were undertaken, 400 herbaria prepared and information on about 875 species of crops, weeds, forestry and grasses was recorded. About 650 plant specimens were identified.

### 16.5.2 Germplasm conservation (*ex situ* & *in situ*) of minor millets and pseudo-cereals in participatory mode in Himachal Pradesh:

The project was started in October, 2003 with the objectives (i) survey and selection of potential sites and nodal farmers for *in situ* conservation (ii) collection of germplasm millets and pseudocereals from different parts of H P and (ii) evaluation of collected germplasm and selection of elite material. One exploration was undertaken during which 101 occasions were collected comprising *Amaranthus hypochondriacus* (24), *A. caudatus* (11), *Eleusine coracana* (30), *Panicum sumatrense* (20), *Panicum miliaceum* (01) and *Setaria italica* (15). Eight farmers in four villages of Sirmour district were identified for *in situ* conservation of minor millets and pseudocereals.

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

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

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

PGR/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, 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). (VD Verma; JC Rana, SK Yadav, K. Pradheep)
2. Germplasm conservation (*ex situ* and *in situ*) of minor millets and pseudo-cereals in participatory mode in Himachal Pradesh. (Govt. of Himachal Pradesh). (JC Rana; VD Verma, SK Yadav, K. Pradheep)
3. Germplasm exploration, collection, characterization, evaluation and documentation of agri-horticultural crops of Himachal Pradesh and Jammu & Kashmir. (NATP). (VD Verma, JC Rana, SK Yadav, K. Pradheep).

## 17. REGIONAL STATION, SRINAGAR

**Summary:** Two explorations were undertaken in different areas of Kashmir Valley and Ladakh (J&K) and Lahaul and Spiti region of Himachal Pradesh. A total of 192 collections comprising different agrihorticultural crops and their wild relatives were made alongwith 31 herbarium specimens sent to National Herbarium of Cultivated Plants (NHCP).

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 cross were also 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). The experimental farm of this station is situated at KD Research Farm, Old Airfield, Rangreth, about 14 km from Srinagar City.

### 17.1 Germplasm Exploration

Two explorations were undertaken, during 26 June to 5 July and 14 to 20 November, 2003 in different areas of Jammu and Kashmir and Lahaul and Spiti regions of Himachal Pradesh. A total of 192 accessions comprising cereals (69), pulses (32), oilseeds (15), vegetables (68) and others (8) were made.

### 17.2 Germplasm Evaluation

A total of 381 accessions of wheat, barley, mustard, pea and lentil were grown during *Rabi* season for characterization and evaluation, but performance of crops was poor due to lack of moisture during germination and irrigation facility at farm.

### Research Project (Project Code: Title, 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. (K. K. Gangopadhyay; D. Gautam).

## 18. REGIONAL STATION, THRISSUR

**Summary:** A total of 484 accessions were collected during the ten explorations by the station that included 311 accessions of cultivated plants, 142 of wild relatives, 35 of medicinal and aromatic plants. And another 1499 accessions were collected during the 75 explorations undertaken by the 18 cooperating centres. A total of 605 accessions were deposited in national genebank for long-term storage; 67 accessions were added to *in vitro* repository at Thrissur and five were sent for cryopreservation. A total of 997 annuals and 241 perennials were grown for characterization / evaluation and 1324 annuals and 1223 perennials for regeneration/ maintenance. Fifty-five voucher specimens (herbaria) were provided to the national herbarium of cultivated plants at NBPGR (HQs).

### 18.1 Exploration and Collection of Germplasm

Ten exploration trips were conducted resulting in collection of 484 accessions. These included cultivated plants (311 accns.), which comprised cereals (73), fibres (7), fruits (13), pulses and legumes (22), oilseeds (29), spices

(25), tubers (4), vegetables (50) and dye yielding plants (88), wild relatives (136), M & A plants (35) and others (2). These were collected from Kerala (189), Tamil Nadu (149), Karnataka (132), Goa (13) and Andhra Pradesh (1). The details of crop diversity collected are given below.

| Regions explored  | Period               | Diversity collected   | Accns. |
|---|----------------------|---|--------|
| Thrissur and Palakkad (Kerala); Coimbatore and Nilgiri (Tamil Nadu); Mysore and Bangalore (Karnataka). In collaboration with CRIJAF, Barrackpore. | 15.01.03 to 27.01.03 | <i>Agave</i> spp., <i>Crotalaria</i> spp., <i>Hibiscus</i> spp., <i>Corchorus</i> spp., M&A plants and others | 106    |
| Kannur (Kerala) and Udupi, Shimoga, Uttar Kannad, Dakshin Kannad, (Karnataka). In collaboration with ERRC, Thiruvananthapuram.                    | 3.02.03 to 8.02.03   | Mysore gamboge, kokam & others  | 18     |
| Bababudangiri hills in Chikmagalur district, and Kudremukh in the border areas between Dakshin Kannada and Chikmagalur in Karnataka.              | 12.05.03 to 18.05.03 | Wild relatives of crop plants   | 48     |
| Western coast and ghat region of Goa, Karnataka and Kerala (in collaboration with ICAR Research Complex for Goa).                                 | 14.07.03 to 21.07.03 | Malabar tamarind, wild relatives & others   | 30     |
| Palakkad (Kerala); Coimbatore, Salem, Dharmapuri and Krishnagiri (Tamil Nadu); Kolar (Karnataka) and Chittoor (Andhra Pradesh).                   | 10.11.03 to 14.11.03 | Henna, niger, lab-lab bean, vegetables & others   | 41     |
| Thrissur, Ernakulam and Alappuzha (Kerala).   | 18-11-03 to 21-11-03 | Rice, henna, vegetables & others  | 100    |
| Karnataka   | 17-11-03 to 23-11-03 | Henna, niger, M&A plants & <i>Sesamum</i> sp.   | 3      |
| Karnataka and Tamil Nadu  | 26-11-03 to 30-11-03 | Niger, amaranth, rice & wild amaranth   | 27     |

|  |                         |  |            |
|--|-------------------------|--|------------|
| Nilgiri and Palani hills of Tamil Nadu                           | 17-12-03 to<br>22-12-03 | Henna, French bean,<br><i>Amaranthus</i> spp. & others | 47         |
| Thrissur, Malappuram, Kozhikode, Kannur<br>and Kasargod (Kerala) | 22-12-03 to<br>24-12-03 | Henna & M & A plants                                   | 25         |
| <b>Total</b>   |                         |  | <b>484</b> |

A combined exploration and collection mission involving NBPGR, CPCRI, CTCRI, IISR and SBI was conducted to Andaman & Nicobar Islands and 106 accessions comprising 11 of coconut, 8 of wild sugarcane, 71 of wild relatives and 16 of other crops were collected.

**Germplasm supplied as voucher samples for MTS at New Delhi:** Two hundred and twenty accessions collected by this station were sent to MTS facility at NBPGR, New Delhi.

**Germplasm supplied to regeneration sites:** One hundred and two accessions collected by the station were sent to 13 different regeneration sites.

A total of 889 accessions received from 9 co-operating centres was also forwarded to NBPGR, New Delhi for conservation under MTS/ LTS as detailed below:

| Material received from | No. accns. sent for conservation |            |
|------------------------|----------------------------------|------------|
|                        | MTS                              | LTS        |
| TNAU (F), Coimbatore   | 88                               | 9          |
| TNAU (H), Coimbatore   | 77                               | 76         |
| UAS, Dharwad           | 196                              | 126        |
| BU, Thiruchirapally    | 63                               | 10         |
| KAU, Pattambi          |                                  | 105        |
| IISR, Bangalore        | 20                               | 9          |
| MSSRF, Chennai         | 86                               |            |
| AICSMIP, Bangalore     |                                  | 12         |
| CARI, Port Blair       |                                  | 12         |
| <b>Total</b>           | <b>530</b>                       | <b>359</b> |

In 73 exploration and collection missions conducted within Zone-II and in 2 trips outside the zone under NATP-PB, 1499 accessions of germplasm were collected by 18 co-operating centres.

**Herbarium:** Herbarium specimens of 53 accessions were deposited in the NHCP, New Delhi, out of which, 50 were collected under NATP-PB and the rest 3 from existing germplasm.

## 18.2 Germplasm Maintenance

A total of 2027 accessions of crop plants or their wild relatives were maintained as follows:

- Annually regenerated germplasm (vegetatively propagated) in 12 crops/species (1339 accessions)
- Annually regenerated germplasm (seed propagated) in 7 crops/species (197 accessions)
- Perennial germplasm 491 accessions in 14 indigenous crops/species and exotic introductions

## 18.3 Germplasm characterisation and evaluation

A total of 3594 accessions was grown in the following crops or their wild relatives, out of which 1238 accessions were characterised for quantitative and qualitative traits as shown below:



| Crop/ Species                    | Accessions<br>grown | Accessions characterised |              |              |
|----------------------------------|---------------------|--------------------------|--------------|--------------|
|                                  |                     | Accessions               | Quantitative | Quantitative |
| <b>a. Annually regenerated</b>   |                     |                          |              |              |
| Rice                             | 418                 | 418                      | 10           | 14           |
| Horsegram                        | 200                 | 200                      | 2            | 3            |
| <i>Vigna</i> spp.                | 125                 | 9                        | 23           | 6            |
| Okra                             | 81                  | 81                       | 11           | 10           |
| Taro                             | 554                 | 58                       | 15           | 3            |
| Greater yam                      | 230                 | 18                       | 5            | 6            |
| Turmeric                         | 653                 | 149                      | 8            | 1            |
| <i>Curcuma</i> spp. (tuberising) | 47                  | 21                       | 5            | 9            |
| <i>Solanum incanum</i>           | 26                  | 25                       |              | 5            |
| <i>Mucuna pruriens</i>           | 22                  | 7                        | 15           | 11           |
| <i>Ocimum gratissimum</i>        | 5                   | 5                        | 9            | 0            |
| <i>Andrographis paniculata</i>   | 8                   | 6                        | 7            | 0            |
| <b>b. Perennial</b>              |                     |                          |              |              |
| Black pepper                     | 183                 | 85                       | 12           | 12           |
| Malabar tamarind                 | 132                 | 11                       | 13           | 0            |
| Kokam                            | 41                  | 3                        | 3            | 0            |
| Banana                           | 307                 | 87                       | 9            | 4            |
| M & A plants                     | 560                 | 13                       | 7            | 16           |
| <b>Total</b>                     | <b>3594</b>         | <b>1238</b>              |              |              |

**18.3.1 Rice (*Oryza sativa*):** A total of 418 accessions of rice was evaluated along with 4 checks namely Ahalya, Jaya, Jyothi and Thulasi during Kharif 2003 in the

Augmented design in the newly established wet land for 10 quantitative and 23 qualitative traits and the results are given below:

| Characters               | Range        | Mean  | SD   | CV (%) |
|--------------------------|--------------|-------|------|--------|
| Leaf length (cm)         | 37.4 – 96.2  | 61.9  | 10.7 | 17.2   |
| Leaf width (cm)          | 0.7 – 2.1    | 1.2   | 0.2  | 18.3   |
| Days to 50% flowering    | 81 – 124     | 104.9 | 6.5  | 6.2    |
| No. of effective tillers | 5 – 21       | 10.6  | 2.9  | 27.3   |
| Plant height (cm)        | 76.6 – 185.2 | 147.7 | 18.0 | 12.6   |
| Panicle length (cm)      | 16.6 – 42.0  | 28.2  | 3.6  | 12.8   |
| Yield (g/ plant)         | 0.1 – 11.8   | 2.6   | 1.8  | 71.5   |

Yield of checks: Ahalya – 25.26; Jaya – 2.18; Jyothi – 2.9; Thulasi – 3.82

(Part of this work was carried out under the USIF Project No. IN-ARS-862 upto 30.09.2003)

**18.3.2 Okra (*Abelmoschus esculentus*):** Eighty-one accessions of okra were evaluated for 10 qualitative and 11 quantitative characters

in the augmented design along with three checks namely Pusa Sawani (C1), Arka Anamika (C2) and Local selection 3 (C3).

**Frequency of ten qualitative traits in 81 accessions of okra**

| Descriptor                  | Descriptor status          | Frequency | Checks     |
|-----------------------------|----------------------------|-----------|------------|
| Early plant vigour          | 1 (Poor)                   | 17        | C2         |
|                             | 2 (Good)                   | 37        | C1, C3     |
|                             | 3 (Very good)              | 27        |            |
| Plant growth habit          | 1 (Erect)                  | 81        | C1, C2, C3 |
| Branching habit             | 1 (Low)                    | 67        | C1, C2, C3 |
|                             | 2 (Profused)               | 14        |            |
| Number of epicalyx segments | 1 (From 5-7)               | 1         |            |
|                             | 2 (From 8-10)              | 69        | C1, C2, C3 |
|                             | 3 (More than 10)           | 11        |            |
| Shape of epicalyx segments  | 1 (Linear)                 | 81        | C1, C2, C3 |
| Immature fruit colour       | 1 (Yellowish green)        | 32        | C2         |
|                             | 2 (Green)                  | 37        | C1, C3     |
|                             | 3 (Dark green)             | 2         |            |
|                             | 4 (Red)                    | 10        |            |
| Number of ridges per fruit  | 2 (From 5-7)               | 78        | C1, C2, C3 |
|                             | 3 (From 8-10)              | 3         |            |
| Fruit pubescence            | 5 (Slightly rough)         | 40        | C1, C2     |
|                             | 7 (Prickly)                | 41        | C3         |
| Mature fruit colour         | 1 (Yellowish green)        | 18        | C2         |
|                             | 2 (Green)                  | 33        | C1, C3     |
|                             | 3 (Green with red patches) | 23        |            |
|                             | 4 (Dark green)             | 6         |            |
|                             | 5 (Dark red)               | 1         |            |
| Seed shape                  | Round (1)                  | 81        | C1, C2, C3 |

**18.3.3 Turmeric (*Curcuma longa*):** A total of 149 accessions was planted in the Augmented design along with 3 checks. Observations were made on eight

quantitative and one qualitative above ground vegetative characters in 149 accessions and the range, mean, SD and CV (%) are given below:

|         | Days to emergence | Early vigour in 1-9 scale | Plant height (cm) | Petiole length (cm) | Sheath length (cm) | Leaf length (cm) | Leaf width (cm) | Sucker number | Leaf number /sucker |
|---------|-------------------|---------------------------|-------------------|---------------------|--------------------|------------------|-----------------|---------------|---------------------|
| Min.    | 18                | 2                         | 49.3              | 19                  | 13.5               | 27.3             | 10.5            | 1             | 3.7                 |
| Max.    | 48                | 9                         | 124               | 58                  | 46.7               | 61               | 23.7            | 6             | 9                   |
| Mean    | 33                | 5                         | 80.9              | 35.8                | 25.3               | 42.5             | 14.9            | 2.9           | 6.6                 |
| SD      | 6.3               | 2                         | 14.4              | 7.3                 | 5.9                | 6.9              | 2.2             | 1.1           | 0.9                 |
| CV      | 19.1              | 40.0                      | 17.8              | 20.3                | 23.1               | 16.2             | 14.5            | 39.7          | 13.9                |
| Check 1 | 37                | 7.17                      | 102.89            | 48                  | 36.5               | 52               | 16.44           | 2.66          | 7.72                |
| Check 2 | 47.3              | 5.7                       | 91.6              | 41.7                | 31.5               | 45.3             | 16.1            | 3.4           | 6.6                 |
| Check 3 | -                 | -                         | -                 | -                   | -                  | -                | -               | -             | -                   |

Check 1=M7 Check 2=M15 Check 3=Pattikkad local (C3 did not perform well)

**Curcuma spp.:** Twenty-one accessions were characterized for five quantitative and nine qualitative characters. The range obtained in the quantitative characters is given below:

| Character           | Range       |
|---------------------|-------------|
| Plant height (cm)   | 25.0 – 90.0 |
| Petiole length (cm) | 12.0 – 53.0 |
| Sheath length (cm)  | 8.0 – 30.0  |
| Leaf length (cm)    | 15.5 – 44.0 |
| Leaf width (cm)     | 5.0 – 15.0  |

An accession of *Curcuma*, IC 329331, collected from Udupi dt., Karnataka has been identified as a new species and has been named as *Curcuma purpurea* sp. nova (pending publication).

**18.3.4 Malabar Tamarind (*Garcinia cambogia*):** Twelve trees belonging to 11 accessions were characterized for 13 quantitative fruit, seed and stalk characters, namely, fruit weight, number of ridges on fruit, rind weight, rind thickness, fruit length, fruit diameter, number of seeds per fruit, seed length, seed width, seed thickness, seed weight, pulp weight and stalk length. Five trees, namely, IC 136683, 244086-1, 244097-3, 244100-1 and 244115 were promising with fruit weight and rind weight above the mean of 78.9g and 52.6g, respectively.

Twenty-eight trees comprising 22 accessions

were characterized for three quantitative fruit yield characters, namely, total number and weight of fruit per tree per year and average weight of fruit. The range of variation observed for these characters was, 10-4111, 0.8 - 214.2kg and 15.1 - 104.1g respectively. Accessions IC136681, IC244077-1, IC244081-2, IC244083-1, IC244100-1, IC244100-2, IC244100-3, IC244101-2, IC244106-2, IC244110 and IC244111-1 yielded more fruits than the mean of 1226.8 fruits per tree per year. Similarly, accessions IC244077-1, IC244081-2, IC244083-1, IC244100-1, IC244100-2, IC244100-3, IC244101-2, IC244101-3, IC244106-2, IC244110, IC244111-1 and IC244115 yielded more than the mean total weight of 60.9 kg per tree per year. Likewise IC136677-1, IC136683, IC244086-1, IC244090-3, IC244096-2, IC244097-3, IC244101-2, IC244101-3, IC244113-1 and 244115 had single fruit weight of more than the mean of 55.6 g.

Dried rind is the commercial part that can be readily sold in the local markets of Kerala for its use as condiment. Hence, a study was undertaken on recovery of dry rind of fruits in 24 trees belonging to 20 accessions. This showed that the recovery of the dry rind of fruit, which is a promising trait, was more than the mean of 7.83 % in IC 244106-

2, 244101-2, 244081-2, 244097-3, 244096-2, 136677-1, 244086-2, 244115, 244101-3, 244110, 244075-1 and 244100-1, when the fresh fruit weight as a whole was taken in to consideration for calculating the percentage of dry rind recovery. Similarly, the time taken for drying isolated fresh rind of fruits to obtain dried rind was less than the mean of 9.13 % in IC 244084-1, 244101-3, 244110, 244075-1 and 244100-1.

Three accessions of Malabar tamarind viz., IC 244100-2, 244101-3 and IC 244111-1 are found to be promising for a combination of important yield related traits as follows:

- IC 244100-2 - early bearing (6 years), no. of fruits/year (4111) and yield/year(214 kg)

- IC 244101-3 - early bearing (7 years), average fruit wt. (74 g) and rind recovery % (17)
- IC 244111-1 - early bearing (7 years), no. of fruits/year (3464) and yield/year(157kg)

**18.3.5 Kokam (*Garcinia indica*):** Yield of 4 trees in three accessions were assessed as follows

| Acc. Number | Total fruits | Total wt. of fruits | Fruit weight (g) |
|-------------|--------------|---------------------|------------------|
| IC136682-2  | 3081         | 43.1                | 14.0             |
| IC136685-1  | 1139         | 12.0                | 10.6             |
| IC136687-2  | 2927         | 38.3                | 13.1             |
| IC136687-3  | 3935         | 55.1                | 14.0             |

**18.3.6 Black Pepper (*Piper nigrum*):** Observations were made on spike and berry characters in 85 accessions of black pepper and the range, mean, SD and CV (%) computed as follows :

|      | Berry L (mm) | Berry W (mm) | Total spike wt/pt (g) | Total fresh berry wt/pt (g) | Total dry berry wt/pt (g) | Per spike wt (g) | 100 berry wt (g) | 100 seed fresh wt (g) | Seed L (mm) | Seed W (mm) |
|------|--------------|--------------|-----------------------|-----------------------------|---------------------------|------------------|------------------|-----------------------|-------------|-------------|
| Min  | 4.2          | 3.9          | 30                    | 16                          | 9.33                      | 1.7              | 5.0              | 3.2                   | 3.6         | 3.2         |
| Max  | 7.8          | 7.3          | 2450                  | 2000                        | 467                       | 36.9             | 20.0             | 20.0                  | 6.2         | 5.2         |
| Mean | 6.0          | 5.7          | 534.5                 | 428.3                       | 143.8                     | 5.8              | 12.3             | 5.9                   | 4.6         | 4.3         |
| SD   | 0.7          | 0.7          | 536.2                 | 449.3                       | 126.0                     | 4.2              | 3.3              | 2.2                   | 0.5         | 0.4         |
| CV%  | 12.2         | 11.5         | 100.3                 | 104.9                       | 87.7                      | 72.4             | 26.4             | 36.9                  | 11.3        | 9.7         |

### 18.3.7 Horsegram (*Macrotyloma uniflorum*):

In horsegram 200 accessions were subjected to multi-location evaluation in the augmented block design along with three checks for three qualitative and two quantitative characters. The frequency distribution of the two quantitative characters are given below:

| Characters            | No. of accessions | Descriptions |
|-----------------------|-------------------|--------------|
| Days to 50% flowering | 16                | 45-55        |
|                       | 119               | 56-65        |
|                       | 65                | >65          |
| Days to 80% maturity  | 10                | 77-85        |
|                       | 111               | 86-94        |
|                       | 79                | 94           |

(Part of this work was carried out under the USIF Project No. IN-ARS-862 upto 30.09.2003)

**18.3.8 Vigna spp:** Nine accessions were characterized for 23 qualitative and six quantitative traits. The range obtained in the six quantitative characters is given below:

| Character                    | Range       |
|------------------------------|-------------|
| Petiole length (cm)          | 0.98 – 1.5  |
| Terminal leaflet length (cm) | 4.60 – 8.58 |
| Terminal leaflet width (cm)  | 2.80 – 7.24 |
| Petiole length (cm)          | 5.62 – 8.6  |
| No. of lobes                 | 0 – 3       |
| No. of primary branches      | 3 - 5       |

**18.3.9 Greater Yam (*Dioscorea alata*):** Eighteen accessions were characterized for five qualitative and six quantitative traits. The results obtained in the six quantitative characters are given below:

| Character                        | Range    | Mean  | CV (%) |
|----------------------------------|----------|-------|--------|
| Leaf length (cm)                 | 9.5-14.5 | 11.58 | 10.71  |
| Leaf width (cm)                  | 6.3-10.9 | 8.57  | 15.74  |
| Petiole length (cm)              | 5.2-9.5  | 7.41  | 16.25  |
| Length of basal wing (cm)        | 2.1-4.5  | 3.21  | 21.97  |
| Distance between basal wing (cm) | 3.8-7.5  | 5.19  | 17.97  |
| Leaf sinus depth (cm)            | 2.7-4.5  | 3.68  | 14.40  |

| Character           | Range     |
|---------------------|-----------|
| Plant height (cm)   | 46 – 112  |
| Petiole length (cm) | 37 – 103  |
| Sheath length (cm)  | 20 – 70   |
| Leaf length (cm)    | 22 – 51.7 |
| Leaf width (cm)     | 17 – 42.3 |
| No. of leaves       | 4.3– 11   |
| No. of suckers      | 1 – 14    |

**18.3.10 Taro (*Colocasia esculenta*):** Fifty-seven accessions were characterised for 7 above ground vegetative quantitative characters. The range of variation is given below:

Observation were made on eight quantitative and three qualitative tuber characters in 57 accessions and the range, mean, SD and CV (%) are given below :

|         | Corm number | Cormel number | Corm length (cm) | Corm thickness (cm) | Cormel length (cm) | Cormel thickness (cm) | Corm weight (g) | Cormel weight (g) |
|---------|-------------|---------------|------------------|---------------------|--------------------|-----------------------|-----------------|-------------------|
| Min     | 1           | 2             | 3.5              | 2.4                 | 4                  | 1.5                   | 40              | 9.5               |
| Max     | 3           | 23.3          | 16               | 9                   | 22                 | 11.5                  | 700             | 610               |
| Mean    | 1.5         | 9.3           | 7.9              | 5.5                 | 8.9                | 3.1                   | 162.7           | 254.6             |
| SD      | 0.5         | 4.8           | 2.6              | 1.3                 | 2.7                | 1.4                   | 128.9           | 143.2             |
| CV.(%)  | 16.8        | 51.9          | 33.5             | 21                  | 30.6               | 43.9                  | 79.2            | 56.3              |
| Check 1 | 1.4         | 7.1           | 6.7              | 6.1                 | 9.9                | 2.8                   | 110.0           | 265.0             |
| Check 2 | 2           | 7             | 7.1              | 5.1                 | 9                  | 2.7                   | 76              | 180               |

Check 1=M1 Check 2=M2

### 18.3.11 Medicinal & Aromatic Plants

***Andrographis paniculata*:** Six accessions of

kalmegh were analysed for seven quantitative characters and the results are given below:

|         | Plant height (cm) | Stem thickness (cm) | Largest leaf length (cm) | Largest leaf width (cm) | Largest leaf petiole length (cm) | Raceme length (cm) | Raceme breadth (cm) | No. of branches/panicle | Total no. of flowers/panicle |
|---------|-------------------|---------------------|--------------------------|-------------------------|----------------------------------|--------------------|---------------------|-------------------------|------------------------------|
| Mean    | 71.9              | 2.2                 | 6.4                      | 2.5                     | 0.3                              | 8.5                | 9.3                 | 15.2                    | 26.0                         |
| Minimum | 62.3              | 1.6                 | 4.6                      | 1.1                     | 0.2                              | 5.7                | 0.3                 | 10.8                    | 15.8                         |
| Maximum | 78.8              | 3.1                 | 7.6                      | 3.1                     | 0.3                              | 11.4               | 16.9                | 18.1                    | 31.2                         |
| SD      | 7.2               | 0.6                 | 1.1                      | 0.8                     | 0.1                              | 2.1                | 7.3                 | 3.2                     | 6.6                          |
| CV.(%)  | 10.0              | 25.1                | 18.0                     | 30.4                    | 19.4                             | 24.4               | 78.5                | 21.2                    | 25.3                         |

***Ocimum gratissimum*:** Five accessions of *Ocimum gratissimum* were analysed for nine

quantitative characters and the results are given below:

|         | Plant height (cm) | Stem thickness (cm) | Largest leaf length (cm) | Largest leaf width (cm) | Largest leaf petiole length (cm) | Raceme length (cm) | Raceme breadth (cm) |
|---------|-------------------|---------------------|--------------------------|-------------------------|----------------------------------|--------------------|---------------------|
| Mean    | 62.8              | 2.1                 | 9.4                      | 6.9                     | 4.4                              | 13.1               | 2.2                 |
| Minimum | 39.6              | 1.6                 | 8.3                      | 6.7                     | 3.9                              | 9.8                | 2.1                 |
| Maximum | 88.0              | 2.6                 | 10.6                     | 7.0                     | 4.8                              | 18.6               | 2.3                 |
| SD      | 17.7              | 0.5                 | 0.9                      | 0.1                     | 0.4                              | 3.3                | 0.1                 |
| CV(%)   | 7.9               | 0.2                 | 0.4                      | 0.1                     | 0.2                              | 1.5                | 0.0                 |

## 18.4 Genetic Enhancement in Sesame and Mung bean

A total of 24 crosses was attempted with four varieties of green gram as female parent and two accessions each of *Vigna mungo* var. *sylvestris* and *V. radiata* var. *sublobata* and one accession each of *V. hainiana* and *V.*

*radiata* var. *setulosa* as male parent. The percentage of pod set in each cross is given in the table below. The results showed that maximum pod set was observed in the cross between green gram x *V. radiata* var. *sublobata* and minimum in the cross between green gram x *V. hainiana*.

| Parents   | Total crosses made | No. of pods set | % of pod set |
|---|--------------------|-----------------|--------------|
| VBNKg-2 x <i>Vigna mungo</i> var. <i>sylvestris</i> | 56                 | 6               | 10.7         |
| " x <i>V. mungo</i> var. <i>sylvestris</i>          | 30                 | 8               | 26.7         |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 44                 | 13              | 29.5         |
| " x <i>V. hainiana</i>                              | 50                 | 3               | 6.0          |
| " x <i>V. radiata</i> var. <i>setulosa</i>          | 34                 | 5               | 14.          |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 14                 | 6               | 42.9         |
| CO-4 x <i>Vigna mungo</i> var. <i>sylvestris</i>    | 76                 | 5               | 6.6          |
| " x <i>V. mungo</i> var. <i>sylvestris</i>          | 24                 | 2               | 8.3          |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 59                 | 4               | 6.8          |
| " x <i>V. hainiana</i>                              | 51                 | 1               | 1.9          |
| " x <i>V. radiata</i> var. <i>setulosa</i>          | 29                 | 4               | 13.8         |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 40                 | 3               | 7.5          |
| CO-5 x <i>Vigna mungo</i> var. <i>sylvestris</i>    | 38                 | 3               | 7.9          |
| " x <i>V. mungo</i> var. <i>sylvestris</i>          | 36                 | 2               | 5.6          |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 74                 | 3               | 4.1          |
| " x <i>V. hainiana</i>                              | 80                 | 0               | 0.0          |
| " x <i>V. radiata</i> var. <i>setulosa</i>          | 42                 | 1               | 2.4          |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 32                 | 3               | 9.8          |
| CO-6 x <i>Vigna mungo</i> var. <i>sylvestris</i>    | 76                 | 6               | 7.9          |
| " x <i>V. mungo</i> var. <i>sylvestris</i>          | 37                 | 4               | 10.8         |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 53                 | 11              | 20.7         |
| " x <i>V. hainiana</i>                              | 63                 | 6               | 9.5          |
| " x <i>V. radiata</i> var. <i>setulosa</i>          | 10                 | 2               | 20.0         |
| " x <i>V. radiata</i> var. <i>sublobata</i>         | 22                 | 1               | 4.5          |



IC 136687-3, a promising accession of Kokam registered as indigenous germplasm



'Gotam'—a traditional variety of mango collected from Goa



Malabar tamarind (IC 244100-2)-a promising collection registered as indigenous germplasm



Women scientists as participants of on-job short training course under NATP (PB) taking observations on wild rice at Thrissur station



Peribera nellu—a landrace of rice with red bran collected from Tamil Nadu

### 18.5 Analysis of Genetic Diversity and Phylogenetic Relationship in *Solanum melongena* and Related Wild and Weedy Taxa

**Exploration and collection:** Six accessions of *Solanum incanum* were collected from Thrissur, Kasargod and Palakkad dts., of Kerala. Herbarium specimens of 2 accession of *Solanum incanum* were deposited in the NHCP.

**Characterisation:** Twenty-five accessions of *Solanum incanum* raised this year were observed for five qualitative characters and the frequency distribution of two characters is given below:

| Characters     | No. of accessions | Code | Descriptions    |
|----------------|-------------------|------|-----------------|
| Corolla colour | 22                | 5    | Pale violet     |
|                | 3                 | 7    | Light violet    |
|                | 4                 | 1    | Green           |
| Petiole colour | 7                 | 3    | Greenish violet |
|                | 12                | 5    | Violet          |
|                | 2                 | 7    | Dark violet     |
|                |                   |      |                 |

### 18.6 *In vitro* propagation and conservation

A total of 166 accessions comprising ginger (149), *Curcuma* sp. (2), *Dioscorea* sp. (10), *Garcinia cambogia* (1) and *G. indica* (4) were maintained in *in vitro*. In ginger, 149 accessions were conserved *in vitro* using MS+BAP 2.5mg/IAA 0.1mg/l+Sucrose 60g/l+Agar 7g/l as the medium and 38 accessions were planted in pots after hardening

A total of 124 accessions were conserved *in vitro* comprising cassava (43), black pepper (28) and ginger (53). Out of the 53 accessions of ginger established in multiplication medium, 32 were hardened and established in pots in shade house.

**Medium term storage:** A total of 170 accessions of rice from KAU, 499 of minor millets from AICSMIP and 248 accessions of wild relatives and 26 of *Mucuna* spp.

### Research Projects (Project Code; Title; 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).

regenerated by this station were added to the existing accessions to make a total of 8564 accessions of various crops including NATP-PB exploration materials.

### 18.7 Germplasm supply

**Supply to NBPGR, New Delhi and its Regional Stations:** A total of 533 accessions was supplied to NBPGR, New Delhi (133 accessions) and NBPGR, Cuttack (400).

**Supply to user agencies:** A total of 681 accessions was supplied to 11 user agencies within Zone-II (614 accessions) and seven user agencies outside Zone-II (67 accessions).

**Germplasm receipt:** In total, 230 accessions of various materials was received as follows: From NBPGR, New Delhi- 16 exotic and 16 indigenous accessions; NBPGR, Hyderabad- 95 accessions; NBPGR, Ranchi- 49 accessions; NBPGR, Cuttack- 1 accession; BU, Trichy- 31; accessions; TNAU (F)- 7 accessions and MSSRF, Chennai- 15 accessions

### 18.8 Germplasm Conservation

**Sent to National Genebank for LTS:** A total of 605 accessions was sent for LTS in the National Genebank, NBPGR, New Delhi.

**Sent to TC&CP Unit for in-vitro conservation/cryopreservation:** A total of 51 accessions was sent to TC & CP Unit, NBPGR, New Delhi for cryopreservation and *in vitro* conservation. These comprised Taro (28), Ginger (6), Turmeric (1), Elephant foot yam (8), Cassava (3) and Malabar tamarind (5).



- 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 (K.C. 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).

## 19. EMPOWERMENT OF WOMEN

Agro biodiversity within a country is a sovereign property of a nation that needs prudent management through its conservation and use in a sustainable and equitable manner. Women, being instinctively the caretakers of household nutrition and health security tend to conserve and improve plants of value, thus have a distinct role in conservation and enhancement of plant genetic resources, which needs to be explicitly recognized and promoted. Women empowerment and involvement in decision making is essential for internalizing gender consideration in research and education and to promote pro-women orientation in technology development and public policy making. Efforts were made towards empowerment of women and mainstreaming the gender issues by providing appropriate infrastructure and unbiased access to opportunities.

### 19.1 Women Cell

The Women Cell at NBPGR, established on February 4, 1998, takes care of welfare of women in general and caters to the issues/grievances pertaining to service conditions of women employees. The women cell members meet every quarter of the year to redress specific problems, if any faced by women employees and intimated to the cell, in consultation with higher authorities. It has following objectives:

- To participate and advise on the planning process of socio-economic development of women.
- To review plan schemes and ensure that aspects of women's development is promoted.

- To introduce wherever feasible a component for women's development in various schemes and programmes.

### 19.2 Women Cadre Strength

There are 87 women staff members in the Bureau including 14 at its regional stations. Of these, 36 are scientists, 12 including 6 officers in technical cadre, 26 in administration and 13 are the supporting staff.

Women constitute 38% of scientists at Headquarters and 17% in the Regional Stations, latter being 33% at Regional station Jodhpur, Hyderabad and Thrissur, whereas at HQs, 24% of technical officers are also women.

### 19.3 Representation of Women in Committees

Women staff has adequate representation in various committees of the Bureau, like institute management committee (IMC), institute joint staff committee (IJC), purchase and monitoring committee (PAMC), DUS-Core Committee (ICAR), Functional Committee on Plant Genetic Resources, Germplasm handling committee, SRC drafting committee, Crop group/ advisory committees on different crops, Divisional purchase committees, committees to prepare guidelines for germplasm exchange, to develop criteria for allocation of technical assistants/officers to different divisions at Bureau's headquarter and regional stations, for grant of honorarium, to fix the price for sale of produce of NBPGR experimental farm, Issapur, New Delhi; Farm Darshan Committee to organize Kisan Mela at above farm, Logistic support committee to examine the typing and shorthand

work and Rajbhasha karyanvan samiti. Women representation is about 80% in the Publication committee and cent percent in Poster display and Canteen committee.

#### **19.4 Human Resource Development (Training received and imparted)**

Seven women scientists and one technical officer were trained for their professional enhancement in various areas like, Plant Quarantine: Thermal treatments for disinfestation of fruit flies (Japan), Applications of HPTLC (Bombay); Protection of intellectual property and agricultural research (Hyderabad), Web technologies and AFLP technique for cultivar identification and analysis of molecular diversity in crop plants (New Delhi).

Nine women scientists and one technical officer also imparted training in various programmes

*viz.*, Orientation course on biosafety considerations for evaluation of transgenic crops and On job short training of NATP sub-project on HRD in PGR management in Toe mode at NBPGR, New Delhi; Zonal Meeting and Zonal workshop/ training on post-collection care and handling of germplasm at NBPGR Regional Stations, Hyderabad and Ranchi; Grass-root level training programmes, PGR literacy in women and biodiversity fair at Gorakhpur and Awareness generation on plant biodiversity at NBPGR Regional Station, Ranchi, wherein over 300 women participated.

Sixteen women scientists and two technical officers projected their contributions in about twenty-five international and national scientific forums like seminars/ symposia/ conferences/workshops etc. (details given in chapter 20).

## 20. GENERAL INFORMATION

### 20.1 Institute Management Committee

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

**Members:** Shri MG Patnaik, IAS, Development Commissioner (Rural), Govt. of Delhi, Delhi; Shri Rajiv Arora, Director (Agriculture), Directorate of Agriculture, Govt. of Haryana, Chandigarh; Dr SP Tiwari, Asstt. Director General (Seeds), ICAR, Krishi Bhawan, New Delhi-110001; Dr PS Sirohi, Head, Division of Vegetable Crops, IARI, New Delhi-110012; Dr JL Karihaloo, Project Director, NRC on DNA Finger Printing, NBPGR, New Delhi; Dr Beche Lal, Principal Scientist, Division of Plant Quarantine, NBPGR, New Delhi; Dr (Mrs) Kalyani Srinivasan, Senior Scientist, Division of Germplasm Conservation, NBPGR, New Delhi; Shri Roshan Lal, Finance & Accounts Officer, NATP, KAB-II, Pusa Campus, New Delhi-110012.

**Member Secretary:** Shri SK Mitra, SAO, NBPGR, New Delhi.

The meetings of IMC were held on 20 February 2003 and 21 October 2003 under the Chairmanship of Dr BS Dhillon, Director of NBPGR.

### 20.2 Research Advisory Committee

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

**Members:** Dr P Puspagadan, 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 Deetha, 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 (Seeds), ICAR, New Delhi; Two persons representing agricultural/ rural interests on the Management Committee of the NBPGR.

**Member Secretary:** Dr Umesh Srivastava, Principal Scientist, NBPGR, New Delhi

A meeting of RAC was held under the Chairmanship of Dr EA Siddiq on 2-3 June, 2003 at NBPGR, New Delhi.

### 20.3 Staff Research Council

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

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

Since the guidelines from ICAR demanded two SRC meetings in a year, the first SRC meeting of the Bureau was conducted on 27-29 May 2003 and the second meeting was held on 16-17, December 2003. 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.

## 20.4 Institute Joint Staff Council

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

**Secretary (Official Side):** Dr Arjun Lal, Principal Scientist

**Members (Official Side):** Shri SK Mitra, SAO, NBPGR, New Delhi; Dr BB Mandal,

Head, TC&CP Unit; Dr (Ms) Anjula Pandey, Scientist; Shri SK Mitra, SAO, NBPGR; Shri BK Bansal, F&AO, NBPGR.

**Members (Staff Side):** Shri Anag Pal, T-II-3; Shri Rakesh Singh, T-5; Shri Yogesh Kumar Gupta, Sr. Clerk; Mrs Vijay Laxmi Sharma, Sr. Clerk; Shri IV Ramachandran, SSGr-II; Shri Yatish Chander, SSGr II.

## 20.5 Personnel

### I. Scientific Staff

| Name  | Designation                 | Discipline              |
|---|-----------------------------|-------------------------|
| Dr. B. S. Dhillon                           | Director                    | RMP                     |
| <b>Division of Germplasm Evaluation</b>     |                             |                         |
| Dr. Mahendra Singh                          | Head                        | Genetics                |
| Dr. R.K. Mahajan                            | Principal Scientist         | Agricultural Statistics |
| Dr. S.K. Pareek                             | Principal Scientist         | Agronomy                |
| Dr. S. Mandal                               | Principal Scientist         | Biochemistry            |
| Sh. Ranbir Singh                            | Principal Scientist         | Economic Botany         |
| Dr. (Ms.) Saroj Sardana                     | Principal Scientist         | Plant Breeding          |
| Dr. D.C. Bhandari                           | Principal Scientist         | Economic Botany         |
| Dr. R.P. Dua                                | Principal Scientist         | Plant Breeding          |
| Dr. I.S. Bisht                              | Senior Scientist            | Plant Pathology         |
| Dr. R.C. Agarwal                            | Senior Scientist            | Agricultural Statistics |
| Dr. V.K. 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          |
| Sh. N.K. Gautam                             | Scientist (Selection Grade) | Economic Botany         |
| Sh. Gunjeet Kumar                           | Scientist                   | Horticulture            |
| Mrs. Sangeeta Yadav                         | Scientist                   | Biochemistry            |
| Dr. Archana Peshin                          | Scientist                   | Agricultural Chemistry  |
| <b>Division of Plant Exploration</b>        |                             |                         |
| Dr. S.S. Malik                              | Head & Pr. Scientist        | Economic Botany         |
| Ms. E. Roshini Nair                         | Principal Scientist         | Economic Botany         |
| Dr. (Ms.) Anjula Pandey                     | Senior Scientist            | Economic Botany         |
| Dr. K.C. Bhatt                              | Senior Scientist            | Economic Botany         |
| Dr. R. Senthil Kumar (posted at Port Blair) | Scientist                   | Horticulture            |
| <b>Germplasm Conservation Division</b>      |                             |                         |
| Dr. A.K. 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. Ashok Kumar                             | Senior Scientist            | Plant Breeding          |

|   |                             |                         |
|---|-----------------------------|-------------------------|
| Dr. Kalyani 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         |
| <b>Division of Plant Quarantine</b>         |                             |                         |
| Dr. R.K. Khetarpal                          | Head & Pr. Scientist        | Plant Pathology         |
| Dr. Arjun Lal                               | Principal Scientist         | Nematology              |
| Dr. Shamsheer Singh                         | Principal Scientist         | Plant Pathology         |
| Dr. P.C. Aggarwal                           | Principal Scientist         | Plant Pathology         |
| Dr. Beche Lal                               | Principal Scientist         | Agricultural Entomology |
| Dr. Usha Dev                                | Principal Scientist         | Plant Pathology         |
| Dr. Manju Lata Kapur                        | Principal Scientist         | Agricultural Entomology |
| Dr. Rajan                                   | Senior Scientist            | Nematology              |
| Dr. D.B. Parakh                             | Senior Scientist            | Plant Pathology         |
| Dr. Baleshwar Singh                         | Senior Scientist            | Plant Pathology         |
| Dr. (Ms.) Shashi Bhalla                     | Senior Scientist            | Agricultural Entomology |
| Dr. (Mrs.) Ceilia Chelam                    | Scientist (Senior Scale)    | Plant Pathology         |
| Dr. (Mrs.) Kavita Gupta                     | Scientist (Senior Scale)    | Agril. Entomology       |
| <b>Division of Germplasm Exchange</b>       |                             |                         |
| Dr. Ranvir Singh                            | Principal Scientist & Head  | Economic Botany         |
| Dr. (Ms.) Pratibha Brahmi                   | Senior Scientist            | Economic Botany         |
| Sh. Deep Chand                              | Scientist (Selection Scale) | Economic Botany         |
| Dr. (Mrs.) Vandana Tyagi                    | Scientist (Senior Scale)    | Economic Botany         |
| Mrs. Nidhi Verma                            | Scientist (Senior Scale)    | Economic Botany         |
| Dr. Anil Kumar Singh                        | Scientist                   | Economic Botany         |
| <b>Tissue Culture and Cryo-preservation</b> |                             |                         |
| Dr. B.B. Mandal                             | Principal Scientist         | Genetics & Cytogenetics |
| Dr. Rekha Chaudhary                         | Senior Scientist            | Economic Botany         |
| Dr. R.K. Tyagi                              | Senior Scientist            | Economic Botany         |
| Dr. (Ms.) Ruchira Pandey                    | Senior Scientist            | Economic Botany         |
| Dr. (Ms.) Neelam Sharma                     | Senior Scientist            | Economic Botany         |
| Dr. Anuradha Agarwal                        | Senior Scientist            | Economic Botany         |
| Dr. (Ms.) Sandhya Gupta                     | Scientist (Senior Scale)    | Economic Botany         |
| Dr. S.K. Malik                              | Scientist (Senior Scale)    | Economic Botany         |
| Dr. Zakir Hussain                           | Scientist                   | Genetics                |
| <b>Regional Station, Shillong</b>           |                             |                         |
| Dr. D.K. Hore                               | Pr. Scientist & In-charge   | Economic Botany         |
| Sh. Rakesh Srivastava                       | Senior Scientist            | Horticulture            |
| Dr. W.L. Barwad                             | Senior Scientist            | Agricultural Entomology |
| <b>Regional Station, Thrissur (Kerala)</b>  |                             |                         |
| Dr. Z. Abraham                              | Pr. Scientist & In-charge   | Economic Botany         |
| Sh. K.C. Velayudhan                         | Principal Scientist         | Economic Botany         |
| Dr. Joseph John K.                          | Scientist (Selection Grade) | Economic Botany         |
| Sh. Mohd. Abdul Nizar                       | Scientist (Senior Scale)    | Economic Botany         |

|  |                              |                         |
|--|------------------------------|-------------------------|
| Ms. Asha K.I.  | Scientist (Senior Scale)     | Economic Botany         |
| Ms. M. Latha   | Scientist (Senior Scale)     | Plant Breeding          |
| <b>Regional Station, Jodhpur (Rajasthan)</b>             |                              |                         |
| Dr. N.K. Dwivedi   | Pr. Scientist & In-charge    | Economic Botany         |
| Dr. Neelam Bhatnagar                                     | Senior Scientist             | Economic Botany         |
| <b>Regional Station, Ranchi</b>                          |                              |                         |
| Dr. J.B. Tomar   | Pr. Scientist & In-charge    | Economic Botany         |
| Dr. V.K. Gupta   | Senior Scientist             | Plant Breeding          |
| <b>Regional Station, Shimla</b>                          |                              |                         |
| Dr. V.D. Verma   | Senior Scientist & In-Charge | Economic Botany         |
| Dr. J.C. Rana  | Senior Scientist             | Plant Breeding          |
| Dr. Satish Kumar Yadav                                   | Scientist                    | Horticulture            |
| Shri K. Pradheep   | Scientist                    | Economic Botany         |
| <b>Regional Station, Akola &amp; Amravati</b>            |                              |                         |
| Dr. I.P. Singh   | Pr. Scientist & In-Charge    | Plant Breeding          |
| Sh. Nilamani Dikshit                                     | Scientist (Sel. Grade)       | Economic Botany         |
| <b>Regional Station, Bhowali</b>                         |                              |                         |
| Sh. K.C. Muneem  | Principal Scientist          | Plant Pathology         |
| Dr. K.S. Negi  | Senior Scientist & Incharge  | Economic Botany         |
| Dr. S.K. Verma   | Senior Scientist             | Horticulture            |
| <b>Base Center, Cuttack</b>                              |                              |                         |
| Dr. D.P. Patel   | Pr. Scientist & In-Charge    | Economic Botany         |
| Sh. Diptiranjana Pani                                    | Scientist                    | Economic Botany         |
| <b>Regional station, Hyderabad</b>                       |                              |                         |
| Dr. K.S. Varaprasad                                      | Pr. Scientist & In-charge    | Nematology              |
| Dr. R.D.V.J. Prasada Rao                                 | Principal Scientist          | Plant Pathology         |
| Dr. S.K. Chakraborty                                     | Senior Scientist             | Plant Pathology         |
| Dr. B. Sarath Babu                                       | Senior Scientist             | Agricultural Entomology |
| Sh. S.R. 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            |
| Sh. Neelam Sunil   | Scientist                    | Economic Botany         |
| <b>Regional Station, Srinagar (J &amp; K)</b>            |                              |                         |
| Dr. K.K. Gangopadhyay                                    | Senior Scientist             | Horticulture            |
| <b>Under Utilised And Under Exploited Plants Project</b> |                              |                         |
| Dr. B.S. Phogat  | Senior Scientist             | Agronomy                |
| Sh. Hanuman Lal Raigar                                   | Scientist                    | Agricultural Statistics |
| <b>National Research Center on DNA Fingerprinting</b>    |                              |                         |
| Dr. J.L. Karihaloo                                       | Project Director             | Genetics & Cytogenetics |
| Dr. Gurinderjit Randhawa                                 | Senior Scientist             | Plant Physiology        |
| Dr. K.V. Bhatt   | Senior Scientist             | Plant Breeding          |
| Dr. Mukesh Kumar Rana                                    | Scientist (Senior Scale)     | Plant Breeding          |
| Sh. Sunil Archak   | Scientist                    | Bio-Technology – (AS)   |
| Ms. Lalit Anand  | Scientist                    | Bio-Chemistry           |

Ms. Madhu Bala  
Dr. (Ms.) Ambika Baldev  
Mr. Rakesh Singh

Scientist  
Scientist  
Scientist

Computer Application  
Bio-Technology  
Bio-Technology

## II. Technical Staff (T-6 and above)

| Name                             | Designation |
|----------------------------------|-------------|
| Sh. Om Prakash                   | T-6         |
| Sh. Jitender Mohan               | T-6         |
| Sh. Harinder Singh               | T-6         |
| Sh. Anil Kumar Singh             | T-6         |
| Dr. C.S. Raghav                  | T-6         |
| Sh. Suresh Chander Sharma        | T-8         |
| Sh. B.P. Dahiya                  | T-7         |
| Dr.(Mrs.) Manju Upreti           | T-6         |
| Ms. Rita Rani                    | T-6         |
| Sh. Ram Prasad Yadav             | T-6         |
| Smt. Indra Rani                  | T-6         |
| Sh. Charan Singh                 | T-6         |
| Sh. Rajiv Mathur                 | T-6         |
| Sh. Ranbir Singh Rathi           | T-6         |
| <b>Hindi Unit</b>                |             |
| Miss Sheela Kumari               | T-6         |
| <b>NRC ON DNA FINGERPRINTING</b> |             |
| Sh. Daya Shankar                 | T-6         |

## III. Administrative Staff

| Name                   | Designation      |
|------------------------|------------------|
| Sh. Sujit Kumar Mitra  | Sr. AO           |
| Sh. B.K. Bansal        | F&AO             |
| Sh. R. P. Dhasmana     | AAO              |
| Sh. M.L. Bagga,        | AAO              |
| Sh. Umesh Chandra Sati | Security Officer |
| Ms. Archana Raghav     | A.D. (OL)        |

## 20.6 Staff Reservations

Total number of employees in position and number of scheduled cases and scheduled tribes among them as on 31.12.2003

| Category       | Total No. of Employees | Total No. of Scheduled Caste Employees | Total No. of Scheduled 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                         |

## 20.7 Staff joined NBPGR on Transfer

1. Dr. W.L. Barwad, Sr. Scientist transferred from Satellite Centre Amravati to Umiam w.e.f. April, 2003.
2. Dr. D.C. Bhandari, Principal Scientist transferred from Regional Station Bhowali to Headquarters, New Delhi w.e.f. May, 2003.
3. Dr. K.C. Muneem, Principal Scientist transferred from Regional Station, Jodhpur to Bhowali w.e.f. May, 2003.
4. Dr. D.B. Parakh, Sr. Scientist transferred from Regional Station Bhowali to Headquarters w.e.f. May, 2003.

5. Dr. K.K. Gangopadhyay, Sr. Scientist transferred from Headquarters to Regional Station, Srinagar w.e.f. May, 2003.
6. Dr. Umesh Chander Srivastava transferred to ICAR, New Delhi from 29.09.03 (FN).

## 20.8 New Appointments

1. Sh. Yogesh Kumar, SSG-I joined NBPGR, New Delhi from NDRI, Karnal on 19.6.2003
2. Sh. M. Venkata Ramana Reddy joined as SSG-I at regional station, Hyderabad on 23.6.2003.



3. Sh. K. Pradeep joined as Scientist at regional station, Shimla on 25.08.2003.

## 20.9 Promotions

1. Sh. M.L. Bagga, Assistant promoted as Assistant Administrative officer on 30.09.2003
2. Sh. Goverdhan Singh, T-2, (Driver) NBPGR Regional Station, Shillong promoted as T-3 (Driver) w.e.f. 1.1.2003
3. Sh. Mohan Ram, T-1 (Driver), NBPGR Regional Station, Bhowali promoted as T-2 (Driver) w.e.f. 29.06.2001
4. Sh. Khushvinder Kumar, T-1 (Driver), NBPGR Regional Station, Shillong promoted as T-2 (Driver) w.e.f. 29.06.2001.
5. Ms Rita Rani, T-5 (Artist), NBPGR, New Delhi promoted as T-6 (Artist) w.e.f. 1.1.2003.

## 20.10 Staff Members Retired

1. Dr. B.D. Sharma, Officer Incharge, Shimla retired on 30.04.2003
2. Sh. R.K. Kale, T-5, Akola Station retired on 31.05.03
3. Dr. P.L. Premi, Sr. Scientist, Germplasm Evaluation Division retired on 31.07.2003
4. Sh. D.P. Sharma, Sr. Clerk, Audit Section retired on 31.07.2003
5. Sh. Bankey Lal, T-5, Germplasm Exchange Division retired on 31.07.2003
6. Mrs. R.K. Dua, AAO, Accounts Section took Voluntary retirement on 1.8.2003

7. Sh. Maha Ram, SSG-III, Issapur Station retired on 31.8.2003
8. Sh. Bhagat Ram, SSG IV, Bhowali station retired on 31.10.2003

## 20.11 Awards/Honours

- **Dr JL Karihaloo** received the Rafi Ahmed Kidwai Award conferred by the Indian Council of Agricultural Research, New Delhi for the biennium 2001-02, for his outstanding contributions in the field of plant genetic resources, at the ceremony held at NAAS, New Delhi on 16 July.
- **Shri Diksha Gautam** won first prize in Hindi Quiz during Hindi Divas at Central Institute of Temperate Horticulture (CITH), Srinagar from 15-21 September.
- **Dr (Ms) Anita Kodaru**, Senior Scientist (Plant Pathology) received Silver Jubilee Gold Medal for Woman for the year 1998-99 from CCS HAU, Hisar for her Doctoral thesis work on 19 April 2003.
- **Shri PS Mehta**, T-5, Evaluation Division, received an incentive award for registration of indigenous technical knowledge regarding (i) use of millipede as an anti-fever tonic for cattle and (ii) indigenous storage technique of rhizomes of *Colocasia*, ginger and turmeric under the mission-mode project of ICAR on collection, documentation and validation of Indigenous Technical Knowledge (ITK).

## 20.12 Participation of staff in workshops/ Trainings/ Seminars/ Symposia

| Name of employee  | Title of the seminar/symposium/conference   | Place and period                            |
|---|---|---|
| Anita Kodaru  | Training Programme on Recent Advances in Agricultural Research Project Management   | NAARM, Hyderabad<br>9-29 April              |
| Anita Kodaru  | Seminar on Australian Fumigation Accreditation Scheme for India   | RPQS, Chennai<br>1 December                 |
| Anuradha Agrawal  | Training course on Recent Techniques in Plant Genetic Engineering and Molecular Biology organized by NRC Plant Biotechnology  | IARI, New Delhi<br>15 January to 4 February |
| Archna P Raina  | National Seminar on "Emerging trends in Research and Business Management of Medicinal and Aromatic Plants   | CCS HAU, Hissar.<br>11-13 March             |
| Archna P Raina and Poonam Suneja  | Training on "Various Applications of HPTLC"   | Anchrom Lab, Bombay<br>8-11 October         |
| Arjun Lal   | National Workshop on " Awareness of gamma radiation processing of foods, spices, animal feed and health care product" organized by Shri Ram Institute for Industrial Research | New Delhi<br>28-29 November                 |
| Arjun Lal   | Biennial Workshop of AICRP on Nematodes   | JNKVV, Jabalpur<br>23-24 December           |
| Arjun Lal   | 6 <sup>th</sup> International workshop on " Plant Growth Promoting Rhizobacteria  | IISR Calicut, Kerala<br>5-10 October        |
| Arjun Lal, Usha Dev, S Singh, ML Kapur, Rajan, S Bhalla, B Singh and V Celia Chalam B Lal | Inception workshop of Classical Biological control of <i>Mikania micrantha</i> with <i>Puccinia spegazinii</i>  | NBPGR New Delhi<br>27-28 June               |
| B Lal, ML Kapur, S Bhalla, Kavita Gupta and Charan Singh                                  | International Workshop on Prospects of Exports of Potato and Potato Products  | New Delhi<br>1 March                        |
| BK Bansal, F & AO   | National Symposium on Frontier areas of Entomological Research  | IARI, New Delhi<br>5-7 November             |
| BS Dhillon, VD Verma and JC Rana  | Training Program conducted by National Institute of Management  | Faridabad<br>1-5 September                  |
| Chitra Pandey and SK Yadav  | 7 <sup>th</sup> International Symposium on Temperate Zone Fruits in the Tropics and Subtropics  | Dr YSPUHF, Solan<br>14-18 October           |
| Dinesh Kumar  | 5 <sup>th</sup> on job short training course under HRD (NATP) on Plant Genetic Resources Management   | NBPGR, New Delhi<br>13 Aug to 6 Sep         |
| DK Hore   | Annual Group Meet on Wheat  | GBPUA & T, Pantnagar<br>22-25 August        |
| DK Hore   | Regional awareness cum training workshop for "Preparation of Peoples Biodiversity Registers   | IIBM, Guwahati<br>9 November                |
| DK Hore   | Seminar cum workshop on Bamboo for Employment and Economic Generation in Imphal   | Imphal, Manipur<br>11-12 December           |
| DK Hore   | Workshop on 'Criteria and indicators for sustainable Forest Management  | Guwahati, Assam<br>11 February              |
| DK Hore   | International workshop on "Organic Food   | Barapani, Shillong<br>14-16 February        |

|   |   |  |
|---|---|--|
| GJ Randhawa and R Singh   | National seminar on "New Perspectives in Spices, Medicinal and Aromatic Plants"   | ICAR Research Complex for Goa, 27-29 November                      |
| GJ Randhawa and R Singh   | The 3 <sup>rd</sup> World congress on Medicinal and Aromatic plants for Human Welfare   | Chian Mai, Thailand 3-7 February                                   |
| J Radhamani, Abha Sharma and AK Singh Jitendera Mohan   | National seminar on "Physiological Interventions for Improved Crop productivity and quality<br>National Seminar on Recent Advances in Indian Floriculture | Tirupati. 12-14 December<br>KAU, Thrissur (Kerala) 12-14, November |
| JL Karihaloo  | XVIII Annual Group Meeting of National Seed Project (Crops)   | MPUA & T, Udaipur 3 March  |
| JL Karihaloo  | Indo-French seminar on Agricultural Research and Education  | Ashoka Hotel, N Delhi 16 April                                     |
| JL Karihaloo  | Seminar on 'Role of indigenous germplasm in improvement of horticultural crops in India'  | GBPUA&T, Pantnagar 24 June   |
| JL Karihaloo  | National Seminar on 'Advances in Genetics and Plant Breeding- Impact of DNA Revolution'   | UAS, Dharwad 30 and 31 October                                     |
| JL Karihaloo  | XXVI Annual Conference of Indian Botanical Society  | Jamia Hamdard 29- 31 December<br>New Delhi                         |
| JL Karihaloo, RK Khetarpal and GJ Randhawa  | Launching workshop of the GEF-World Bank aided capacity building project on biosafety organized by Ministry of Environment & Forests                      | 13-14 November   |
| JL Karihaloo, RK Khetarpal, Arjun Lal, Usha Dev, S Singh, ML Kapur, Rajan, S Bhalla, B Singh and Celia Chalam | Review workshop on Plant Quarantine Policies and Procedures   | NBPGR, New Delhi 21 January  |
| KS Negi   | Workshop on Capacity building of NGO's with reference to project formulation and implementation under CAPARTS   | Nainital 18 September  |
| KS Negi   | International Conference on Emerging Trends in Essential Oil  | Mumbai 22-24 August  |
| KS Negi   | workshop on Sustainable Herbal Enterprises in the Himalaya at India International Center  | New Delhi 18 April   |
| KS Negi   | Farmers Training Programme  | Bhowali 25-26 March  |
| KS Negi   | Third Trainers Training programme at NBPGR  | New Delhi 4 March  |
| KS Varaprasad   | Training programme Information Management on Virtual platform   | MANAGE, Hyderabad 25-27 March                                      |
| KV Bhat and Madhu Bala  | Training programme on "Web Technologies"  | IASRI, New Delhi-12 21 August- 10 September                        |
| Manju Lata Kapur and Usha Dev   | Women training on PGR literacy cum diversity fair   | PRDF, Gorakhpur 20-24 September                                    |
| N Dikshit   | Training on plant taxonomy and Wild Relatives of Crop Plants  | NBPGR New Delhi 27 January -1 February                             |

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|--|--|---|
| NK Gautam and<br>S Sardana<br>R Srivastava                                     | National Symposium on "Pulses for Crop Diversification and National Management<br>Training Programme on "Advances in Production and Evaluation of Quality Vegetable Seed"  | RKanpur<br>20-22 December<br>IVRI, Varanasi<br>2-22, December       |
| Ranbir Singh   | Annual Research Worker's Group Meeting on Sunflower and Castor   | TNAU, Coimbatore<br>2-4 May   |
| R K Khetarpal  | Workshop on Biopesticides for sustainable Agriculture: Prospects and Constraints"  | TERI, New Delhi<br>29 January                                       |
| RK Khetarpal, Usha<br>Dev, Rajan, Kavita<br>Gupta and Chalam Celia<br>S.Mandal | North Zone Symposium on Post Harvest Pathology organized by the Indian Society of Mycology and Plant Pathology<br>XIX Annual Workshop of All India Co-ordinated Research Project on Arid Legumes                                 | NBPGR, New Delhi<br>22 March<br>KAU, Pattambi (Kerala)<br>15-16 May |
| S Sardana  | 20 <sup>th</sup> Scientific Advisory Panel Meeting of "Network Project on Genetic Evaluation and Improvement of <i>Sesbania</i> (Dhaincha) and <i>Crotalaria</i> (Sunn hemp) for Green manuring"                                 | CSAUAT, Kanpur<br>24-25 November                                    |
| S Sardana  | Annual Group Meet on Chickpea and MULLaRP crops  | UAS, Bangalore<br>11-13 September                                   |
| S Sardana  | Annual Review Workshop of Rice-Wheat Production System Research Project under Irrigated Areas  | GBPUAT, Pantnagar<br>3-4 June.                                      |
| Sandhya Gupta  | Training course on 'Efficient designings of experiments and analysis of experimental data'   | IASRI, New Delhi<br>5-25 March                                      |
| Sandhya Gupta  | National Symposium on "Biotechnology: expanding horizons"  | INSA, New Delhi<br>17-18 October                                    |
| SK Chakraborty   | Training programme on Protection of intellectual property and agricultural research  | NAARM, Hyderabad<br>14-17 October                                   |
| SK Mitra   | Management Development Programme on Smart Office in Internet Era to be conducted by NIFM, Faridabad  | Faridabad<br>19-23 May  |
| SK Mitra   | Attended a training programme on Communication skills for Managers conducted by ASCI, Hyderabad  | 16-20 June  |
| SR Pandravada and<br>N Sivaraj   | National Symposium on Biodiversity Conservation and Commercial Exploitation of medicinal plants  | Osmania Univ,<br>Hyderabad<br>8-10 November                         |
| U Srivastava   | Participated in Vegetable workshop   | GAU, Anand<br>25-28 May   |
| V Celia Chalam and<br>AK Mauriya<br>VD Verma                                   | XXVI Annual Conference on Electron Microscopy and Allied Fields ( <b>Received Best Poster Award</b> )<br>National Seminar on the Role of Indigenous Germplasm in Improvement of Horticultural Crops                              | CPRI, Shimla<br>16-18 April<br>GBPUA&T, Pantnagar<br>24 June        |
| Veena Gupta  | National Seminar on 'Spices and Herbs' organized by National News Services   | New Delhi<br>7 September  |
| Veena Gupta  | National Seminar on 'Bill to Protect Intellectual Property Rights of Local Communities, Farmers and Traditional Knowledge Holders' organized by the National University of Juridical Services, Kolkata and St. Stephen's College | IIC, New Delhi,<br>24-25 September                                  |

|  |  |                                       |
|--|--|---------------------------------------|
| Veena Gupta                              | Training programme on 'Sustainable Herbal Enterprises in the Himalayas' organized by 'Pragya' (NGO)                | IIC, New Delhi<br>17-19 April         |
| Veena Gupta                              | National Seminar on 'Emerging Trends in Research and Business Management of Medicinal and Aromatic Plants'         | CCS, IHAU, Hisar<br>11-13 March 2003. |
| VK Gupta                                 | Participated in the National Symposium on Biodiversity Management at Banaras Hindu University                      | BHU, Varanasi<br>28-30 June           |
| Z Abraham                                | Workshop on Natural Resource Management: changing scenarios and shifting paradigms                                 | KAU, Thrissur<br>21 to 24 February    |
| Z Abraham and M Latha                    | XIXth Annual workshop of AICRP on Arid Legumes   | KAU, Pattambi<br>15-16 May            |
| Z Abraham                                | Training Programme on "Post Collection Care and Handling of Germplasm"   | NBPGR, RS, Hyderabad<br>5-6 March     |
| Z Abraham, M Abdul Nizar and Smt M Latha | Workshop on "Patent Awareness and Implications of Intellectual Property Rights" sponsored by TIFAC, DST, New Delhi | KAU, Vellanikkara<br>21 March         |
| Z Abraham, M. Latha and R Asokan Nair    | Seminar on "Database Management of Genetic Resources of Horticultural Crops"                                       | CPCRI, Kasaragod<br>19 June           |
| Z Abraham                                | Workshop on "Tamil Nadu Biodiversity Strategy and Action Plan" under NBSAP   | BSI, Coimbatore<br>28-29 January      |
| Zakir Hussain                            | Training on "Techniques in Biochemistry and Molecular Biology"   | IARI, New Delhi<br>1-21 November      |

### 20.13 Deputations / Visits abroad

| Scientist         | Purpose of visit   | Place of visit                                 | Period                   |
|-------------------|--|--|--------------------------|
| Dr BS Dhillon     | Participated in the first meeting of Indo-Iran Joint Working Group on Agriculture  | Teheran  | 19-21 May                |
| Dr BS Dhillon     | Participated in the Arnel R. Hallauer International Symposium on Plant Breeding  | Mexico   | 17-22 August             |
| Dr JC Rana        | Received training in Molecular plant Breeding with special reference to PCR technology                                     | South China Agricultural University, Guangzhou | February- July           |
| Dr N Sivaraj      | Received training in Geographical information system and Biodiversity Mapping  | CIAT, Cali, Columbia, South America            | 17-31 May                |
| Dr RK Khetarpal   | SAARC workshop on setting up a Regional network on Sanitary and Phytosanitary measures and Quality control at Islamabad    | Pakistan                                       | 18-19 March              |
| Dr RK Khetarpal   | FAO Assignment on Strengthening Plant Health Management Capabilities for Plant and Seed Certification schemes to Mauritius | Mauritius                                      | Mauritius                |
| Dr Kavita Gupta   | Deputed for training on Plant Quarantine-Thermal treatments for to disinfections of fruit flies                            | Naha Plant Protection Station, Okinawa, Japan  | 27 May-11 September      |
| Dr B Sarath Babu  | Received training in Integrated management of viral Disease problems in Mungbean and uradbean                              | The State University of New Jersey, USA        | 18-29 August 2003        |
| Dr Cella Chalam V | Received training on Use of Molecular Techniques for Detection of Plant viruses in seed and seed Certification norms       | Washington State Univ, Pullman USA             | October 2003 to Jan 2004 |

## 20.14 Workshops/ Group Meetings/ Training Programmes organized by NBPGR

| Title of the programme  | Duration                 | Venue                    |
|---|--------------------------|--------------------------|
| Review workshop on Plant Quarantine Policies and Procedures   | 21 January               | New Delhi                |
| Inception workshop on Classical Biological Control of <i>Mikania micrantha</i> with <i>Puccinia spëgazinii</i>  | 27-28 June               | New Delhi                |
| 5 <sup>th</sup> on job short training course under HRD (NATP) on Plant Genetic Resources Management   | 13 August to 6 September | New Delhi                |
| Training on Plant Taxonomy and Wild Relatives of Crop Plants  | 27 January to 1 February | New Delhi                |
| 3 <sup>rd</sup> Trainers Training Programme under the HRD Component of NATP sub-project on Sustainable Management of Plant Bio-diversity  | 13 February to 5 March   | New Delhi                |
| Training course on 'AFLP Technique for Cultivar Identification and Analysis of Molecular Diversity in Crop Plants'  | 2-9 December             | New Delhi                |
| <i>In vitro</i> multiplication and cryopreservation techniques in <i>A. sativum</i> under the Human Resource Development Programme  | February-May             | New Delhi                |
| Tissue culture and germplasm conservation under the Human Resource Development Programme  | May-June                 | New Delhi                |
| 'Standardization of Cryopreservation Protocol in Jojoba [ <i>Simmondsia chinensis</i> (Link) Schneider] for its Long-Term Conservation  | 19 March to 7 July       | New Delhi                |
| Micropropagation of wild and cultivated species of turmeric ( <i>Curcuma</i> spp.) from February 8 -May 7, 2003   | 8 February to 7 May      | New Delhi                |
| Plant Tissue Culture for Multiplication and Conservation of Fruit Crops Genetic Resources ' and " Uses of plant tissue culture and RAPD techniques" from May 19 to June 27, 2003  | 19 May to 27 June        | New Delhi                |
| Fifth on-job short training course under NATP in ToE  | 13 August to 12 October  | Thrissur                 |
| Training on post collection handling of germplasm   | 15 to 17 July            | Thrissur                 |
| Short training by Zone V & VI on Collection and Characterization of Wild Relatives Including Vegetatively propagated Material and Post Harvest Collection Care of Germplasm under NATP on Sustainable Management of Plant Bio Diversity | 4 to 6 August            | Regional Station, Shimla |
| An Orientation course on Biosafety considerations for Evaluation of Transgenic Crops  | 10 to 18 November        | New Delhi                |



QRT Team visiting NBPGR regional station at Barapani, Shillong



QRT members visit to Jodhpur Station on 25 March 2003

## 20.15 Library and Documentation Services

NBPGR Library maintained its designated services and activities of acquisition of books and journals, exchange of literature, cataloguing and documentation. During the year 464 new books related to various aspects of PGR management were added to Headquarters and Regional Stations' libraries through purchase and exchange basis. AGRIS, AGRICOLA, CABSAC and CABCD databases have been purchased for the library. On-line J-Gate service was provided to the Scientists at Headquarters. Fifteen NBPGR publications were digitized on CD. Library procured 86 Journals including 41 foreign and 45 Indian through subscription/ gift and exchanges for the use at Headquarters and different Regional Stations. Newspaper clipping services related to PGR and its related subjects were provided to the readers regularly. The library provided reprography service to its internal as well as external users. Bureau's publications were supplied to over 250 different organizations in India and abroad. In return we received 300 publications gratis from various organizations. Scientists, technical staff, M. Sc. students and trainees were regular users of NBPGR library. About 450 reference queries were attended from internal as well as external users. A monthly list of New Arrivals in NBPGR library was also provided to the Headquarters readers. NBPGR Annual Report, Newsletters, Crop Catalogues, NBPGR Brochures and other publications were also distributed to various trainees and visitors from India and abroad.

## 20.16 Publications

### I. Research papers

1. Abraham Z, M Latha, R Senthil Kumar, K Rathi, PB Shelja and CK Sunandha (2002) Variability Studies in Kokam (*Garcinia indica*). *Indian J. Plant. Genet. Resources* **15**:183-185.
2. Agrawal RC and MK Burman (2002) Designing of exotic germplasm database using client/server technology. *Indian J. Plant Genetic Resources*. **15**: 278-283.
3. Archak S, AB Gaikwad, D Gautam, EVVB Rao, KRM Swamy and JL Karihaloo (2003) DNA Fingerprinting of cashew varieties of India using RAPD and ISSR techniques. *Euphytica* **130**: 397-404.
4. Archak S, AB Gaikwad, D Gautam, EVVB Rao, KRM Swamy and JL Karihaloo (2003) Comparative assessment of DNA fingerprinting techniques (RAPD, ISSR and AFLP) for genetic analysis of cashew (*Anacardium occidentale* L.) accessions of India. *Genome* **46**: 362-369.
5. Asha KI and C Maya Nair (2002) Ethnic knowledge system on wild dioscoreas (yams) by the kanikkars of southern western ghats, Kerala. *Indian J. Plant Genet. Resources* **15**:146-149.
6. Asha KI, C Maya Nair and RS Liji (2002) Determination of leaf area in *Dioscorea alata* L.- a critical analysis. *Indian J. Plant Genet. Resources* **15**: 43-145.
7. Barua U and R Srivastava (2003) *Myrica esculenta* Buch.-Ham.- A lesser known wild edible fruit of Meghalaya. *J. NE Council*. **23**: 17-20.

8. Bhalla S, ML Kapur, B Lal, BR Verma and Charan Singh (2003) Quarantine risk associated with exchange of plant genera carrying hidden infestation. *Indian J. Plant Genet. Resources* **15**: 160-163.
9. Bhalla S, ML Kapur, Charan Singh, Naresh Kumar and B Lal (2003) Plant Quarantine: Interception and elimination of exotic insect pests in germplasm exchange *Pesticide Research Journal* **15**: 92-96.
10. Chalam V Celia, B Singh, YPS Rathi and RK Khetarpal (2002) Occurrence of *Zucchini yellow mosaic potyvirus* on summer squash (*Cucurbita pepo*) in India. *Indian Journal of Mycology and Plant Pathology* **33**: 284- 285.
11. Chitra Devi L, K Kant and M Dadlani (2003) Effect of size grading and ageing on sinapine leakage, electrical conductivity and germination percentage in the seed of Mustard (*Brassica juncea*. L.). *Seed Science and Technology* **31**: 505-509.
12. Dev Usha, B Singh, PC Agarwal, S Singh, AK Maurya, Dinesh Chand, KD Joshi and RK Khetarpal (2003) Quarantine processing of chemically treated wheat (*Triticum species*), barley (*Hordeum vulgare*) and Triticale germplasm imported during 1992-2001. *Indian Journal of Agricultural Sciences* **73** : 462-465.
13. Dixit Sonali, BB Mandal, Sangeeta Ahuja and PS Srivastava (2003) Genetic stability assessment of plants regenerated from cryopreserved embryogenic tissue of *Dioscorea bulbifera* L., using RAPD, biochemical and morphological analysis. *CryoLetters* **24**: 77-84.
14. Kala CP, KS Rao, RK Maikhuri and KS Negi (2003) Comparative assessment of the Valley of Flowers National Park and its adjacent areas in Chamoli districts of Uttaranchal. *Indian For.* **129**: 1085- 1089.
15. Karihaloo JL, YK Dwivedi, S Archak and AB Gaikwad (2003) Analysis of genetic diversity of Indian mango cultivars using RAPD markers. *J. of Horticultural Science and Biotechnology* **78**:285-289.
16. Mangal M, K Malik and GJ Randhawa (2003) Import of Transgenic Planting Material: National Scenario. *Curr Sci.* **85**: 454-58.
17. Mohapatra AK, MA Nizar, Dipanka Saha, A Saha and D Gupta (2003) *Corchorus pseudo-olitorius* as a new record for Indian flora. *Curr. Sci.* **84**: 984-985.
18. Nautiyal S, KS Negi, KS Rao, BM Singh RK Maikhuri, OP Dhariwal and OP Paliana (2003) Mandakini Valley: Religious, cultural and botanical significance. *News letter Hima- Paryavaran* **14** (1&2): 14- 16.
19. Negi KS, KS Rao, BS Negi, S Nautiyal, B Singh., PK Joshi and DC Bhandari (2003) Ethnobotanical notes on the exploration of germplasm in Om Parvat and Adi- Kailash Mountains in Uttaranchal. *News letter Hima- Paryavaran* **14** (1&2): 8- 10.
20. Pandey G, BD Joshi and S Mandal (2002) Collection and characterization of Walnut (*Juglans regia* L.) from Himachal Pradesh. *Indian J. Plant Genetic Resources* **14**: 368-370.
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- Lohit and Dibang Valley districts of Arunachal Pradesh. *Indian J. Hill Farmg.* **15**:56-60.
22. Sharma N and B Sharma (2003). Cryopreservation of shoot tips of *Picrorrhiza kurroa* Royle ex Benth., an indigenous endangered medicinal plant through vitrification. *CryoLetters* **24**: 181-190.
  23. Singh AK, SL Dwivedi, S Pande, JP Moss, SN Nigam, and DC Sastri (2003) Registration of Rust and Late Leaf Spot Resistant Peanut Germplasm Lines. *Crop Sci.* **43** : 440-441.
  24. Singh B, Rajan, S Bhalla, V Celia Chalam, BM Pandey, SK Singh, Naresh Kumar and RK Khetarpal (2003) Quarantine processing of imported transgenic planting material. *Indian Journal of Agricultural Sciences* **73** : 97-100.
  25. Singh Baleshwar, SK Singh, PC Agarwal, Indra Rani and RK Khetarpal (2003) *Colletotrichum dematium* causing anthracnose in strawberry- a new record for India and its control. *Indian J. Agricultural Sciences* **73**: 238-39.
  26. Singh Neeta, ML Kapur, and RK Mahajan (2003) Effect of fumigation on germination and viour in chickpea and green gram during prolonged storage. *Seed Science and Technol* **31**:161-168.
  27. Singh R, J Kumar, RP Deshwal, GJ Randhawa, S Walia, R Parsad and BS Parmar (2003) Morphological, chemical and genetic variability in Neem accessions *Indian J. Plant Genet. Resources* **15**: 237-247.
  28. Tyagi RK and T Hymowitz (2003) Pollen from *Glycine* species survive cryogenic exposure. *Cryoletters* **24**:119-124.
  29. Verma NK, PK Singh, P Kumar, A Sharma and DK Hore (2003) *Leonotis nepetaefolia* R. Br. – A less known medicinal plant. *Indian Forester.* 1032-1036.
  30. Verma SK, RR Arya, H Singh and PN Bhardwaj (2003) Vegetative and fruit characteristics of some *Rubus* species grown in Uttaranchal. *Prog. Hort.* **35** (2): 183- 188.
- ## II. Chapters in books, proceedings, bulletins, manuals etc.
1. Abraham Z, M Latha and S Lakshmi Narayanan (2003) Genetic diversity of crop plants in the southern Western Ghats. In: B.Mohan Kumar et al. (eds) *Natural Resource Management: changing scenarios and shifting paradigms*. Kerala Agricultural University, Thrissur, pp. 46-52.
  2. Agrawal A and HO Sharma (2003) *In vitro* cryopreservation of tropical fruit species. In: Chaudhury et al. (eds) *In Vitro Conservation and Cryopreservation of Tropical Fruit Species*. IPGRI Office for South Asia, New Delhi, India/ NBPGR, New Delhi, India, pp.163-174.
  3. Bhalla S, Kavita Gupta and ML Kapur (2003) Agreement on Application of Sanitary and Phytosanitary Measures of WTO: An Overview, In: *Souvenir*, National Symposium on Frontier Areas of Entomological Research, 5-7 November, 2003, Division of Entomology, IARI, New Delhi, pp 7-12.
  4. Chaudhury R (2003) Cryopreservation: Principles and practices. In: Mandal etal (eds) *Conservation Biotechnology of Plant Germplam*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome Italy, pp 179-186.

5. Chaudhury R and SK Malik (2003) Management of cryopreserved collections: Practical issues. In: Mandal et al (eds) *Conservation Biotechnology of Plant Germplasm*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome Italy, pp. 229-236.
6. Chaudhury R and SK Malik (2003) Slow-Freezing. In: Mandal et al (eds) *Conservation Biotechnology of Plant Germplasm*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome Italy, pp. 263-266.
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9. Gupta S and BB Mandal (2003) *In vitro* methods for PGR conservation: Principles and prospects. In: Chaudhury et al. (eds) *In Vitro Conservation and Cryopreservation of Tropical Fruit Species*. IPGRI Office for South Asia, New Delhi, India/ NBPGR, New Delhi, India, pp.71-80.
10. Gupta Veena (2003) Recent trends in spices and herbal industry. In: *Proc. National Seminar on Spices and Herbs*, Pragati Maidan, New Delhi, pp. 46-48.
11. Gupta Veena and Singh AK (2003) Conservation strategies for medicinal and aromatic plants in India In: *Proc. Natl Seminar on "Emerging Trend in Research and Business Management of Medicinal and Aromatic Plants"* held at CCS, HAU Hisar, pp. 16-20.
12. Gupta VK and JB Tomar (2003) *Jatropha* sp : A potential source for bio-diesel and bio-drug in Jharkhand. In: *Proc. National seminar on Environmental Friendly Industries- Today and Tomorrow*. Indian Institute of Plant Engineers (Jharkhand Chapter & Eastern Region), Ranchi, p.109.
13. Khetarpal RK, DB Parakh and V Celia Chalam (2003) Virus indexing of plant germplasm. . In: Mandal et al (eds) *Conservation Biotechnology of Plant Germplasm*. NBPGR New Dehi, India/ IPGRI, Rome, Italy, pp 99-104.
14. Khetarpal RK, Kavita Gupta and BM Pandey (2003) Sanitary and Phytosanitary Measures: Implications on India and other Developing Countries. In: AK Vasisht and Alka Singh (eds) *WTO and New International Trade Regime- Implications for Indian Agriculture*. Advance Publishing Concept, New Delhi. pp. 146-171.
15. Khetarpal RK, V Celia Chalam, HS Prakash, HS Shetty and A Mishra (2003) Diagnostics and development of seed certification protocols for management of seed-transmitted viral diseases of grain legumes. In: Amerika Singh et al. (eds) *Recent Advances in IPM*, NRC on New Dehi, pp 220-223.
16. Malik SK and R Chaudhury ( 2003) Desiccation – Freezing. . In: Mandal et al

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  18. Mandal BB and S Gupta (2003) Meristem Culture. In: Mandal etal (eds) *Conservation Biotechnology of Plant Germplam*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome Italy, pp.247-251.
  19. Pandey R and A Das (2003) *In vitro* clonal multiplication techniques in tropical fruit species. In: Chaudhury et al. (eds) *In Vitro Conservation and Cryopreservation of Tropical Fruit Species*. IPGRI Office for South Asia, New Delhi, India/ NBPGR, New Delhi, India, pp.91-100.
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  23. Parakh DB and A Agrawal (2003) Virus indexing in tissue culture raised plants. In: Mandal etal (eds) *Conservation Biotechnology of Plant Germplam*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome Italy, pp. 253-255.
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  36. Verma SK, KS Negi, KC Muneem, S Gupta, SK Malik and KK Mishra (2003) Fruit germplasm maintained at NBPGR R/S Bhowali. In: Singh et al (eds) *Role of Indigenous Germplasm in Improvement of Horticultural Crops.*, GBPUA & T, Pantnagar, pp 259- 275.
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- III. Annual Report, Technical Bulletin, Crop Catalogue etc.**
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  2. Prasada Rao RDVJ, DVR Reddy, SN Nigam, AS Reddy, FWaliyar, T Yellamanda Reddy, K Subramanyam, M John Sudheer, KSS Naik, A Bandyopadhyay, S Desai, MP Ghewande, MS Basu and Somasekhar

(2003) Peanut stem necrosis: A new disease of groundnut in India. *Information Bulletin No. 67*, ICRISAT Patancheru 502 324, Andhra Pradesh, India, pp 12.

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4. Tomar JB and VK Gupta (2003) Germplasm exploration, collection and processing. *Technical bulletin No. 01* National Bureau of Plant Genetic Resources Regional Station, Ranchi.
5. Verma VD, BD Sharma, JC Rana and SK Yadav (2003) *Uttar-Pashchim Himalaya Me Jaiv Vividhta*. NBPGR, Regional Station, Phagli, Shimla, pp 48.

#### IV. Books

1. Chaudhury R, R Pandey, SK Malik, and Bhag Mal (eds) (2003) *In Vitro Conservation and Cryopreservation of Tropical Fruit Species*. IPGRI Office for South Asia, New Delhi, India/ NBPGR, New Delhi, India.
2. Mandal BB, R Chaudhury, F Engelmann, Bhag Mal, KL Tao and BS Dhillon (eds) (2003) *Conservation Biotechnology of Plant Germplasm*. NBPGR, New Delhi, India/ IPGRI, Rome, Italy/ FAO, Rome, Italy.
3. Singh BM, RK Mahajan, U Srivastava and SK Pareek (2003) *Minimal Descriptors of Agri-horticultural Crops*. National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi – 110012, xii + 439 p.

#### V. Plant Germplasm Reporter/ Crop Inventories

1. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Vol 2 No 1, 89 p.
2. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Vol 2 No 2, 98 p.
3. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Plant Vol 2 No 3, 150 p.
4. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Plant Vol 2 No 4, 141 p.
5. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Vol 3 No 1, 99 p.
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7. Singh RV, Deep Chand, V Tyagi, N Verma, AK Singh, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Vol 4 No 3, 203 p.
8. Singh RV, Deep Chand, V Tyagi, N Verma, AK Singh, SP Singh and SS Ranga (2003) *Plant Germplasm Reporter* Vol 4 No 4, 220 p.
9. Singh RV, Deep Chand, V Tyagi, N Verma, SP Singh and SS Ranga (2003) *An Inventory of Plant Genetic Resources-Vigna spp. Introductions (1981-2001) in India*. 49 p.

## VI. Popular /Technical Articles (in Hindi/English)

1. Dua RP, P Brahma, RK Khetarpal and BS Dhillon (2003) WTO and its impact on agricultural trade in India. *Indian Horticulture* **48** (1): 59-60.
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### 20.17 Budget estimates and expenditure incurred (Rupees in lakhs) during 2003-2004

| Item sub-head         | Budget         |               | Revised        |               | Expenditure    |               |              |               |
|-----------------------|----------------|---------------|----------------|---------------|----------------|---------------|--------------|---------------|
|                       | Non-plan       | Plan          | Non-Plan       | Plan          | Non-Plan       | Plan          | NRC on DNAFP | M & AP (G-15) |
| Establishment Charges | 752.00         | 0.00          | 716.00         | 0.00          | 715.00         | 0.00          | 34.40        | 0.09          |
| Travelling Charges    | 5.80           | 8.00          | 6.30           | 5.18          | 6.30           | 5.17          | 1.00         | 0.78          |
| Overtime allowance    | 0.20           | 0.50          | 0.10           | 0.50          | 0.10           | 0.49          | 0.00         | 0.00          |
| Contingencies         | 200.00         | 106.50        | 292.30         | 80.42         | 292.36         | 81.04         | 57.13        | 1.23          |
| Equipments            | 0.00           | 47.50         | 5.00           | 42.29         | 4.91           | 41.93         | 7.46         | 0.00          |
| Works                 | 47.00          | 37.50         | 124.70         | 81.61         | 124.69         | 81.33         | 0.00         | 0.00          |
| Wages                 | 0.00           | 0.00          | 22.50          | 0.00          | 22.49          | 0.00          | 0.00         | 0.00          |
| Matching grant        | 0.00           | 0.00          | 0.00           | 0.00          | 0.00           | 0.00          | 0.00         | 0.00          |
| Revenue generation    | 0.00           | 0.00          | 0.00           | 0.00          | 0.00           | 0.00          | 0.00         | 0.00          |
| <b>TOTAL</b>          | <b>1005.00</b> | <b>200.00</b> | <b>1166.90</b> | <b>210.00</b> | <b>1165.95</b> | <b>209.96</b> | <b>99.99</b> | <b>2.10</b>   |

## प्रतिवेदन सारांश

राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो ने लंगातार प्रगति की ओर कदम बढ़ाते हुए, इस वर्ष पादप आनुवंशिक संसाधनों के उचित प्रबन्धन से जुड़ी सभी गतिविधियों जैसे देशीय जननद्रव्यों का अन्वेषण एवं संग्रहण, विदेशों से विशिष्ट गुणों वाले जननद्रव्यों का आयात/प्रवेश, पादप संशोधन परीक्षण, जननद्रव्यों का लक्षण वर्णन/मूल्यांकन तथा अनुरक्षण, दीर्घाविधि हेतु संरक्षण, डी एन ए फिंगरप्रिंटिंग, नीति निर्धारण तथा मानव संसाधन विकास पर विशेष प्रगति की। इन सभी गतिविधियों पर प्राप्त उपलब्धियों का संक्षिप्त विवरण नीचे दिया गया है।

### पादप अन्वेषण तथा जननद्रव्य संग्रहण

राष्ट्रीय स्तर पर देश के विभिन्न क्षेत्रों से कुल 197 अन्वेषण किए गए जिनमें पादप प्रजातियों की 9517 प्राप्तियां संग्रहित की गईं। इन प्राप्तियों के संग्रहण में ब्यूरो के वैज्ञानिकों का सहयोग राष्ट्रीय कृषि तकनीकी परियोजना 'पादप जैवविविधता' के अन्तर्गत देश भर से सम्मिलित कार्यकर्ताओं ने किया तथा विभिन्न जलवायु में उगने वाली दुर्लभ प्रजातियों को संग्रहित किया। इस दौरान मुख्यालय, नई दिल्ली 'जोन-7' ने 35 पादप अन्वेषण कर कुल 1509 प्राप्तियों का संग्रहण किया। इन पादप अन्वेषणों के अन्तर्गत फसलों की जंगली प्रजातियों, सब्जियों, कम उगाए जाने वाले फल तथा औषधीय प्रजातियों के संग्रहण पर विशेष ध्यान दिया गया।

क्षेत्रीय केन्द्र अकोला ने मराठावाड़ा तथा विदर्भ 'महाराष्ट्र' में सीताफल के संग्रहण के लिए विशेष अन्वेषण किया तथा अन्य फसलों के जननद्रव्यों का अन्वेषण मावतमाल, चन्द्रपुर तथा गढ़ चिरोली 'महाराष्ट्र के जिले' से किया और कुल 152 प्राप्तियों का संग्रहण किया। सीताफल की प्राप्तियों में अच्छी विविधता पायी गई।

क्षेत्रीय केन्द्र, भवाली ने उत्तरांचल की पहाड़ियों में सात अन्वेषणों के तहत कुल 252 प्राप्तियों का संग्रहण किया तथा अन्य सहयोगियों ने चार अन्वेषण कर कुल 425 प्राप्तियाँ संग्रहित की।

क्षेत्रीय केन्द्र, कटक द्वारा चार अन्वेषण उड़ीसा में किये तथा एक विशेष अन्वेषण सुन्दरबन 'पश्चिम बंगाल' में किया तथा विभिन्न प्रजातियों की कुल 421 प्राप्तियां संग्रहित की। इस दौरान मिर्च की एक प्रजाति, पाइपर छाबा जो स्वाद में बहुत ही तीखी, वर्ष भर फल देने वाली तथा पौधे की ऊँचाई 210 से.मी. होती है एकत्रित की गई।

क्षेत्रीय केन्द्र, हैदराबाद ने आन्ध्र प्रदेश एवं कर्नाटक में 17 अन्वेषणों के दौरान कुल 2322 प्राप्तियाँ एकत्रित की, जिनमें जंगली प्रजातियों पर विशेष ध्यान दिया गया। इस वर्ष कुल 8888 नमूनों को मध्यावधि भंडारण में रखा गया। इस तरह क्षेत्रीय भंडारण में भंडारित कुल नमूनों की संख्या 43760 हो गई है।

क्षेत्रीय केन्द्र, जोधपुर ने कुल सात अन्वेषण राजस्थान, हरियाणा तथा गुजरात प्रान्तों में किए तथा 333 प्राप्तियों का संग्रहण किया। पौध या कलम से उगाई जाने वाली प्रजातियों की 33 प्राप्तियों को खेत में उगाकर अनुरक्षण किया गया।

अन्वेषण आधार केन्द्र, रांची ने 10 अन्वेषण कर विभिन्न फसलों एवं जंगली प्रजातियों के कुल 1196 प्राप्तियां संग्रहित की। फलाकारटिया इनडिका तथा अरिस्तालोचीया आनकोसेफारमस पहली बार एकत्रित कर राष्ट्रीय जीन बैंक में संरक्षण किए गए।

क्षेत्रीय केन्द्र, शिलांग ने उत्तर-पूर्व राज्यों के हिस्सों में आठ अन्वेषणों के दौरान कुल 1865 प्राप्तियां एकत्रित की। इस अतिरिक्त दो विशेष पादप अन्वेषण क्रमशः ब्रह्मपुत्र नदी के द्वीपों तथा अरुणाचल प्रदेश में किए गए तथा केला, चावल, स्टार्च सेब, ककड़ी आदि फसलों में व्याप्त विधिता को एकत्र किया गया।

क्षेत्रीय केन्द्र, शिमला ने 10 अन्वेषण करके विभिन्न फसलों की कुल 979 प्राप्तियां संग्रहित की।

क्षेत्रीय केन्द्र, श्रीनगर द्वारा कश्मीर घाटी, लदाख, लाहोल तथा स्पिती इलाकों में दो अन्वेषण किए तथा कुल 192 प्राप्तियां एकत्रित की।

क्षेत्रीय केन्द्र, त्रिशूर ने दस अन्वेषणों के दौरान कुल 484 प्राप्तियां संग्रहित की जिनमें 311 प्राप्तियां फसलों की, 142 जंगली प्रजातियों की तथा 35 प्राप्तियां औषधीय पौधों की थी। इसके अतिरिक्त 1499 प्राप्तियां 18 सहयोगी संस्थाओं द्वारा 75 अन्वेषणों के दौरान की गई।

## जननद्रव्य प्रवर्तन

इस वर्ष 41 देशों से विभिन्न फसलों की कुल 33320 प्राप्तियां '107202 नमूने' आयात कर प्रवेश कराई गई जिनमें 24140 प्राप्तियां '34968 नमूने' ट्रायल के लिए थी। इसी प्रकार 16 विदेशों में वैज्ञानिकों की मांग को पूरा करने के लिए कुल 490 प्राप्तियां '549 नमूने' निर्यात किए गए। अपने देश के अनुसंधानकर्ताओं की मांग को पूरा करने के लिए विभिन्न फसलों के 15289 नमूने ब्यूरो के क्षेत्रीय केन्द्रों तथा अन्य संस्थाओं से प्राप्त कर उपलब्ध कराये गए।

गेहूँ, मक्का, जौ, सूरजमुखी, कुसुम, तिल, मटर, राजमा, मिर्च, टमाटर, तम्बाखू इत्यादि फसलों के विदेशों में उपलब्ध रोग रोधी किस्मों तथा जननद्रव्यों को आयात कर अनुसंधानकर्ताओं को भेजा गया। इसके अलावा अधिक पैदावार, अधिक तेल तथा प्रतिकूल वातावरण में अच्छी पैदावार के लिए विकसित की गई किस्मों/जननद्रव्यों का भी आयात किया गया तथा वैज्ञानिकों को उपलब्ध कराई गई।

## पौध संगरोध गतिविधियां

मुख्यालय पर आयातित बीज तथा पौध सामग्री का संगरोधालयों में आवश्यक निरीक्षण किया गया तथा केवल स्वस्थ बीज ही मांगकर्ताओं को भेजा गया। आयातित '107202 नमूनों' का गहन निरीक्षण करने पर 621 नमूने कीटों द्वारा ग्रसित पाए गए, 1511 नमूने सूत्रकृमियों द्वारा ग्रसित पाए गए तथा 171 नमूने फफूंदी तथा जीवाणुओं से ग्रसित पाए गए। कुल 2303 ग्रसित/संक्रमित नमूनों में से 2214 नमूनों को विभिन्न विधियों जैसे धूमन, एक्स-रे रेडियोग्राफी, गर्म जल उपचार, कीटनाशक दवाईयों द्वारा उपचारित कर स्वस्थ पौध सामग्री/बीज को मांगकर्ताओं को भेजा गया। सोयाबीन के 87 नमूने डाउनी मिल्ड्यू फफूंद से ग्रसित पाए जाने पर जलाकर नष्ट कर दिए गए। निर्यात के लिए 549 नमूनों का गहन निरीक्षण किया गया तथा कुल 27 स्वस्थता प्रमाण पत्र जारी किए गए। राष्ट्रीय कृषि तकनीकी परियोजना के तहत संग्रहित 2352 प्राप्तियों का विभिन्न कीटों/बीमारियों के लिए निरीक्षण कर स्वस्थ प्राप्तियों को दीर्घावधि/मध्यावधि भण्डारण हेतु भेजा गया। विषाणु ग्रसित बीजों के उगाने से विभिन्न दलहनी फसलों 'ग्रेन लेग्यूम' में विषाणु रोगों का देशभर में सर्वेक्षण किया गया तथा नमूने एकत्रित किए गए। विषाणुओं की बीजों में व्याप्त दर, कीटों तथा जलवायु का प्रभाव रोगों के फैलाने पर आकलन किया गया।

क्षेत्रीय केन्द्र, हैदराबाद द्वारा 10884 आयातित नमूनों तथा 12154 निर्यातित नमूनों का विभिन्न पौध परजीवियों के लिए गहन निरीक्षण किया गया। निर्यात किए गए नमूनों को 184 स्वस्थता प्रमाण पत्र जारी किए गये। निरीक्षण के दौरान कुल 2198



ने ग्रसित/संक्रमित पाए गए जिनमें से 2012 को उपचारित कर भेजा गया तथा 186 रोग ग्रसित पाये जाने पर रद्द कर दिए इस दौरान दक्षिण भात में 27 संस्थानों को पादप संगरोध की सेवायें प्रदान की गईं।

## जननद्रव्य लक्षणवर्णन, मूल्यांकन तथा अनुरक्षण

रबी तथा खरीफ में ब्यूरो के विभिन्न केन्द्रों पर जननद्रव्यों को लक्षणवर्णन, मूल्यांकन, पुनरुत्पादन अथवा अनुरक्षण हेतु आया गया जो इस प्रकार रहा: ईसापुर फार्म-12616 प्राप्तियां, अकोला 1521 प्राप्तियां, भवाली 2061, कटक 2882, हैदराबाद 1141, जोधपुर 1219, शिलांग 2545, शिमला 1915 तथा त्रिशूर 1238 प्राप्तियां। विभिन्न फसलों के पूर्व निर्धारित गुणों के लिए आंकड़े लिए गए तथा आंकलन पश्चात विशिष्ट गुणों के लिए प्राप्तियों की पहचान की गई। विभिन्न केन्द्रों पर रबी तथा खरीफ में फसल दिवस आयोजित किए गए जिनमें अनुसंधानकर्ताओं ने भाग लेकर गुणों के आधार पर मूल्यांकन कर अच्छी प्राप्तियों चयन किया। पौध तथा कलम से उगाई जाने वाली फसलों/पौधों को फील्ड जीन बैंक में उगाकर अनुरक्षण किया गया।

एक नई पहल के अन्तर्गत विभिन्न फसलों के जननद्रव्यों के मूल्यांकन हेतु भारतीय कृषि अनुसंधान परिषद की विभिन्न संस्थाओं के साथ साझा कार्यक्रम बनाया गया। इस साझा कार्यक्रम के तहत गेहूँ की 2080 प्राप्तियां मूल्यांकन हेतु गेहूँ अनुसंधान निदेशालय, करनाल तथा 155 प्राप्तियां अलमोड़ा को भेजी गईं, मक्का के साझा कार्यक्रम में 108 प्राप्तियां मक्का अनुसंधान निदेशालय को 8 क्षेत्रों के लिए 54 प्राप्तियां सिक्किम केन्द्र को तथा 54 प्राप्तियां अलमोड़ा को भेजी गईं, जौ की 28 प्राप्तियां अलमोड़ा को, ज्वार की 60 प्राप्तियां राष्ट्रीय ज्वार अनुसंधान केन्द्र, हैदराबाद को, तुहर की 28 प्राप्तियां भारतीय दलहन अनुसंधान संस्थान, कानपुर को, सरसों की 121 प्राप्तियां राष्ट्रीय सरसों अनुसंधान केन्द्र, भरतपुर को, बैंगन की 200 प्राप्तियां तथा टमाटर की 300 प्राप्तियां भारतीय सब्जी अनुसंधान संस्थान, बनारस, लहसुन की 252 प्राप्तियां राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र, पूना, मेथी की 52 प्राप्तियां तथा धनियां की 30 प्राप्तियां राष्ट्रीय बीज मसाले अनुसंधान केन्द्र, अजमेर को भेजे गए।

## जननद्रव्य संरक्षण

संग्रहित जननद्रव्यों को धरोहर के रूप में दीर्घकालीन अर्वाधि के लिए-20 डिग्री सेल्सियस पर राष्ट्रीय जीन बैंक में संरक्षण हेतु रखा जाता है ताकि आवश्यकता पड़ने पर इन्हें निकालकर अनुसंधान के उपयोग में लाया जा सके। इस वर्ष कुल 20027 पादप प्राप्तियों को दीर्घावधि के लिए संरक्षित किया जो जीन बैंक के पामदंडों के अनुसार ठीक पाई गई। इसके अतिरिक्त 8035 प्राप्तियों को मध्यावधि भंडारण में रखा गया। जीन बैंक में दीर्घावधि के लिए संरक्षित 2486 प्राप्तियों की अंकुरणक्षमता/जीवनक्षमता की जांच की गई, 156980 प्राप्तियों का सत्यापन तथा सूचीकरण किया गया तथा 1334 प्राप्तियों के बारे में दर्ज पासपोर्ट सूचना को पूर्ण किया गया। तिल, कुसुम, लोकी, मूली तथा नीम के बीजों को अधिकतम स्तर पर सुखाकर 'अल्ट्रा डेसिकेशन' संरक्षण पर होने वाली लागत तथा बीजों की जीवनक्षमता पर प्रभाव पर अध्ययन जारी रहे।

## जननद्रव्यों का टीश्यू-कल्चर तथा क्रायोप्रीजर्वेशन द्वारा संरक्षण

कलम, कन्द, मूल तथा पौध से उगाई जाने वाली फसलों की कुल 1396 प्राप्तियों का टीश्यू-कल्चर विधि द्वारा कमरे के तापक्रम अथवा कम तापक्रम पर संरक्षण किया गया। प्रजातियों के अनुसार सब-कल्चर का औसतन अन्तराल 4-24 महीने रहा। कई प्रजातियों के कल्चर हेतु नये प्रोटोकॉल विकसित किए गए तथा आम में सोमेटिक इम्ब्रियोजेनेसिस की पहल की गई। तरल नाइट्रोजन '-196 डिग्री सें0' में रतालू, केला 'विलियम्स-अअअ' सहतूत प्रजाति, जेनटिना प्रजाति तथा सिमोंडिसय चाईनेसिस के संरक्षण पर सफल परीक्षण किए गए। आ ए पी डी विधि द्वारा 10 प्राइमर्स का उपयोग कर पता लगाया गया कि अरबी के दो वर्ष तक इन-विट्रो द्वारा संरक्षित प्राप्तियों तथा मातृ पौध के बीच में कोई बदलाव नहीं पाया गया। केले की

61 प्राप्तियां 'इन विट्रो कल्चर' मांगकर्ताओं को भेजी गई। कुल 5242 प्राप्तिओं 'आर्थोडोक्स, इन्टरमिडियेट तथ रिक्लेसीट्रेंट बीज' को तरल नाइट्रोजन में संरक्षित किया गया।

## डी एन ए फिंगरप्रिंटिंग

वर्ष के दौरान कुल 753 फसलों की किस्मों अथवा आशाजनक जननद्रव्यों का डी एन ए फिंगरप्रिंटिंग किया गया। ए एफ एल पी विधि द्वारा उड़द, चवला, मूंग, मोठ, अरहर, राइसबीन, मटर, तुहर, मिर्च केसर, बैंगन तथा सरसों की किस्मों का विश्लेषण किया गया। चावल, ज्वार, गेहूं तथा चने की किस्मों का एस टी एम एस विधि द्वारा विश्लेषण किया गया।

## पादप आनुवंशिक संसाधनों की नीति संबंधित मुद्दे

ग्लोबल प्लान आफ एक्सन में दिए गए सभी 20 क्षेत्रों में भारत द्वारा किए गए कार्यों की प्रगति प्रतिवेदन तैयार कर संयुक्त सचिव 'बीज', कृषि मंत्रालय, भारत सरकार तथा उप महानिदेशक 'बीज' भारतीय कृषि अनुसंधान परिषद के समक्ष प्रस्तुत की गई। राष्ट्रीय जैव विविधता, नीति एवं कार्य योजना 'एन बी एस ए पी' द्वारा तैयार किए गये दस्तावेज में अवांछित वाक्यांशों को हटाकर राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो के द्वारा निर्धारित नीतियों का समावेश कराया गया। पादप आनुवंशिक संसाधनों पर गठित कार्यवाहक समिति की प्रथम बैठक में पारित सिफारिशों पर ब्यूरो द्वारा की गई कार्रवाई की रिपोर्ट भारतीय कृषि अनुसंधान परिषद को भेजी गई।

## अन्य गतिविधियां

- विभिन्न समितियों जैसे संस्थान प्रबन्धन समिति, अनुसंधान सलाहकार समिति, कर्मचारी अनुसंधान परिषद, संस्थान संयुक्त कर्मचारी परिषद एवम फसल सलाहकारी समितियों की समय-समय पर सभायें आयोजित कर पादप आनुवंशिक संसाधनों के उचित प्रबन्धन संबंधी सभी पहलुओं पर चर्चा कर आवश्यक सुझाव दिए गए।
- विशिष्ट वैज्ञानिकों, प्रशासनकर्ताओं, उन्नतिशील कृषकों, अध्यापकों तथा विद्यार्थियों ने ब्यूरो के जीन बैंक, क्रायोबैंक, डी एन ए फिंगरप्रिंटिंग प्रयोगशालायें, पौध संगरोध शीशधर आदि सुविधाओं को देखा और आवश्यक जानकारी प्राप्त की।
- ब्यूरो के वैज्ञानिकों, अनुसंधान सहायकों तथा तकनीकी कर्मचारियों ने देश-विदेश में आयोजित कार्यशालाओं, सम्मेलनों एवं प्रशिक्षण कार्यक्रमों में भाग लेकर ज्ञान का आदान-प्रदान किया।
- पादप आनुवंशिक संसाधनों के बारे में अधिक से अधिक लोगों को जानकारी देने के लिए कई प्रशिक्षण पाठ्यक्रमों, कार्यशालाओं, बैठकों तथा जैव विविधता मेलों का आयोजन किया गया। इन आयोजनों में ग्रामीण महिलाओं को पादप आनुवंशिक संसाधनों के प्रबन्धन में साझेदार बनाने पर विशेष ध्यान दिया गया।
- ईसापुर फार्म तथा मुख्यालय, नई दिल्ली, आकोला, जोधपुर, त्रिशूर, शिमला एवं हैदराबाद केन्द्रों पर रबी तथा खरीप-में फसल दिवसों का आयोजन किया गया जिनमें प्रगतिशील किसानों तथा पादप प्रजनकों ने भाग लिया।

अनुवादक : अर्जुन लाल

**Annexure I. Meterological data (temperature in degree Celsius and rainfall in mm)**

| Station   | Parameter  | Jan  | Feb   | Mar   | Apr  | May  | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec  |
|-----------|------------|------|-------|-------|------|------|-------|-------|-------|-------|-------|-------|------|
| Akola     | Max. temp  | 29.9 | 33.1  | 37.0  | 40.7 | 42.3 | 36.6  | 31.3  | 29.6  | 29.8  | 32.7  | 32.4  | 29.5 |
|           | Min. temp. | 12.4 | 16.0  | 18.8  | 25.9 | 28.1 | 26.5  | 24.5  | 23.7  | 22.9  | 18.8  | 16.1  | 11.7 |
|           | Rainfall   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0  | 75.6  | 66.7  | 107.9 | 101.5 | 1.5   | 0.0   | 4.9  |
| Bhowali   | Max. temp  | 14.7 | 13.4  | 16.8  | 23.1 | 27.3 | 27.3  | 24.5  | 24.8  | 23.1  | 23.6  | 21.1  | 16.2 |
|           | Min. temp. | 1.2  | 1.42  | 5.8   | 9.3  | 12.3 | 17.1  | 17.3  | 18.4  | 16.7  | 10.4  | 3.3   | 1.3  |
|           | Rainfall   | 0.0  | 226.0 | 85.0  | 61.0 | 32.0 | 99.5  | 334.4 | 213.0 | 252.2 | 0.0   | 11.0  | 37.0 |
| Cuttack   | Max. temp. | 26.9 | 30.1  | 32.9  | 36.9 | 37.5 | 35.9  | 31.4  | 30.9  | 30.9  | 30.3  | 29.5  | 26.1 |
|           | Min. temp. | 14.7 | 19.5  | 21.7  | 25.7 | 26.6 | 27.1  | 26.1  | 25.7  | 25.7  | 24.5  | 19.4  | 15.8 |
|           | Rainfall   | 0.0  | 12.6  | 15.2  | 2.4  | 29.2 | 218.9 | 555.2 | 587.0 | 397.2 | 401.7 | 26.8  | 26.2 |
| Hyderabad | Max. temp  | 29.6 | 33.0  | 34.9  | 37.9 | 40.9 | 36.9  | 30.1  | 29.3  | 30.9  | 30.4  | 29.8  | 28.4 |
|           | Min. temp. | 13.7 | 18.7  | 20.8  | 23.1 | 25.2 | 25.4  | 23.0  | 22.2  | 22.4  | 19.9  | 14.9  | 12.0 |
|           | Rainfall   | 0.0  | 0.0   | 167.6 | 34.4 | 0.0  | 79.7  | 305.4 | 278.2 | 44.0  | 124.9 | 0.0   | 0.0  |
| Jodhpur   | Max. temp. | 25.4 | 27.2  | 33.6  | 39.6 | 41.0 | 39.4  | 34.3  | 33.7  | 35.2  | 37.0  | 32.9  | 28.8 |
|           | Min. temp. | 11.2 | 13.8  | 18.1  | 24.3 | 27.0 | 28.7  | 26.0  | 26.0  | 24.5  | 18.3  | 15.5  | 12.3 |
|           | Rainfall   | 00.7 | 23.1  | 02.7  | 0.0  | 00.6 | 65.7  | 260.3 | 65.3  | 01.6  | 0.0   | 0.0   | 0.0  |
| Shillong  | Max. temp. | 19.4 | 20.9  | 23.3  | 26.6 | 27.1 | 26.8  | 27.2  | 28.3  | 27.1  | 24.6  | 22.8  | 19.8 |
|           | Min. temp. | 5.9  | 8.5   | 11.5  | 16.1 | 17.6 | 19.7  | 20.1  | 20.8  | 19.7  | 17.5  | 11.7  | 8.6  |
|           | Rainfall   | 8.3  | 5.6   | 20.7  | 14.8 | 69.5 | 69.2  | 91.6  | 66.2  | 32.5  | 176.7 | 30.3  | 33.8 |
| Shimla    | Max. temp. | 13.8 | 13.0  | 17.3  | 23.3 | 25.6 | 27.3  | 23.5  | 23.3  | 23.1  | 21.4  | 17.79 | 14.3 |
|           | Min. temp. | 4.8  | 4.2   | 7.5   | 12.3 | 15   | 17.7  | 16.7  | 16.4  | 14.9  | 11.5  | 7.76  | 6.1  |
|           | Rainfall   | 39.7 | 113.5 | 108.9 | 51.4 | 39.9 | 113.7 | 352.2 | 588.8 | 17.6  | 0.0   | 9.5   | 10.4 |
| Thrissur  | Max. temp. | 33.2 | 34.7  | 34.6  | 34.6 | 34.0 | 30.9  | 29.5  | 30.0  | 31.0  | 30.8  | 31.5  | 32.2 |
|           | Min. temp. | 22.9 | 23.6  | 24.1  | 25.0 | 25.0 | 23.8  | 22.2  | 23.4  | 22.7  | 23.1  | 23.9  | 21.9 |
|           | Rainfall   | 0.0  | 162.1 | 94.8  | 23.8 | 40.3 | 570.6 | 492.6 | 490.1 | 53.7  | 276.6 | 18.2  | 0.0  |

