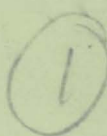


NBPGR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2005-2006



राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो
(भारतीय कृषि अनुसंधान परिषद)
पूसा परिषर, नई दिल्ली-110012

NATIONAL BUREAU OF PLANT GENETIC RESOURCES
(Indian Council of Agricultural Research)
Pusa Campus, New Delhi - 110 012



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Dr. K. C. Bhatt, Senior Scientist

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	IC	Indigenous Collection
ARIS	Agricultural Research Information System	ICAR	Indian Council of Agricultural Research
AVRDC	Asian Vegetable Research and Development Center	ICARDA	International Center for Agricultural Research in the Dry Areas
AVT	Advance Varietal Trial	ICRISAT	International Crops Research Institute for Semi-Arid Tropics
BARC	Bhabha Atomic Research Center	IFPGR	International Fund for Plant Genetic Resources
BPH	Brown Plant Hopper	INIBAP	International Network for the Improvement of Banana and Plantain
CBD	Convention on Biological Diversity	INPGRS	Indian National Plant Genetic Resources System
CGIAR	Consultative Group on International Agricultural Research	IPGRI	International Plant Genetic Resources Institute
CGRFA	Commission on Genetic Resources for Food and Agriculture	IPR	Intellectual Property Rights
CIAT	International Center for Tropical Agriculture	IRRI	International Rice Research Institute
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	MoU	Memorandum of Understanding
CSIR	Council of Scientific and Industrial Research	MTA	Material Transfer Agreement
DAC	Department of Agriculture and Cooperation	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	Department of Plant Protection, Quarantine & Storage	NATP	National Agricultural Technology Project
DRDO	Defense Research and Development Organization	NBPGR	National Bureau of Plant Genetic Resources
DST	Department of Science and Technology	NGO	Non-Governmental Organization
DWR	Directorate of Wheat Research	NHCP	National Herbarium of Cultivated Plants
EC	Exotic Collection	NRC	National Research Center
ELISA	Enzyme Linked Immuno Sorbent Assay	NRCWA	National Research Centre for Women in Agriculture
FAO	Food and Agricultural Organization	PAGE	Polyacrylamide Gel Electrophoresis
GATT	General Agreement on Tariffs and Trade	PEQN	Post-Entry Quarantine Nursery
GHU	Germplasm Handling Unit (of NBPGR)	PGRFA	Plant Genetic Resources for Food and Agriculture
GIS	Geographical Information System	RFLP	Restricted Fragment Length Polymorphism
GPA	Global Plan of Action	SAU	State Agricultural University
HYV	High Yielding Variety	STMS	Sequence Tagged Microsatellite Site
IARC	International Agricultural Research Center	TGMS	Temperature-sensitive Genic Male Sterile
		TRIPS	Trade Related Intellectual Property Rights

PREFACE

It gives me immense pleasure to present before you the Annual Report of NBPGR for the year 2005-2006. The report presents the achievements of the NBPGR in the areas of plant exploration and germplasm collection, introduction of germplasm and its quarantine before release to users in the country, issuance of phytosanitary certificate to facilitate germplasm exchange with other countries, characterization and evaluation for development of information on potential value of accessions, *ex-situ* conservation of germplasm in National genebank through storage of seed, tissue culture and cryopreservation, regeneration/ maintenance of germplasm, accessioning and data documentation, and DNA Fingerprinting of released varieties. The National Agricultural Technology Project (Plant Biodiversity) was successfully completed which helped in developing strong linkages among partners/ stakeholders for the efficient management of plant genetic resources in the country.

During the preceding year, our PGR management activities got further impetus through our well-defined and well-structured research projects. The multi-location evaluation of germplasm in collaboration with AICRP/ Project Directorates/ crop based institutes of ICAR was successfully carried out generating useful information and deserves special mention. NBPGR faculty provided high quality education and training in the field of plant genetic resources, molecular characterization, biosafety issues, genebank management etc. in the country.

Regular meetings of Institute Management Committee, Research Advisory Committee, Staff Research Council and Germplasm Advisory Committees and high-level technical committees etc. were organized which led to the development of more cohesive and focused target orienting programmes in the right direction. NBPGR successfully organized an international symposium on "Plant Introduction: Achievements and Opportunities in South Asia" from 15 to 17 February 2005 at New Delhi reemphasizing the interdependence among nations and importance of introduction of germplasm to facilitate crop improvement and increase productivity.

I wish to take this opportunity to put on record our sincere thanks and gratitude to Dr Mangala Rai, Secretary, Department of Agricultural Research and Education & Director General, Indian Council of Agricultural Research and to Dr G Kalloo, Deputy Director General (Crop Sciences & Horticulture), ICAR for their support, guidance and encouragement. I wish to express my sincere appreciation to all the scientists, technical, administrative and supporting staff of NBPGR for their dedicated efforts and cooperation in carrying out the activities of Bureau so efficiently and effectively.

Special mention has to be made of the efforts of Drs Arjun Lal, Mrs Neeta Singh and KC Bhatt for compiling and editing the information so meticulously and bringing out the report in time.

10th June, 2006
New Delhi

AK Singh
Director (Officiating)

देश में पादप आनुवंशिक संसाधनों के प्रबन्ध हेतु राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो ने निरन्तर अगुआई करते हुए सफल पथ प्रदर्शन किया। पादप आनुवंशिक संसाधनों के उचित प्रबन्धन से संबंधित सभी गतिविधियों पर वर्ष 2005-2006 के अन्तर्गत अर्जित उपलब्धियों का संक्षिप्त विवरण इस अध्याय में दिया गया है जो इस प्रकार है।

पादप अन्वेषण शतथा जननद्रव्य संग्रहण

राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो (पादप ब्यूरो) तथा राष्ट्रीय कृषि प्रौद्योगिकी परियोजना-पादप जीवविधिता (एन. ए.टी.पी.-पी.बी.) के अन्तर्गत सहयोगी संस्थाओं के सहयोग से देशभर में कुल 65 अन्वेषण किए गये जिनमें विविध पादप प्रजातियों के 4263 नमूने (जिसमें फसलीय तथा जंगली प्रजातियां सम्मिलित हैं) संग्रहित की गईं। इनमें से मुख्यालय, नई दिल्ली द्वारा 13 अन्वेषणों के दौरान 625 प्राप्तियां संग्रह की गईं। संग्रहित पादप प्राप्तियां को संग्रहण स्थल के निकट (पादप ब्यूरो के क्षेत्रीय केन्द्र) उगाया गया एवं उचित मात्रा में एकत्रीत बीज को राष्ट्रीय जीन बैंक में दीर्घाविधि भण्डारण हेतु संग्रहित किया गया। राष्ट्रीय वनस्पति संग्रहालय कृष्ट पादप में कुल 1144 नमूने सम्मिलित किए गए।

संग्रहित भू-जातियां (लैंड रेसेज): आंध्र प्रदेश के नालगोंडा तथा खमाम जिलों से ज्वार की पछाजोना, टेलाजोना, कोंडाजोना, पीली ज्वार, काकी जोना एवं छोपाजोना भूजातियां संग्रहित की गईं। उत्तर केरल से धान की 25 परम्परागत भूजातियां एकत्रीत की गईं जिनमें दो औषधीय (नजबारा, थेन्नोशन), तीन सगंधीय धान (गंधकसाला, जीरकसाला, कूनजूनेल्लू) तथा 20 अन्य गुणों वाली शामिल थी।

तटीय सौराष्ट्र (गुजरात) से बाजरे की भूजाति 'रिजका बाजरी' संग्रहित की गई तथा कच्छ से ज्वार की भूजाति 'वाकोडिया ज्वार' संग्रहित की गई।

वन्य प्रासंगिक पादप: सोलेनम की वन्य प्रजातियां क्रमशः सोलेनम सूरटेंस (2 प्रजातियां) अन्य फसलों के नौ नमूने कटक, मयूरगंज, बालासोर, भद्रक, पुरी (उड़ीसा), महबूबनगर, चित्तौड़, कुडडापा तथा अनन्तपुर (आन्ध्र प्रदेश) से संग्रहित किए गए।

फसल विशेष अन्वेषण: पहाड़ी क्षेत्रों में आम के लिए दो विशेष अन्वेषण उत्तरांचल (शिमलासु, टेहरी बांध क्षेत्र), मिर्च के लिए खातिमा, देहरादून, कमलपुर, विकासनगर, हरिद्वार (उत्तरांचल) तथा मथानिया, जोधपुर में किए गए। एलियम तथा सब्जियों के लिए तवांग तथा प. तवांग जिलों में अन्वेषण किए गए। चंगलांग जिले से धान की उल्लेखनीय प्राप्ति एकत्रीत की गई।

जननद्रव्य विनिमय

आयातित जननद्रव्य: इस वर्ष विभिन्न फसलों की कुल 28,656 प्राप्तियां (64,806 नमूने) 32 देशों से आयात किए गए जिनमें 15,486 प्राप्तियां जननद्रव्यों की तथा 13,170 प्राप्तियां परीक्षण सामग्री के लिए आयात की गईं। हमारे देश के अनुसंधानकर्ताओं के प्रतिवेदन के आधार पर विभिन्न फसलों के 9,413 नमूने मटेरियल ट्रांसफर एग्रीमेंट के तहत फसल सुधार कार्यक्रमों हेतु आपूर्ति किए गए। विभिन्न फसलों में विशिष्ट गुणों वाले जननद्रव्यों का आयात किया गया जो इस प्रकार हैं: (इसी = एकजोटिक कलेक्सन)

धान: सी.एम.एस. एवं मेनटेनर प्राप्तियां (इसी 565092-117, इसी 565278-321, इसी 559259-90), थरमोजेनिक मेल स्टेरायल (टी.जी.एम.एस.) लाईनें (इसी 564674-81, इसी 565322-26, इसी 559230-32); लवण प्रतिरोधिता (इसी 564773-79, इसी 565135-58, इसी 556582, इसी 566358-386, इसी 568964-94); सूखा प्रतिरोधी (इसी 564780-790, इसी 556570-75); अधिक लोह तत्व (इसी 565159); मानोजेनिक लाईने (इसी 566268-299); ब्लास्ट रोधी एवं टुगरो विषाणु रोधीलाईने (इसी 568146, 556567-569); ब्राउन प्लांट हापर प्रतिरोधी लाईने (इसी 568081-87); जीवाणु झुलसा रोग प्रतिरोधी लाईने (इसी 568093-8144) सभी आई.आर. आर. आई, फिलीपींस से।

गेंहू: अधिक प्रोटीन मात्रा वाली कामूल किस्म (इसी 556272) बेलजीयम से; अधिक उपज एवं स्ट्राइप रस्ट प्रतिरोधी किस्म ईडन (इसी 556885) अमेरिका से; अधिक प्रोटीन मात्रा, दाने का वजन तथा हेशियन मक्खी प्रतिरोधी किस्म होलिस (इसी 556386) अमेरिका से।

मक्का: सी.एम.एस लाईने (इसी 568876-881) अमेरिका से।

जौ: अधिक उपज, स्मट एवं रस्ट रोग प्रतिरोधी (इसी 570289) कनाडा से; लाजींग स्केल्ड एवं कवर्ड स्मट प्रतिरोधी (इसी 570290) कनाडा से आयात की गई।

ज्वार: मेल स्टेरायल (इसी 568885-86) तथा मेनटेनर लाईन (इसी 568887) अमेरिका से।

ब्रेसिका जूनसिया: जल्दी पकने वाली, अधिक तेल मात्रा तथा 'ब्लैक लेग' रोग प्रतिरोधी (इसी 564690-643, 564644-649) आस्ट्रेलिया से; कम यूरेसिक एसिड (0.6 प्रतिशत) तथा ग्लूकोसिनोलेट (0.4-0.6 प्रतिशत) (इसी 559572, 564728) रूस से आयात किए।

ब्रेसिका नेपस: अधिक गुणवत्ता वाले तेल की मात्रा (इसी 557008-017), सकेलेरोशियम स्कलेरोटम फफुंद रोधी (इसी 657011-12, 657018-19, -021, -026) आस्ट्रेलिया से।

चना: गर्मी रोधी किस्म (इसी 565197-5214), ऐसकोचायटा झुलसा प्रतिरोधी कतार (इसी 554857), अमेरिका से; काबुली भूमि जातियां, ऐसकोचायटा रेबई एवं फ्यूजेरियम रोग प्रतिरोधी (इसी 556541-542) स्पेन से; सर्दी रोधी कतारें (इसी 566900-909) एवं लवण रोधी कतारें (इसी 566910-919) आस्ट्रेलिया से।

राजमा: साधारण जीवाणु झुलसा रोग, बीन कामन माजेक विषाणु प्रतिरोधी (इसी 566209) अमेरिका से; बीन गोल्डन यलो माजेक विषाणु, एंथ्रेकनाज, ऐंग्यूलर लीफ स्पॉट रोग प्रतिरोधी (इसी 559573-74) हॉन्ड्यूरस से।

बाकला (विसिया फाबा): ब्रूमरेप खरपतवर प्रतिरोधी (इसी 556902) स्पेन से।

मूंग: मूंगबीन येलो माजेक विषाणु प्रतिरोधी कतारें (इसी 565626-33) एवीआरडीसी ताईवान से।

मिर्च: मिर्च माजेक विषाणु (सी.एम.बी.), चीली वेनल माजेक विषाणु प्रतिरोधी (इसी 559416-9426); एंथ्रेकनाज एवं सी.एम.वी. प्रतिरोधी (इसी 559491-496); पाटी विषाणु वाई एवं बेक्टेरिया विल्ट प्रतिरोधी (इसी 559424-9508); टमाटर माजेक विषाणु, पाटी विषाणु वाई, सी.एम.बी. एवं लीफ कर्ल प्रतिरोधी (इसी 570005-12) सभी ए.वी.आर.डी.सी., तायवान से आयात

की गई।

ककड़ी (कुकुमिश सटाइवस): बड़ी आकार एवं हरी छाल वाली (इसी 565750); मादा कतार (इसी 565764); अंगेति (इसी 565796); आचार वाली (इसी 565832) सभी नीदरलैण्ड से।

टमाटर: टोमेटो लीफ कर्ल विषाणु, लेट ब्लाइट, वरतीसिलम विल्ट, बैक्टेरियल विल्ट प्रतिरोधी (इसी 568938-44); प्लम के आकार वाले छोटे फल एवं गर्मीरोधी (इसी 570019), ग्लोब के आकार वाले बड़े फल एवं गर्मी रोधी (इसी 570015-16) सभी ए.वी.आर.डी.सी. ताईवान से तथा बीटा केरोटीन की अधिकता वाली (इसी 565215) अमेरिका से आयात की गई।

फ्रोरिया अनानासा: अधिक उपज एवं छोटे दिन वाली (इसी 569143-44) अमेरिका से।

वेक्सीनम आक्षीकाकोस: बहुफलदायक, लम्बे समय तक खराब न होने वाले फल तथा लीफ हापर प्रतिरोधी (इसी 562097) अमेरिका से।

पायरस प्रजातियां: ब्लिस्टर मायट प्रतिरोधी (इसी 560258) अमेरिका से।

कपास: अधिक पैदावार एवं लम्बे रेशे वाली (इसी 559008-12); औषतन अधिक कपास (इसी 559013), जल्दी पकने वाली (इसी 559014-15)-अमेरिका से; बड़े बोल आकार (भार 7.4-7.7 ग्राम), अधिक रेशा (39.1-41.8 प्रतिशत) तथा बारीक मजबूत रेसा (इसी 560321-328) टर्की से आयात किया गया।

जननद्रव्य निर्यात: विदेशों में अनुसंधानकर्ताओं की मांग आपूर्ति हेतु कुल 4730 प्राप्तियां (मुख्यालय-76, हैदराबाद-4654) भा.कृ.अ. परिषद की स्वीकृति के बाद स्वस्थता प्रमाण पत्र के साथ विभिन्न देशों को निर्यात की गई।

पादप संगरोध: अनुसंधान कार्यों के लिए विनिमय (आयात + निर्यात) होने वाले जननद्रव्यों की संगरोध जांच पादप ब्यूरो के मुख्यालय तथा क्षेत्रीय केन्द्र, हैदराबाद में की जाती है। जांच एवं परीक्षणों के आधार पर स्वस्थ पाई गई पौध सामग्री एवं बीज ही मांगकर्ता को भेजी जाती है।

मुख्यालय नई दिल्ली में कुल 28,732 प्राप्तियां संगरोध जांच हेतु प्राप्त हुए जिनमें 28656 प्राप्तियां (64,882

नमूने) आयात हुए तथा 76 प्राप्तियां विदेशों को निर्यात की गईं। इन नमूनों में बीज, जड़ सहित पौधे, कलम, कंद, टिश्यू कल्चर की पौध शामिल थे। पौध संगरोधालयों में विस्तृत निरीक्षण करने पर 165 नमूने कीटों द्वारा ग्रसित पाये गये, 313 नमूने सूत्र कृमियों द्वारा एवं 252 नमूने फफूंद/जीवाणुओं द्वारा ग्रसित पाये गये। कुल 730 ग्रसित/संक्रमित नमूनों में से 723 नमूनों को विभिन्न विधियों जैसे धूमन, एक्सरे रेडियोग्राफी, उष्ण जल उपचार, फफूंदनाशक एवं कीटनाशक रसायनों द्वारा उपचारित कर स्वस्थ बीज/पौध सामग्री को मांगकर्ताओं को भेजा गया। अमेरिका तथा ताईवान से आयातित सोयाबीन के सात नमूनों में डाऊनी मिलड्यू फफूंद पाये जाने पर उन्हें जलाकर नष्ट कर दिया गया। निर्यात के लिए 76 नमूनों को स्वस्थ पाये जाने पर 'स्वस्थता प्रमाण पत्र' जारी कर निर्यात किए गए। कपास, मक्का, -आलू एवं धान के ट्रांसजेनिक बीज (69 नमूने) प्राप्त हुए जिन्हें गहन जांच के बाद स्वस्थ पाया गया।

क्षेत्रीय केन्द्र, हैदराबाद द्वारा 6,632 नमूने आयात तथा 4,758 नमूने निर्यात हेतु प्राप्त हुए जिनका विस्तृत निरीक्षण किया गया। आयातित नमूनों में 987 नमूने ग्रसित/संक्रमित पाये गये जिन्हें रोग/कीट मुक्त कर मांगकर्ताओं को भेजा गया। निर्यात किए जाने वाले 104 नमूने रोग/कीट ग्रस्त पाये गये जिन्हें जलाकर नष्ट कर दिया गया तथा 4654 स्वस्थ नमूनों को 'स्वस्थता प्रमाण पत्र' देकर निर्यात किया गया। केन्द्र द्वारा 30 से भी अधिक संस्थाओं को दक्षिण भारत में संगरोध सेवायें प्रदान की गईं।

जननद्रव्य लक्षण वर्णन, मूल्यांकन तथा अनुरक्षण

पादप ब्यूरो के मुख्यालय, ईसापुर फार्म, क्षेत्रीय केन्द्रों तथा भारतीय कृषि अनुसंधान परिषद की विभिन्न संस्थाओं के साथ तैयार साझा कार्यक्रम के अन्तर्गत विभिन्न फसलों के जननद्रव्यों को लक्षण वर्णन, मूल्यांकन एवं अनुरक्षण/पुनरूत्पादन हेतु उगाया गया जो निम्नवत् है:- ईसापुर फार्म तथा मुख्यालय दिल्ली में 10874 (लक्षण वर्णन एवं मूल्यांकन के लिए) तथा 6511 प्राप्तियां (अनुरक्षण अथवा पुनरूत्पादन हेतु); अकोला में 7943 प्राप्तियां (लक्षण वर्णन तथा मूल्यांकन हेतु) एवं 7154 प्राप्तियां अनुरक्षण हेतु; कटक केन्द्र में 1395 प्राप्तियां; हैदराबाद में 3239 प्राप्तियां; रांची केन्द्र में 376 प्राप्तियां तथा 162 जंगली पौध प्रजातियां; शिलांग (बड़ापानी फार्म) पर 2381 प्राप्तियां; शिमला पर 2096 प्राप्तियां फसलों की तथा 1086 प्राप्तियां फलों की अनुरक्षण हेतु; श्रीनगर में 406 प्राप्तियां तथा त्रिशूर में 654 प्राप्तियां

मूल्यांकन हेतु तथा 135 प्राप्तियां लक्षण वर्णन हेतु। विभिन्न फसलों के पूर्व निर्धारित गुणों के लिए आंकड़े लिए गए तथा आंकलन पश्चात विशिष्ट गुणोंके लिए प्राप्तियों की पहचान की गई।

विभिन्न फसलों के क्षेत्रीय केन्द्रों एवं मुख्यालय पर रबी तथा खरीफ में फसल दिवसों का आयोजन किया गया जिनमें अनुसंधान कर्ताओं ने भाग लेकर वांछित गुणों के आधार पर मूल्यांकन कर अच्छी प्राप्तियों का चयन किया। वानस्पतिक संवर्धन से उगाई जाने वाली फसलों पौधों को फील्ड जीनबैंक में उगाकर अनुरक्षण किया गया।

जननद्रव्य संरक्षण

बीज जननद्रव्य संरक्षण: राष्ट्रीय जीनबैंक में दीर्घकालीन संरक्षण हेतु विभिन्न फसलों (बीज) की कुल 33,889 प्राप्तियां प्राप्त हुईं। इन सभी को जीनबैंक द्वारा निर्धारित मापदण्डों के अनुसार संशोधित किया गया। इनमें से 25,596 प्राप्तियों को आधार संग्रहों में सम्मिलित किया गया। जिसके फलस्वरूप राष्ट्रीय जीनबैंक के आधार संग्रहों की कुल संख्या बढ़कर 3,12,583 हो गयी है (तालिका-1)। इस दौरान जननद्रव्य संचालन यूनिट ने 7,526 प्राप्तियां प्राप्त की जिनमें से 4,432 प्राप्तियों को मध्यावधि भण्डार गृह में संदर्भ सामग्री के रूप में रखा गया। जीनबैंक में संरक्षित 1,652 प्राप्तियों का निरीक्षण किया गया तथा 2,928 प्राप्तियों की पासपोर्ट सूचना को पूर्ण किया गया।

पादप उत्तक कल्चर संरक्षण: वानस्पतिक संवर्धन वाली पादप प्रजातियां जिनमें बीज नहीं बनता जैसे बागवानी, प्रकन्दीय, औषधीय तथा संकटापन्न पौधों एवं नई औद्योगिक फसलों की 1783 प्राप्तियों का उत्तक संवर्धन विधि द्वारा कमरे के तापक्रम अथवा निम्न तापक्रम (4⁰ सें.) पर संरक्षित किया गया। प्रजातियों के अनुसार उप-संवर्धन का अन्तराल 4-24 माह रहा। विभिन्न प्रजातियों के अनुसार नये प्राटोकाल विकसित किए गए। पाइरस और वेक्सीनियम वंशों को पहली बार उत्तक कल्चर के लिए डाला गया। संरक्षण की लागत को कम करने के लिए भी कई फसलों पर प्रयोग किए गए तथा उत्साहवर्धक परिणाम मिले। केले की 85 प्राप्तियां तथा औषधीय पौधों की सात प्राप्तियों के उत्तक-कल्चर पौधे मांगकर्ताओं को भेजे गये।

तरल नाइट्रोजन में हिम-परिरक्षण: विभिन्न पौधों की 1298 प्राप्तियां (जिनमें आर्थोडोक्ष तथा रिकेल्सीटेंट बीज, पराग कण, सुषुप्त कालकोप सम्मिलित थे) को तरल

तालिका 1: राष्ट्रीय जीन बैंक में दीर्घावधि हेतु जननद्रव्य का ब्योरा (31.12.2005 तक)

फसल वर्ग	जनवरी से दिसम्बर 2005	वर्तमान (31.12.05 को)
धान		
गेहूँ	3,184	74,857
मक्का	1,652	35,927
अन्य	789	6,297
धान्य	804	10,175
ज्वार	6,429	1,27,256
बाजरा	47	17,537
मोटे अनाज	508	7,245
अन्य	1,636	18,434
मोटे अनाज तथा चारे की फसलें	641	2,810
रामदाना	2,832	46,026
कूटु	738	4,259
अन्य	110	403
कूट धान्य	10	179
चना	858	4,841
अरहर	289	15,933
मूंग	2,496	10,016
अन्य	406	3,365
दलहन	2,286	19,004
मूंगफली	5,477	48,318
सरसों	1,658	13,095
सूरजमुखी	649	7,812
अन्य	875	6,999
तिलहन	2,240	14,412
कपास	5,422	42,318
जूट	29	4,623
अन्य	23	2,608
रेशेदार फसलें	485	1,911
बैंगन	537	9,142
मिर्च	228	3,260
अन्य	9	1,990
सब्जियां	1,707	13,612
सरीफा	1,944	18,862
पपीता	-	57
अन्य	-	23
फलदार फसलें	2	94
पोस्ता	2	174
तुलसी	53	346
तम्बाकू	43	241
अन्य	511	1,448
औषधीय, संगधीय तथा नशीले पौधे	480	1,657
धनिया	1,087	3,692
सोवा	89	385
अन्य	-	59
मसाले	492	690
पोंगम तेल वृक्ष	581	1,134
अन्य	19	62
कृषि वानिकी	408	563
मसूर	427	625
अरहर	-	7,712
द्वितीयक नमूने	-	2,523
योग	-	10,235
योग	25,596*	312,583**

* इनमें 245 निर्मुक्त किस्में तथा 28 आनुवंशिक धरोहर शामिल हैं।

** इस संख्या में 2272 किस्में तथा 705 आनुवंशिक धरोहर शामिल हैं।

नाइट्रोजन में -160° से -180° सें. पर परिरक्षण किया गया। एलियम ट्यूबरोसम, बाकोपा मोनिरी, रतालू, जेंटीयाना क्रूरो, शहतूत तथा केले पर हिम-परिरक्षण प्रयोग किए गए जिनमें आशाजनक परिणाम मिले।

डी.एन.ए. फिंगर प्रिंटिंग

धान की 60 किस्मों, राजमा की 74 किस्मों/प्राप्तियों, मसूर की 144 किस्मों/भूजातियों तथा देशी अलसी की 21 किस्मों का एस.टी.एम.एस., ए.एफ.एल.पी., एस.आर.ए.पी. एवं आई.एस.एस.आर. विधियों द्वारा फिंगर प्रिंटिंग किया गया। सभी किस्मों को इन विधियों से एक दूसरे से पृथक किया जा सकता है। इसके अतिरिक्त नये एस.टी.एम.एस. मार्कर की पहचान की गई जो मूंग, उड़द, अरहर तथा रायसबीन की डी.एन.ए. प्रोफाइल में उपयोगी होगी। फसल डी.एन.ए. फिंगर प्रिंट डेटाबेस को अपडेट किया गया। वर्तमान डेटाबेस में 16 फसलों की 923 किस्में सम्मिलित हैं। आयातित ट्रांसजेनिक बीजों में विद्यमान ट्रांसजेनिस की पहचान के लिए प्राईमर्स का रूपांकन किया तथा 180 प्राप्तियों में टर्मिनेटर जीन की जांच की गई। किसी भी नमूने में टर्मिनेटर जीन नहीं पाया गया।

अन्य गतिविधियां

- विभिन्न समितियों जैसे संस्थान प्रबन्धन समिति, अनुसंधान सलाहकार समिति तथा तथा वैज्ञानिक अनुसंधान परिषद की समयानुसार सभायें आयोजित कर पादप आनुवंशिक संसाधनों के उचित प्रबन्ध संबंधी सभी पहलुओं पर चर्चा कर आवश्यक सुझाव दिये गये।
- ब्यूरो के वैज्ञानिकों, अनुसंधान सहायकों, तकनीकी तथा प्रशासनिक कर्मचारियों ने कार्यशालाओं, सम्मेलनों एवं प्रशिक्षण कार्यक्रमों में भाग लेकर ज्ञान का आदान-प्रदान किया।
- विशिष्ट वैज्ञानिकों, प्रशासकों, प्रगतिशील किसानों, नीति नियन्ताओं तथा विद्यार्थियों ने राष्ट्रीय जीनबैंक, डी.एन.ए. फिंगर प्रिंटिंग प्रयोगशाला, संगरोध प्रयोगशाला,

शीशघर एवं सी-4 स्तर की राष्ट्रीय संगरोध नियन्त्रित सुविधा तथा उत्तक संवर्धन प्रयोगशालाओं को देखा और जानकारी प्राप्त की।

- 'पादप प्रवेश: उपलब्धियां एवं दक्षिण एशिया में अवसर' विषय पर अन्तर्राष्ट्रीय सम्मेलन 15 से 17 फरवरी 2005, नई दिल्ली में आयोजित किया गया।
- 'बायोसेफ्टी कनसर्न आफ ट्रांसजेनिक्स एवं डेटेक्सन आफ एल.एम.ओ.' विषय पर नई दिल्ली में 14-21 मार्च, 2005 को एक प्रशिक्षण कार्यक्रम आयोजित किया गया।
- लघु अवधि (3 से 6 माह) के कई प्रशिक्षण कार्यक्रम विश्वविद्यालयों के स्नातकोत्तर छात्र-छात्राओं के लिए विभिन्न विषयों पर आयोजित किए गए।
- प्रायोगिक प्रक्षेत्र, ईसापुर, नई दिल्ली, अकोला, हैदराबाद, जोधपुर, शिमला तथा त्रिशूर केन्द्रों पर 'रबी' एवं 'खरीफ' फसलों पर खेत दिवस आयोजित किये गये जिनमें फसल विशेषज्ञों ने भाग लिया एवं फसल सुधार हेतु जननद्रव्यों का चयन किया।
- ट्रांसजेनिक सोयाबीन, ट्रांसजेनिक मक्का तथा ट्रांसजेनिक गेंहू में ट्रांसजेनिक पहचान विधि पर तीन पेटेन्ट प्रार्थना पत्र दर्ज किए गए।
- भारतीय कृषि अनुसंधान परिषद द्वारा गठित 'जनन द्रव्य पंजीकरण समिति' ने डा. कल्लू की अध्यक्षता में प्राप्त आवेदनों पर चर्चा कर 14 फसलों की 34 किस्मों को राष्ट्रीय जीनबैंक में पंजीयन किया गया।
- प्रकाशन सामग्री: ब्यूरो की वार्षिक प्रतिवेदन तथा समाचार पत्र को प्रकाशित कर संबंधित संस्थाओं को भेजा गया। इसके अतिरिक्त वैज्ञानिकों ने अनुसंधान पत्र (90) राष्ट्रीय तथा अन्तर्राष्ट्रीय जर्नल में प्रकाशित किए। किसानों के लिए पादप संगरोध कीटों पर नो सलाहकार पत्र तथा हिन्दी में विभिन्न विषयों में 20 लेख पत्र/पत्रिकाओं में प्रकाशित किए।

EXECUTIVE SUMMARY

The NBPGR continued its leadership role in plant genetic resources management in the country. Significant achievements made during 2005-2006 in plant exploration and germplasm collection; germplasm introduction from abroad; plant quarantine inspection, treatment and release of healthy germplasm; characterization, evaluation/identification of promising accessions and maintenance; conservation of germplasm in National genebank and DNA Fingerprinting of crop cultivars are summarized hereunder. Details of these PGR activities are given in respective ensuing chapters.

PLANT EXPLORATION AND GERmplasm COLLECTION

In all, 65 explorations were undertaken across the country under NATP (Plant Biodiversity)/ national exploration plan and other externally-funded projects and 4,263 accessions of various agri-horticultural crops, wild relatives of crops and other economic plants were assembled. Of these, 625 accessions were collected by the Headquarters, New Delhi through 13 explorations covering parts of Haryana, Himachal Pradesh, Jammu and Kashmir, Rajasthan, Uttar Pradesh and West Bengal, including one special mission in Andaman and Nicobar Islands. A total of 1,144 herbarium specimens, 128 seed samples and 27 economic products were processed and added to National Herbarium of Cultivated Plants (NHCP) maintained at the Headquarters.

Landraces collected: Landraces of sorghum namely **pacchha jonna**, **tella jonna**, **konda jonna**, **pilijowar**, **kakijonna** and **choppa jonna** were collected from Nalgonda and Khammam districts of Andhra Pradesh. Diversity was observed in plant height, panicle length, width and compactness, seed colour and size, glume covering and colour and presence of awns.

In a trip to North Kerala, collected 43 accessions of 25 traditional landraces comprising 6 accessions of 2 medicinal rice varieties (**njavara**, **thonnooran**) and 12 accessions of 3 aromatic rice varieties (**gandhakasala**, **jeerakasala** and **kunjunellu**) and other 20 named landraces. In another trip to North Kerala, collected 23 named rice landraces viz., one accession each of **vellamthangi**, **chuvanna kuruka**, **sulochana**, **chettadi**, **vella**, **vella kodiyan**, **mysori**,

kattamodan, **nayaruvella**, **chuvanthutti**, **ulantha**, **palakkadan matta**, **kunjukunju**, **malamutti** and **theakkan**; two accessions each of **chuvanna chitteni**, **mundakan vella**, **mundaka cheera**, **njavara**, **vellaryan**, **kuttadan**, **aayiram meni** and four of **karutha njavara**.

A landrace of bajra namely **rijka bajri** for grains as well as for forage was collected from coastal Saurashtra, Gujarat. A collection of clusterbean called as "**vakodia guar**" (IC538002) collected from Jam Kunariya (Kachchh) is considered as superior vegetable type by the local farmers.

Wild relatives of crop plants: Wild species collected included *Solanum surratense* (2 accessions), *S. torvum* (1), *S. incanum* (27), *S. insanum* (1), *Solanum* sp. (8) and other crops (9) from coastal districts of Orissa covering Cuttack, Mayurbhanj, Balasore, Bhadrak, Joipur and Puri and parts of Mahaboobnagar, Kumool, Cuddapah, Chittoor and Anantapur districts of Andhra Pradesh.

Crop specific explorations: Two collaborative and hills crop-specific explorations were especially undertaken for the collection of mango from village Simlasu, Tehri Dam Catchment Area and chilli (hot and sweet) from Khatima, Dehradun, Kamalpur, Vikasnagar and Haridwar (Uttaranchal) and Mathania, Jodhpur. The district of Tawang and West Kameng were explored for the Allium and vegetables. A noteworthy accession of rice genotype was collected from Changlang district.

EXCHANGE OF GERmplasm

Introduction of germplasm: During the period under report 28,656 accessions (64,806 samples) were imported from 32 countries. These included 15,486 germplasm accessions (16,194 samples) as well as trial material 13,170 entries (48,612 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were met by arranging material from different Indian sources and 76 samples including CIMMYT transit material were sent to four countries. A total of 9,413 samples of different crops were supplied to various users under the material transfer agreement (MTA) for utilization in the various crop improvement programmes in the country.

Promising material introduced during 2005

- **Oryza sativa** : Cytoplasmic male sterility (CMS) lines and maintainers (EC565092-117, EC565215-17, EC565278-321, EC559259-90); thermogenic male sterile (TGMS) lines (EC564674-81, EC565322-26, EC559230-32); salinity tolerant lines (EC564773-79, EC565135-58, EC556582, EC566358-386, EC568964-94); drought tolerant lines (EC564780-790, EC556570-75); high iron content line (EC565159); monogenic lines (EC566268-299) for blast resistance; Tungro virus resistant lines (EC568146, EC556567-569); brown plant hopper resistant lines (EC568081-87); bacterial blight resistant lines (EC568093-8144); Iron toxicity tolerant lines (EC5688152-52, 56-57)- all from IRRI, Philippines.
- **Triticum aestivum**: High protein content (variety Kamut EC556272) from Belgium; high grain yield, superior quality, resistant to stripe rust (var Eden EC556885) from USA; high grain protein content, high grain weight, superior bread baking quality and resistant to Hessian fly (Var. Hollis EC556386) from USA; homozygous for the blue aleurone trait (EC557028-30) from USA.
- **Zea mays**: Cytoplasmic male sterile (CMS) lines (EC568876-881) from USA.
- **Hordeum vulgare**: High grain and biomass yield, resistant to surface borne smut and true loose smut (EC570289) from Canada; yellow aleurone, lodging resistant, resistant to scald and covered smut (EC570290) from Canada.
- **Sorghum bicolor**: Male sterile lines (EC568885-86) and maintainer line (EC568887) from USA.
- **Brassica juncea**: Early maturity, high oil content and double low quality and high black leg resistance (EC564640-643, EC564644-649) from Australia; low erucic acid (0.6%) and glucosinolate-0.4-0.6% (EC559572, EC564728) from Russia.
- **Brassica napus**: Double low quality, high oil content (EC557008-017); tolerant to *Sclerotinia sclerotum* (EC657011-12, 18-19, 21, 26) from Australia.
- **Cicer arietinum**: Heat tolerant types (EC565197-5214), Ascochyta blight resistant line (EC554857) from USA; Kabuli land races, resistant to *Ascochyta rabiei* and *Fusarium oxysporum* (EC556541-542) from Spain; cold tolerant lines (EC566900-909) and salt tolerant lines (EC566910-919) from Australia.
- **Glycine max**: Vegetable type (EC559539-4271) and rust tolerant and vegetable type (EC559572) from AVRDC, Taiwan.
- **Phaseolus vulgaris**: Resistant to common bacterial blight, *Bean common mosaic necrosis virus* and *Bean common mosaic virus* (EC566209) from USA; resistant to *Bean golden yellow mosaic virus* (BGYMV), anthracnose (*Colletotrichum lindemuthianum*), angular leaf spot (*Phaeoisariopsis griseola*) and *Tharatephorus cucumeris* (EC559573-74) from Honduras.
- **Vicia faba**: EC556902- resistant to broomrape (*Orobanche crenata*) from Spain.
- **Vigna radiata**: *Mungbean yellow mosaic virus* resistant lines (EC565626-33) from AVRDC, Taiwan
- **Capsicum annuum**: Resistant to *Capsicum mosaic virus* (CMV), *Chilli veinal mosaic virus* (EC559416-9426); resistant to Anthracnose and *Capsicum mosaic virus* (EC559491-496); resistant to Poty virus Y and bacterial wilt (EC559424-9508); resistant to *Tomato mosaic virus*, Poty virus Y, *Chilli mosaic virus* and leaf curl (EC570005-12)- all from AVRDC, Taiwan.
- **Capsicum frutescens**: Resistant to *Tomato etch virus* (EC568929) from AVRDC, Taiwan.
- **Cucumis sativus**: Large size with green skin type (EC565750), female line (EC565767), early type (EC565796), pickle type (EC565832)- all from Netherlands.
- **Lycopersicon esculentum**: Resistant to *Tomato leaf curl virus*, late blight, verticillium wilt, bacterial wilt (EC568938-44), plum shaped, small fruited and heat tolerant (EC570019), globe shaped, large fruited and heat tolerant (EC570015-16)- all from AVRDC, Taiwan; Rich in β -carotene (EC565215) from USA.
- **Fragaria ananassa**: High yielding and short day type (EC569143-44) from USA.
- **Vaccinium corymbosum**: Firm fleshed, good flavour, vigorous, resistant to cracking, early ripening (EC562075-78) from USA.

- ***Vaccinium oxycoccus***: Prolific bearer, good keeping quality, resistant to leaf hopper (EC562097) from USA.
- ***Vaccinium macrocarpon***: Resistant to blunt nose leafhopper and false blossom (EC562086, EC562097) from USA.
- ***Pyrus spp.***: Resistant to blister mite (EC560258) from USA.
- ***Rubus idaeus***: High yielding big sized fruits, and good keeping quality (EC559018) from USA.
- ***Gossypium hirsutum***: High yielding, good fibre strength (EC559008-12); high ginning outturn (EC559013); early maturing (EC559014-15) –all from USA; boll weight ranging from 5.4 to 7.7 g, lint percentage ranging from 39.1 to 41.8 with fine and strong fibres (EC560321-328) from Turkey.
- ***Nicotiana excelsior***: Aphid resistant line (EC559237) from USA.

Export of germplasm: 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 along with phytosanitary certificates issued by the Plant Quarantine Division of the Bureau and import permit, if any, after approval from ICAR/DARE. Thus, *Brassica juncea* (25) to Australia; *Zea mays* (6) to East Timor; *Triticum aestivum* (22) to Kenya and *Zea mays* (23) to Mexico were supplied.

QUARANTINE OF GERmplasm

At New Delhi, 28,732 accessions (64,882 samples) comprising 28,656 exotic accessions (64,806 samples) [germplasm-15,486 accessions (16,194 samples); international nurseries/ breeding trial material (13,170 entries; 48,612 samples)] of various crops and 76 accessions/ samples under export were processed for quarantine clearance. In addition, 7,694 accessions of Indian origin were repatriated. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 730 samples were found infested/ infected contaminated with various pests viz., insects / mites -165 samples including 103 with hidden infestation; nematodes- 313 and fungi/ bacteria- 252. Of the 730-infested/ infected/-contaminated samples, 723 were salvaged through fumigation, hot water treatment (HWT), X-ray

radiography, pesticidal dip and mechanical cleaning. Seven samples of soybean from Taiwan and USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. Six Phytosanitary Certificates were issued for consignments meant for export. Sixty-nine samples of transgenic crops viz., cotton, maize, potato and rice were processed for quarantine clearance.

At Hyderabad, 11,390 samples consisting of 6,632 import samples and 4,758 export samples were processed for quarantine clearance and 121 phytosanitary certificates were issued to samples meant for export. Several pathogens of quarantine importance were intercepted. The import samples (987) that were found infested/ infected with pests/ pathogens could be salvaged and released to the consignees. In exports, 104 samples were rejected due to the association of quarantine pests/ pathogens. Quarantine service was extended to more than 30 organizations in South India including ICRISAT.

Seed health testing of indigenous germplasm: A total of 2,205 samples collected indigenously were processed for pest-free conservation. Of the 189 infested samples, 151 were salvaged and 2,167 samples were released for pest-free conservation in NGB.

GERmplasm CHARACTERISATION, EVALUATION AND MULTIPLICATION

A total of 10,874 accessions of different agri-horticultural crops including cereals (6,907), pulses (1,367), oilseeds (913), vegetables (812), forages (267), under-utilized crops (493) and medicinal and aromatic plants (115) were grown for characterization and evaluation at Experimental farm, Issapur and New Delhi. Besides, 6,511 accessions of various crops comprising cereals (1,699), pulses (1,497), oilseeds (560), vegetables (2,367), forage (13), under-utilized crops (79) and medicinal and aromatic plants (296) were grown for regeneration, multiplication and maintenance. In addition, 130 accessions of perennial fruit plants were also maintained in the field genebank. Promising accessions for various agro-morphological characters were identified. The biochemical evaluation was carried out for oil content and fatty acid profile in different oilseed crops namely rapeseed mustard (484), safflower (500), sunflower (116) and linseed (78). Similarly, several accessions of chickpea (487), barley (49), synthetic wheat (81) and linseed (78) were also analyzed for protein content and other quality attributes.

Medicinal and aromatic plants were phytochemically analyzed and evaluated for their active compounds. Multi-location evaluation of four crops (rice, wheat, chickpea and pigeonpea) resulted in the identification of promising accessions for agronomic, biotic stress and quality attributes. Annual report on collaborative germplasm evaluation undertaken with AICRP/ICAR/SAU was brought out. To develop an effective network for germplasm evaluation at national level, the first Annual Workshop on Germplasm Evaluation and Utilization was organized.

At Akola station, 7943 accessions of various crops were grown for characterization/evaluation and 7,154 for maintenance during Rabi and Kharif seasons at the experimental farm. Promising accessions were identified in linseed and castor.

At Cuttack center, 1395 accessions comprising cultivated rice (1190), turmeric (165) and mung bean (40) were multiplied and 200 accessions of rice and 165 accessions of turmeric germplasm received from NBPGR, Thrissur were evaluated under multi-locational trial. A total of 298 accessions comprising cultivated rice (204) and turmeric (94) were grown for preliminary characterization.

At Hyderabad station, 3239 accessions of different agri horticultural crops comprising brinjal, chillies, black gram, finger millet, maize, sorghum, tomato and other crops/ wild species were grown for characterization, evaluation, rejuvenation and multiplication.

At Ranchi center, 376 accessions of 162 plant species of wild relatives of crop plants, medicinal and aromatic plants and economically important plants were maintained in the field genebank while 430 germplasm of fruit plants was characterized and maintained at the station.

At Shillong station, 2381 accessions belonging to 12 crops were characterized and the promising genotypes for various attributes were identified.

At Shimla station, 2096 accessions of various agri-horticultural crops were characterized and multiplied for conservation while 1086 accessions of fruit crops, their wild relatives, medicinal plants and ornamentals were conserved and maintained in field genebank.

At Sri Nagar station (J&K), wheat (40 accessions), barley (100) and mustard (40) were characterized and evaluated during rabi 2004-2005 and 226 accessions were sown in rabi 2005-2006 for evaluation.

At Thrissur station, rice (306 accessions), horse gram (55), Chinese spinach (23), Malabar spinach (11), snake gourd (20), okra (97), field bean (63), taro (7), turmeric (142) were grown for evaluation while taro (17), jack fruit (23), black pepper (26), Malabar tamarind (19), kokam (3), *Mucuna pruriens* (15) and 32 accessions of 3 species namely, *Solanum incanum*, *S. insanum* and *S. melongena* were grown for characterisation

GERMPLASM CONSERVATION

Conservation in seed genebank: A total of 33,899 germplasm accessions of various crops were received for long-term conservation in the National Genebank. These were processed following the genebank standards and adding another 25,596 accessions to the base collection raising the total germplasm holding to 312,583. A total of 4,432 accessions out of the 7,526 received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (1,652 accessions) and updating of passport data (2,928 accessions) was carried out. Studies on seed storage of *Baliospermum montanum*, showed intermediate behaviour while *Aegle marmelos* and *Wrightia tinctoria* had orthodox behaviour. Longevity of castor, groundnut, pigeonpea and cotton at ambient temperatures was found to be more when seeds were dried to ultra low moisture contents (i.e. < 5 per cent moisture content). Methods for breaking seed dormancy were developed in *Hypericum perforatum*, *Desmodium motorum*, *Chlorophytum borivilianum* and *Tephrosia jamnagensis*.

In vitro/ tissue culture Conservation: During the year, a total of 1,783 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. Two new genera namely, *Pyrus* and *Vaccinium* were introduced in the *in vitro* genebank during the period reported upon. Research work was carried out on aspects related to *in vitro* slow growth and cryopreservation in aforementioned group of crops. Employing several slow growth strategies, subculture duration could be enhanced to varying periods in alliums, *Bacopa monnieri*, *Centella asiatica*, *Colocasia esculenta* and *Mentha* sp. Cost-effective conservation experiments yielded encouraging results in *Curcuma*

longa cv. Prathibha and *B. monnieri*. A total of 85 accessions of *Musa* and 7 accessions of five medicinally important genera were supplied as *in vitro* cultures to various indentors.

Cryopreservation in liquid nitrogen: A total of 1,298 accessions were cryostored at temperatures between -160 to -180 °C as seeds/ embryonic axes/ dormant buds/ pollens, depending upon the size and storage behavior of the species. These comprised temperate fruits and nuts (300), spices (40), agroforestry species (42), cereals (30), millets & forages (10), grain legumes (16), oilseeds (138), fibre crops (4), vegetables (19), M & AP (124), narcotics and dyes (2), industrial crop (502) and others (1). The cryostored germplasm included released varieties, wild species, wild relatives of crop plants, landraces, registered germplasm and, rare and endangered species. Pollen grains of 20 accessions of litchi and hops were also cryostored. Cryopreservation experiments led to varying degree of success in *Allium tuberosum*, *Bacopa monnieri*, *Dioscorea bulbifera*, *Gentiana kurroo*, *Morus* spp. and *Musa* spp. Employing RAPD and ISSR markers, there were no significant differences between *in vitro*-conserved cultures and their respective mother clones, in *Curcuma* spp., and between micro-corm generated plantlets and their respective mother plants, in *C. esculenta*.

DNA FINGERPRINTING

Under the five institutional and four externally funded projects, 60 varieties of rice, 74 accessions and varieties of French bean, 44 cultivars and landraces of lentil and 21 Indian linseed cultivars were fingerprinted using STMS, AFLP, SRAP and anchored ISSR methods. The results indicated that all varieties were distinguishable from one another. In addition, new STMS markers were identified for DNA profiling in mungbean, uradbean, ricebean and pigeonpea. These were orthologous markers transferred from *Glycine* and *Phaseolus*. Although, for majority of the markers very low polymorphism was observed, some of the markers exhibited high polymorphism and these are being used for DNA fingerprinting of cultivars. The Crop DNA Fingerprint Database of NRC was updated with the AFLP and RAPD profiles of *Gladiolus* varieties. Presently, the database consists of 923 varieties of 16 crops. Forty web pages for NRC on DNA Fingerprinting were developed and modified according to the new format of ICAR and will be linked

with NBPGR website. Under the externally funded project, 31 transgenic cotton lines, having *vip3A*, *APX*, *CP4EPSPS*, *cry1Ab*, *cry1Ac*, *cryX*, *uid*, and *aad* genes; 36 rice transgenic lines having *lyc*, *crtl*, and *psy* genes for beta-carotene; 41 transgenic corn lines having *cry1Ab* gene and ten transgenic potato lines with *RB* gene were received and primers were designed for the specific genes. One hundred eighty transgenic lines were tested for terminator gene technology cassette using primer specific to *cre* sequence amplifying amplicon of 1031 bp. There was no evidence for presence of terminator gene in any of the samples.

OTHER ACTIVITIES RELATED TO PGR MANAGEMENT

- Meetings of the Institute Management Committee, Research Advisory Committee and Staff Research Council were held timely to review the progress of work related to PGR management and planning strategies to strengthen various activities and infrastructure / facilities to achieve the targets.
 - The scientists, research associates, technical and administrative staff from the headquarters and its regional stations/ centres participated in a number of seminars, symposia, conferences, workshops, trainings and summer institutes to exchange ideas and upgrade their skills. Five scientists were sent abroad to participate in foreign meetings and one technical officer was sent for training in Japan. Details of these participations are given in General Information.
 - Several distinguished scientists, administrators, policy makers, farmers and students visited the National genebank, DNA Fingerprinting labs, plant quarantine glasshouses, National Containment facility (C4 level) and tissue culture labs at the headquarters and field genebanks at Issapur, Akola, Bhowali, Cuttack, Hyderabad, Jodhpur, Ranchi, Shillong, Shimla and Thrissur.
 - International Symposium on Plant Introduction: Achievements and Opportunities in South Asia was organized by NBPGR at New Delhi from 15-17 February 2005.
 - Symposia/ Workshops/ Trainings Organized by NBPGR: NBPGR organised the following trainings-
1. Training Programme on "Biosafety Concerns of

Transgenics and Detection of LMOs” sponsored by Ministry of Environment and Forests, Govt. of India was organized at NBPGR New Delhi from March 14 - 21, 2005

2. Ten regional level training programs were held on “Statistical techniques useful for DUS testing” under Development and Digitalization of Extant-Notified Plant Varieties.
3. First National Stakeholder workshop was organized at NBPGR, New Delhi on January 24-25, 2005.
4. Training on “Microsatellites for Genetic Diversity Assessment and Cultivar Identification” was organized by NRC on DNA Fingerprinting at NBPGR, New from January 28 - 5 February 2005.
5. Short-term training programs (3 to 6 months) were organized for M. Sc. students representing several universities. These trainings were mostly imparted on tissue culture techniques, cryopreservation, and assessment of genetic diversity using RAPD and ISSR markers.
6. Training cum PGR awareness programs for farmers were organized by Bhowali station in which local farmers (including women) and students participated
 - **Field days organized:** Seven germplasm field days were organized for *rabi* and *kharif* crops at various experimental farms of NBPGR namely Issapur, New Delhi (organized two field days- one on wheat, barley and triticale and another on medicinal & aromatic plants), Akola (on *kharif* crops like millets, soybean, sesame,

niger and okra germplasm), Hyderabad/ICRISAT (on pigeon pea), Jodhpur (on *kharif* crops), Shimla (amaranth, buckwheat, chenopod, French bean, adzuki bean, ricebean, cowpea, horsegram and kiwi fruit), and Thrissur (on okra germplasm) in which plant breeders from SAUs and ICAR participated and selected material as per their requirement.

- **Patent Applications filed:** Three patent applications (File No. 3452L/DEL/2005 for process enabling simultaneous detection — in transgenic soybean; File No. 3451L/DEL/2005 for process enabling simultaneous detection— in transgenic maize; File No. 3530/DEL/2005 for process enabling simultaneous detection — in transgenic wheat) by Randhawa G J., Firke P K and Karihaloo J L.
- **Publications:** NBPGR Annual Report and quarterly Newsletter were published and distributed to all concerned with PGR management. Besides, research papers (90) on various subjects were published in national and international journals; book chapters (48) in various edited books; proceedings/ annual review/ books (11); plant germplasm reporter (4); crop inventories (1); information bulletins/ brochures (5); advisory leaflets on plant quarantine pests (9); and popular articles in Hindi/ English (26) were published by the scientists of the NBPGR (details are given in chapter 19).

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 10 regional stations/base centres that provide access to representative agro-ecological situations in the country. It has strong linkages with leading crop-based Institutes, National Research Centers, All India Coordinated Crop Improvement Projects, State Agricultural Universities and other stakeholders. NBPGR also works in close collaboration with several international institutes/organizations through memoranda/workplans developed under bilateral/multilateral agreements. The Bureau not only provides genetic resources to on-going crop improvement programmes to sustain continued advances in agricultural productivity and stabilize production, but also conserves them safely to meet needs of future generations.

Organizational set-up

The Director, NBPGR is overall in-charge of administration, research management and coordination. The Institute Management Committee, Research Advisory Committee, Crop Advisory Committees and the Staff Research Council play important roles. The Bureau functions through its four main Divisions, namely i) Plant Exploration and Germplasm Collection, ii) Plant Quarantine, iii) Germplasm Evaluation, and iv) Germplasm Conservation. The Bureau has units of Germplasm Exchange, Tissue Culture and Cryopreservation (TC&CP), PGR and Policy Planning (PPU). A principal scientist/senior scientist heads each Division/Unit.

Other centralized services include units of Administration and Management, Purchase, Stores, Maintenance, Audit and Accounts, Security and Library. Regional Stations/Base Centres, headed by a principal scientist/senior scientist, are located at Akola, Shimla, Bhowali, Shillong, Jodhpur, Hyderabad, Thrissur, Srinagar, Ranchi and Cuttack. It also houses NRC on DNA Fingerprinting, an All India Coordinated Research Project on Underutilized 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

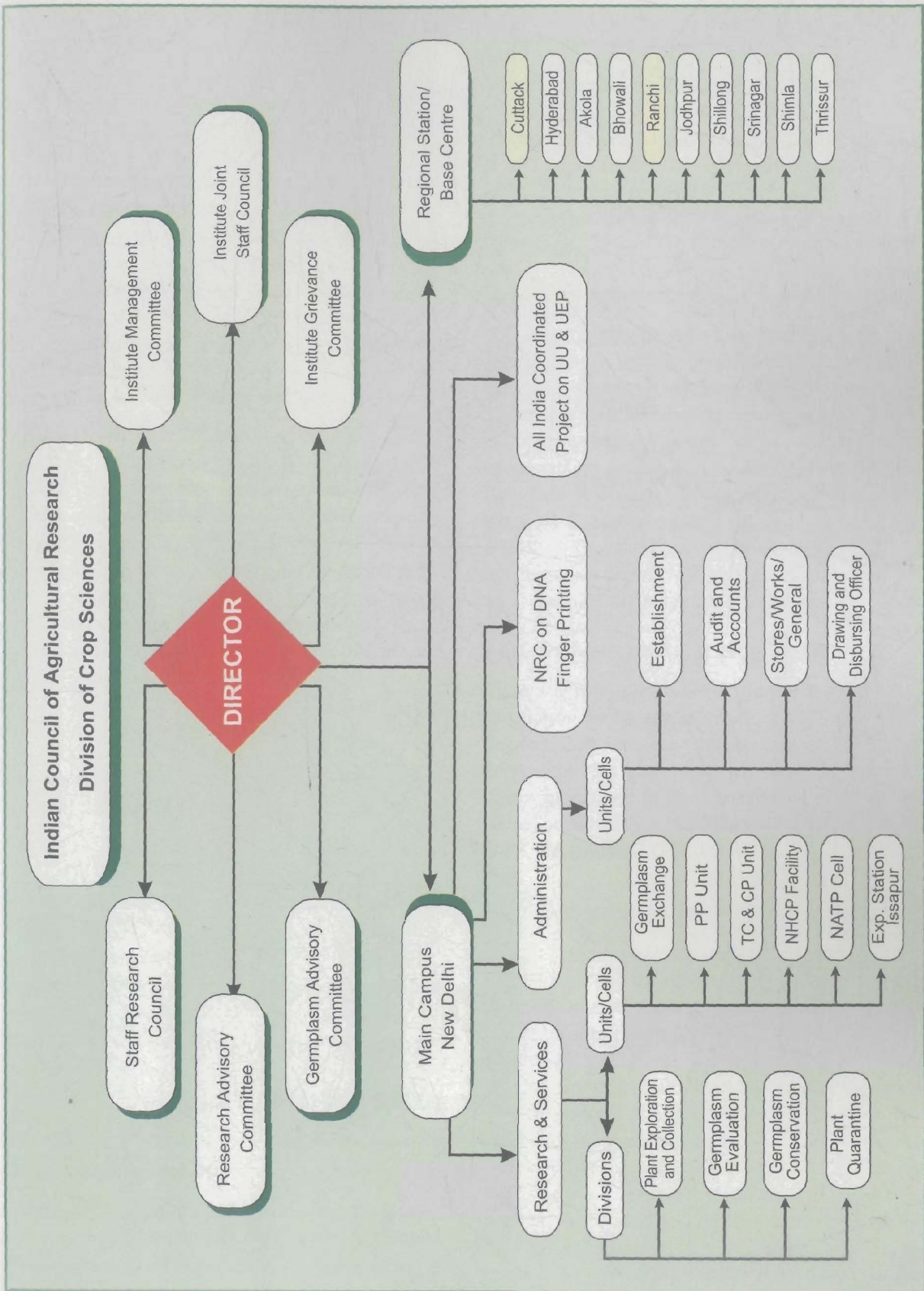
The Indian National Genebank was established by the

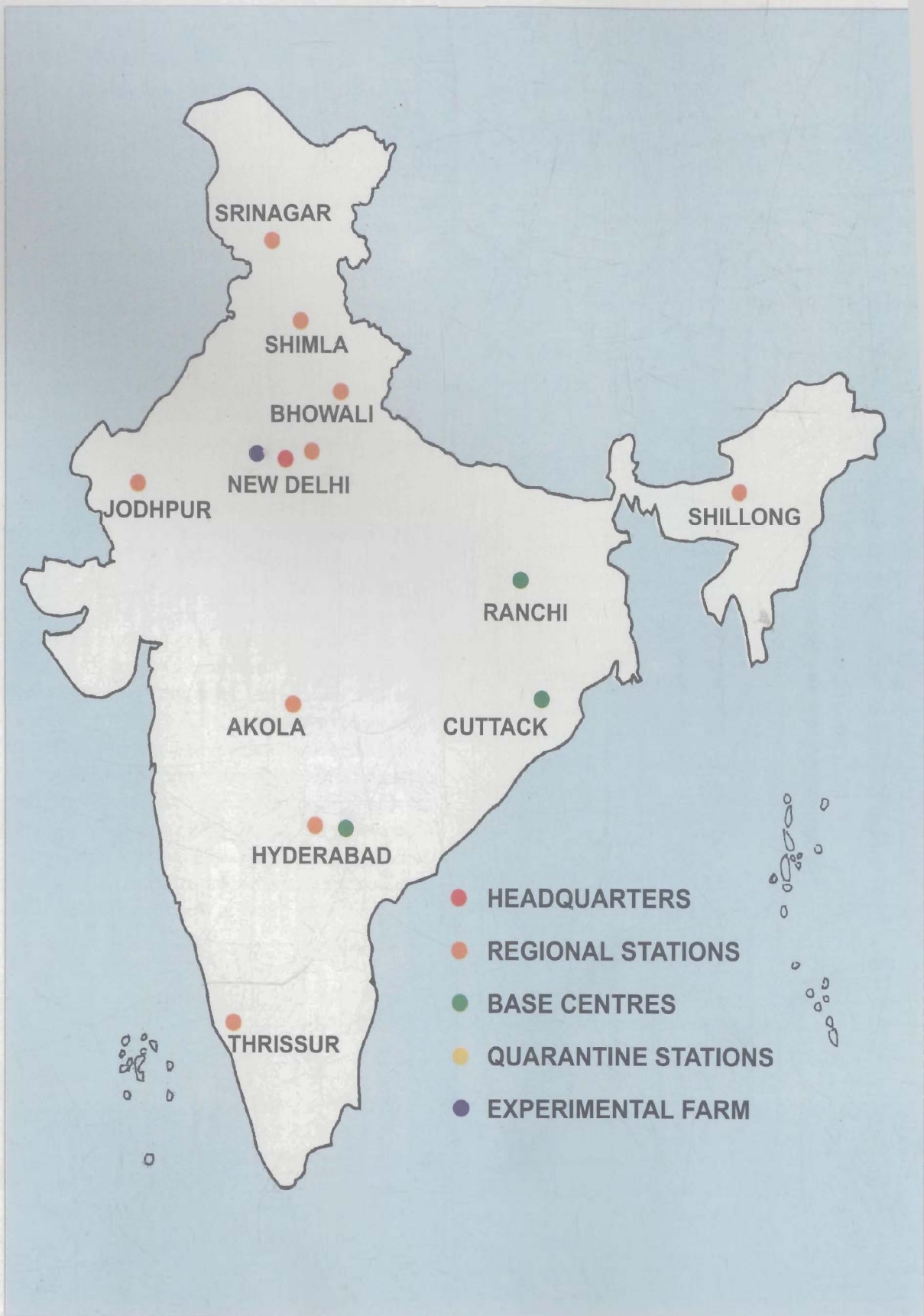
MANDATE

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.





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 m³ and two of 176 m³ 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 50,000 to 76,000 samples depending upon the size of seeds. 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 0.85 to 1.25 million samples. This is one of the most modern Genebanks in the world.

Indian national plant genetic resources system (INPGRS)

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

International collaboration

NBPGR implements workplans developed under MoU between ICAR and IPGRI. FAO and IPGRI also sponsor regional training courses on conservation and utilization of genetic resources of local crops of

agricultural importance in South Asia and adjoining regions to be conducted by NBPGR.

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

Training programmes and information services

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

Post-graduate teaching programme

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

Extension services for PGR awareness

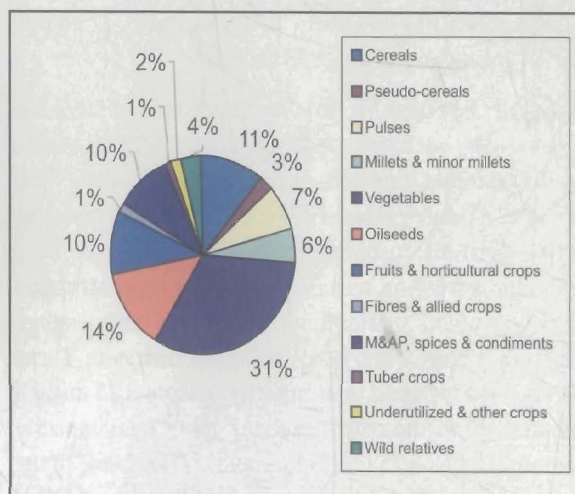
Bureau organizes kisan diwas/field days for *rabi* and *kharif* crops and distributes seeds/planting material along with relevant literature on technical know-how for raising crops and management of PGR. Under the National Agricultural Technology Project- Plant Biodiversity (NATP-PB), special emphasis 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 GERmplasm COLLECTION

Summary: In all, 65 explorations were undertaken across the country under NATP (Plant Biodiversity)/ national exploration plan and other externally-funded projects and 4,263 accessions of various agri-horticultural crops, wild relatives of crops and other economic plants were assembled. Of these, 625 accessions were collected by the Headquarters, New Delhi through 13 explorations covering parts of Haryana, Himachal Pradesh, Jammu and Kashmir, Rajasthan, Uttar Pradesh and West Bengal, including one special mission in Andaman and Nicobar Islands (A & N). A total of 1,144 herbarium specimens, 128 seed samples and 27 economic products were processed and added to National Herbarium of Cultivated Plants (NHCP).

1.1 Plant Exploration and Germplasm Collection

A total of 65 explorations were undertaken and 4,263 accessions of different agri-horticultural crops comprising 3,131 accessions of cultivated plants and 1,132 of wild species including wild relatives of crop plants were collected from parts of Andaman and Nicobar Islands, Bihar, Goa, Gujarat, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, North-eastern hill region, Rajasthan, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. The zone-wise details of collected germplasm are given in Table 1. The diversity represented in various crops/ crop groups is given in Table 2.

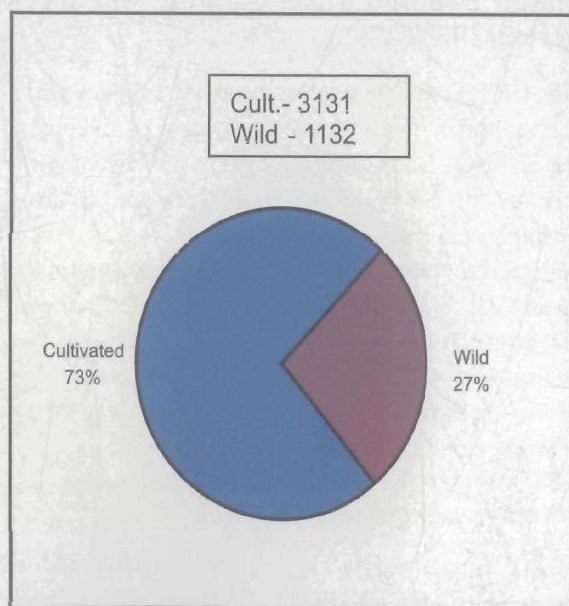


Germplasm (%) collected in different crop groups

Table 1: Plant explorations undertaken and germplasm collected during 2005

Zone	Region	Number of explorations undertaken	Accessions collected
I	Arid region	4	136
I	South West coastal region	9	442
III	Humid/ moist tropical East coastal region	1	25
IV	North East hill region	8	1083
V	Central Himalayan region	4	207
VI	North West Himalayas and high altitude region	8	765
VII	North West plains	13*	625
VIII	Sub-tropical humid region	5*	410
X	South East coastal region	13	570
	Total	65	4263

* Exploration(s) undertaken jointly are reflected in that zone.



Germplasm (%) collected in cultivated and wild species including wild relatives

Table 2: Details of crop diversity collected during 2005

Crop group	Crops (accessions)	Number of accessions
Cereals	Barley (8), maize (198), oat (2), paddy (250) and wheat (17)	475
Pseudo-cereals	Amaranth (72), buckwheat (17), chenopods (7) and Job's tear (12)	108
Pulses	Black gram (23), chickpea (17), cowpea (112), horse gram (24), lentil (19), green gram (14), pigeon pea (44), rice bean (25), <i>Vigna</i> spp. (19) and others (3)	300
Millet and minor millets	Barnyard millet (3), finger millet (70), foxtail millet (23), little millet (25), pearl millet (53), proso-millet (1) and sorghum (72)	247
Vegetables	Ash gourd (23), brinjal (158), bitter melon (46), bottle gourd (37), chilli (186), <i>Cucumis</i> spp. (17), cucumber (98), <i>Cyphomandra crassicaulis</i> (4), faba bean (16), French bean (86), garlic (19), jackfruit (23), kachri (7), kale (5), knol-khol (7), lasora (19), long melon (13), methi (19), muskmelon (43), okra (53), onion (2), pea (16), pointed gourd (6), pumpkin (98), radish (23), ridge gourd (12), satputia (10), sem bean (19), snake gourd (25), snap melon (20), <i>Solanum</i> spp. (19), spinach (31) spine gourd (2), sponge gourd (53), summer squash (7), tomato (8), water melon (13), winged bean (8) and others (89)	1340
Oilseeds	<i>Brassica</i> spp. (185), castor (11), groundnut (2), <i>Jatropha</i> spp. (173), linseed (38), mahua (31), niger (2), <i>Perilla</i> (38), <i>Pongamia</i> (33), safflower (7), sesame (27), soybean (25) and sunflower (5)	577
Fruits/ horticultural crops	Aonla (10), apple (29), apricot including wild types (48), arecanut (6), banana (9), bougainvillea (9), bael (26), ber (10), cherry (7), citrus (5), custard apple (3), <i>Hippophae</i> (4), jamun (24), karonda (5), makhana (16), mango (15), <i>Mangifera</i> spp. (3), mulberry (6), raspberry (5), passion fruit (5), papaya (2), peach (9), pear (19), <i>Prunus salicina</i> (9), <i>P. amygdalus</i> (1), walnut (4) and others (153)	442
Fibres and allied crops	Cotton (5), jute (6), roselle (16), <i>Sesbania</i> (27) and others (5)	59
Medicinal and aromatic plants, spices and condiments	<i>Abrus precatorius</i> (2), <i>Acorus calamus</i> (8), <i>Aloe barbadensis</i> (34), <i>Andrographis paniculata</i> (13), <i>Asparagus adscendens</i> (8), <i>A. racemosus</i> (13), <i>Bacopa monnieri</i> (9), <i>Bergenia ciliata</i> (4), <i>Carum</i> sp. (3), <i>Ceasalpinia bonduc</i> (3), <i>Centella asiatica</i> (2), coriander (21), fennel (2), ginger (31), <i>Habenaria</i> spp. (2), <i>Hedychium</i> spp. (9), <i>Lepidium sativum</i> (4), <i>Mucuna</i> (3), <i>Ocimum</i> spp. (14), <i>Opuntia elatior</i> (1), <i>Polygonatum verticillatum</i> (2), <i>Spilanthes acmella</i> (4), <i>Terminalia bellirica</i> (3), <i>Tinospora cordifolia</i> (19), turmeric (12), <i>Valeriana jatamansi</i> (5), <i>Withania somnifera</i> (12) and others (197)	440
Tuber crops	<i>Colocasia</i> (30), <i>Dioscorea</i> (16) and others (3)	49
Under utilized & other crops	Coffee (1), grasses (6), <i>Lagerstroemia indica</i> (2), sugarcane (2) and others (60)	71
Wild relatives	<i>Allium carolinianum</i> (11), <i>A. fistulosum</i> (3), <i>A. przewalskianum</i> (1), <i>A. sativum</i> (8), <i>A. schoenoprasum</i> (6), <i>A. tuberosum</i> (1), <i>Allium</i> spp.(22), <i>Carica candamarcensis</i> (1), <i>Cicer microphyllum</i> (3), <i>Cotoneaster buxiifolia</i> (1), <i>Diospyros virginiana</i> (1), <i>Diospyros</i> sp. (9), <i>Linum perene</i> (6), <i>Malus baccata</i> (1), <i>Prunus cerasoides</i> (2), <i>P. cornuta</i> (1), <i>P. laurocerasus</i> (1) <i>P. pissardii</i> (1), <i>P. serrulata</i> (2), <i>Prunus</i> sp.(1), <i>Rosa</i> spp. (14), <i>Rubus</i> spp. (3), <i>Solanum virginianum</i> (2), <i>S. torvum</i> (1), <i>S. incanum</i> (27), <i>S. insanum</i> (1), <i>Solanum</i> spp. (16) and others (9)	155
	Total	4263

1.2 Explorations Undertaken by the Headquarters

Thirteen multi-crop and crop-specific explorations were undertaken by Headquarters in parts of Andaman and Nicobar Islands, Haryana, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Uttar Pradesh and West Bengal and a total of 625 accessions of different agri-horticultural crops were assembled. The details of areas explored and germplasm collected during explorations are given below:

1.2.1 Exploration in Tsunami-affected areas of Andaman and Nicobar Islands: Fifty-two accessions of different agri-horticultural crops were collected from coastal tropical plains and hills of Car Nicobar district. The prevailing diversity was collected in paddy (1), pulses (8), vegetables (16), *Jatropha curcas* (3), M&AP (8) and others like *Abelmoschus manihot*, *Abelmoschus vaginalis*, *Corchorus capsularis*, *Cucumis sagittatus*, *Gossypium herbaceum*, *Ipomoea pescarpea*, *Passiflora edulis*, *Vigna marina*, etc.

1.2.2 Exploration for multi-crops in Lahaul and Spiti region of Himachal Pradesh: Sixty accessions of various agri-horticultural crops comprising pseudo-cereals (18), minor millets (5), pulses (7), oilseeds (4), vegetables (23), M&AP (2) and other (1) were collected from remote localities of Lahaul and Spiti districts of Himachal Pradesh. Efforts were made to collect germplasm of landraces of radish and turnip locally known as *tamyung/labung* and *makali* from these areas. The indigenous knowledge for storage of potato for seed in pits and trenches was also recorded.

1.2.3 Exploration for cucurbits in upper Gangetic plains: A total of 109 accessions of different vegetables mainly cucurbits comprising bitter gourd (12), bottle gourd (5), cucumber (17), kachri (*Cucumis callosus*) (7), pointed gourd (4), pumpkin (15), ridged gourd (5), satputia (*Luffa hermaphrodita*) (9), snake gourd (5), snap melon (11), sponge gourd (12) and others (7) were collected from Barabanki, Chaundli, Ghazipur, Jaunpur, Mirzapur, Sultanpur and Varanasi districts of Uttar Pradesh. The variability in fruit size, shape, colour, fruit bearing, etc. was observed.

1.2.4 Exploration for cucurbits in West Bengal: Forty four accessions comprising cucumber (36) and snap melon (8) were collected from Burdwan, Murshidabad, Nadia and North and South 24 Pargana districts. Variability was observed in various agromorphological traits.

1.2.5 Exploration for ber in Uttar Pradesh: An exploration was undertaken in Baghpat and Muzaffarnagar districts of Uttar Pradesh for collection of bud wood of ber (*Ziziphus mauritiana*) from the earlier identified plants for powdery mildew resistance. Bud wood (10 accessions) were collected and supplied to Regional Research Station of CCSHAU, Bawal, Haryana for establishment, maintenance and screening.

1.2.6 Exploration for jamun in Uttar Pradesh and adjoining Haryana: A total of 20 accessions of jamun were collected from Baghpat, Mathura, Muzaffarnagar, Saharanpur districts of Uttar Pradesh and Faridabad, Jhajjar, Karnal and Sonipat districts



Large sized fruits of jamun

of Haryana. Variability was observed in fruit size, shape, taste, etc.

1.2.7 Exploration for minor fruits in Haryana and Rajasthan: In all, 27 accessions of minor fruits comprising bael (2), ker (2), lasora (13), pilu (4) and others (6) were collected from Rewari (Haryana) and Alwar (Rajasthan) districts. Rich



Freshly harvested fruits of lasora (*Cordia myxa*)

variability was observed in various agromorphological traits in collected germplasm.

1.2.8 Exploration for minor fruits in Himachal Pradesh and Jammu & Kashmir

An exploration was undertaken in parts of Himachal Pradesh

(Kullu valley, Lahaul and Spiti); Jammu and Kashmir (Ladakh - Leh valley, Nubra valley, Turtuk, Kargil and Batalik) and Kashmir valley for



Variability in *Ribes alpestre* collected from Lahaul and Spiti valley

collection of germplasm of wild/ minor fruits species. In all, 102 accessions of minor/ cultivated temperate fruits comprising aonla (1), apple (11), apricot (45), citrus (3), *Crataegus oxyacantha* (2), *Diospyros* sp. (1), *Elaeagnus latifolia* (1), *Ficus* spp. (2), peach (2), *Prunus* spp. (8), *Pyrus* spp. (6), *Ribes* spp. (8), *Rosa* sp. (5), sea-buckthorn (4) and others (3) were collected. Rich variability was collected in wild apricot and sea-buckthorn and an indigenous cultivated apple "Ladakhi apple".

1.2.9 Exploration for Medicinal & Aromatic Plants in South-eastern Rajasthan:

Twenty seven accessions comprising *Aloe barbadensis* (15), *Mucuna pruriens* (1) and *Withania somnifera* (11) were collected from Ajmer, Alwar, Bharatpur, Dausa, Jaipur, Kuroli, Sawai Madhopur and Tonk districts of Rajasthan. The germplasm of *A. barbadensis* was collected from wastelands (dry habitats), moist places and kitchen gardens. In *W. somnifera*, variability was observed in plant size, leaf size, fruit size and colour. During survey, associated indigenous knowledge regarding medicinal uses, local recipes, etc. was also documented.

1.2.10 Exploration for M&AP in parts of Eastern Uttar Pradesh:

An exploration was conducted under National Medicinal Plant Board project for collection of germplasm of medicinal and aromatic plants from Allahabad, Fatehpur, Raibareilly, Sultanpur and

Varanasi districts of Uttar Pradesh. In all, 50 accessions comprising *Aloe barbadensis* (11), *Andrographis paniculata* (10), *Asparagus racemosus* (9), *Tinospora cordifolia* (18) and others (2) were collected. Besides this, herbarium specimens (18) were prepared and notes on uses of medicinal and aromatic plants were also recorded from local inhabitants.

1.2.11 Exploration for *Bacopa monnieri* in Haryana and Uttar Pradesh:

A total of seven accessions of jal brahmi (*Bacopa monnieri*) were collected from Gurgaon district of Haryana and Lucknow district of Uttar Pradesh by NBRI, Lucknow under NATP (PB).

1.2.12 Exploration for M&AP in parts of Himachal Pradesh:

An exploration under G-15 and National Medicinal Plant Board projects was undertaken in parts of Himachal Pradesh for collection of germplasm of medicinal and aromatic plants. In all, 31 accessions comprising *Acorus calamus* (8), *Andrographis paniculata* (2), *Asparagus adscendens* (8), *Bergenia ciliata* (4), *Centella asiatica* (2), *Hedychium spicatum* (3), *Plumbago zeylanica* (1), *Rauwolfia serpentina* (1), *Tinospora cordifolia* (1) and *Withania somnifera* (1) were collected from Shimla, Sirmor and Solan districts.

1.2.13 Exploration for *Jatropha curcas* in Rajasthan:

This exploration was undertaken under New Millennium Indian Technology Leadership

Initiative (NMITL) project on Genetic Improvement of *Jatropha curcas* on Adaptability and Oil Yield for survey and collection of germplasm (cuttings)



An elite plant of *Jatropha curcas* for seed oil (35.8%) in Rajasthan

from elite plants. A total of 14 accessions (cuttings) of *Jatropha curcas* (11) and *J. gossypifolia* (3) were collected from Banswara, Chittorgarh, Dungarpur, Rajsamand, Sirohi and Udaipur districts. Besides this, seed samples from elite plants were also collected for oil analysis.

1.3 Enrichment of Germplasm

A total of 89 accessions (21 genera, 33 species) of wild relatives of crop plants were assembled, which included 62 accessions collected from Himachal Pradesh and 19 from Uttaranchal. The important species augmented were *Allium* spp., *Cicer microphyllum*, *Eleusine indica*, *Linum perene*, *Nicotiana rustica*, *Rosa* spp., *Solanum* spp., *Vicia hirsuta*, *V. sativa*, *V. tetrasperma*, etc. In addition, documentation of existing information on over 300 species of wild relatives of Western Himalaya has been done.

A total of 18 accessions of rooted cuttings of prevailing elite germplasm of *Jatropha curcas* were procured from different centres namely CMSCRI, Bhavnagar (5), FRI, Dehradun (5), SK Nagar, Gujarat (5), NBRI, Lucknow (2) and EXCEL, Bhavnagar (1) for performance evaluation trial under New Millennium Indian Technology Leadership Initiative (NMITL) project on *Jatropha curcas* at NBPGR, New Delhi.

1.4 National Herbarium of Cultivated Plants (NHCP)

A total of 1,144 herbarium specimens, 128 seed samples and 27 economic products were processed and added to the NHCP. Some of the important taxa added are listed in Table 3. Additions included 500 specimens collected and processed from Delhi and adjoining areas, Jodhpur (Rajasthan), Rewari (Haryana), Dehra Dun (Uttaranchal) and Hyderabad (Andhra Pradesh). These included *Alhagi pseudoalhagi*, *Citrullus colocynthis*, *Leptadenia pyrotechnica*, *Solanum viarum*, *Centella asiatica*, *Psoralea corylifolia*, *Barleria cristata*, *Vicia hirsuta*, *V. sativa*, *Abroma augusta* and *Urena lobata*; diversity in crops such as *Brassica* (39), *Ocimum* (30), *Sesbania* (18), *Avena* (14), *Hordeum* (12), *Pisum* (5) *Stevia* and *Vigna* (5), grown at experimental farms of Headquarters. Voucher specimens of *Macrotyloma* (39) and specimens received from Shillong, Shimla and Thrissur stations were also processed and added. Identification was done for 56 specimens/ seed samples. Digitation of 111 herbarium specimens was done with emphasis on economically important taxa.

Table 3: Some important taxa added to NHCP

Botanical Name	Common Name	Family
<i>Blumea balsamifera</i> DC.	Kakaronda *	Asteraceae
<i>Calamus tenuis</i> Roxb.	Bet *	Arecaceae
<i>Ceratonia siliqua</i> L.	Carob tree, Locust bean	Caesalpinaceae
<i>Corylus avellana</i> L.	Hazel-nut, Filbert	Betulaceae
<i>Curcuma latifolia</i> Rosc.	Wild turmeric	Zingiberaceae
<i>Curcuma oligantha</i> Trim.	Wild turmeric	Zingiberaceae
<i>Curcuma soloensis</i> Val.	Wild turmeric	Zingiberaceae
<i>Cydonia oblonga</i> Mill.	Quince	Rosaceae
<i>Dioscorea glabra</i> Roxb.	Nara taga (Telugu)	Dioscoreaceae
<i>Euphorbia neriiifolia</i> L.	Patton ki send*	Euphorbiaceae
<i>Feijoa sellowiana</i> Berg.	Pineapple guava, Feijoa	Myrtaceae
<i>Ficus auriculata</i> Lour.	Timla*	Moraceae
<i>Garcinia mangostana</i> L.	Mangosteen	Clusiaceae
<i>Goniothalamus sesquipetalis</i> Hk.f. & Thoms.	Singnyok-kung*	Annonaceae
<i>Hedychium coronarium</i> Koenig.	Common ginger lily, Garland flower	Zingiberaceae
<i>Heteropanax fragrans</i> Seem.	Tarla*	Araliaceae
<i>Hydnocarpus kurzii</i> (King) Warb.	Dalmugri*	Flacourtiaceae
<i>Jasminum angustifolium</i> Vahl.	Wild jasmine	Oleaceae
<i>Nepeta hindostana</i> (Roth) Haines	Billilotan*	Lamiaceae
<i>Nephelium lappaceum</i> L.	Rambutan	Sapindaceae
<i>Paederia foetida</i> L.	Gandhali (Hindi)	Rubiaceae
<i>Parrotlopsis jacquemontiana</i> (Decne) Rehd.	Paser (Himalayan region)	Hamamelidaceae
<i>Phoenix humilis</i> Royle	Dwarf date palm	Arecaceae
<i>Pistacia atlantica</i> Desf.	Bombay mastic plant	Anacardiaceae
<i>Stevia rebaudiana</i> Bertoni	Meetha Patta*	Asteraceae
<i>Symphytum peregrinum</i> Ledeb.	Russian comfrey, Blue comfrey	Boraginaceae
<i>Thunbergia grandiflora</i> Roxb.	Mulluta*	Acanthaceae
<i>Valeriana jatamansi</i> Jones	Mushkbala*	Valerianaceae

* Local names.

1.5 Biosystematic Studies

Taxonomic studies were undertaken on (a) species of *Vigna*, viz. *V. angularis* var. *nipponensis* and *V. umbellata/V. minima* (related to rice bean-adzuki bean), *V. grandifolia* and *V. trinervia/V. bourneae*, *V. trilobata/V. aridicola/V. stipulacea* (related to green gram-black gram and moth bean groups); representative diversity used for study included plants grown from seeds procured from various exotic sources and herbarium specimens of the species in area of distribution; (b) diversity patterns in *Macrotyloma uniflorum* (horse gram; kulthi) with emphasis on (i) characters showing variation in cultivated species in the Indian region (359 accessions from 12 states); (ii) characters differentiating two

cultigens of *Macrotyloma*, *M. uniflorum*, the Indian species and *M. geocarpum* (Kersting's or Hausa groundnut), the West African species; (iii) wild species related to *M. uniflorum*, using morphology (plant habit, rooting system and other characters of vegetative parts, flower colour and markings (greenish yellow/ creamish yellow flowers with mauve or purple markings) and habitat preferences. *M. daltonii* closely resembling *M. uniflorum* in vegetative characters and occurring in sandy soils, and *M. africanum* with short lived plants, more seeds/pod and occurring in grassy habitats were closest to *M. uniflorum*. Distinctive types were delineated for molecular study of species and variants.

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

PGR/PGC-BUR-01: Exploration for collection of germplasm of agri-horticultural crops, maintenance of herbarium and biosystematic and ethnobotanical studies (SS Malik upto September 17; DC Bhandari wef September 18; All scientists of Exploration Division).

PGR/PGC-BUR-02: Exploration for collection of genetic resources of cultivated crops and their wild relatives (SS Malik; KC Bhatt, Rajbir Singh and NS Panwar).

PGR/PGC-BUR-03: Exploration for collection of genetic resources of horticultural crops and their wild relatives (DC Bhandari; Gunjeet Kumar and AK Singh).

PGR/PGC-BUR-04: Exploration for collection of medicinal and aromatic plants diversity from different phyto-geographical regions; (KC Bhatt; NS Panwar).

PGR/PGC-BUR-05: National herbarium of cultivated plants (NHCP), establishment, maintenance, build-up and taxonomic studies on cultivated crop plants (E Roshini Nayar; Anjula Pandey and Rita Gupta).

PGR/PGC-BUR-06: Collection, conservation and documentation of wild/ weedy relatives of crop plants (WRCP) of North-western Himalayas (Anjula Pandey; KC Bhatt, SS Malik, KS Negi, JC Rana and J Radhamani).

Externally funded projects

PGR/PGC-BUR- 07: Systematic and molecular taxonomic studies in Asiatic *Vigna* and *Macrotyloma* (subtribe *Phaseolinae*) species; (E Roshini Nayar; KV Bhat and IS Bisht).

PGR/PGC-BUR- 08: New Millennium Indian Technology Leadership Initiative (NMIL) project on Genetic improvement of *Jatropha curcas* for adaptability and oil yield (Director; JB Tomar, KC Bhatt and KV Bhat).

2. DIVISION OF GERmplasm EVALUATION

Summary: A total of 10,874 accessions of different agri-horticultural crops including cereals (6,907), pulses (1,367), oilseeds (913), vegetables (812), forages (267), under-utilized crops (493) and medicinal and aromatic plants (115) were grown for characterization and evaluation. Besides, 6,511 accessions of various crops comprising cereals (1,699), pulses (1,497), oilseeds (560), vegetables (2,367), forage (13), under-utilized crops (79) and medicinal and aromatic plants (296) were grown for regeneration, multiplication and maintenance. In addition, 130 accessions of perennial fruit plants were also maintained in the field genebank. Promising accessions for various agro-morphological characters were identified. The biochemical evaluation was carried out for oil content and fatty acid profile in different oilseed crops namely rapeseed mustard (484), safflower (500), sunflower (116) and linseed (78). Similarly, several accessions of chickpea (487), barley (49), synthetic wheat (81) and linseed (78) were also analyzed for protein content and other quality attributes. Medicinal and aromatic plants were phytochemically analyzed and evaluated for their active compounds. Multi-location evaluation of four crops (rice, wheat, chickpea and pigeonpea) resulted in the identification of promising accessions for agronomic, biotic stress and quality attributes. Annual report on collaborative germplasm evaluation undertaken with AICRP/ ICAR/ SAU was brought out. To develop an effective network for germplasm evaluation at national level, the first Annual Workshop on Germplasm Evaluation and Utilization was organized. Two germplasm field days (one on wheat, barley and triticale, and another on medicinal, aromatic and vegetable crops) were organized to promote germplasm utilization by the plant breeders/ user scientists. A total of 396 accessions were supplied to 40 indenters in the country belonging to different institutes for their use in crop improvement programmes.

2.1 Germplasm Evaluation

2.1.1 Characterization and preliminary evaluation for agro-morphological traits:

A total of 10,874 accessions of various agri-horticultural crops comprising cereals (6,907), millets & forages (267), pulses (1,367), oilseeds (913), vegetables (812), under-utilized crops (493) and medicinal and aromatic plants (115) were grown for characterization and evaluation. Besides, a total of 6,511 accessions of various crops namely cereals (1,699), forage (13), pulses (1,497), oilseeds (560), vegetables (2,367),



Field day on M&AP at Issapur Farm



Field day on Wheat, Barley and Triticale grown in PEQN

under-utilized crops (79) and medicinal and aromatic plants (296) were grown for regeneration, multiplication and maintenance. In addition, 130 accessions comprising pomegranate (49), citrus (17), pear (12), ber (11), bael (10), guava (9), aonla (4), mulberry (4), plum (4), karonda (3), mango (3), apple (2), almond (1) and lasora (1) were also maintained in the field genebank. The details of germplasm grown for characterization, evaluation, regeneration and seed increase are presented in Table I.

Table 1: Germplasm characterized, evaluated and multiplied/ maintained during 2005

Crop (Botanical name)	Accession (no.)	
	Characterization and evaluation	Regeneration/ multiplication & maintenance
Cereals	6,907	1,699
Wheat* (<i>Triticum aestivum</i>)	1,573	-
Wheat* (<i>Triticum durum</i>)	838	-
Barley* (<i>Hordeum vulgare</i>)	1,949	-
Triticale* (<i>Triticale</i>)	140	-
Wheat (<i>Triticum aestivum</i>)	1,901	650
Barley (<i>Hordeum vulgare</i>)	506	1,049
Millets and forages	267	13
Pearl millet (<i>Pennisetum typhoides</i>)	267	-
Oat (<i>Avena sativa</i>)	-	13
Pulses	1,367	1,497
Cowpea (<i>Vigna unguiculata</i>)	440	135
Urdbean (<i>Vigna mungo</i>)	450	110
Pea (<i>Pisum sativum</i>)	365	200
Lentil (<i>Lens culinaris</i>)	112	1,052
Oilseeds	913	560
Rapeseed-mustard (<i>Brassica</i> spp.)	455	500
Safflower (<i>Carthamus tinctorius</i>)	216	-
Sunflower (<i>Helianthus annuus</i>)	180	60
Linseed (<i>Linum usitatissimum</i>)	62	-
Vegetable Crops	812	2,367
Brinjal (<i>Solanum melongena</i>)	126	1,700
Tomato (<i>Lycopersicon esculentum</i>)	220	-
Onion (<i>Allium cepa</i>)	120	-
Garlic (<i>Allium sativum</i>)	-	667
Spinach (<i>Beta vulgaris</i>)	66	-
Bottle gourd (<i>Lagenaria siceraria</i>)	65	-
Coriander (<i>Coriandrum sativum</i>)	48	-
Ridged gourd (<i>Luffa acutangula</i>)	65	-
Sponge gourd (<i>Luffa cylindrica</i>)	60	-
Fenugreek (<i>Trigonella foenum-graecum</i>)	42	-
Under-utilised Crops	493	79
Faba bean (<i>Vicia faba</i>)	215	-
Rice bean (<i>Vigna umbellata</i>)	128	-
Amaranth (<i>Amaranthus</i> spp.)	72	-
Sesbania (<i>Sesbania</i> spp.)	78	79
Medicinal & Aromatic Plants	115	296
Vetiver (<i>Vetiveria zizanioides</i>)	-	135
Aloe (<i>Aloe barbadensis</i>)	32	38
Giloe (<i>Tinospora cordifolia</i>)	31	31
Satawar (<i>Asparagus racemosus</i>)	5	22
Mucuna (<i>Mucuna pruriens</i>)	16	9
Kalmegh (<i>Andrographis paniculata</i>)	15	-
Basil (<i>Ocimum basilicum</i>)	16	6
Palmarosa (<i>Cymbopogon martinii</i>)	-	55
Total	10,874	6,511

* International Nurseries grown for post-entry quarantine inspection

Based on characterization and preliminary evaluation, promising accessions for various attributes, namely,

earliness, growth habit, pod length, pods per plant, seeds per pod and 100-seed weight were identified (Table 2).

Table 2: Promising accessions identified for different traits

Crop	Promising traits	Accession No.
Pulses		
Pea	Early flowering (< 66 days) Long pods (> 8 cm) No. of pods (> 38) High yield potential (> 600 g/ 4.05 m ²)	IC26712, IC76502, IC276503 EC342007 IC267151, IC356364 IC312622, IC267169, IC414876
Lentil	Pod per plant (> 150) Tall plant type (> 50 cm)	IC212656, IC201785 IC267663, IC267120, IC201675
Urdbean	Early flowering (< 45 days) Seed yield per plant (> 25 g) Bold seeds (> 4.5 g/ 100 seed)	PLU406, IPU99-23, IC2584, UPU832, IPU99/232 IC24811, IPU180, DCU129, G163 HPU180, JU21
Cowpea	Long pods (> 30 cm) Fodder type with bold seeds (> 30 g test wt)	EC202783 IC202790, IC202779, IC202789
Oilseeds		
Toria	Long siliqua (> 5 cm) Early maturity	IC355668 IC355668
Mustard	Early maturity	IC426329, IC426354
Sunflower	Broad head Bold seeded	EC512688, EC512693 EC512751
Under-utilized crops		
Amaranth	Plant height (> 105 cm) No. of branches per plant (> 15) Days to flowering (< 30 days) Days to maturity (< 150 days) No. of inflorescence per plant (>30) Inflorescence length (> 70 cm)	KG 3/139 RSR/AKS-5, 12, 3 RSR/AKS-3, 16, 31, 39, 44 MKSP 103, KG 3/118, KG 3/39 RYM 5, KG 3/90, 53/UR/165 RSR/AKS 41, RSR/AKS 34,
Faba bean	Plant height (> 105 cm) No. of branches per plant (>7) Days to 50% flowering (< 45 days) Days to maturity (≤ 135 days) Days to pod set (> 50 days) No. of pods per plant (> 90) Pod length (≥ 11 cm) No. of seed per pod (> 4)	IC 331887, IC 331561, IC 361496 MKS/TRS 1265, EC 117755, VKS 14/17, IC 117809 EC 329681 MKS/AKT 260 EC 329723, EC 329681 VKS 14/17, EC 243808, EC 374731 IC 493459, IC 493453, MKS/TRS 1265 MKS/AKT 2/3, IC 3614881
Rice bean	Grain yield per plot (> 500 g) Days to 50% flowering (< 45 days) Days to maturity (< 120 days) No. of pods per plant (> 100)	LRB 73-1, LRB 74-1, LRB-68 LRB 28 LRB 47, IC 364080, LRB 31-1 LRB 53, LRB 104, LRB 10
Vegetables		
Tomato	Primary branches/ plant (>19) Higher fruits/ plant (> 800) Higher fruit weight (>125 g)	EC10662, EC521048, EC321079 IC370867, IC427678, EC 6486 EC521062, EC521075, EC531805
Spinach	Leaf length (>50 cm) Days to 1st harvest (< 20 days)	IC274633, IC279072, IC343018 IC411678
Fenugreek	Petiole length (> 2.8 cm)	IC433586, IC371755
Sponge gourd	Fruit weight (> 512 g) Fruit length (> 36.4 cm) Node no. at which 1 st female flower appear (> 11)	IC342824, IC355635 IC264897 IC284844, IC398538

Bottle gourd	Early flowering (< 36 days)	IC284897
	Node no. at which 1 st female flower appear (> 11)	IC284926, IC244758
Ridged gourd	Early flowering (> 37)	IC284953, IC32278
	Fruit per plant (> 14)	IC418458, IC276528
	Node no. at which 1 st female flower appear (< 14)	IC427676, IC424548
Brinjal	Early flowering (< 37 days)	IC398596, IC398589
	Fruit weight (> 187 g)	IC276403, IC8993393
	No. of primary branches (>13)	IC90965, IC350885, IC127036
	Fruit diameter (> 10)	IC332506, IC332507
	Fruit length (> 18.3)	IC332507
	Fruit per plant (> 24.3)	EC316276, IC112773, IC90965
	Fruit weight (> 492 g)	IC350885, IC332506, IC332507

Medicinal and Aromatic Plants

<i>Mucuna</i>	Early flowering (<75 days)	EC25334
	Pod cluster number (>18)	IC21996, IC383843
Basil	Herbage yield per plant (> 350 g)	IC32673, EC38889
	No. of branches per plant (>18)	EC112548, EC387837
Aloe	Plant weight (>3500 g)	IC112518, IC112579

2.2 Germplasm Enhancement in Sesame and Mungbean

Sesame: Progeny (F₃) advancement of five inter-specific crosses involving four wild *Sesamum* spp. continued for selection of superior types. Progenies of superior enhanced germplasm and the exotic accession with non-shattering habit and white seed colour were grown for evaluation and further enhancement.

Mungbean: Progenies (F₂) of inter-specific crosses between green gram (*Vigna radiata*) accessions and wild *Vigna* species (*V. radiata* var. *setulosa*, *V. radiata* var. *sublobata*, *V. mungo* var. *silvestris* and *V. hainiana*) were grown for evaluation and further progeny enhancement.

2.3. Biochemical Evaluation of Field Crops

2.3.1 Oil content and fatty acid profile in oil seed

crops: A total of 1,178 accessions comprising *Brassica* (484), safflower (500), sunflower (116) and linseed (78) were analysed for oil content and quality. The oil content ranged from 25.5 to 37.4% in safflower, 22.0 to 47.6% in sunflower and 17.6 to 27.1% in linseed collections. Appressed and non appressed pod type *Brassica* collections (50 accs.) and sunflower were studied for fatty acid profile. There was no variation among two type of *Brassica* for individual fatty acids, but varied for oleic acid and erucic acid levels and ranged from 49.0 to 53.0% for erucic acid and 10.42 to 13.5% for linoleic acid. In sunflower, high oleic (upto 85.5%) along with comparatively low linoleic acid (upto 61.3%) containing lines were identified.

The *Brassica* collections comprising *B. juncea* (259), yellow sarson (105), brown sarson (35), toria (36), *B. napus* (25) and *B. rapa* (24) were analyzed. The range and mean of oil content along with promising accessions have been presented in Table 3.

Table 3. Range, mean and promising accessions for oil in *Brassica* species

Species (accs.)	Range	Mean	Promising accessions
<i>Brassica juncea</i> (259)	43.6-28.9	37.18	IC 426403
Yellow sarson (105)	48.4-32.5	40.07	IC 385678 (48.4), Ragini (47.5)
Brown sarson (35)	45.8-34.4	40.19	BSH-1 Sel, BCS-1 (44.8)
Toria (36)	45.7-34.9	38.31	JBT-37/19 (45.7), JBT-38/199 (45.1)
<i>B. napus</i> (25)	43.7-33.3	39.30	GSL-1 (43.7)
<i>B. rapa</i> (24)	43.5-32.6	37.24	Pusa Kalyani (43.5)

2.3.2 Protein content and amino acid profile of field crops: A total of 695 accessions comprising chickpea (487), barley (49), synthetic wheat (81) and linseed (78) were studied for protein content. Fifteen accessions of elite synthetic wheat having high protein content were also studied for amino acid content by HPLC and amino acid analyzer. The range and mean values of eight amino acids for these accessions along with control are presented in Table 4.

Table 4: Essential amino acid composition (g/16gN₂) of synthetic wheat

Amino acid	Range	Mean
Threonine	2.15-4.40 (3.87-4.66)	2.78 (4.31)
Tyrosine	1.80-4.17 (2.44-4.76)	2.71 (2.76)
Valine	3.42-5.20 (1.09-4.02)	4.09 (2.62)
Methionine	1.17-2.95 (1.20-1.86)	1.79 (1.67)
Lysine	1.97-3.20 (2.24-2.91)	2.65 (2.49)
Isoleucine	2.22-8.72 (5.89-7.06)	2.94 (6.54)
Leucine	5.31-8.72 (5.89-7.06)	6.87 (6.54)
Phenylalanine	2.06-4.78 (3.06-3.57)	3.74 (3.40)
Total		27.57 (27.17)

* Range and mean values of control lines are given in parenthesis

2.3.3 Standardization of analytical technique for glucosinolate content in Brassica species: Analytical technique was standardized for the identification and

estimation of individual glucosinolate present in different *Brassica* species, involving HPLC with Waters Empower Software System. Under the present technique, μ Bonded C18 reversed phase column was used to separate the individual component from the 30 μ l injected total glucosinolate extract. The glucosinolate components were detected using UV detector (Waters 2475) at 235 nm wavelengths. Following two solvent systems run under gradient mode in calculated combination was used to elute the individual glucosinolate from the column. Sinigrin was used as reference standard.

Eluent A: 0.1M Ammonium acetate buffer having pH 7.0

Eluent B: 16.7% Acetonitrile in water

2.4 Phyto-chemical Evaluation of Medicinal & Aromatic Plants

2.4.1 Chemical analysis for medicinal and aromatic plants: A total of 355 samples of different medicinal and aromatic plants obtained from different sources were analyzed for their active compounds. The details of crops and range of active compound along with promising accessions are presented in the Table 5.

Table 5: Active components in different medicinal and aromatic plants

Plant (Botanical name)	Plant part	Active compound	Range (%)	Promising accessions
Basil (<i>Ocimum basilicum</i>)	Herbage	Essential oil	0.086-0.25	EC 388887 (0.25%) EC 388890 (0.23%) EC 388893 (0.22%)
Vetiver (<i>Vetiveria zizanioides</i>)	Roots	Essential oil	0.11-0.88	IC 210756 (0.88%) IC 210615 (0.71%)
Coriander (<i>Coriandrum sativum</i>)	Seeds	Essential oil	0.08-0.47	IC 397621 (0.47%)
Greater galangal (<i>Alpinia galanga</i>)	Root/ rhizome	Essential oil	0.29-0.73	IC 87883 (0.73%) IC 349746 (0.69%)
Lesser galangal (<i>Alpinia calcarata</i>)	Root/ rhizome	Essential oil	0.75-1.09	IC 210421 (1.09%)
Giloe (<i>Tinospora cordifolia</i>)	Stem	Total bitters	0.27-0.82	IC 281972 (0.82%) IC 281963 (0.77%)
Ghrit kumari (<i>Aloe barbadensis</i>)	Leaf	Aloe gel	0.45-1.22	IC 112521 (1.22%) IC 112526 (1.11%)
Satavar (<i>Asparagus racemosus</i>)	Root	Total saponins	1.54-3.19	-
Kalmegh (<i>Andrographis paniculata</i>)	Herbage	Andrographolide	1.15-2.12	IC 342138 (2.12%)

2.4.2 Analysis of aroma constituents (GC) in essential oil: In coriander, 24 constituents were identified and linalool was identified as a major constituent. A total of 26 components were identified in greater galangal (*Alpinia galanga*) germplasm, among these, 1:8 cineole was rich and varied from 60.5 to 68.9 per cent. The GC profile of lesser galangal (*Alpinia calcarata*) oil also showed the presence of 1:8 cineole as major constituent.

2.4.3 Development of calibration curve in High Performance Thin Layer Chromatography (HPTLC): A linear calibration curve was developed for estimation of podophyllotoxin ($C_{22}H_{22}O_8$) in root and rhizome of *Podophyllum hexandrum* on HPTLC. Spectra of podophyllotoxin showed maximum absorption at 210 nm. In addition, three collections belonging to different regions were also analysed for podophyllotoxin content which varied from 1.33 to 3.14 per cent.

2.5 Documentation of Plant Genetic Resources

Germplasm characterization and evaluation of field crops (Rabi 2004-05) and Horticultural crops (2004-05) was brought out. In addition, germplasm characterization and evaluation report (6,273 accs.) for the germplasm evaluated under collaborative / multilocation evaluation was also brought out.

2.6 Distribution of Germplasm for Utilization

Utilization of germplasm of various crops by breeders and other scientists in the country for crop improvement programmes is an important aspect for sustainability of crop production. During the period, a total of 396 seed samples of various crop groups namely, cereals (15), legumes (132), oilseeds (40), vegetables (116), forage (1), under-utilized crops (30) and medicinal and aromatic plants (62) were supplied to 40 research workers of ICAR Institutes, SAUs and other research centers engaged in crop improvement programmes (Table 6). Besides, 6,576 seed samples comprising exotic wheat (5,623), barley (892) and triticale (61) were also supplied to 65 indentors.

Table 6: Distribution of germplasm of different crops

Crop group /Crop	No. of samples (Indentors)
Cereals	15 (3)
Wheat	10 (1)
Barley	2 (1)
Maize	3 (1)
Pulses	132 (13)
Cowpea	48 (4)
Pea	27 (3)
Urdbean	17 (2)
Lentil	39 (3)
Lathyrus	1 (1)
Oilseeds	40 (4)
Rapeseed-mustard	10 (1)
Sunflower	3 (1)
Sesame	15 (1)
Crambe	12 (1)
Vegetables	116 (7)
Brinjal	20 (1)
Tomato	65 (2)
Sponge gourd	10 (1)
Ridged gourd	10 (1)
Spinach	10 (1)
Methi	1 (1)
Forages	1 (1)
Oat	1 (1)
Under-utilized crops	30 (5)
<i>Sesbania</i>	28 (4)
<i>Coix</i>	2 (1)
M & A plants	62 (7)
<i>Ocimum</i>	36 (3)
<i>Mucuna</i>	11 (2)
<i>Andrographis</i>	14 (1)
Satawari	1 (1)
Total	396 (40)

2.7 Germplasm Holding in Medium Term Storage (MTS)

A total of 16,486 accessions of various field crops comprising cereals (3,621), pulses (5,396), oilseeds (3,667), vegetables (2,428), under-utilized crops (1,010), medicinal and aromatic plants (187), and millets (177) were maintained in medium term storage during the period under report (Table 7).

Table 7: Active germplasm holding in MTS as on 31.12.2005

Crop Group	Accession (no.)
Cereals	4,040
Wheat	1,200
Maize	1,500
Barley	1,340
Millets and forage	250
Pearl millet	200
Sorghum	50
Pulses	4,480
Pea	675
Cowpea	1300
Lentil	410
Mung bean	645
Urd bean	450
Chickpea	1,000
Oilseeds	4,385
Rapeseed-mustard	3,300
Sunflower	168
Sesame	550
Linseed	38
Safflower	300
<i>Lepidium</i>	7
<i>Crambe</i>	22
Vegetable	3,731
Brinjal	1,260
Tomato	925
Bottle gourd	270
Sponge gourd	200
Ridged gourd	250
Bitter gourd	55
Pumpkin	6
Radish	170
Methi	325
Palak	45
Coriander	80
Ash gourd	20
Under-utilized crops	1,038
Faba bean	295
Rice bean	103
<i>Amaranthus</i>	40
<i>Sesbania</i>	400
<i>Crotalaria</i>	200
Medicinal and aromatic plants	206
<i>Ocimum</i>	45
<i>Mucuna</i>	55
Poppy	53
<i>Psoralea</i>	10
<i>Andrographis</i>	19
Periwinkle	15
Ashwagandha	4
<i>Hyocyamus</i>	5
Total	18,130

2.8 Germplasm Field Days Organised

To promote germplasm utilization, two field days were

organized. A field day on wheat, barley and triticale was organized on March 29, 2005. In which, wheat/barley breeders and other scientists participated and selected materials of their choice. Another field day was organized on medicinal and aromatic plants and vegetables crops on November 30, 2005. In this, 30 participants from different parts of country belonging to ICAR institutes, SAUs, Central Council for Research in Unani Medicine (CCRUM), Central Council for Research in Ayurveda and Siddha (CCRAS) participated and variability was observed for agro-morphological traits. The scientists/research workers selected the material of their choice.

2.9 Collaborative Germplasm Evaluation

Germplasm evaluation for agronomic performance has been taken up in collaboration with different ICAR's crop based Institutes/ NRCs, AICRIPs and SAUs. Based on collaborative evaluation, the promising accessions for different characters in various crops have been identified. The details of promising accessions, location of evaluation along with traits have been presented in Table 8.

Under collaborative evaluation, germplasm accessions of different crops have been evaluated/supplied at different locations through coordinated projects, Directorate, NRC etc.

2.10 Multi-location Evaluation of Germplasm

Multi-location evaluation of germplasm of major crops (rice, wheat, chickpea and pigeonpea) was undertaken in collaboration with crop based institutes and AICRPs.

2.10.1 Rice: 1056 accessions of rice were evaluated at 20 centres for agronomic traits and screened for biotic and abiotic stresses. Some of the germplasm accessions were found having multiple disease resistance. The details of promising accessions resistant to different diseases have been presented here.

Leaf blast: In germplasm screening nursery, 1,056 accessions were tested for blast at six locations out of which 22 accessions were found resistant to leaf blast. The important accessions were IC 115003, IC 115352, IC 114334, IC 114506 etc.

Rice Tungro Virus: Out of 1,056 accessions evaluated

at two locations for rice tungro virus, 11 accessions were found promising. The important accessions resistant to rice tungro virus are IC 114231, IC114873, IC114650, and IC 114782.

Bacterial leaf blight: Out of 1056 accessions evaluated at three locations for bacterial leaf blight, 15 accessions were found resistant to bacterial leaf blight.

Multiple disease resistant: The accessions namely, IC 114334 (leaf blight and bacterial blight), IC 114506 (leaf blight and bacterial blight), IC 114650, IC 114782

(bacterial blight and rice tungro disease).

2.10.2. Wheat: 1,500 accessions of wheat were evaluated for biotic stress (yellow rust, brown rust Karnal bunt, blight etc.) at nine locations belonging to different zones like North West Plain Zone (DWR Karnal, PAU Ludhiana, GBPUAT Pantnagar), North East Plain Zone (BHU Varanasi, NDUAT Faizabad), Central Zone (JNKV, ARS Powarkhera; SKGAN, WRS Vijapur), Peninsular Zone (IARI Pune and UAS, Dharwad). The resistant material identified for different biotic stresses is presented below.

Table 8: Promising accessions identified under collaborative evaluation

Crop/Location	Trait	Accessions
Wheat (DWR, Karnal)	Resistant reaction to yellow and brown rust	IC361692, IC310124, IC310106, IC279333, IC145795, IC145748, IC128631, IC128637, IC128638, IC128639, C128642, IC128643, IC28647, IC128652, IC128656, IC28654, IC128592, IC128593, IC28555, IC128663, IC128624, IC128619, IC128263, IC128179
Indian mustard (NRCRM, Bharatpur)	Oil content (> 40%) 1000 seed weight (>5.5 g) Protein content (>23 %)	IC342780, IC482990, IC333199 IC261670, IC312514, IC312525 EC482974, EC482984, IC330533
Yellow sarson (NRCRM, Bharatpur)	Oil content (>42.5%) 1000 seed weight (>4.0 g) Protein content (>22.5%)	IC355312, IC342760, IC334292, IC355397 IC355378, IC355319, IC355385 IC355363, IC355365, IC355368
Brown sarson (NRCRM, Bharatpur)	Oil content (>39.5%) 1000 seed weight (>4 g) Protein content (>22.5%)	IC361583, EC333578 IC312517 IC361169, IC268310, EC289696
Castor (DOR, Hyderabad)	Days to maturity (<95 days) 100 seed weight (>47 g) Seed yield/plant at 210 days after planting (>120 g)	RG3124, RG3159 RG3130 RG3148
Lentil (IIPR, Kanpur)	Plant height (>56 cm) Pods/plant (>540) 100 seed weight (>2.5 g) Days to maturity (<135 days)	IC201706, IC201778, IC201782 IC201661, IC201743 IC201678, IC201690, IC201693, IC201740 IC201771, IC201772, IC201773
Mung bean (IIPR, Kanpur)	Plant height (>18 cm) Pods/plant (> 28) 100 seed weight (>3.5 g)	U53/VR44, U53/VR14 IC333086, IC369823 IC369790, IC369823, DRA24, BRS2435
Brinjal (IIVR, Varanasi)	Days to 50% flowering (<55 days) Plant height (>88 cm) Fruits/plant (> 15) IC112349, IC112898 Fruit weight (> 130 g)	EC169073, EC383345, EC484629 IC099666, IC111023, IC112346 EC169073, EC316283, IC005547, IC090898, IC20113, IC089945, IC03768
Tomato (IIVR, Varanasi)	Days to 50% flowering (< 82 days) Plant height (> 213 cm) No. of branches per plant (> 21) EC032019 No. of fruit/plant (>175)	EC362956, EC163663, EC006845, EC005424 EC002697, EC003366, EC006148, EC164336A EC003366, EC000487, EC006148, EC010652, EC012689, EC128025, EC000151
Coriander (NRCSS, Ajmer)	Days to 50% flowering (< 70 days) Days to 1 st green leaf harvest (> 31.5)	YS/RC258, YS/RC41, IC338223 AKP-12/99, IC321256
Fenugreek (NRCSS, Ajmer)	Days to 50% flowering (>60 days)	IC144290, IC143856, IC143816

Stem leaf and stripe rust: 42 accessions

Stem and leaf rust: 162 accessions

Stem and stripe rust: 119 accessions

Leaf and stripe rust: 52 accessions

Leaf blight, black rust and yellow rust: IC145780 and IC145779

Leaf blight, brown rust and yellow rust: IC145780

Leaf blight, black rust and brown rust: IC145798, IC145780

Karnal bunt, black rust, brown rust and yellow rust: 23 accessions

Karnal bunt, black rust, brown rust: 68 accessions

Karnal bunt, black rust, yellow rust: 48 accessions

Karnal bunt, brown rust, yellow rust: 27 accessions

Leaf blight and Karnal bunt: IC 145797, IC 145779, IC 145798

2.10.3. Chickpea: A total of 930 accessions of chickpea were evaluated at eight locations for agronomical traits, whereas 487 accessions were evaluated against biotic (wilt, root rot, color rot, pod borer) and abiotic (cold and drought) stresses at eighteen locations. The promising accessions for agronomic traits, biotic and abiotic stresses and protein content were identified and are presented below:

a. Agronomic traits

Bold seededness : Two accessions (IC 269064 and IC 269131) were found to have bold seeds with the average test weight (100 seed) more than 27g.

No. of seeds per pod: Seven accessions (IC 269314, IC 268875, IC 268891, IC 268904, IC 26880, IC 268928 and IC 26909) were recorded to have on an average more than two seeds/ pod.

b. Biotic stresses

Wilt: Thirteen accessions (IC 327051, IC 327061, IC 327063, IC 327045, IC 327075, IC 327080, IC 327081, IC 327100, IC 327140, IC 327190, IC 327282, IC 327289 and IC 327777) were moderately resistant/ resistant to wilt at two or more locations.

Root rot: Sixteen accessions (IC 327031, IC 327032, IC 327038, IC 327039, IC 327041, IC 327049, IC 327050, IC 327051, IC 327074, IC 327094, IC 327100, IC 327101, IC 327119, IC 327204, IC 327205 and IC 327065) were resistant at Durgapura (Rajasthan). However, all the accessions were highly susceptible at Coimbatore (Tamil Nadu).

Colar rot: Thirty four accessions (IC327030, IC 327056, IC 327060, IC 327069, IC 327070, IC 327073, IC 327083, IC 327099, IC 327100, IC 327104, IC 327111, IC 327112, IC 327116, IC 327192, IC 327288, IC 327290, IC 327337, IC 327393, IC 327446, IC 327582, IC 327583, IC 327679, IC 327683, IC 327703, IC 327749, IC 327757, IC 327791, IC 327812, IC 327816, IC 327822, IC 327933, IC 327944, IC 327954 and IC 327960) were found resistant at Jabalpur (MP).

c. Abiotic stresses

Rainfed conditions: Seven accessions namely IC 327287, IC 327288, IC 327289, IC 327290, IC 327330, IC 327821 and IC 327914 were found promising under rainfed conditions. These accessions had either equal or more seed yield than the check varieties at Durgapura and Sehore.

Cold tolerance: IC 327109 had higher number of pods set at VPKAS, Almora and PAU, Ludhiana where the temperature was low.

d. Quality parameters

Protein content: Seventeen accessions (IC 32707, IC 327214, IC 327217, IC 327220, IC 327246, IC 327251, IC 32726, IC 327263, IC 327264, IC 327265, IC 327276, IC 327277, IC 327278, IC 327281, IC 327282, IC 32707, IC 327709) possessed more than 27.0% protein content.

During 2005-06, 1,200 new accessions were also multiplied at three locations for their evaluation

2.10.4. Pigeonpea: A total of 375 accessions tested for biotic stresses at different locations. The promising accessions for different biotic stresses have been presented below:

Wilt: Eleven accessions (IC 245184, IC 245198, IC 245344, IC 73739, IC 73740, IC 73743, IC 73749, IC 73768, IC 73764, IC 73892 and IC 73906) were found resistant or moderately resistant to wilt at two locations (RAU, Dholi and BHU, Varanasi).

Sterility mosaic disease: IC 73747 was found resistant for sterility mosaic virus at both the locations (RAU, Dholi and BHU, Varanasi).

2.11 First Annual Workshop on Germplasm Evaluation and Utilization

First Annual Workshop on Germplasm Evaluation and

Utilization was organized on 26-27 May, 2005 at NBPGR, New Delhi. In this workshop, 80 participants belonging to ICAR institutes, NRCs, Project Directorates, AICRPs and SAUs participated. The purpose of workshop was to develop effective network for evaluation and utilization of germplasm and also chalk out the workable plan for evaluation of germplasm at national level.

2.12 ARIS Activities Related to PGR Management

2.12.1 Human resource development: Training was imparted to scientists on “Use of DUSNT software for the analysis of distinctness and uniformity” and “Documentation of extant varieties as per DUS guidelines” during the 10 training programmes organized by ICAR Institutes and SAUs (details given in chapter 19).

2.13 Establishment of information sharing mechanism for monitoring of the implementation of global plan of action (GPA) for management and sustainable utilization of plant genetic resources for food and agriculture (PGRFA): This project is operative for the establishment of the National Information-Sharing Mechanism on the Implementation of GPA, as a centralized information system for gathering and sharing information on GPA implementation in India. NBPGR has been assigned the responsibility of the National Focal Point. A list of 114 stakeholders (Annexure I) has been prepared after discussion in the National Co-ordination and Monitoring Committee and during subsequent meetings. These stakeholders are drawn from a diverse range of organizations connected with plant genetic resources for food and agriculture.

The first National Stakeholder workshop was held at National Bureau of Plant Genetic Resources, New Delhi, on 24-25 January 2005. Fifty-four participants attended the workshop, with representatives of key stakeholders from the various Government Ministries and Departments, crop based institutes of the ICAR and ICRISAT. A detailed presentation was made on the GPA Reporting Format and its various components. The use of GPA computer application was also demonstrated to the participants. During the workshop, participants were actively involved in the discussions on how the activities were to be coordinated and the information collected.

The schedules of regional meetings/ training workshops and the data submission by stakeholders were also finalized during the workshop. A hard and soft copy of the Common Tables was distributed to all participants of the workshop.



National Workshop for the Establishment of the NISM-GPA held at NBPGR, New Delhi (24-25th January 2005). The workshop was inaugurated by Mr. Prem Narain, Joint Secretary (Seed), Govt. of India. Dr. S P Tiwari, the then ADG (Seed) and presently Director, NAARM; Dr. Ng Quat, CTA, FAORAP, Bangkok also addressed the participants of the workshop

The report on the progress of the implementation of NISM was presented by Dr. J.L.Karihaloo, Director, NBPGR at FAO, Rome on 25th October 2005 during Inter-governmental Technical Working Group on PGRFA.

Second round of meetings for the data validation and to discuss the draft report on monitoring the implementation of the NISM were held during the month of November, 2005 at NBPGR Regional Stations, Hyderabad, NBPGR Regional Station, Thrissur and NBPGR, New Delhi. A total of 72 stakeholders participated in these meetings.



Participants of the second regional workshop organized at NBPGR, New Delhi (23-24 November 2005)

Research Projects (Code, Title, Project leader/PI, Project Associates)

- PGR/GEV- BUR-DEL-01: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of various crops (SK Mishra w.e.f. 21 September 2005, All scientists of Evaluation Division).
- PGR/GEV- BUR-DEL-02: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of wheat, barley and triticale (Dinesh Kumar; AK Sharma, PS Mehta, KC Muneem and DC Bhandari).
- PGR/GEV- BUR-DEL-03: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of maize (AK Sharma; Dinesh Kumar, PS Mehta and Someshwara Rao)
- PGR/GEV- BUR-DEL-04: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of cowpea and pea (S Sardana; NK Gautam and Babu Ram)
- PGR/GEV- BUR-DEL-05: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of oil seeds with special reference to *Brassica* and sunflower (Ranbir Singh; Vandana Joshi and YS Rathi).
- PGR/GEV- BUR-DEL-06: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of tomato, spinach, palak, and cucurbits (VK Dobhal (upto 13 April); KK Gangopadhyay, Gunjeet Kumar and BL Meena).
- PGR/GEV- BUR-DEL-07: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of brinjal, carrot & radish, fruits and ornamentals (KK Gangopadhyay; Gunjeet Kumar and BL Meena).
- PGR/GEV- BUR-DEL- 08: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of bottle-gourd, methi, Chinese cabbage & coriander (Gunjeet Kumar (on study leave); KK Gangopadhyay and B.L.Meena).
- PGR/GEV- BUR-DEL-09: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of onion & garlic, and medicinal and aromatic plants (Ashok Kumar; SK Pareek, Archana Raina, Jitendra Mohan, CS Raghav and Poonam Suneja).
- PGR/GEV- BUR-DEL-10: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of forage (Vandana Joshi; DC Bhandari).
- PGR/GEV- BUR-DEL-11: Biochemical evaluation of germplasm resources of various field crops (S Mandal; Sangita Yadav).
- PGR/GEV- BUR-DEL-12: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under utilized crops (BS Phogat; Hanuman Lal and RS Rathi).
- PGR/GEV- BUR-DEL-13: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under utilized crops (BS Phogat; Hanuman Lal and RS Rathi).
- PGR/GEV- BUR-DEL-14: Studies on statistical techniques for efficient management of PGR (RK Mahajan).
- PGR/GEV- BUR-DEL-15: Genetic Resources Information Programme (RK Mahajan; RC Agrawal).
- PGR/GEV- BUR-DEL-16: Genetic enhancement of crop species with particular reference to sesame and mungbean (I S Bisht; Z Abraham and M Latha).

3. DIVISION OF GERMLASM CONSERVATION

Summary: A total of 33,899 accessions of various crops were received for long-term conservation in the National Genebank. These were processed following the genebank standards adding another 25,596 accessions to the base collection raising the total germplasm holding to 3,12,583. A total of 4,432 accessions out of the 7,526 received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (1,652 accessions) and updating of passport data (2,928 accessions) was carried out. Studies on seed storage behaviour of *Baliospermum montanum*, showed intermediate behaviour while *Aegle marmelos* and *Wrightia tinctoria* had orthodox behaviour. Longevity of castor, groundnut, pigeonpea and cotton at ambient temperatures was found to be more when seeds were dried to ultra low moisture contents (i.e. < 5 per cent moisture content). Methods for breaking seed dormancy were developed in *Hypericum perforatum*, *Desmodium motorum*, *Chlorophytum borivilianum* and *Tephrosia jamnagarensis*.

The Division continued its efforts to support the national repository with long-term storage of seeds of various agricultural and horticultural crops in the National Genebank (-18°C), and voucher samples of introduced and collected accessions in the medium-term storage at (7°C) for reference. In addition, the registration of potentially valuable germplasm and conservation of released varieties and genetic stocks identified under the National Agricultural Research System has been another important activities. Supportive research directed towards understanding the storage behaviour of hitherto unexplored and under-explored species, identification and implementation of factors that prolong the storage life of seeds and maintain the genetic integrity of conserved germplasm in a cost effective manner continued.

3.1 Germplasm Augmentation

The Germplasm Handling Unit (GHU) received a total of 7,526 seed accessions collected during explorations conducted in ten NATP zones. Of these a, total of 4,432 accessions were stored in medium-term storage module for safety and as reference material. Another 3,094 accessions with sufficient quantity of seed were sent for long-term conservation.

A total of 33,899 germplasm accessions of various agricultural crops were received for long-term conservation at the National Genebank. These included 3,621 accessions restored from International Crops Research Institute for Semi-Arid Tropics (ICRISAT) to NBPGR under an Indian Council of Agricultural Research (ICAR)-ICRISAT collaborative project on "Restoration of ICRISAT mandate crop germplasm to NBPGR". A total of 25,596 accessions qualified for conservation as per the genebank standards and were stored as base collections at -18°C. These included

cereals (6,429), pseudocereals (858), millets and forages (2,832), legumes (5,477), oilseeds (5,422), fibres (537), vegetables (1,944), medicinal and aromatic plants and narcotics (1,087), spices (581), agro-forestry species (427), fruits (2), released varieties (245) and genetic stocks (28).

The crop-wise details of the various accessions added to the National Genebank are listed in Table 1. With this, the total germplasm holdings in the National Genebank has increased to 3,12,583 accessions representing 579 plant species. In addition, a total of 1,697 exotic accessions of different crops received from 6 countries were kept as voucher specimen in the medium-term storage module.

3.2 Germplasm Registration

A total of 105 proposals were received for germplasm registration and 34 proposals belonging to 14 crops were approved for registration in the Plant Germplasm Registration Committee meeting.

3.3 Documentation and Database Management

Efforts were continued to update passport data on germplasm conserved before NATP. Passport data were updated for a total of 2,928 accessions comprising vegetables (304 accessions), millets (2,364), and pulses (260). Data pertaining to all the accessions conserved in the LTS were validated.

3.4 Monitoring of Germplasm

Germplasm (1,652 accessions) stored in the long-term storage module for 10 years or more were monitored for seed viability, seed quantity and seed health to identify

Table 1: Status of germplasm holdings in the National Genebank at -18 °C (as on 31 December, 2005)

Crop Group	Accessions stored during 1.1.05 to 31.12.05	Status as on 31.12.05
Paddy	3,184	74,857
Wheat	1,652	35,927
Maize	789	6,297
Others	804	10,175
Cereals	6,429	1,27,256
Sorghum	47	17,537
Pearl millet	508	7,245
Minor millets	1,636	18,434
Others	641	2,810
Millets and forages	2,832	46,026
Amaranth	738	4,259
Buckwheat	110	403
Others	10	179
Pseudocereals	858	4,841
Chickpea	289	15,933
Pigeonpea	2,496	10,016
Mung bean	406	3,365
Others	2,286	19,004
Grain legumes	5,477	48,318
Groundnut	1,658	13,095
Brassica	649	7,812
Safflower	875	6,999
Others	2,240	14,412
Oilseeds	5,422	42,318
Cotton	29	4,623
Jute	23	2,608
Others	485	1,911
Fibre crops	537	9,142
Brinjal	228	3,260
Chilli	9	1,990
Others	1,707	13,612
Vegetables	1,944	18,862
Custard apple	-	57
Papaya	-	23
Others	2	94
Fruits	2	174
Opium poppy	53	346
Ocimum	43	241
Tobacco	511	1,448
Others	480	1,657
Medicinal, aromatic & narcotic plants	1,087	3,692
Coriander	89	385
Sowa	-	59
Others	492	690
Spices & condiments	581	1,134
Pongam oil tree	19	62
Others	408	563
Agro-forestry	427	625
Lentil	-	7,712
Pigeonpea	-	2,523
Duplicate safety samples	-	10,235
Total	25,596*	312,583**

* The figure includes 245 Released varieties and 28 Genetic stocks

** The figure includes 2272 Released varieties and 705 Genetic stocks

accessions that may require regeneration as per the genebank standards. This included accessions of cereals (226), millets (30), fibres (663), oilseeds (450), pulses (255) and vegetables (213). The results showed that viability of all the accessions was maintained conforming to the genebank standards.

3.5 Regeneration of Germplasm

A total of 6,773 germplasm samples of various crops were supplied for seed multiplication/ research / evaluation and restoration of lost active collections. These comprised accessions of paddy (5,333), maize (430) and pigeonpea (1,010).

3.6 Supportive Research

To develop protocols for cost effective conservation, studies on storability of seeds dried to low moisture contents were continued in castor, groundnut, pigeonpea, cotton and *Dalbergia* species. Monitoring of *Dalbergia* seeds stored at moisture contents of 1.7 to 10% at different temperatures revealed that loss of viability of over dried seeds was faster at ambient temperature (30-40% viability) after 3 years of storage but maintained a reasonably good viability (60-70%) at 4 and -18°C storage temperatures. In cotton, groundnut,

pigeonpea and castor, seeds dried to 2 to 3 per cent moisture retained higher germination than those stored at higher moistures at ambient temperature after more than 6 years of storage.

Studies on *Baliospermum montanum* showed that the seeds have intermediate storage behaviour while *Aegle marmelos* and *Wrightia tinctoria* have orthodox seed storage behaviour. Methods to break seed dormancy were worked out in medicinal plant species viz., *Chlorophytum borivilianum* (with Gibberellic acid), *Tephrosia jannagarensis* (treatment with concentrated sulphuric acid), *Desmodium motorum* (with hot water) and *Hypericum perforatum* (with chilling) to improve seed germination. Seed treatment with GA₃ (50 ppm) in case of *Crambe* and KNO₃ (0.2%) in *Putranjiva* improved seed germination. Pre-soaking of seeds in water overnight enhanced both seedling vigour and rate of germination in *Perilla*, olive and *Jatropha* seeds.

Germplasm of various crops stored at Khardungla, Leh were monitored for viability after four years of storage. Results showed that samples stored with poor viability or higher moisture content or both, registered reduction in viability, while those stored with 85% or more viability maintained viability values close to initial.

Research Projects (Project Code, Title, Project leader; Associate/s)

PGR/GCN-BUR-DEL-01: Management of information and facilities of germplasm conserved in the national network (RC Agrawal; AK Singh and Sanjeev Saxena).

PGR/GCN-BUR-DEL-02: Conservation of legume germplasm using conventional seed storage methods (Neeta Singh; Chitra Pandey).

PGR/GCN-BUR-DEL-03: Conservation of paddy using conventional seed storage methods (Sanjeev Saxena; AD Sharma).

PGR/GCN-BUR-DEL-04: Conservation of oilseed and fruit crops germplasm using conventional seed storage methods (J Radhamani; Anjali Kak).

PGR/GCN-BUR-DEL-05: Conservation of cereals excluding paddy and agro-forestry species, using conventional seed storage (K Srinivasan; Manju Uprety).

PGR/GCN-BUR-DEL-06: Conservation of spices, medicinal and aromatic plant, and pseudo-cereals germplasm using conventional seed storage methods (Veena Gupta).

PGR/GCN-BUR-DEL-07: Conservation of forage and fibre crop species germplasm using conventional seed storage (Anjali Kak; J Radhamani).

PGR/GCN-BUR-DEL-08: Conservation of millets germplasm using conventional seed storage methods (AK Singh; Veena Gupta).

PGR/GCN-BUR-DEL-09: Conservation of vegetable germplasm using conventional seed storage methods (Chitra Pandey; Neeta Singh).

PGR/GCN-BUR-DEL-10: Investigating seed dormancy, seed storage behaviour, and physiological and biochemical changes during storage (Kalyani Srinivasan; Neeta Singh, Sanjeev Saxena, Veena Gupta, J Radhamani, Anjali Kak, Chitra Devi, Manju Uprety and AD Sharma).

4. DIVISION OF PLANT QUARANTINE

Summary: A total of 28,732 accessions (64,882 samples) comprising 28,656 exotic accessions (64,806 samples [germplasm-15,486 accessions (16,194 samples); international nurseries/ breeding trial material (13,170 entries; 48,612 samples)] of various crops and 76 accessions/ samples under export were processed for quarantine clearance. In addition, 7,694 accessions of Indian origin were repatriated. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 730 samples were found infested/infected contaminated with various pests viz., insects / mites -165 samples including 103 with hidden infestation; nematodes-313 and fungi/ bacteria- 252. Of the 730-infested/ infected/-contaminated samples, 723 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip and mechanical cleaning. Seven samples of soybean from Taiwan and USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. Six Phytosanitary Certificates were issued for consignments meant for export. A total of 2,205 samples collected indigenously were processed for pest-free conservation. Of the 189 infested samples, 151 were salvaged and 2,167 samples were released for pest-free conservation. Sixty-nine samples of transgenic crops viz., cotton, maize, potato and rice were processed for quarantine clearance. Reverse- transcription Polymerase Chain Reaction protocols for detection of BCMV and SMV under the Diagnostics Network Project were standardized. The cultures of BCMV, SMV and ULCD are being multiplied under greenhouse conditions and the purification of BCMV and SMV is in progress. The experiments conducted so far clearly ruled out the possibility of involvement of Tobacco streak virus and Whitefly-transmitted Geminiviruses in the etiology of ULCD.

4.1 Quarantine of Germplasm Imported

4.1.1 Quarantine examination: A total of 28,656 exotic accessions (64,806 samples) comprising germplasm (15,486 accessions or 16,194 samples) and nurseries/ trial breeding material (13,170 entries or 48,612 samples) of various crops including both true seed and vegetative propagules were processed for the detection of associated exotic insect pests, mites, plant parasitic nematodes, plant pathogens (fungi, bacteria, viruses) and weed seeds by various detection techniques. Of the import samples, 1,480 samples were exposed to X-ray radiography for detection of hidden infestation of bruchids and chalcids. A total of 730 samples were found infested/ infected/ contaminated. Of these, 165 samples were found infested with insects and mites including 103 samples with hidden infestation; 313 samples infected with nematodes and 252 found infected with fungi/ bacteria. A number of pests of major quarantine importance were intercepted (Table 1).

4.1.2 Salvaging of infested/ infected/ contaminated germplasm: Of the total 730 infested/infected/ contaminated samples, 723 were salvaged by various disinfestation techniques/ treatments like mechanical cleaning to remove damaged/ abnormal seeds, soil clods, plant debris etc., fumigation with ethylene dichloride-carbon tetrachloride mixture @ 320 mg/ litre for 48 h at 30°C under normal air pressure against insect infestation and hot water treatment (HWT) at 52°C for 30 minutes for various

seed-borne pathogens and nematodes and X-ray screening for hidden infestation, pesticidal dip/ spray for vegetative propagules. Samples (165) infested with insects/ mites were salvaged through fumigation (59), X-ray radiography (103) and pesticidal dips (3); 313 samples infected with nematodes were salvaged by hot water and nematicidal dip treatments; 252 samples infected with fungi/ bacteria were salvaged by fungicidal seed treatment (236) and HWT (9); and samples infected with viruses were salvaged through grow-out test. Seven samples of soybean from Taiwan and USA were rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India.

Prophylactic treatments: A total of 10,186 seed samples were subjected to fumigation, 119 samples of vegetative propagules were given dip/ spray treatment and 9,347 samples of paddy were given mandatory hot water treatment. In order to prevent the introduction of new strains of tobamoviruses through seeds, all the introduced germplasm samples of chilli (125), and tomato (62) were subjected to prophylactic seed treatment with 10% tri-sodium orthophosphate.

Grow-out test in Post-entry Quarantine Nursery (PEQN): International nurseries trial material (3,742 entries) comprising wheat (2,549), barley (1,055) and triticale (138) from CIMMYT Mexico; ICARDA, Syria were grown in PEQN. Loose smut of wheat (*Ustilago nuda* f. sp. *tritici*)

was intercepted in one entry (9th EGPSN-35 from CIMMYT) and covered smut (*U. hordei*) in three lines viz., IBON-06-LRA-C-70, IBYT-06-LRA-C-12 and IBYT-06-MRA-01 from ICARDA.

A total of 493 samples of exotic germplasm comprising *Glycine max* (44), *Phaseolus* spp. (124), *Pisum* spp. (15), *Vicia faba* (10), *Vigna mungo* (1), *V. marina* (1), *V. radiata* (30) and *V. unguiculata* (188) were grown in Post-entry Quarantine Greenhouses. The plants showing virus-like symptoms were tested by electron microscopy and using specific antisera against various seed-transmitted viruses using enzyme-linked

immunosorbent assay. The harvest from only healthy plants of different accessions was released to the indentors. The interceptions made are presented in Table-1.

4.2 Quarantine of Germplasm for Export

A total of 76 accessions/ samples of various crops intended for export to various countries were processed for detection of associated pests. Of these, one sample of wheat was found infected with the fungus, *Drechslera sorokiniana*. Six samples were given prophylactic fumigation. Six Phytosanitary Certificates were issued.

Table 1: Pests intercepted in the exotic germplasm during the year 2005

Pest	Host	Country/ Source
Insects and mites		
<i>Acanthoscelides</i> sp.	<i>Phaseolus vulgaris</i>	Colombia
<i>Bruchus dentipes</i> *	<i>Vicia faba</i>	Spain
<i>B. emarginatus</i>	<i>Pisum sativum</i>	Russia
<i>B. lentis</i>	<i>Lens culinaris</i>	ICARDA (Syria)
<i>B. pisorum</i>	<i>Pisum sativum</i>	Russia
<i>Callosobruchus maculatus</i>	<i>Cajanus cajan</i>	CIAT (Colombia)
	<i>Phaseolus vulgaris</i>	CIAT (Colombia)
<i>Callosobruchus</i> sp.	<i>Vigna unguiculata</i>	Taiwan
<i>Rhizopertha dominica</i>	<i>Hordeum vulgare</i>	Syria (ICARDA)
	<i>Oryza sativa</i>	Bangladesh, Philippines
	<i>Triticum aestivum</i>	Syria (ICARDA)
	<i>Zea mays</i>	Nigeria
<i>Sitophilus oryzae</i>	<i>Oryza sativa</i>	Bangladesh
	<i>Triticum aestivum</i>	USA
<i>Sitophilus zeamais</i>	<i>Zea mays</i>	Thailand
<i>Sitotroga cerealella</i>	<i>Oryza sativa</i>	Bangladesh
	<i>Zea mays</i>	Bangladesh, Nigeria, Spain
<i>Tribolium castaneum</i>	<i>Hordeum vulgare</i>	Syria (ICARDA)
	<i>Triticum aestivum</i>	Syria (ICARDA)
	<i>Zea mays</i>	Nigeria
Mites	<i>Fragaria ananassa</i> *	USA
Scales	<i>Salix</i> sp. *	UK
Nematodes		
<i>Aphelenchoides besseyi</i>	<i>Oryza sativa</i>	Nepal, Philippines, Sri Lanka, UK
<i>Aphelenchoides</i> sp.	Raspberry *	Philippines
<i>Helicotylenchus</i> sp.	Fenugreek (soil)	Australia
	<i>Geranium</i> spp (soil as contaminant)	Denmark
<i>Tylenchorhynchus</i> sp.	<i>Origanum vulgare</i> (soil as contaminant)	Denmark
	Raspberry *	Philippines
	<i>Fragaria ananassa</i> (strawberry) *	USA
Fungi and bacteria		
<i>Alternaria brassicicola</i>	<i>Brassica juncea</i>	Australia, Canada
	<i>B. napus</i>	Australia, Russia
	<i>B. oleracea</i>	Netherlands
<i>Alternaria padwickii</i>	<i>Oryza sativa</i>	Philippines
<i>Botrytis cinerea</i>	<i>Helianthus annuus</i>	France, Germany
	<i>Brassica juncea</i>	Canada
<i>Colletotrichum dematium</i>	<i>Glycine max</i>	Taiwan
<i>Drechslera oryzae</i>	<i>Oryza sativa</i>	Bangladesh, Philippines
<i>D. sorokiniana</i>	<i>Brassica juncea</i>	Canada
	<i>Hordeum vulgare</i>	Mexico
	<i>Triticum</i> spp.	Belgium, Nepal, Mexico, USA

<i>Fusarium moniliforme</i>	<i>Capsicum annuum</i> <i>Lycopersicon esculentum</i> <i>Oryza sativa</i> <i>Triticum aestivum</i> <i>Zea mays</i>	Taiwan Taiwan Philippines Mexico USA
<i>Fusarium solani</i>	<i>Helianthus annuus</i> <i>Lycopersicon esculentum</i> <i>Oryza sativa</i> <i>Oryza sativa</i> <i>Glycine max</i> <i>Triticum spp.</i> <i>Glycine max</i> <i>Brassica juncea</i> <i>Oryza sativa</i> <i>Papaver dubium</i> <i>Triticum aestivum</i> <i>Oryza sativa</i> <i>Solanum melongena</i> <i>Capsicum annuum</i> <i>Helianthus annuus</i> <i>Brassica juncea</i>	Taiwan Germany Taiwan Philippines Philippines Taiwan Belgium Taiwan, USA Canada Philippines Denmark USA Philippines Taiwan Taiwan France Canada
<i>Gerlachia oryzae</i> <i>Macrophomina phaseolina</i> <i>Nigrospora oryzae</i> <i>Peronospora manshurica</i> <i>Phoma lingam</i> <i>Rhizoctonia bataticola</i> <i>Rhizoctonia solani</i> <i>Tilletia foetida</i> <i>Verticillium albo-atrum</i>		
<i>Xanthomonas campestris</i> pv. <i>campestris</i>		
Viruses		
<i>Alfalfa mosaic virus</i>	<i>Phaseolus vulgaris</i> ♣ <i>Glycine max</i> <i>Vigna unguiculata</i> <i>G. max</i> <i>V. unguiculata</i> <i>Phaseolus vulgaris</i>	Canada, Kenya, USA AVRDC (Taiwan) USA Thailand, USA USA CIAT (Colombia), Kenya, USA Kenya
<i>Bean common mosaic virus</i>		
<i>Bean common mosaic virus</i>		
<i>Bean common mosaic necrosis virus</i>	<i>P. vulgaris</i>	
<i>Bean yellow mosaic virus</i> <i>Broad bean stain virus</i> * <i>Cherry leaf roll virus</i>	<i>Vicia faba</i> <i>V. faba</i> <i>G. max</i>	Spain, ICARDA (Syria) Syria AVRDC (Taiwan), Sri Lanka, Thailand, USA Sri Lanka, Thailand USA USA Russia, USA Spain, ICARDA (Syria) AVRDC (Taiwan), Sri Lanka, Thailand, USA AVRDC (Taiwan), Sri Lanka, Thailand, USA USA AVRDC (Taiwan), Sri Lanka, Thailand, USA Brazil, Canada, CIAT (Colombia), Kenya, USA USA AVRDC (Taiwan), Sri Lanka, Thailand, USA AVRDC (Taiwan), Sri Lanka, Thailand, USA
<i>Cowpea aphid-borne mosaic virus</i> <i>Cucumber mosaic virus</i> <i>Pea seed-borne mosaic virus</i>	<i>G. max</i> <i>V. unguiculata</i> <i>V. unguiculata</i> <i>Pisum sativum</i> <i>V. faba</i> <i>G. max</i>	
<i>Raspberry ring spot virus</i>	<i>G. max</i>	
<i>Southern bean mosaic virus</i>	<i>G. max</i> <i>V. unguiculata</i> <i>G. max</i>	
<i>Soybean mosaic virus</i>		
<i>Tomato black ring virus</i>	<i>Phaseolus vulgaris</i> ♣	
<i>Tomato black ring virus</i> <i>Tomato ring spot virus</i>	<i>V. unguiculata</i> <i>G. max</i>	
<i>Tobacco streak virus</i>	<i>G. max</i>	

◆ Vegetative propagules (while others are in the form of seeds)

* Pest not yet reported from India

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

4.3 Seed-health Testing of Indigenous Germplasm for Pest-free Conservation

A total of 2,205 samples received from Germplasm Handling Unit (GHU) of Conservation Division were processed for pest-free conservation under medium

term storage conditions. Of these, 1,217 samples were subjected to X-ray screening and 189 were found infested. Thirty-eight samples of different crops were rejected due to heavy insect infestation. Insect pests detected were *Callosobruchus maculatus* in cowpea, *Rhizopertha dominica* in *Oryza sativa*; *Sitophilus*

oryzae in *Oryza sativa* and *Zea mays*; and *Sitotroga cerealella* in *O. sativa* and *Zea mays*. Two thousand one hundred and sixty seven samples were released to GHU.



Symptoms due to rust fungus (*Puccinia spegazzinii*) on *Micania micrantha*, an alien invasive plant species

4.4 Detection of Viruses in *In-Vitro* Cultures of Germplasm Meant for Conservation

A total of 24 accessions (20 tissue cultures and 4 pot grown) of *Allium* spp. were indexed against three viruses (the ones against which the commercial antisera kits are available) viz., Onion yellow dwarf virus (OYDV), Leek yellow stripe virus (LYSV) and Carnation latent virus (CLV) by Double Antibody Sandwich-ELISA technique. Of these, 8 accessions revealed the presence of OYDV, 4 accessions revealed LYSV and 2 accessions revealed CLV. Two accessions revealed the presence of all the three viruses.

4.5 Network Project on Diagnostics of Emerging Plant Viruses

A total of 258 seed samples comprising of blackgram (86), greengram (85) and soybean (87) were procured from various sources in 13 states to study seed transmission of mandate viruses i.e., *Bean common mosaic virus* (BCMV), *Soybean mosaic virus* (SMV) and *Urdbean leaf crinkle disease* (ULCD). Studies on the seed transmission revealed a seed transmission rate of 1.4 to 16.34% and 1.28 to 27.11% of BCMV in blackgram and greengram, respectively; 10-20% ULCD in blackgram and 0.7 to 35.8% SMV in soybean. A total of 887 leaf samples showing symptoms of BCMV and SMV after sap inoculation were tested against BCMV (269) and SMV (618) using Direct

Antigen Coating- ELISA and Double Antibody Sandwich- ELISA. A total of 293 samples were found positive, of which, 147 were with BCMV and 146 with SMV. The newly infected leaves were examined by immunosorbent electron microscopy and flexuous particles of 700-900 nm were detected in case of French bean, black gram, green gram and soybean. The cultures of BCMV, SMV and ULCD are being multiplied in respective host plants under greenhouse conditions and the purification of BCMV and SMV is in progress. Virus- specific primers targeting coat protein gene were designed for detection of BCMV and SMV. Gel electrophoresis revealed the presence of amplicons of 800 bp in case of BCMV and 544 bp in case of SMV. The experiments conducted so far clearly ruled out the possibility of involvement of *Tobacco streak virus* and Whitefly-transmitted Geminiviruses in the etiology of ULCD.

4.6 Quarantine Inspection of Transgenic Planting Material

A total of 115 samples of imported transgenic planting material comprising cotton (30) from USA, maize (39) from the Philippines and USA, rice (36) from England and USA and potato *in-vitro* plantlets (10) from USA were received for quarantine processing. The cotton seed contained genes viz., *CryIAC*, *nptII*, *aad*, *CryX* (*CryIAC* & *Cry2Ab*), *nptII*, *uidA* encoding insecticidal protein; *CryIAB* and *vip-3A* imparting resistance to the attack of bollworms and other common insect-pests; *CP4EPSPS* for tolerance to glyphosate herbicide and ascorbate peroxidase (*APX*) for increasing the ability to withstand various stress conditions; maize had *CryIA(b)* imparting resistance against insect-pests; rice had *psy* (phytoene synthase), *crtl* (phytoene desaturase) for synthesis of *b*-carotene and potato had *RB* gene imparting late blight resistance.

Seeds of transgenic material were subjected to various tests for detection of insects, mites, nematodes, bacteria, fungi and viruses. Important fungi intercepted included *Fusarium moniliforme*, *F. semitectum*, and *Verticillium albo-atrum* in cotton seeds from USA; *F. moniliforme* in maize and rice from the Philippines and USA, respectively.

Rice samples were given mandatory hot water treatment at 52°C for 30 minutes against various seed-borne pathogens and nematodes. Besides infected samples of



Rice seedlings in Containment Facility

cotton and rice were salvaged by fungicidal seed treatment.

Post-entry quarantine inspection of cotton imported from USA and maize from the Philippines grown in containment at Proagro, Hyderabad and Monsanto, Mumbai, respectively was done and the crops were found to be free from exotic pests/ diseases.

4.7 Human Resource Development

An orientation Course, sixth in the series, on “Biosafety Considerations for Evaluation of Transgenic Crops” was organized from 7–14 November, 2005 at NBPGR, New Delhi. Eighteen participants engaged in research in Biotechnology, Biochemistry, Cytogenetics, Plant breeding and Plant protection in various ICAR and CSIR Institutes, Universities, State Government Departments and Private sector organizations attended the course. Training comprised lectures by eminent Biotechnologists,

Plant breeders, Plant protection specialists, Policy makers, representative of private sector like Monsanto, Mahyco, and also from International Service for the Acquisition of Agri-biotech Applications (ISAAA) covering different aspects like Indian plant genetic resources management system, Global scenario of transgenic crops, National plant quarantine system and regulatory mechanism, Exchange and safe movement, Risk assessment, Cartagena protocol, Pest control through transgenics, Environmental issues and concerns, Implication of transgene flow, Management of containment glass house, Intellectual property rights, and Experiences of private sector etc.

4.8 Classical Biological Control of *Mikania micrantha* with *Puccinia spegazzinii* (DFID-Funded ICAR-CABI Collaborative Project)

As per the recommendations of SRC, 15 additional lines of sunflower were screened against *P. spegazzinii* for host specificity of the rust, *Puccinia spegazzinii*. Chlorotic flecks showing hypersensitive reaction were observed only in one line, JBT-38/228-IC-424494. Based on the results of screening of 107 crop species belonging to various crop groups (including crop species tested at CABI, UK) Plant Protection Advisor to Government of India granted the permission for limited field release of the rust inoculum at two identified sites in Kerala and Assam. Rust inoculum is being multiplied in the Containment Facility. Four consignments of rust inoculums were supplied to Assam and Kerala for multiplication and field release.



Participants of VI Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops from 7-14 November 2005

Research Projects (Project Code, Title, Project leader; Associate/s)

- PGR/PQR-BUR-DEL-01: Quarantine processing of plant germplasm under exchange and supportive research (RK Khetarpal; All scientists of the Division).
- PGR/PQR- BUR-DEL-02: Quarantine processing of germplasm for joint inspection (PC Agarwal; Usha Dev, Shashi Bhalla, DB Parakh , Kavita Gupta).
- PGR/PQR- BUR-DEL-03: Post-entry quarantine processing of exotic germplasm (Shamsher Singh; Arjun Lal, P C Agarwal, B Lal, DB Parakh, V Celia Chalam).
- PGR/PQR- BUR-DEL-04: Quarantine processing of imported transgenic germplasm and supportive research (Manju Lata Kapur; Rajan, Shashi Bhalla, Baleshwar Singh, V Celia Chalam).
- PGR/PQR- BUR-DEL-05: Detection and identification of insect and mite pests in quarantine and supportive research (Kavita Gupta B Lal, Manju Lata Kapur, Shashi Bhalla).
- PGR/PQR- BUR-DEL-06: Detection and identification of nematode pests in quarantine and supportive research (Arjun Lal; Rajan).
- PGR/PQR- BUR-DEL-07: Detection and identification of fungi and bacteria in quarantine and supportive research (Usha Dev; P C Agarwal, Baleshwar Singh).
- PGR/PQR-BUR-DEL-08: Detection and identification of viruses in quarantine and supportive research (V Celia Chalam; DB Parakh, Shamsher Singh).
- PGR/PQR-BUR- DEL-09: Quarantine treatments for disinfestation of germplasm under exchange against insect and mite pests and supportive research (Shashi Bhalla; B Lal, Manju Lata Kapur, Kavita Gupta).
- PGR/PQR-BUR-DEL-10: Quarantine treatments for disinfection of germplasm under exchange against nematodes and supportive research (Rajan; Arjun Lal).
- PGR/PQR-BUR-DEL-11: Quarantine treatments for disinfection of germplasm under exchange against pathogenic fungi and bacteria and supportive research (Baleshwar Singh; PC Agarwal, Usha Dev).
- PGR/PQR-BUR-DEL-12: Seed-health testing for conservation of indigenous germplasm free from pests (B Lal; Arjun Lal, Usha Dev, Manju Lata Kapur, Baleshwar Singh).
- PGR/PQR-BUR-DEL-13: Detection of Viruses in *In- vitro* cultures of germplasm meant for conservation (DB Parakh; DB Parakh, V Celia Chalam, Shamsher Singh).

Externally Funded Projects

1. Seed-health testing of germplasm of different agri-horticultural crops for pest-free conservation of germplasm (*NATP*) (Arjun Lal; RK.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).
2. National containment/ quarantine facility for transgenic planting material (*DBT*)(RK Khetarpal, Gurinder Jit Randhawa Manju Lata Kapur, Kavita Gupta).
3. Network project on diagnostics of emerging plant viruses (RK Khetarpal, DB Parakh, V Celia Chalam)
4. Classical biological control of *mikania micrantha* with *Puccinia spegazzinii* (*DFID funded ICAR-CABI Collaborative Project*) (Usha Dev –Co-PI).

5. GERMLASM EXCHANGE UNIT

Summary: During the period under report, 28,656 accessions (64,806 samples) were imported from 32 countries. These included 15,486 germplasm accessions (16,194 samples) as well as trial material 13,170 entries (48,612 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were met by arranging material from different Indian sources and 76 samples including CIMMYT transit material were sent to four countries. A total of 9,413 samples of different crops were supplied to various users under the material transfer agreement (MTA) for utilization in the various crop improvement programmes in the country.

5.1 Import of Plant Genetic Resources

The unit continued to channelize its efforts for germplasm introduction to meet the specific requirement of scientists working in ICAR research institutes, State Agricultural Universities (SAUs) and non- governmental organizations (NGOs). PGR introduction comprised material obtained on request from the scientists as well as collaborators for international trials to be conducted in India. Introductions of seed/ plant propagules made during the year were as follows.

Accessions procured and processed :	28,656 (64,806)
(a) Germplasm :	15,486 (16,194)
(b) Trials :	13,170 (48,612)
Number of transgenic material imported :	69
Number of countries involved :	32
Number of Import Permits issued :	624

5.1.1 Cereals and millets: *Hordeum vulgare* (2) from Canada; *Oryza alata* (1), *O. australiensis*(3), *O. barthii* (3), *O. brachyantha* (4), *O. eichengeri* (2), *O. glaberrima* (4), *O. glumaepetula* (2), *O. grandiglumis* (3), *O. granulata* (2), *O. latifolia* (4), *O. longiglumis* (3), *O. longistaminata* (3), *O. minuta* (4), *O. latifolia* (4), *O. nivara* (3), *O. officinalis* (3), *O. punctata* (2), *O. rhizomatis* (3) *O. ridleyi* (1), *O. rufipogon* (2) all from IRRI, Philippines; *Oryza sativa* (3,871) from Columbia, Nepal, Philippines, Sri Lanka, UK and USA; *Sorghum bicolor* (696) from France, Niger and USA; *Triticum aestivum* (733) from Australia, Belgium, Mexico and USA; *T. durum* (42) from USA; *Zea mays* (3980) from Australia, Bolivia, Brazil, Mexico, Philippines, South Africa, Spain, Thailand, UK, USA and Zimbabwe. **Trial material:** *Hordeum vulgare* (1,228 entries; 6, 892 samples)-IBCB-S, IBON-LRA-C,

IBON-LRA-M, IBON-MRA, INBON, ISEBON, IBYT-LRA-C, IBYT-LRA-M, IBYT-MRA, IBYW-W from ICARDA, Syria and CIMMYT, Mexico; *Oryza sativa* (1,154 entries, 4,604 samples)-IRHON-2005, IRSBN-05, IRBBN-05, AERON-05, IIRON-05, IRSSTN-05, IRBHN-2005, IURON-05, IRCTN-05, ITRON-05 AERON-05, IURON-05, IRBN-S-05 from IRRI, Philippines; *Triticum aestivum* (6,100 entries; 27,803 samples) -CWGR051ND001, 9th EGPSN, 7th EGPYT, 2nd SAMNYT, 1 DTN, 13th EMBSN, 15th HBSN, 33rd IBON, 28th IBYT, 37th ITSN, 37th ITYN, 35th HRWYT, 26th ESWYT, 5th HLWSN, 13th HRWYT, 38th IBWSN, 37th IDSN, 37th IDYN, 2nd ISWSN, 1st LSSN, 9th SRSN, 23rd SAWSN-W, 13th SAWYT, 2nd YCSN, EBWYT-05-06, CWANA-1st, DSBW-SN, IDONO6- 1FA, IDONO6-MD, IDSP06-MD, IDYT 06-DCA, 6TH RWYT-LR/CA,6TH RWYT-MR-SC, 15TH SRRSN from ICARDA, Syria, CIMMYT, Mexico and CIMMYT, Nepal; *Zea mays* (4,248 entries;7, 442 samples)- ETHYB05, EPOPO5, QHYBO5, Acid Soil 13 Yellow IN 04 B131, CHTTY-05, CHTSY 05, TTWSCYL 05,EVT 16A, EVT 16B, CHTSW-05, CHTHIY-05, EVTI7 HLW05, ILPOP05, ESCY 05-01, ESCY 05-02, ESSCY 05-01,02, SHTY-0521, SHTY-0522, SHTYQ-0525, STCY-0502, STY-0503, TSCEW 05, TSCEW 05, TSCEY05, TSCLW 05, TSCLWQ 05, TSCLY 05, TTWCLW05, TTWCLY 05, EVTWQ, ESSCY 05 from CIMMYT, Mexico.

5.1.2 Grain legumes : *Cicer anatolicum* (6) from USA; *C. arietinum* (961) from Australia, Spain, Syria and USA; *C. bijugum* (17) from Syria; *C. canariense* (1) from USA; *C. cuneatum* (4) from Australia, *C. echinospermum* (23) from Syria and USA; *C. judaicum* (28) from Syria and USA; *C. macracanthus* (2), *C. microphyllum* (4), *C. multijugum* (3) all from USA; *C. oxydon* (4) from USA; *C. pinnatifidum* (16) from Syria and USA; *C.*

reticulatum (34) from Syria and USA; *C. songaricum* (3) from Syria and USA; *C. yamashitae* (1) from USA; *Glycine max* (34) from AVRDC, Taiwan; *Phaseolus vulgaris* (15) from Honduras, Russia and USA; *Pisum sativum* (18) from Russia; *Vicia faba* (2) from Spain; *Vigna marina* (1) *V. radiata* (8), *V. unguiculata* (4) all from AVRDC, Taiwan. **Trial material:** *Cicer arietinum* (367 entries; 1, 718 samples)- CICTN, CIEN-SL 1, CIEN-SL2, CIFWN, CIEN-LA; *Lathyrus sativus* (15 entries; 45 samples)-ILAT-LS; *Vicia faba* (15 entries; 45 samples)-IVAT-VS- all from ICARDA, Syria.

5.1.3 Oilseeds: *Arachis duranensis* (1) from Brazil; *A. hypogaea* (48) from USA and Vietnam; *Arachis* sp. (1) from Brazil; *Brassica juncea* (90) from Australia and Canada; *B. napus* (31) from Australia and Russia; *B. rapa* (2) from Korea; *Carthamus glaucus* (1), *C. lanatus* ssp. *turkestanicus* (3), *C. oxycantha* (3), *C. palestinus* (1), *Carthamus* sp. (5)- all from USA; *C. tinctorius* (3) from Germany; *Helianthus annuus* (109) from France and Yugoslavia.

5.1.4 Vegetable crops: *Abelmoschus esculentus* (54) from AVRDC, Taiwan; *Brassica oleracea* var. *botrytis* (39) from Netherlands; *Capsicum annuum* (153) from Russia and AVRDC, Taiwan, *C. baccatum* (7) *C. chacoense* (4) *C. chinense* (5), *Capsicum* sp. (10) all from AVRDC, Taiwan; *Citrullus lanatus* (10) from Russia; *Cucumis sativus* (138) from Netherlands; *Lycopersicon esculentum* (39) from Cuba, Taiwan and USA; *Daucus carota* (19) from USA, *Solanum melongena* (13) from AVRDC, Taiwan. **Trial material:** *Capsicum annuum* (20 entries; 40 samples)- ICPN 14, ICPN 15; *Lycopersicon esculentum* (23 entries; 23 samples)-determinate tomato lines, processing tomato inbred lines, late blight resistant tomato lines and Gemini virus resistant lines for International distribution-all from AVRDC, Taiwan.

5.1.5 Fruit Crops: *Fragaria ananassa* (3), *F. chiloensis* (8), *F. nilgerrensis* (1), *Fragaria* sp. (1)- all from USA; *Pyrus amygdaliformis* (1), *P. communis* (1), *P. cossonii* (1), *P. fauriei* (1), *P. gharbiana* (1), *P. nivalis* (1), *P. salicifolia* (1), *Pyrus* sp. (63), *P. ussuriensis* (1), *P. uyematsvana*

(1)- all from USA; *Rubus axillaris* (1), *R. caesium* (1), *R. cissoides* (1), *R. drejeri* (1), *R. hirsutus* (2), *R. hispidus* (1), *R. idaeus* (1), *R. laciniatus* (1), *R. parviflorus* (1), *R. saxatilis* (1), *Rubus* sp. (44), *R. uilmifolius* (1), *R. ursinus* (2)- all from USA; *Vaccinium corymbosum* (6), *V. hybrid* (2), *V. macrocarpon* (12), *V. ovatus* (2), *V. oxycoccus* (3), *Vaccinium* sp. (2)- all from USA.

5.1.6 Fibres: *Gossypium hirsutum* (391) from China, Turkey and USA.

5.1.7 Forage: *Trifolium pratense* (2) from USA.

5.1.8 Plantation crops: *Salix alba* (1) from Israel; *S. acumophylla* (8) from Israel; *Salix* sp. (1) from UK.

5.1.9 Narcotics: *Nicotiana acuminata* (1), *N. africana* (1), *N. arentsii* (1) *N. calyciflora* (1), *N. cavicola* (8), *N. corymbosa* (1), *N. goodspeedii* (5), *N. gossei* (1), *N. heterantha* (1), *N. longsdorfii* (1), *N. linearis* (1), *N. maritima* (6), *N. miersii* (1), *N. obtusifolia* (1), *N. occidentalis* ssp. *obliqua* (1), *N. pauciflora* (1), *N. raimondii* (1), *N. rosulata* (13), *N. rosulata* ssp. *ingulba* (7), *N. rotundifolia* (11), *N. simulans* (2), *Nicotiana* sp. (8), *N. suaveolens* (12), *N. tabacum* (1)- all from Australia.

5.1.10 Beverages: *Theobroma cacao* (13) from UK.

5.1.11 Tuber crops: *Solanum bulbocastanum* (7) from Netherlands and USA; *S. bulbocastanum* ssp. *bulbocastanum* (14) *S. chacoense* (3), *S. circaeifolium* (7), *S. commersonii* (8), *S. commersonii* ssp. *commersonii* (2), *S. commersonii* ssp. *maëmeanum* (5), *S. tuberosum* (5), *S. humectohilum* (1), *S. moschiquense* (4), *S. palustre* (3), *S. pinnatisectum* (8)- all from Netherlands. *Solanum tuberosum* (138) from Australia, Bangladesh, Canada, China, Peru, South Africa, Switzerland and USA; *S. tuberosum* ssp. *tuberosum* (2) from USA.

5.2 Repatriation of Germplasm of Indian Origin

A total of 7,694 accessions of Indian origin comprising *Oryza sativa* (7,350) from IRRI,

Philippines, and USA; *Triticum aestivum* (95) from CIMMYT, Mexico; *Cicer arietinum* (3) from ICARDA, Syria and USA; *Phaseolus vulgaris* (231) from CIAT, Columbia; *Abelmoschus esculentus* (4) and *Solanum melongena* (9) from AVRDC, Taiwan; *Manihot esculenta* (2) from CIAT, Columbia were repatriated.

In addition 3,188 accessions were received for national accessioning which included *Triticum aestivum* (9), *Cajanus cajan* (13), *Cicer arietinum* (738), *Lathyrus sativus* (1), *Phaseolus multiflorus* (16), *Phaseolus vulgaris* (44), *Arachis hypogaea* (1,578), *Carthamus tinctorius* (235), *Lycopersicon esculentum* (98), *Gossypium arboreum* (3), *Gossypium hirsutum* (427) and *Nicotiana tabacum* (26).

5.3 Export of Plant Genetic Resources

The seed and plant materials of agricultural and horticultural crops were exported on the basis of (i) requests received by the Bureau/ICAR headquarters (ii) requests 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 along with phytosanitary certificates issued by the Plant Quarantine Division of the Bureau and import permit, if any, after approval from ICAR/DARE. The export of seed/planting materials during 2005 is indicated below.

Number of requests registered :	6
Number of countries to which material exported :	4
Number of accessions exported :	76

Cereals: *Triticum aestivum* (22) to Kenya; *Zea mays* (29) to East Timor and Mexico

Oilseeds: *Brassica juncea* (25) to Australia
Country wise export

Australia (25) *Brassica juncea*; East Timor (6) *Zea mays*; Kenya (22) *Triticum aestivum*; Mexico (23) *Zea mays*.

Table 1: Promising material introduced during 2005

Cop/EC No.	Source country	Traits	Distribution
Cereals and pseudocereals			
<i>Oryza sativa</i> EC565092-117 EC565215-17 EC565278-321 EC559259-90	IRRI, Philippines	Cytoplasmic male sterility (CMS) lines and maintainers	<ul style="list-style-type: none"> • Mahyco Res. Foundation, AP. • Bioseed Research India Pvt. Ltd. • Advanta India Ltd., Hyderabad • Proagro seeds Co., Pvt. Ltd., Hyderabad
<i>Oryza sativa</i> EC564674-81 EC565322-26 EC559230-32	IRRI, Philippines	Thermogenic male sterile (TGMS) lines	<ul style="list-style-type: none"> • Bioseed Research India Pvt. Ltd. • Advanta India Ltd., Hyderabad • Agril. Res. Station, Thirupathisaram, TN
<i>Oryza sativa</i> EC564773-79 EC565135-58 EC565582 EC566358-386 EC568964-94	IRRI, Philippines	Salinity tolerant lines	<ul style="list-style-type: none"> • Dept. of Agri. Botany, Annamalai University, TN • Mahyco Res. Foundation, AP • Advanta India Ltd., Bangalore • ARS, Thirupathisaram, TNAU, TN • PAJANCOA, Pondichery
<i>Oryza sativa</i> EC564780-790 EC565570-75	IRRI, Philippines	Drought tolerant lines	<ul style="list-style-type: none"> • Dept. of Agri. Botany, Annamalai University, TN • Advanta India Ltd., Bangalore

<i>Oryza sativa</i> EC565159	IRRI, Philippines	High iron content	<ul style="list-style-type: none"> • Mahyco Res. Foundation, AP
<i>Oryza sativa</i> EC566268-299	IRRI, Philippines	Monogenic lines for blast resistance	<ul style="list-style-type: none"> • HPKV, Palampur
<i>Oryza sativa</i> EC556545-566 EC559320-2, 23, 25, 35	IRRI, Philippines	New plant type (NPT)	<ul style="list-style-type: none"> • Advanta India Ltd., Bangalore • Proagro Seeds Co. Pvt. Ltd. Hyderabad
<i>Oryza sativa</i> EC556567-569	IRRI, Philippines	Tungro virus resistant lines	<ul style="list-style-type: none"> • Advanta India Ltd., Bangalore
<i>Oryza sativa</i> EC556580	IRRI, Philippines	Iron and zinc rich lines	<ul style="list-style-type: none"> • Advanta India Ltd., Bangalore
<i>Oryza sativa</i> EC558724-727	Nepal	Early maturing, high yielding and fine grained upland varieties	<ul style="list-style-type: none"> • Gramin Vikas Trust, Bhopal
<i>Oryza sativa</i> EC568081-87	IRRI, Philippines	Brown plant hopper resistant lines	<ul style="list-style-type: none"> • Mahyco Res. Foundation, Hyderabad
<i>Oryza sativa</i> EC568088-92	IRRI, Philippines	Blast resistant lines	<ul style="list-style-type: none"> • Mahyco Research Foundation, Hyderabad
<i>Oryza sativa</i> EC568093-8144	IRRI, Philippines	Bacterial blight resistant lines	<ul style="list-style-type: none"> • Mahyco Research Foundation, Hyderabad
<i>Oryza sativa</i> EC 568146	IRRI, Philippines	Tungro virus resistant lines	<ul style="list-style-type: none"> • Mahyco Research Foundation, Hyderabad
<i>Oryza sativa</i> EC568152, 56-57	IRRI, Philippines	Iron toxicity tolerant lines	<ul style="list-style-type: none"> • Mahyco Research Foundation, Hyderabad
<i>Oryza sativa</i> EC568153-55,58-59	IRRI, Philippines	High yielding lines	<ul style="list-style-type: none"> • Mahyco Research Foundation, Hyderabad
<i>Triticum aestivum</i> var KAMUT EC556272	Belgium	High protein content line	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Triticum aestivum</i> var Eden EC556885	USA	High grain yield, superior quality, resistant to stripe rust	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Triticum aestivum</i> var. Hollis EC556386	USA	High grain protein content, high grain weight, superior bread baking quality and resistant to Hessian fly	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Triticum aestivum</i> EC557028-30	USA	Homozygous for the blue aleurone trait, blue aleurone traits exhibits a strong Xenia effect	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Triticum aestivum</i> EC560451-473	USA	Partial waxy, reduced amylose content, useful as donor of wx null alleles	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Zea mays</i> EC568876-881	USA	Cytoplasmic male sterile (CMS) lines	<ul style="list-style-type: none"> • Pioneer Overseas Corporation, Ghaziabad, UP
<i>Hordeum vulgare</i> EC570289	Canada	High grain and biomass yield, resistant to surface borne smut and true loose smut	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi
<i>Hordeum vulgare</i> EC570290	Canada	Yellow aleurone, lodging resistant, resistant to scald and covered smut	<ul style="list-style-type: none"> • DWR, Karnal • NBPGR, New Delhi

<i>Sorghum bicolor</i> EC568885-86	USA	Male sterile lines	<ul style="list-style-type: none"> • NRC Sorghum, Hyderabad
<i>Sorghum bicolor</i> EC568887	USA	Maintainer lines	<ul style="list-style-type: none"> • NRC Sorghum, Hyderabad
Oilseeds			
<i>Brassica juncea</i> EC564640-643 EC564644-649	Australia	Early maturity, high oil content and double low quality and high black leg resistance.	<ul style="list-style-type: none"> • NRC Rapeseed Mustard, Bharatpur
<i>Brassica juncea</i> EC564728	Russia	Low erucic acid (0.6%) and glucosinolate (0.4-0.6%) content	<ul style="list-style-type: none"> • NRC Rapeseed Mustard, Bharatpur
<i>Brassica napus</i> EC557008-017	Australia	Double low quality, high oil content	<ul style="list-style-type: none"> • NRC Rapeseed Mustard, Bharatpur
<i>Brassica napus</i> EC557013,22	Australia	Bold seeded	<ul style="list-style-type: none"> • NRC Rapeseed Mustard, Bharatpur
<i>Brassica napus</i> EC657011-12, 18-19,21,26	Australia	Tolerant to <i>Sclerotinia sclerotum</i>	<ul style="list-style-type: none"> • NRC Rapeseed Mustard, Bharatpur
Grain legumes			
<i>Cicer arietinum</i> EC565197-5214	USA	Heat tolerant types	<ul style="list-style-type: none"> • IIPR, Kalyanpur, Kanpur
<i>Cicer arietinum</i> EC554857	USA	Ascochyta blight resistant line	<ul style="list-style-type: none"> • Division of Genetics, IARI, New Delhi
<i>Cicer arietinum</i> EC556541-542	Spain	Kabuli land races, resistant to Ascochyta blight (<i>Ascochyta rabiei</i>) and fusarium wilt (<i>Fusarium oxysporum</i>)	<ul style="list-style-type: none"> • Division of Genetics, IARI, New Delhi
<i>Cicer arietinum</i> EC556900-01	USA	Kabuli type, bold seeded resistant to Ascochyta blight	<ul style="list-style-type: none"> • Division of Genetics, IARI, New Delhi
<i>Cicer arietinum</i> EC568900-909	Australia	Cold tolerant lines	<ul style="list-style-type: none"> • IIPR, Kalyanpur, Kanpur • Division of Genetics, IARI, New Delhi
<i>Cicer arietinum</i> EC566910-919	Australia	Salt tolerant lines	<ul style="list-style-type: none"> • IIPR, Kalyanpur, Kanpur • Division of Genetics, IARI, New Delhi
<i>Glycine max</i> EC559539-4271	AVRDC, Taiwan	Vegetable type	<ul style="list-style-type: none"> • PEQN (seed for NRC Soybean, Indore)
<i>Glycine max</i> EC559572	AVRDC, Taiwan	Rust tolerant and vegetable type	<ul style="list-style-type: none"> • PEQN (seed for NRC Soybean, Indore)
<i>Phaseolus vulgaris</i> EC566673-74	USA	Large seeded, resistant to Curly top virus (CTV), resistant to Bean common mosaic virus (BCMV) and halo blight	<ul style="list-style-type: none"> • NBPGR Reg. Strn., Shimla • IIPR, Kalyanpur, Kanpur
<i>Phaseolus vulgaris</i> EC566209	USA	Resistant to common bacterial blight, <i>Bean common mosaic necrosis virus</i> and <i>Bean common mosaic virus</i>	<ul style="list-style-type: none"> • NBPGR Reg. Strn., Shimla • IIPR, Kalyanpur, Kanpur
<i>Phaseolus vulgaris</i> EC559573-74	Honduras	Resistant to <i>Bean golden yellow mosaic virus</i> (BGYMV), anthracnose (<i>Colletotrichum lindemuthianum</i>), angular leaf spot (<i>Phaeoisariopsis griseola</i>) and web blight (<i>Tharatephorus cucumeris</i>)	<ul style="list-style-type: none"> • NBPGR Reg. Strn., Shimla • IIPR, Kalyanpur, Kanpur

<i>Pisum sativum</i> EC564818	Russia	Vegetable type fully podded with uniform number of seeds	<ul style="list-style-type: none"> • NBPGR Reg. Strn., Shimla • IIPR, Kalyanpur, Kanpur
<i>Vicia faba</i> EC556902	Spain	Resistance to broomrape (<i>Orobancha crenata</i>)	<ul style="list-style-type: none"> • IIPR, Kalyanpur, Kanpur
<i>Vigna radiata</i> EC565626-33	AVRDC, Taiwan	<i>Mungbean yellow mosaic virus</i> resistant lines	<ul style="list-style-type: none"> • Pulses & Oilseeds Research Station, Berhampore, WB
<i>Vigna unguiculata</i> EC563227-28	USA	Vegetable type	<ul style="list-style-type: none"> • Horticultural College & Research Institute, TNAU, Tamil Nadu

Vegetables

<i>Capsicum annuum</i> EC559416-9426	AVRDC, Taiwan	Resistant to <i>Capsicum mosaic virus</i> (CMV), <i>Chilli veinial mosaic virus</i> (CVMV)	<ul style="list-style-type: none"> • IIHR, Bangalore
<i>Capsicum annuum</i> EC559491-496	AVRDC, Taiwan	Resistant to Anthracnose and <i>Capsicum mosaic virus</i>	<ul style="list-style-type: none"> • IIHR, Bangalore
<i>Capsicum annuum</i> EC559424-9508	AVRDC, Taiwan	Resistant to <i>Poty virus Y</i> and bacterial wilt	<ul style="list-style-type: none"> • IIHR, Bangalore
<i>Capsicum annuum</i> EC570005-12	AVRDC, Taiwan	Resistant to <i>Tomato mosaic virus</i> , <i>Poty virus Y</i> , <i>Chilli mosaicvirus</i> and leaf curl	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, Hyderabad
<i>Capsicum annuum</i> EC568925-29	AVRDC, Taiwan	Resistant to <i>Tomato mosaic virus</i> , <i>Tomato etch virus</i>	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, Hyderabad
<i>Capsicum frutescens</i> EC568929	AVRDC, Taiwan	Resistant to <i>Tomato etch virus</i>	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, Hyderabad
<i>Cucumis sativus</i> EC565750	Netherlands	Large size with green skin type	<ul style="list-style-type: none"> • Syngenta India Ltd., Pune
<i>Cucumis sativus</i> EC565767	Netherlands	Female line	<ul style="list-style-type: none"> • Syngenta India Ltd., Pune
<i>Cucumis sativus</i> EC565796	Netherlands	Early type	<ul style="list-style-type: none"> • Syngenta India Ltd., Pune
<i>Cucumis sativus</i> EC565832	Netherlands	Pickle type	<ul style="list-style-type: none"> • Syngenta India Ltd., Pune
<i>Lycopersicon esculentum</i> EC568938-44	AVRDC, Taiwan	Resistant to <i>Tomato leaf curl virus</i> , <i>LATYLC</i> , late blight, verticillium wilt, bacterial wilt	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi
<i>Lycopersicon esculentum</i> EC570019	AVRDC, Taiwan	Plum shaped, small fruited and heat tolerant	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi
<i>Lycopersicon esculentum</i> EC570024-28	AVRDC, Taiwan	Resistant to bacterial wilt, <i>Tomato mosaic virus</i> , <i>Fusarium wilt</i> , grey leaf spot <i>Stemphyllum solanii</i>	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi
<i>Lycopersicon esculentum</i> EC570015-16	AVRDC, Taiwan	Globe shaped, large fruited and heat tolerant	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi
<i>Lycopersicon esculentum</i> EC562072-74	USA	Large fruited and resistant to <i>Fusarium oxysporum</i> f.sp. <i>lycopersici</i>	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi
<i>Lycopersicon esculentum</i> EC560340	Cuba	Heat tolerant and resistant to early blight (<i>Alternaria solanii</i>)	<ul style="list-style-type: none"> • IIVR, Varanasi • NBPGR, New Delhi

<i>Lycopersicon esculentum</i> EC565215	USA	Rich in β -carotene	• MPKV, Rahuri
Fruits			
<i>Fragaria ananassa</i> EC569143-44	USA	High yielding and short day type	• NBPGR, Reg. Stn., Shimla
<i>Fragaria</i> sp. EC560169	USA	Downy mildew resistant	• TCCP Unit, NBPGR
<i>Vaccinium corymbosum</i> EC562075-78	USA	Firm fleshed, good flavour, vigorous, resistant to cracking, early ripening	• TCCP Unit, NBPGR
<i>Vaccinium hybrid</i> EC562081-82	USA	Firm fleshed, good flavour, low chilling and early ripening	• TCCP Unit, NBPGR
<i>Vaccinium oxycoccos</i> EC562097	USA	Prolific bearer, good keeping quality, resistant to leaf hopper	• TCCP Unit, NBPGR
<i>Vaccinium macrocarpon</i> EC562086,97	USA	Resistant to blunt nose leaf hopper and false blossom	• TCCP Unit, NBPGR
<i>Pyrus</i> spp. EC560258	USA	Resistant to blister mite	• TCCP Unit, NBPGR
<i>Rubus idaeus</i> EC559018	USA	High yielding big sized fruits, and good keeping quality	• NBPGR Reg. Stn., Shimla
<i>Gossypium hirsutum</i> EC559348-63	China	Isolines	• CICR, Nagpur
<i>Gossypium hirsutum</i> EC559008-12	USA	High yielding, good fibre strength	• CICR, Nagpur Seed for Proagro Seed Company, Hyderabad
<i>Gossypium hirsutum</i> EC559013	USA	High ginning out-turn	• CICR, Nagpur Seed for Proagro Seed Company, Hyderabad
<i>Gossypium hirsutum</i> EC559014-15	USA	Early maturing	• CICR, Nagpur Seed for Proagro Seed Company, Hyderabad
<i>Gossypium hirsutum</i> EC560321-328	Turkey	Boll weight ranging from 5.4 to 7.7, lint percent ranging from 39.1 to 41.8 with fine and strong fibres	• CICR, Nagpur
Narcotics			
<i>Nicotiana excelsior</i> EC559237	USA	Aphid resistant line	• CTRI, Rajamundry, AP
Forages			
<i>Trifolium pratense</i> EC560447-448	USA	Short internodes, plants usually present a rosette appearance but flower sparingly under long day conditions	• IGFRI, Jhansi

Table 2: Transgenic material introduced during 2005

Crop/EC No.	Source country	Traits	Distribution
<i>Oryza sativa</i> EC560441-446	UK	American long grained cultivar "Cocodrie" capable of synthesizing beta-Carotene containing Psy (Phylone synthase) and Crtl (Phytoene desaturase) genes	Directorate of Rice Research, Hyderabad
<i>Gossypium hirsutum</i> EC559687	USA	VIP 3-A gene for imparting resistance to boll worm and other common insect pests of cotton	CICR, Nagpur (seed for Syngenta India Ltd, Pune)
<i>Gossypium hirsutum</i> EC559688	USA	Ascorbate peroxidase (APX) gene for increase in the levels of ascorbate peroxidase enzyme and for increasing the ability to withstand various stress conditions	CICR Nagpur (seed for Ankur Seeds Pvt. Ltd, Nagpur, MS)
<i>Gossypium sp</i> EC565218	USA	Containing CP4 EPSPS gene for tolerance to glyphosate herbicide	CICR, Nagpur (seed for Mahyco Seed Co., Mumbai)
<i>Gossypium hirsutum</i> EC568958-960	USA	Cry 1 Ab gene for imparting resistance to boll worm and other insect pests	CICR, Nagpur (seed for Syngenta Seeds Pvt. Ltd., MS)
<i>Gossypium hirsutum</i> EC559020-32	USA	Three transgenes designated as Cry 1Ac, npt 11 and add genes and Cry X (Org 1Ac & Cry 2Ab genes) npt 11 and uid A genes, Cry 1Ac & Cry X genes for an insecticidal protein derived	CICR Nagpur (seed for Proagro Seed Company, Bangalore)
<i>Zea mays</i> EC564695-722 EC564723-727 EC568961-963	USA Philippines Philippines	Expressing Cry 1A(b) gene for imparting resistance against insect pests of corn	Monsanto India Ltd., Mumbai
<i>Solanum tuberosum</i> EC565190-96	USA	Kathadin expressing RB gene for potato late blight resistance	CPRI, Shimla

5.4 Inland Supply of Plant Genetic Resources

The seed and planting materials of diverse agricultural and agri-silvicultural crops were supplied

to ICAR institutes/coordinated projects, agricultural universities and Union Territories of India. Based on specific requests received 9,413 samples were supplied by the Bureau as per the details given below under the material transfer agreement (MTA)

Crop name	Samples	Recipient states
Cereals and millets (7,648)		
<i>Echinochloa frumentacea</i>	1	Uttar Pradesh
<i>Eleusine coracana</i>	5	Uttar Pradesh
<i>Hordeum vulgare</i>	232	Delhi, Haryana
<i>Oryza sativa</i>	391	HP, Orissa, TN
<i>Panicum milliaceum</i>	8	Uttar Pradesh
<i>Paspalum scrobiculatum</i>	5	Uttar Pradesh
<i>Pennisetum glaucum</i>	35	Delhi, Rajasthan
<i>Setaria italica</i>	9	Delhi, Uttar Pradesh
<i>Triticum aestivum</i>	109 (G)6,849 (T)	Delhi, Haryana, Bihar, HP different locations in various states
<i>Zea mays</i>	4	Delhi
Oilseeds (43)		
<i>Brassica sp.</i>	10	Uttaranchal
<i>Crambe abyssinica</i>	12	Uttaranchal
<i>Glycine max</i>	11	Uttaranchal
<i>Ricinus communis</i>	10	Uttar Pradesh
Grain legumes (613)		
<i>Cajanus cajan</i>	109	AP

<i>Cyamopsis tetragonoloba</i>	157	Karnataka, AP, Delhi, Rajasthan
<i>Lathyrus sativus</i>	1	Delhi
<i>Lens culinaris</i>	43	J&K, Bihar, Uttaranchal
<i>Mucuna sp.</i>	11	Delhi
<i>Phaseolus vulgaris</i>	15	J&K
<i>Pisum sativum</i>	35	J&K, Maharashtra
<i>Vicia faba</i>	30	HP
<i>Vigna aconitifolia</i>	115	Delhi, Maharashtra
<i>Vigna angularis</i>	15	Delhi
<i>Vigna mungo</i>	18	Delhi, Haryana, TN
<i>Vigna radiata</i>	3	Delhi, Haryana
<i>Vigna sp.</i>	1	Haryana
<i>Vigna unguiculata</i>	57	Delhi, J&K, Rajasthan, Maharashtra, TN
<i>Vigna vexillata</i>	3	New Delhi
Vegetables (501)		
<i>Capsicum sp.</i>	262	A&N, Karnataka, Maharashtra, AP, Uttar Pradesh, Uttaranchal, J&K, HP
<i>Cucumis sativus</i>	2	Kerala, Uttar Pradesh
<i>Dolichos lablab</i>	2	Uttar Pradesh
<i>Luffa acutangula</i>	10	Delhi
<i>Luffa cylindrica</i>	10	Delhi
<i>Lycopersicon esculentum</i>	86	A&N, Gujarat, Uttar Pradesh, Delhi, J&K
<i>Solanum melongena</i>	108	A&N, MP, Karnataka, Uttaranchal
<i>Spinacea oleracea</i>	10	MP
<i>Trichosanthes anguina</i>	10	T N
<i>Trigonella foenum graecum</i>	1	Delhi
Fruits (295)		
<i>Actinidia chinensis</i>	1	Kerala
<i>Actinidia sp.</i>	1	HP
<i>Aegle marmelos</i>	7	Uttaranchal
<i>Artocarpus heterophyllus</i>	1	Uttaranchal
<i>Averrhoa carambola</i>	1	Uttaranchal
<i>Carissa congesta</i>	6	Uttaranchal
<i>Emblica officinalis</i>	4	Uttaranchal
<i>Eriobotrya japonica</i>	1	Uttaranchal
<i>Ficus carica</i>	7	Uttaranchal
<i>Fragaria sp.</i>	27	Uttaranchal, HP
<i>Garcinia mangostana</i>	4	Karnataka
<i>Grewia subinaequalis</i>	1	Uttaranchal
<i>Lebera</i>	4	Uttaranchal
<i>Morus alba</i>	2	Uttaranchal
<i>Musa sp.</i>	169	Uttar Pradesh, Kerala, Punjab, Delhi, TN
<i>Nephelium lappaceum</i>	24	Karnataka
<i>Passiflora edulis</i>	2	Uttaranchal
<i>Punica granatum</i>	9	Uttaranchal, Delhi
<i>Rubus sp.</i>	2	Uttaranchal
<i>Syzygium cumini</i>	20	Uttar Pradesh, Jammu
<i>Ziziphus mauritiana</i>	2	Bihar, Uttaranchal
Forages (51)		
<i>Acacia sp.</i>	22	Delhi
<i>Avena sativa</i>	1	Uttar Pradesh
<i>Capparis decidua</i>	2	Delhi
<i>Prosopis sp.</i>	24	Delhi
<i>Salvadora oleoides</i>	2	Delhi
Ornamentals (37)		
<i>Tagetes sp.</i>	36	Uttaranchal
<i>Fragaria sp.</i>	1	Uttar Pradesh
Under-utilized crops (73)		
<i>Amaranthus sp.</i>	55	Maharashtra, Pondicherry

<i>Coix lacryma jobi</i>	2	Delhi
<i>Jatropha</i> sp.	10	Rajasthan
<i>Lpil-lpil</i>	1	Haryana
<i>Sesbania</i> sp.	4	Delhi
<i>Vigna umbellata</i>	1	Haryana
Fibers (32)		
<i>Hibiscus sabdariffa</i>	29	Maharashtra
<i>Gossypium</i> sp.	3	Maharashtra
Spices (32)		
<i>Zingiber officinale</i>	14	Punjab, Maharashtra
<i>Curcuma longa</i>	8	Punjab
Tubers (13)		
<i>Dioscorea</i> sp.	13	Delhi
Narcotics (3)		
<i>Nicotiana tabacum</i>	3	AP
Medicinal and Aromatic Plants (67)		
<i>Achillea millefolium</i>	1	Uttaranchal
<i>Aloe barbadensis</i>	3	Uttaranchal
<i>Andrographis paniculata</i>	14	Uttar Pradesh
<i>Artemisia</i> sp.	3	Kerala
<i>Bacopa monnieri</i>	1	Uttar Pradesh
<i>Centella asiatica</i>	1	Uttar Pradesh
<i>Coleus</i> sp.	1	Uttar Pradesh
<i>Cryptomeria japonica</i>	1	Uttaranchal
<i>Digitalis purpurea</i>	1	Uttaranchal
<i>Ginkgo biloba</i>	1	Uttaranchal
<i>Lavendula officinalis</i>	1	Uttaranchal
<i>Ocimum sanctum</i>	31	West Bengal
<i>Picrorrhiza kurroa</i>	1	Uttar Pradesh
<i>Rauvolfia serpentina</i>	1	Dayalbagh Educational Institute, Agra
<i>Rosmarinus officinalis</i>	1	Sherwood College, Nainital
<i>Salvia officinalis</i>	2	Sherwood College, Nainital
<i>Stevia</i> sp.	1	DARL, Pithoragarh
<i>Taxus baccata</i>	1	Sherwood College, Nainital
Total	9,413	

Research Projects (Code, Title, Project leader, Associate/s)

PGR/GEX-BUR-DEL-01: Exchange of plant genetic resources with foreign countries (import/export) and national supplies of the Plant genetic resources and related information to the scientist/users in the country (RV Singh).

PGR/GEX-BUR-DEL-02: Import, export and inland (national) supply of plant genetic resources and exchange of related information to the scientists/users in the country (Deep Chand).

PGR/GEX-BUR-DEL-03: Documentation and dissemination of information on germplasm both imported and collected indigenously in the form of plant germplasm reporter (Vandana Tyagi).

PGR/GEX-BUR-DEL-04: Preparation of bibliography through survey of literature on plant genetic resources (Vandana Tyagi).

PGR/GEX-BUR-DEL-05: Assembly of literature and preparation of crop inventories on plant genetic resources (AK Singh).

6. TISSUE CULTURE AND CRYOPRESERVATION UNIT

Summary: During the year, a total of 1,783 accessions belonging to fruit crops, bulbous and tuber crops, medicinal, aromatic and rare/ endangered species, 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. Two new genera namely, *Pyrus* and *Vaccinium* were introduced in the *in vitro* genebank during the period reported upon. Research work was carried out on aspects related to *in vitro* slow growth and cryopreservation in aforementioned group of crops. Employing several slow growth strategies, subculture duration could be enhanced to varying periods in *Alliums*, *Bacopa monnieri*, *Centella asiatica*, *Colocasia esculenta* and *Mentha* sp. Cost-effective conservation experiments yielded encouraging results in *Curcuma longa* cv. Prathibha and *Bacopa monnieri*. Cryopreservation experiments led to varying degree of success in *Allium tuberosum*, *B. monnieri*, *Dioscorea bulbifera*, *Gentiana kurroo*, *Morus* spp. and *Musa*. Employing RAPD and ISSR markers, there were no significant differences between *in vitro*-conserved cultures and their respective mother clones, in *Curcuma* spp., and between micro-corm generated plantlets and their respective mother plants, in *Colocasia esculenta*. A total of 85 accessions of *Musa* and seven accessions of five medicinally important genera were supplied as *in vitro* cultures to various indentors. A total of 7,265 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen 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, 204 new accessions were added in the *in vitro* genebank and these included *Alliums* (13), *Colocasia esculenta* (20), *Curcuma* spp. (18), *Dioscorea* spp. (20), *Fragaria* spp.(18), *Gladiolus* cv. (3), medicinal and aromatic plants (20), *Morus* spp. (4), *Musa* spp. (26), *Piper* spp. (3), *Pyrus* spp. (28), *Vaccinium* spp.(13), *Vitis vinifera* (1), *Rubus* spp.(13) and *Zingiber* spp. (4). A total of 1783 accessions belonging to different crop groups were maintained *in vitro* and sub cultured at periodic interval (Table 1).

Tropical fruits

A total of 394 accessions of *Musa* (~ 5,000 cultures)

and three of *Vitis vinifera* were conserved as *in vitro* cultures at 25 °C and 8/16 h photoperiod. The average subculture duration under these conditions varied from 6 to 12 months in banana, depending on the genotype. In all, 26 new accessions of banana and one accession of grape were added during the year. In banana, new germplasm included two notified varieties developed at NRC on Banana, Trichy and one wild species (*Musa aurantica*). The remaining accessions comprised various triploid landraces of French Plantain (Nendrans) that have been evaluated at Banana Research Station, Kannara, Kerala.

To cryopreserve shoot meristems of banana, the vitrification method was applied in three accessions of banana (*Musa* spp.) belonging to subgroups Monthan, Ash, Batheesa and Unique of ABB. Post-thaw recovery varied from 10-30% in different accessions. These accessions have been cryopreserved in the LN cryotank for long-term conservation.

Table 1: Status of *in vitro* conserved germplasm in TCCU (As on December 31, 2005)

Crop groups	Storage temp. (°C)	Subculture interval (months)	Acces. in culture (no.)
Fruits			
<i>Musa</i> spp.	25	8-12	394
<i>Actinidia</i> spp.	25	10-12	3
<i>Aegle marmelos</i>	25	12	1
<i>Fragaria</i> spp.	25, 4	8-12	66
<i>Prunus</i> spp.	25	4-6	2
<i>Pyrus</i> spp.	25	-	28
<i>Rubus</i> spp.	25	8-10	18
<i>Malus</i> sp.	25	4-6	4

<i>Morus</i> spp.	25	8-10	52
<i>Vaccinium</i> spp.		-	13
<i>Vitis vinifera</i>	25	3-4	3
Tuber Crops			
<i>Alocasia</i> spp.	25	10	3
<i>Colocasia esculenta</i>	25	8-10	151
<i>Dioscorea</i> spp.	25	8-12	95
<i>Ipomoea batatas</i>	25	8-12	255
<i>Xanthosoma sagittifolium</i>	25	10	9
Bulbous Crops			
<i>Allium sativum</i>	25,4	6-12	145
<i>Allium</i> spp.	25, 4	4-23	17
Medicinal and Aromatic Plants			
<i>Acorus calamus</i>	-	-	1
<i>Aristolochia indica</i>	25	-	1
<i>Bacopa monnieri</i>	25	6	18
<i>Centella asiatica</i>	-	-	10
<i>Coleus aromaticus</i>	-	-	3
<i>Coleus forskohlii</i>	25	12	13
<i>Chlorophytum</i> sp.	-	-	3
<i>Costus speciosus</i>	-	-	1
<i>Curculigo orchiooides</i>	-	-	2
<i>Digitalis</i> spp.	4	11	6
<i>Eremostachys superba</i>	4	10	2
<i>Gentiana kurroo</i>	4	12	1
<i>Kaempferia galanga</i>	25	-	6
<i>Kaempferia rotundata</i>	25	-	4
<i>Mentha</i> sp.	4	12	24
<i>Peristrophe bicalyculata</i>	-	-	1
<i>Picrorhiza kurroa</i>	4	12	9
<i>Plumbago zeylanica</i>	25	6-10	13
<i>Pogostemon patchouli</i>	25	12	2
<i>Pycnanthemum</i> spp.	4	12	4
<i>Rauvolfia</i> spp.	25	12	12
<i>Rheum</i> spp.	4	12	5
<i>Saussurea lappa</i>	4	12	3
<i>Swertia chirayita</i>	4	6	3
<i>Tylophora indica</i>	25	6-12	10
<i>Valeriana wallichii</i>	4	12	11
Spices			
<i>Curcuma</i> spp.	25	6-10	127
<i>Elettaria</i> spp.	25	15	5
<i>Piper</i> spp.	25	10-22	10
<i>Zingiber</i> spp.	25	8-24	184
<i>Vanilla planifolia</i>	25	6	4
Industrial Plants			
<i>Humulus lupulus</i>	25	6	8
<i>Simmondsia chinensis</i>	25	6	12
Others			
<i>Cicer microphyllum</i>	-	-	1
<i>Gladiolous</i> cv.	-	-	5
Total			1,783

Bulbous crops

A total of 167 accessions belonging to 16 species (*Allium* spp. and *Gladiolous* cultivars) 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 to 23 months, depending on the species.

During the year, 16 new accessions were established *in vitro* which included *Allium sativum* (12), *Allium* spp. (1) and *Gladiolus* cultivars (3). In 40 accessions of *A. sativum*, bacterial contamination appeared following transfer of *in vitro* conserved (at low temperature) cultures to fresh medium, for rejuvenation under culture room conditions. However, sterilant treatment to remove bacterial contamination reduced the number of cultures up to one or two per accession.

In Dahlia, procured from Bhowali regional station, contamination-free cultures were established following sterilant treatment and only single shoot per nodal segment explant was obtained.

Regarding *in vitro* conservation, in *Allium chinense*, replacement of cotton plugs with polypropylene caps as closures prolonged subculture duration up to 10 months on shoot multiplication medium and with inclusion of high sucrose (10%) in the medium, it could be extended up to 18 months, under culture room conditions. In *Allium fistulosum*, use of polypropylene caps as closures was beneficial in prolonging subculture duration from 3 months to 6 months, tested so far. In *Allium tuberosum*, encapsulated *in vitro* shoot bases and in *A. chinense*, *in vitro* bulblets, conserved in cryovials without nutrient medium, lost viability by 11 wks whereas those stored at 4°C remained viable

Cryopreservation experiments were also initiated in *A. ramosum* using *in vitro* shoot bases. Explants maintained on multiplication medium and pregrown on the same medium, could tolerate PVS2 dehydration but failed to survive LN freezing. In *A. tuberosum* using encapsulation-dehydration technique, *in vitro* shoot bases encapsulated in alginate exhibited up to 5% regrowth following LN freezing.

Medicinal, aromatic, rare and endangered plants

In vitro maintenance of 168 accessions belonging to 24 genera and 33 species was achieved through periodic subculture (4 to 24 months) either under culture room conditions and/ or at low temperature.

A total of 21 accessions belonging to 10 genera were added in the *in vitro* genebank and these included *Acorus calamus* (1- new species), *Bacopa monnieri* (4), *Centella asiatica* (4), *Chlorophytum borivillianum* (1), *Coleus aromaticus* (1), *Kaempferia galanga* (1),

Plumbago zeylanica (4), *Rauvolfia serpentina* (1), *Tylophora indica* (2) and *Valeriana wallichii* (2).

Regarding short-to medium-term conservation, shoot cultures of *Bacopa monnieri* and *Centella asiatica* could be conserved for 15 months and 10 months, respectively. Experiments on reduction of cost of conservation using sugar cubes and isabgol, results in *B. monnieri* revealed that shoot cultures could be maintained for 12 months, at 25 °C tested, so far. In *Mentha* sp., 12 out of 22 exotic accessions exhibited 25 to 80% survival after 48 months at low temperature (4 °C in dark). In *Gentiana kurroo*, with mannitol, cultures survived up to 24 months at 4 °C tested so far while those at 25 °C survived up to nine months.

Regarding cryopreservation experiments, in *B. monnieri*, up to 20% regrowth was achieved in frozen shoot tips using vitrification technique. In *G. kurroo*, shoot tips exhibited up to 20% post-thaw regeneration following encapsulation-dehydration technique and up to 40% survival using droplet-freezing technique.

Spices, plantation and new industrial crops

A total of 350 accessions (~4,800 cultures) comprising 184 of *Zingiber* sp., 127 of *Curcuma* sp., 10 of *Piper* sp., 5 of *Elettaria* sp., 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. A total of 25 accessions belonging to *Curcuma* spp. (18 accessions), *Zingiber officinale* (4 accessions) and *Piper* spp. (3 accessions) were added to the *in vitro* genebank.

Experiments on reduction of cost of conservation in *Curcuma longa* cv Prathibha using low-cost carbon sources and gelling agent in the culture medium showed that up to 84% reduction in cost of medium for *in vitro* plant regeneration and conservation could be achieved. No adverse effects on plantlet regeneration and conservation were observed on the low-cost media up to 12 months.

Cryopreservation experiments were initiated in ginger (*Zingiber officinale*) using vitrification and encapsulation-dehydration techniques. Non-frozen controls could tolerate PVS2 dehydration (vitrification) better than the sucrose dehydration (ED). However, post-thaw recovery of cryopreserved explants could not be achieved.

Temperate and minor fruit crops

A total of 187 accessions belonging to 9 genera and 28 species (~2,200 cultures) of temperate and minor fruits comprising *Actinidia* spp. (3), *Aegle marmelos* (1), *Fragaria* spp. (66), *Malus* sp. (4), *Morus* spp. (52), *Prunus* spp. (2), *Pyrus* spp. (28), *Rubus* spp. (18) and *Vaccinium* spp. (13) were maintained through periodic subculture under short-to-medium term storage.

Two new genera namely, *Pyrus* and *Vaccinium* were introduced in tissue culture repository. Seventy-six accessions including *Fragaria* spp. (18), *Morus* spp. (4), *Pyrus* spp. (28), *Rubus* spp. (13) and *Vaccinium* spp. (13) were added in the *in vitro* genebank.

Shoot tips of three *Morus* species viz., *M. indica*, *M. alba* and *M. sinensis* were successfully cryopreserved using encapsulation-dehydration technique with 35% post-thaw regrowth in the former two and 30% in the latter.

Tuber crops

A total of 40 accessions of tuber crops including taro (20) and yams (20) were added to existing cultures in the *in vitro* genebank. Regarding *in vitro* slow growth, in taro, the subculture interval could be enhanced from 6 to 22 months with 100% survival of cultures following use of ABA (20 µM) in combination with 0.2% agar. *In vitro* corm formation in taro was also achieved on MS basal medium with 8% sucrose.

Cryopreservation of one accession of *Dioscorea bulbifera* was attempted using the technique of vitrification. Cryopreserved shoot tips exhibited up to 70 % survival and up to 20% regeneration.

Other crops

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

6.2 Genetic Stability of *In Vitro* Conserved Germplasm

Genetic stability assessment using random amplified polymorphic DNA (RAPD) and inter-simple sequence repeat (ISSR) analyses was done in 18 *in vitro*

conserved accessions of *Curcuma* spp. and *in vitro* plantlets of *Colocasia esculenta*.

In turmeric, 36 RAPD and 3 ISSR primers generated a total of 569 and 26 amplicons, respectively. No significant differences were observed in the RAPD and ISSR profiles of *in vitro*-conserved cultures and their respective field maintained mother clones.

In taro, micro-corms were induced in the cultures using shoot tip explants. The plantlets with micro-corms were established in the field. Eight RAPD and 6 ISSR primers generated 246 and 144 amplicons, respectively. No significant differences were observed in the RAPD and ISSR profiles of micro-corm generated plantlets and their respective field-maintained mother clones.

Protocols for DNA isolation and amplification to study genetic stability of *in vitro*-conserved plants of *Plumbago* sp. using RAPD markers were standardized.

6.3 *In Vitro* Germplasm Supply

A total of 85 banana accessions were supplied as *in vitro* cultures, comprising exotic accessions procured from International Network for Improvement of Banana and Plantain (INIBAP) Transit Centre, Belgium, as well as popular Indian varieties.

Germplasm of *Bacopa monnieri* (2), *Centella asiatica* (1), *Coleus forskohlii* (2), *Rauwolfia serpentina* (1) and *Picrorhiza kurroa* (1) were supplied as *in vitro* cultures for research purpose.

6.4 Seed Cryopreservation

Cryopreservation of various crops (7,265 accessions) has been undertaken using seeds, embryos/ embryonic axes, pollen and dormant buds (Table 2). A total of 1,303 accessions of diverse crop germplasm including litchi pollen (20 accessions) and *Morus* spp. (50 accessions) were received from various sources. A total of three exploration trips were undertaken in parts of Haryana, Rajasthan, UP, Himachal Pradesh and J&K. Two collection trips, one to CHES, Ranchi for litchi pollen and another to NRC Citrus, Nagpur for Citrus germplasm were also undertaken. A total of 177 accessions of *Aegle* sp., *Cordia* spp., *Salvadora* spp., *Syzygium* spp., minor temperate fruits, litchi (pollens), citrus and trifoliate orange were collected from aforementioned areas.

Table 2: Status of cryopreserved germplasm in TCCU (As on December 31, 2005)

Categories	Accessions (no.)
Recalcitrant & Intermediate	
Fruits & Nuts	1713
Spices & Condiments	96
Plantation Crops	19
Agroforestry & Forestry species	1737
Industrial crops	502
Orthodox	
Cereals	238
Millet and Forages	292
Pseudo-cereals	76
Grain Legumes	632
Oilseeds	477
Fibres	62
Vegetables	429
Medicinal & Aromatic Plants	721
Narcotics & Dyes	34
Miscellaneous	10
Total	7038
Dormant buds	70
Pollen grains	157
Total	7265
Wild sp.*	701
Varieties	554
Elite*	4
Endangered sp.*	59
Registered germplasm*	22

*- Included in respective crop groups

Total No. of species : 659

During the period, a total of 1,298 accessions were cryostored at temperatures between -160 to -180 °C as seeds/ embryonic axes/ dormant buds/ pollens, depending upon the size and storage behavior of the species. These comprised temperate fruits and nuts (300), spices (40), agroforestry species (42), cereals (30), millets & forages (10), grain legumes (16), oilseeds (138), fibre crops (4), vegetables (19), M & AP (124), narcotics and dyes (2), industrial crop (502) and others (1). The cryostored germplasm included released varieties, wild species, wild relatives of crop plants, landraces, registered germplasm and, rare and endangered species. Pollen grains of 20 accessions of litchi and hops were also cryostored.

Basic studies on seed viability, moisture content, desiccation and freezing sensitivity in cheura (*Diploknema butyracea*), *Poncirus* sp., *Salvadora* sp., *Syzygium* spp. and wild apricot (*Prunus armeniaca*) indicated that except wild apricot, other four species were recalcitrant. Retesting of 50 accessions of orthodox and non-orthodox seeds and 10 accessions of mulberry revealed that original viability was retained in most of the accessions. Morphological characterization of 42 accessions of wild apricot collected from J&K revealed sizable variability.

Research Projects (Project code, Title, Project Leader; Associate)

- PGR/TCCU-BUR-DEL-01: *Ex situ* conservation of genetic resources of vegetatively propagated crops using *in vitro* and cryopreservation techniques (RK Tyagi).
- PGR/TCCU-BUR-DEL-02: *In vitro* conservation of tuber crops with special reference to sweet potato, yams and taro (BB Mandal; Zakir Hussain).
- PGR/TCCU-BUR-DEL-03: *In vitro* conservation of spices, plantation and industrial crops (RK Tyagi; Anuradha Agrawal, RPYadav).
- PGR/TCCU-BUR-DEL-04: *In vitro* conservation of bulbous and ornamental crops (Ruchira Pandey; Neelam Sharma).
- PGR/TCCU-BUR-DEL-05: *In vitro* conservation of medicinal and aromatic plants with special reference to rare and endangered species (Neelam Sharma; Ruchira Pandey).
- PGR/TCCU-BUR-DEL-06: *In vitro* conservation of tropical fruit crop species (Anuradha Agrawal; RK Tyagi).
- PGR/TCCU-BUR-DEL-07: *In vitro* conservation of temperate and minor fruit crops (Sandhya Gupta).
- PGR/TCCU-BUR-DEL-08: Studies on genetic stability of *in vitro* conserved and cryopreserved germplasm (Zakir Hussain; RK Tyagi).
- PGR/TCCU-BUR-DEL-09: *Ex situ* conservation of plant genetic resources of agricultural and horticultural crops using cryopreservation of seeds (Rekha Chaudhury).
- PGR/TCCU-BUR-DEL-10: Cryopreservation of orthodox and intermediate seed species in various forms using standard protocols (Rekha Chaudhury; SK Malik).
- PGR/TCCU-BUR-DEL-11: Investigating desiccation and freezing tolerance in sub-orthodox seed species for cryopreservation (S K Malik; Rekha Chaudhury).

7. PGR POLICY PLANNING UNIT

The PGR Policy Planning unit at NBPGR was established in 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 inputs as per requirements of the policy makers for negotiations and formulations of policies at various national and international fora on issues related to PGR management.

7.1 Achievements-Policy Issues

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

7.1.1 Implementation of the FAO Project on Establishment of Information Sharing Mechanism for Monitoring the Implementation of Global Plan of Action: The following activities were undertaken in above-mentioned project-

- The National Stakeholders Workshop was organized on January 24-25, 2005, to discuss the work plan of the project and the process of data collection. Representatives of key stakeholders' departments namely Department of Agriculture and Cooperation, Department of Biotechnology, Ministry of Environment and Forests and crop based institutes of ICAR attended the workshop and presented their views on the commitments in information sharing mechanism and their activities related to GPA.
- The first round of Regional Workshops and trainings were organized during March-April 2005 at three regional coordinating centers namely, NBPGR, New Delhi, CICR, Nagpur and NBPGR's Regional Station, Hyderabad and two other centers namely, NBPGR's Regional Station Thrissur, and Department of Agriculture, Kolkata.

- A total of 114 stakeholders were trained during the above workshops to use the software provided by FAO for data collection and recording. The trained scientists were requested to submit the information within one-month to NBPGR, New Delhi.
- The second round of Regional meetings were conducted at NBPGR's Regional Stations, Hyderabad and Thrissur and its headquarters at New Delhi to validate the data collected and to discuss the draft of National Report of the project during November, 2005. The Chief Technical Officer of the project Dr. N. Quat Ng from FAO Regional Office Bangkok also attended the meeting at New Delhi.
- The draft National Report is being revised as per the suggestions received from stakeholders participated and FAO representative during the second round of Regional Meetings.

7.1.2 Other policy Issues

- The fourth meeting of the Functional Committee on Plant Genetic Resources was organized on 16th June 2005. The agenda included exchange of genetic resources after enactment of the Biological Diversity Act and progress of the FAO funded project on implementation of GPA.
- Inputs were provided to the compliance measure of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and on the development of Standard Material Transfer Agreement (SMTA). A meeting to discuss the draft SMTA was organized at NBPGR on 28th June 2005 and proposed suggestions were sent to Department of Agriculture and Cooperation for onward submission to the FAO.
- Technical inputs were provided to the Ministry of Environment and Forests on the development of third National Report of the India on compliance to Convention on Biological Diversity (CBD), on thematic areas of Agrobiodiversity, *ex-situ* conservation activities, alien invasive species, and risk assessment aspects under the WTO/ CBD.

- Technical inputs were provided to Department of Agriculture and Cooperation (DAC) for revision of the International Standards of Phytosanitary Measures viz., code of conduct for the import and release of exotic biological control agents; glossary of phytosanitary terms; diagnostic protocols for regulated pests; requirements for the establishment and maintenance of pest-free areas for tephritid fruit flies; requirements for the submission of phytosanitary treatments; and guidelines for consignments in transit.
- Prepared generic pest risk analysis (PRA) for ninety crop species, which are not listed in Schedule V, VI or VII for facilitating import of their germplasm, and submitted it to DAC for validation.
- Formulated projects on SPS-WTO related issues under the recent INDO-US Initiative on Agricultural Research and Education.
- Participated in INDO- US and INDO- Japan negotiations for export of mangoes.
- Other miscellaneous policy documents dealt with during the year were: establishment of Global Crop Diversity Trust; country report on conservation of PGR for SSEEA workshop held in China along with proposal for funding for the Region of South Asia. (Follow up report and revised draft sent in April 2005); draft document for the Inter-Governmental Commission on Genetic Resources, traditional knowledge and folklore of the WIPO; IPGRI workshop on Access and Benefit Sharing at Chennai; Questionnaires on 'Funding Strategies' options for the ITPGRFA; for the Plant Quarantine (regulation for import into India) Order 2003 for comments received from various countries; the Protection of Plant Varieties and Farmer Rights Act (second set of draft rules and regulations); Biological Diversity Act analysis for management of agro-biodiversity and exchange of genetic resources; Draft guidelines for exchange of genetic resources; SANPGR – Compliance report to IPGRI; African Seed and Biotech Program, and Johl Committee Report (revision).

Research Projects (Project code, Title, Project Leader; Associate)

PGR/PPU-BUR-DEL-01: Policy planning and back-up research (P Brahmi).

PGR/PPU-BUR-DEL-02: PGR management and related issues (P Brahmi; S Saxena, GJ Randhawa).

PGR/PPU-BUR-DEL-03: Policy issues related to plant quarantine (Rajan; Kavita Gupta).

8. NRC ON DNA FINGERPRINTING

Summary: Under the five institutional and four externally funded projects, 60 varieties of rice, 74 accessions and varieties of Frenchbean, 44 cultivars and landraces of lentil and 21 Indian linseed cultivars were fingerprinted using STMS, AFLP, SRAP and anchored ISSR methods. The results indicated that all varieties were distinguishable from one another. In addition, new STMS markers were identified for DNA profiling in mungbean, urdbean, ricebean and pigeonpea. These were orthologous markers transferred from *Glycine* and *Phaseolus*. Although, for majority of the markers very low polymorphism was observed, some of the markers exhibited high polymorphism and these are being used for DNA fingerprinting of cultivars. The Crop DNA Fingerprint Database of NRC was updated with the AFLP and RAPD profiles of *Gladiolus* varieties. Presently, the database consists of 923 varieties of 16 crops. Forty web pages for NRC on DNA Fingerprinting were developed and modified according to the new format of ICAR and will be linked with NBPGR website. Under the externally funded project, 31 transgenic cotton lines, having *vip3A*, *APX*, *CP4EPSPS*, *cry1Ab*, *cry1Ac*, *cryX*, *uid*, and *aad* genes; 36 rice transgenic lines having *lyc*, *crtI*, and *psy* genes for beta-carotene; 41 transgenic corn lines having *cry1Ab* gene and ten transgenic potato lines with *RB* gene were received and primers were designed for the specific genes. One hundred eighty transgenic lines were tested for terminator gene technology cassette using primer specific to *cre* sequence amplifying amplicon of 1031 bp. There was no evidence for presence of terminator gene in any of the samples. NRC organized two training programmes and ten M. Sc students from other universities were trained in molecular techniques.

8.1 DNA Fingerprinting of Released Varieties

Rice: Out of hundred thirty two-rice varieties procured from National Gene Bank representing 14 states, sixty rice varieties were taken up for DNA fingerprinting with 30 STMS markers. A total of 84 alleles were detected with a mean of 2.8 alleles per locus and the average Polymorphism Information Content (PIC) value was 0.66. All the accessions were diverse from each other at 0.62 similarity coefficient. Cluster analysis on the basis of dendrogram generated using Jaccard's similarity coefficient, grouped all the rice varieties in two major clusters. A single variety Pant Dhan-6 out grouped in dendrogram at 45% similarity with other varieties.

Pulses: DNA profiling of 26 Frenchbean (*Phaseolus vulgaris*) varieties and 48 promising germplasm accessions was completed using 12 AFLP primer pairs. The data were analyzed and the results indicated presence of high diversity among germplasm accessions and moderate diversity among the released varieties. All the released varieties were observed to cluster together in the second group in the dendrogram (Figure 1) whereas the germplasm accessions were distributed in all the four clusters formed. Further, using the AFLP profiles, all released varieties were distinguishable since the 850 amplicons scored indicated presence of only 52% similarity on average among cultivars analyzed.

Forty-four cultivars and landraces representing 14 lentil (*Lens culinaris*) growing states of India were fingerprinted using sequence related amplified polymorphism (SRAP) markers. A total of 30 primer combinations from five forward and six backward primers were used. All primer-combinations successfully produced amplification products. All primer-combinations were found to produce polymorphic bands. Landraces and cultivars grouped in separate clusters with few exceptions. Cultivars namely B177, Precoz, B77 and JL3 and landraces IC53234 and IC32367 were found to be distinct.

Oilseeds: Anchored inter-simple sequence repeat (ISSR) markers were used to get information on the prevailing diversity in 21 Indian linseed (*Linum usitatissimum*) cultivars. Fifty ISSR primers were tested, of which 24 were finally used for amplification after the PCR conditions for each were standardized. A total of 183 markers were generated, 7.6 bands per primer were observed and 2.7 bands per primer were found to be polymorphic. Percent polymorphism was 34.97 whereas average Jaccard's genetic similarity among the cultivars was 56 per cent. Average polymorphism information content for 24 primers was 0.126. Cluster analysis revealed three cultivars, namely KL3, Gaurav and Jawahr 522 to be distinct from the rest.

8.2 Generation of New Molecular Markers For DNA Profiling in Pulses

The publicly available 67 STMS primer pairs from

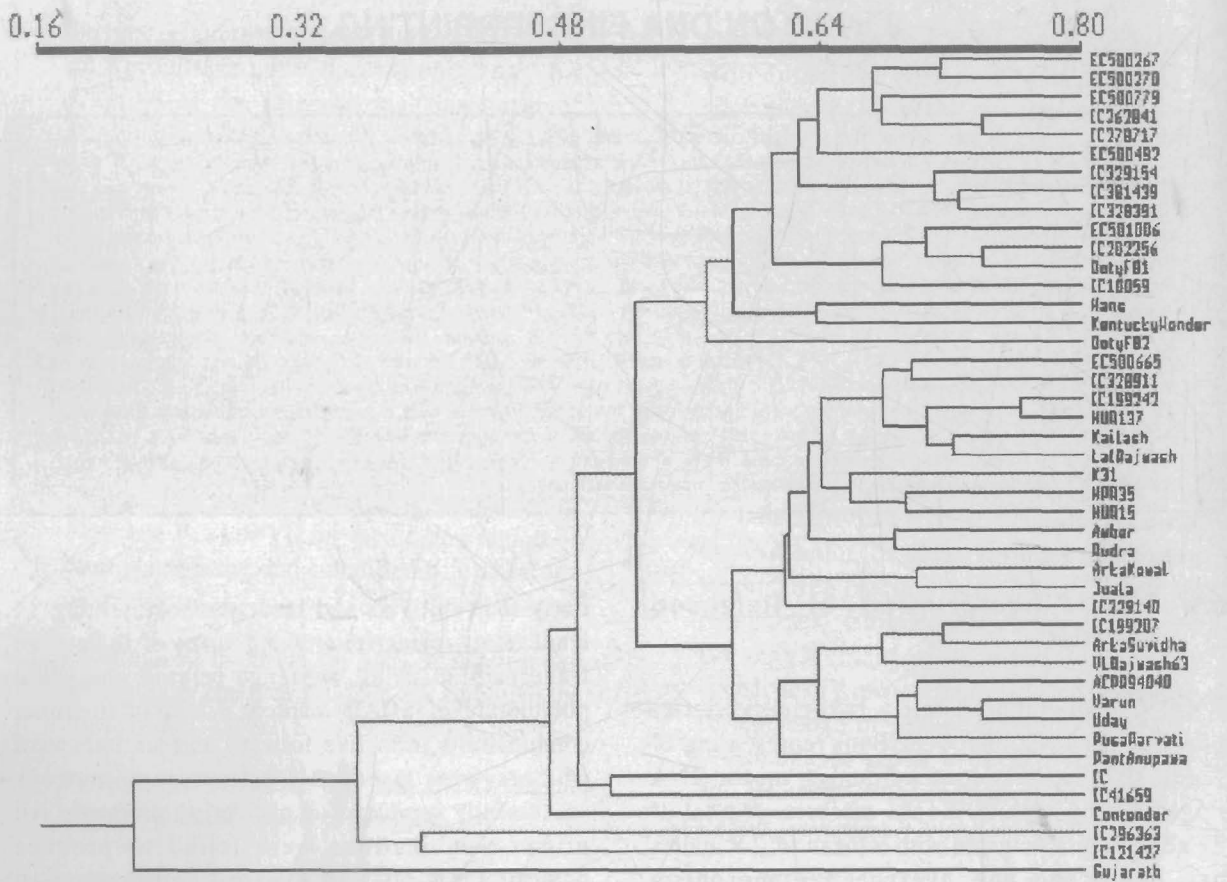


Figure 1. UPGMA tree based on AFLP data indicating presence of moderate diversity in released Frenchbean varieties and high diversity in germplasm accessions.

adzuki bean and cowpea were screened to determine their transferability and utility in mungbean and urdbean. Forty-five primer pairs suitable for DNA profiling of mung bean and urdbean were identified. The number of alleles scored ranged from 2 to 21 per primer pair. These markers are being used to analyse the released varieties of mungbean and urdbean. Similarly, in pigeonpea, 56 STMS primer pairs from soybean and Frenchbean were screened and 38 pairs generating polymorphic alleles in pigeonpea were identified. The number of alleles scored in selected pigeonpea varieties ranged from 2 to 4 per primer pair. These studies indicated higher rate of cross species transferability of primers among related legumes.

8.3 Crop DNA Fingerprint Database and Statistical Analysis Package

The Crop DNA Fingerprint Database was converted to Visual Basic environment. The major features of the database are user friendly forms for each submenu such as Data Uploading Form, Storage Form, Search for Primer form, Search for Variety Form and Statistical Analysis Form. The Crop DNA Fingerprint Database was updated with the AFLP and RAPD profile tables having varieties of *Gladiolus* crop. Presently database consists of 923 varieties of 16 crops. Table 1 shows list of crops with respective technique and number of varieties stored in the database.

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

Crop	Technique	Varieties Fingerprinted
Cereals		
Rice	STMS, RAPD	192
Sorghum	AFLP	29
Barley	RAPD	50
Pulses		
Chickpea	AFLP	23
Mungbean	AFLP	27
Oilseeds		
Brassica	AFLP	42
Soybean	AFLP	72
Fibres		
Cotton	AFLP, RAPD	48
Vegetables		
Tomato	RAPD	27
Chilli	ISSR	38
Fruits & nuts		
Banana	AFLP	107
Mango	ISSR, AFLP	23
Citrus	AFLP	33
Cashew	ISSR, AFLP	140
Saffron	AFLP	13
Flowers		
Gladiolus	AFLP, RAPD	59

8.4 Website

Forty web pages for NRC on DNA Fingerprinting have been developed and modified according to the new format of ICAR and will be linked with NBPGR website. It consists of information about the Centre, organizational setup, research, services, cadre strength, facilities, projects, varieties fingerprinted, human resource development, publications and databases. Detailed information about the respective scientists and the various crops is also provided.

8.5 Digital Photo Library

Database of Digital photo library has been updated with the photographs of annual report 2003-04. Photographs were scanned and relevant information about the picture was entered in the database. Software has been upgraded by adding some of the new options of adding, deleting, importing and editing photographs. Also, facility has been developed to save the selected picture at desired location. In addition to this, an overview option has been developed which shows total number of crop photographs, gel photographs, dendrograms, other photographs, AFLP profiles in database. Also, it shows number of crops according to crop group-wise. Compact Disc of this software has also been developed.

8.6 CD For Training Manual

CD for Training Manuals has been updated with the lectures of training programme on "Microsatellites for Genetic Diversity Assessment and Cultivar Identification" held at NBPGR, New Delhi from 28th January to 6th February 2005.

8.7 Molecular Testing of Transgenic Planting Material (DBT Funded Project)

During the period, thirty one transgenic cotton lines, having *vip3A*, *APX*, *CP4EPSPS*, *cry1Ab*, *cry1Ac*, *cryX*, *uid*, and *aad* genes; thirty six rice transgenic lines having *lyc*, *crtl*, and *psy* genes for beta-carotene; forty one transgenic corn lines having *cry1Ab* gene and ten transgenic potato lines with *RB* gene were received for molecular testing. Primers were designed for the specific genes.

All the one hundred eighty transgenic lines were tested for terminator gene technology cassette using primer specific to *cre* sequence amplifying amplicon of 1031 bp. No amplicon of corresponding size was observed in any of the tested lines, confirming the absence of terminator gene technology.

Development of PCR based methods for testing of transgenic planting material: Third round of cross validation of the standardized detection protocols for transgenic maize and soybean with CFTRI Mysore; and Bt cotton and transgenic soybean with Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad were also successfully completed. The confidence level of the results of all three partners was more than 95%, which is good indicator of successful cross validation.

8.8 Capacity Building for Implementation of Cartagena Protocol on Biosafety (World Bank funded project)

Genomic DNA extraction protocols from seed material have been standardized in transgenic maize, rice, cotton, soybean and *Brassica* using modified CTAB or SDS method. Standardized the PCR based protocols for transgenic reference materials of maize

MON810 event supplied by Fluka BioChemica Company using event, promoters and gene specific primers. The samples contain different levels of transgene, i.e., 0%, 0.1%, 0.5%, 1%, 2% and 5%. For developing rice biology document, information was collected and compiled on history, economic importance, taxonomy, centre of origin/ diversity, germplasm explorations and conservation of varietal diversity for useful traits in cultivated and wild rices, donor sources for biotic and abiotic stresses, priority areas for germplasm conservation along with map representation of areas of concern and weed flora in rice cultures.

8.9 Molecular Taxonomy Studies in Asiatic *Vigna* and *Macrotyloma* Species (Subtribe: Phaseolinae)

Study of chloroplast DNA in genus *Vigna* using

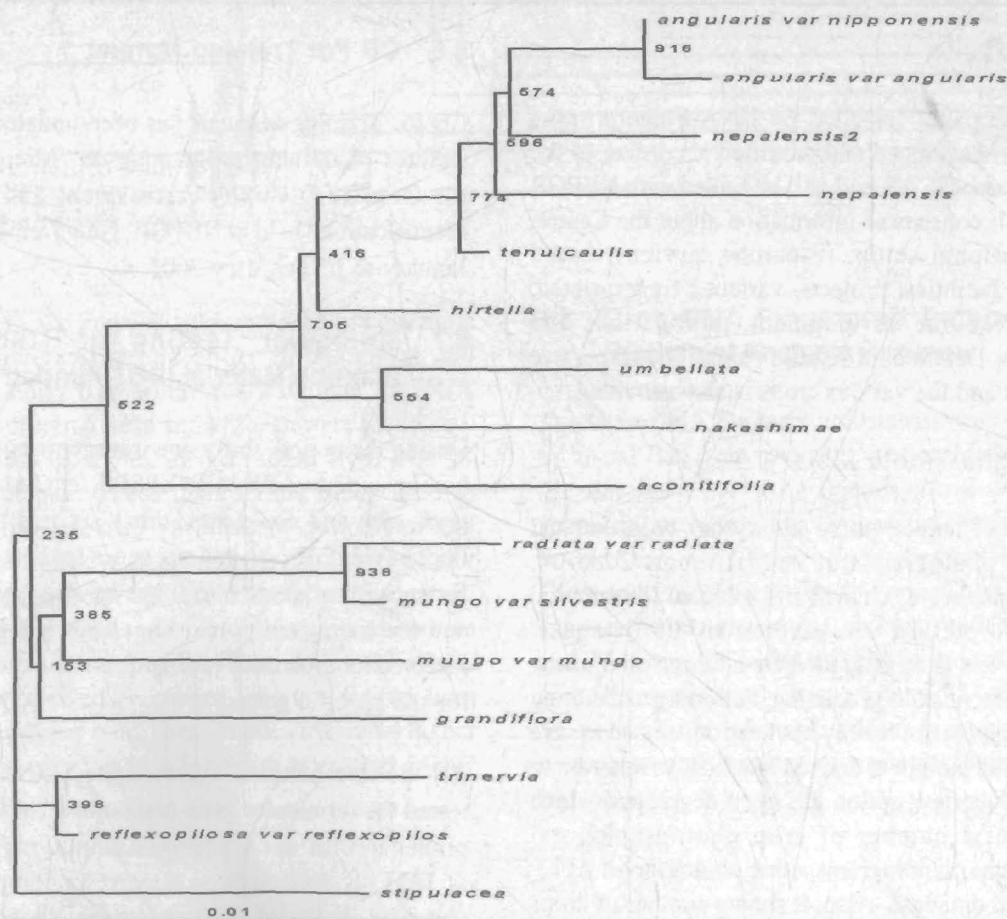


Figure 2. Neighbor joining tree based on *trnH* intergenic spacer sequence variation in some of the *Vigna* species. The tree indicates diverse paths of evolution for the Indian and African sections of *Vigna*. *V. trinervia* and *V. grandiflora* appear to be the closest to cultivated Asiatic species, *V. radiata* and *V. mungo*.

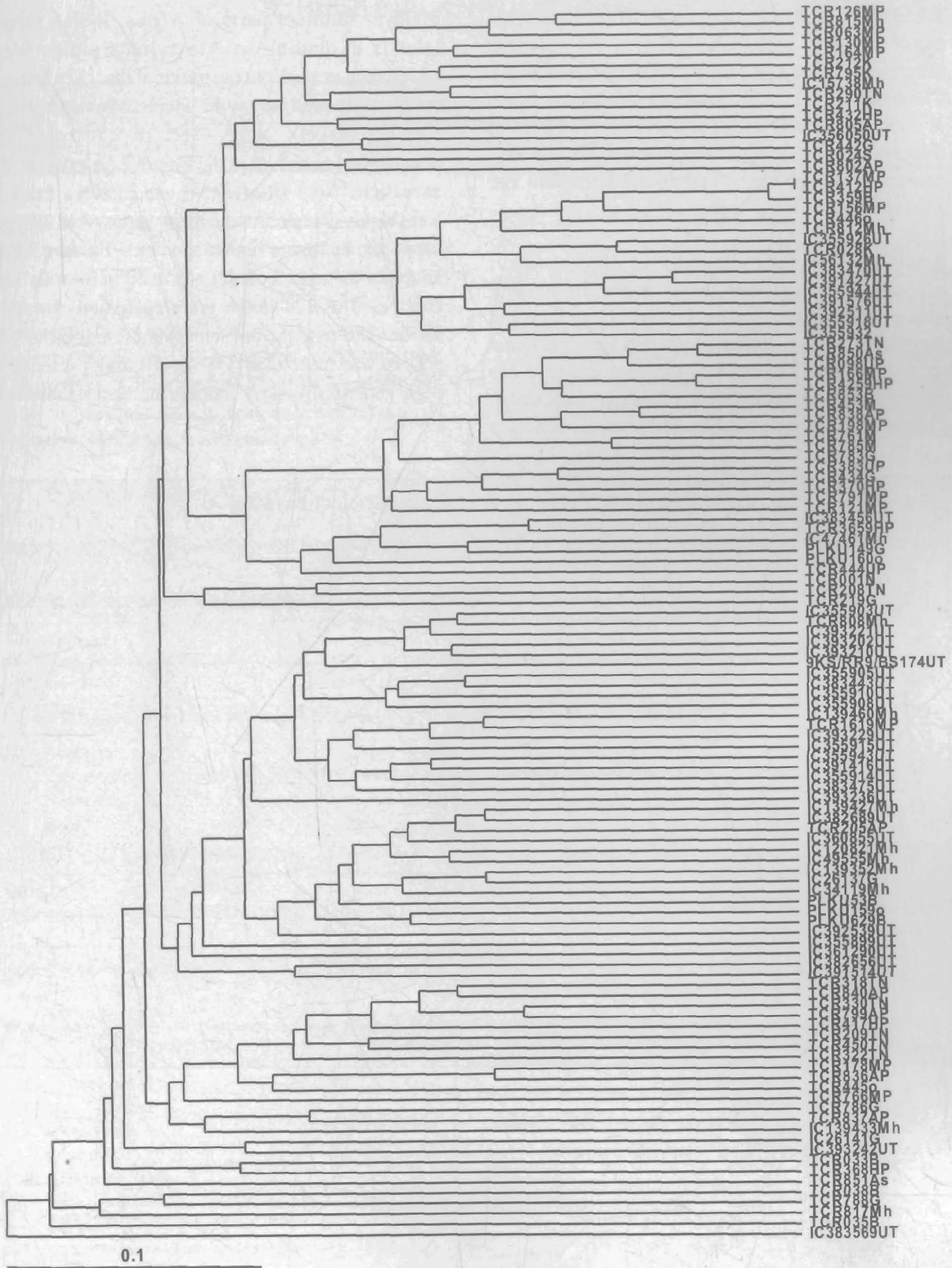


Figure 3: Dendrogram of horsegram accessions based on RAPD polymorphism data indicating presence of high genetic diversity in Indian cultivars.

RFLPs: PCR-RFLP analysis of trnH intergenic spacer region was completed in 30 selected accessions of *mungo-radiata* relatives from India. The results (Figure 2) indicated primitiveness of the *V. hainiana* in comparison to the closest relatives of the cultivars belonging to *mungo* and *radiata* group, namely, *V. mungo* var. *silvestris* and *V. radiata* var. *sublobata*.

Analyses of genetic diversity in *Macrotyloma*: *Macrotyloma uniflorum* (horse gram; kulthi) is a minor legume cultivated over a wide latitudinal and longitudinal range. Indian region has been indicated to be the center of origin of the crop and also has maximum area under cultivation in this crop. Cultivation of horse gram extends to small pockets in

Malaya, southern parts of Africa, Indian Ocean islands extending to Australia. Studies were undertaken to work out the trends of diversity patterns in the cultivated and wild species. A total of 225 RAPD markers were used to construct the dendrogram as shown in the Figure 3. In general, the accessions from Uttaranchal and Madhya Pradesh were highly diverse. All the major nodes were strongly supported by higher bootstrap values. Further, AFLP analysis using selected 12 primer pairs was also conducted in 124 horse gram accessions from 16 states. The percent polymorphism among the 650 AFLPs was more than 87% confirming presence of high genetic diversity among the accessions from India.

Research Projects (Code, Title of the project, Project Leader; Project Associates)

PGR/DFP-BUR-DEL-01: Technology Development for DNA Fingerprinting of Cereals and Millets (Lalit Arya; GJ Randhawa, Rakesh Singh (on study leave), Sunil Archak (on study leave).

PGR/DFP-BUR-DEL-02: Technology Development for DNA Fingerprinting of Pulses, Oilseeds and Fibre Crops (KV Bhat; MK Rana, GJ Randhawa, Rakesh Singh (on study leave), Ambika Baldev (on study leave).

PGR/DFP-BUR-DEL-03: Technology Development for DNA Fingerprinting of Horticultural Crops (JL Karihaloo, Sunil Archak (on study leave), Ambika Baldev (on study leave).

PGR/DFP-BUR-DEL-04: Technology Development for DNA Fingerprinting of Medicinal Plants (GJ Randhawa; Rakesh Singh (on study leave).

PGR/DFP-BUR-DEL-05: Crop DNA Fingerprint Database and Statistical Analysis Package (Madhu Bala).

Externally Funded Projects

Analysis of Genetic Diversity and Phylogenetic Relationships in *Solanum melongena* L. and Related Wild and Weedy Taxa., (JL Karihaloo; Ambika Baldev (on study leave); Sanjay Kalia, Z Abraham; Shivraj) - Funded by DBT

National Containment/Quarantine Facility for Transgenic Planting Material (Transgene Detection) (Ravi Khetrpal and GJ Randhawa; Manisha Mangal and Ashish) - Funded by DBT

Development of PCR based methods for testing of transgenic planting material (GJ Randhawa, Rakesh Singh (on study leave); Prashant K Firke and H Mohan) - Funded by DBT

Capacity building for implementation of Cartagena Protocol on Biosafety under Global Environment Facility (GEF) (Co-ordinators; BS Dhillon, JL Karihaloo; GJ Randhawa (PI); Dhiraj R Thakare and Ashish Khanduri) GEF (World Bank Project)

9. REGIONAL STATION, AKOLA

Summary: A total of 7,943 accessions of various crops were grown for characterization/ evaluation and 7,154 for maintenance during *Rabi* and *Kharif* seasons at the experimental farm. Promising accessions were identified in linseed and castor. A total of 570 accessions were deposited in NGB for long-term storage while 859 were supplied to various indentors.

NBPGR's Regional Station at Akola was established in November 1977. It is situated between 20°43' North Latitude and 77°04' East Longitude. The experimental farm area is 50 acres with black cotton soils derived mostly from basalt rocks. The station has responsibility of plant exploration and germplasm collecting from Maharashtra, Chhatisgarh, Madhya Pradesh and adjoining regions of Gujarat and Karnataka, its evaluation, maintenance and conservation.

9.1. Characterization of Germplasm

A total of 7,943 accessions were grown in the

experimental farm during *Rabi* 2004-2005 and *Kharif* 2005. Crop-wise accessions grown during 2005 are presented (Table1). Crop-wise accessions evaluated were amaranth (477), amaranth AVT (13), safflower cultivated (45), linseed (58) and castor (150) during *Rabi* 2004-2005 and sesame (229), okra (174), finger millet (207), barnyard millet (91) and little millet (69) during *Kharif* 2005-2006. Standard cultural practices and plant protection measures were adopted. Observations were recorded on five randomly selected plants and post harvest observations were recorded in the laboratory.

Table 1: Crop -wise accessions grown during 2005-2006

Crop group	No. of accessions	Multi-location	Total	Checks used
Millets (1033)				
Barnyard millet	98	100	198	K 21, PS 118
Little millet	67	-	67	PRC 3, CO 2
Proso millet	19	-	19	PRC 3, CO 2
Kodo millet	73	-	73	GPUK 3, IPS 147
Foxtail millet	427	-	427	K 221, PS 118
Finger millet	249	-	249	VL 149, PR 202
Pulses (171)				
Grass pea	171	-	171	Narayangaon local
Oilseeds (3743)				
Sesame	2,085	-	2,085	JLT 7
Niger	567	50	617	CHH 1, CHH 2
Ground nut	120	-	120	
Castor	223	-	223	RLC 6, J 23 10
Soybean	207	-	207	Brag
Linseed	204	-	204	
Safflower	287	-	287	Bhima
Vegetables (2562)				
Okra cultivated	1,145	-	1,145	Sel.2
Winged bean	244	-	244	AKWB 1
Amaranth	1,173	-	1,173	Suvarna, Akola local
Wild relatives (434)				
Okra (wild)	427	-	427	
Soybean	4	-	4	
<i>Cucumis hardwickii</i>	2	-	2	
<i>Cucumis callosus</i>	1	-	1	
Grand total	7,793	150	7,943	

Figures in the parentheses indicate number of accessions characterized.

9.1.1 Variability observed in morphological characteristics of amaranth germplasm: A total of 477 accessions were grown in an augmented design having check Suvarna and Akola local for morpho-agronomic characteristics. The traits studied include

growth habit, inflorescence compactness, stem surface, inflorescence shape, stem colour, leaf colour and inflorescence colour. The spectrum of variability observed is mentioned in Table 2.

Table 2: Variability observed in amaranth germplasm

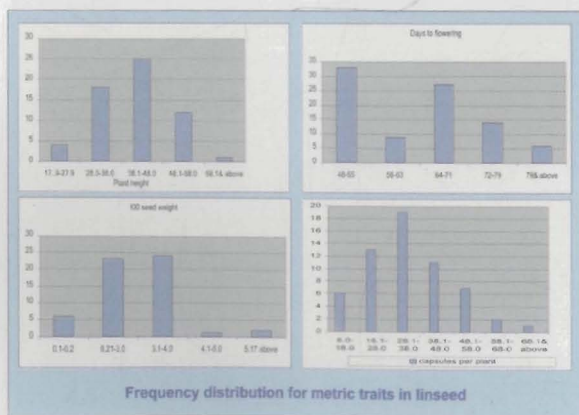
Descriptors	Descriptor state	Descriptor state	Descriptor state
Growth habit	Erect (441)	Spreading (33)	Drooping (3)
Inflorescence Compactness	Lax (40)	Intermediate (385)	Dense (57)
Stem surface	Smooth (172)	Ridge (305)	
Inflorescence shape	Globose (44)	Semi-drooping (11)	Straight (422)
Stem colour	Green (210)	Yellow (9)	Yellowish green (89)
	Red (18)	Reddish green (152)	Reddish orange (3)
	Pink (5)		
Leaf colour	Green (5)	Pinkish green (9)	Yellow (4)
	Yellowish green (303)	Red (4)	Reddish green (152)
Inflorescence colour	Yellowish green (4)	Red (152)	Pink (7)
	Pinkish green (6)	Yellowish green (304)	Light yellow (4)

9.1.2 Morpho-agronomic traits observed in linseed: A total of 58 accessions were characterized for morpho-agronomic traits in linseed. These included 32 exotic and 26 indigenous accessions. The checks used were J-23-10 and C-429. The variability observed in morpho-agronomic traits are given in Table 3. The

promising accessions identified on the basis of superiority over check value are- number of capsules/ plant EC541200 (72), EC541202 (63), check value (28); plant height (cm)-EC541217 (89.7 cm), EC541227 (56.6 cm), check (44.5 cm).

Table 3: Variability observed in Linseed germplasm

Character	Range	Mean \pm SEM	CV (%)
Plant height (cm)	17.9-89.7	41.4 \pm 1.3	25.3
Days to 50% flowering	48-81	63.0 \pm 1.04	12.5
Days to 80% maturity	78-112	93.6 \pm 0.8	8.5
Number of capsules/ plant	8.5-72	34.7 \pm 1.8	39.4
100 seed wt (g)	0.1-0.5	0.32 \pm 0.1	25.0



Variability in fruits of okra

9.1.3 Morpho-agronomic characteristics in castor germplasm:

A total of 145 accessions were characterized in an augmented design using 48-1 and DCS-9 as checks. The accessions were grown in three observation rows of 3 m length and row-to-row spacing

of 90 cm. The qualitative and quantitative traits studied are mentioned in Table 4. The promising accessions identified for various traits are- effective raceme length IC343311 (65.2 cm), IC47596 (61.5 cm), check value (29.1 cm).

Table 4: Variability observed in qualitative traits in castor germplasm

Descriptors	Descriptor state	Descriptor state	Descriptor state	Descriptor state
Plant vigour	Poor (69)	Good (52)	Very good (24)	
Stem colour	Green (75)	Light purple (66)	Dark purple (4)	
Petiole colour	Green (74)	Light purple (38)	Purple (19)	Dark purple (14)
Lamina leaf colour	(Green (145)			
Capsule type	Non spiny (12)	Spiny (133)		

Table 5: Variability observed in quantitative traits in Castor germplasm

Character	Range	Mean \pm SEM	CV (%)
Stem length (cm)	12.2-166.5	79.9 \pm 2.5	38.1
No. of nodes /stem	13-32	21.7 \pm 0.3	18.5
No. of secondary branches	1.0-42.5	5.4 \pm 0.3	78.2
Effective raceme length (cm)	2.5-65.2	30.3 \pm 0.9	38.2
100 seed wt (g)	15.6-59.8	27.7 \pm 0.7	28.4

9.1.4 Characterisation of sesame germplasm: A total of 229 accessions of sesame germplasm were grown during Kharif 2005 in an augmented design in 3 m row length and row to row spacing of 65 cm. Seven qualitative and six quantitative traits were recorded. The range of variation observed for some economic traits are given in Table 6.



Okra germplasm being observed by vegetable breeders on a field day.



Flowering in *Sesamum* sp.

Table 6: Range of variation observed in Sesame germplasm

Character	Range	Mean \pm SEM	CV (%)
Plant height	40.3-144	88.1 \pm 1.20	20.7
Internode length	2.6-12.6	5.95 \pm 0.11	30.3
Days to 80% maturity	89-125	104.4 \pm 0.46	6.8
Capsule length	11.0-30.0	21.4 \pm 0.24	17.0
Seeds/ capsule	3.5-43.6	21.1 \pm 0.52	37.7
100 seed wt (g)	0.11-0.4	0.26 \pm 0.00	25.6

9.1.5 Characterization of okra germplasm: A total of 174 of okra accessions were grown in an augmented design in 3 m rows. Sel-2 and Parbhani Kranti were

used as checks. The range of variability observed is given in Table 7.

Table 7: Range of variation observed in okra germplasm

Character	Range	Mean \pm SEM	CV (%)
Plant height (cm)	25.3-81.0	43.91 \pm 1.34	26.9
Days to flowering	64-127	94.28 \pm 1.56	14.5
First fruit producing node	1.6-7.6	3.63 \pm 0.15	37
Fruit length (cm)	4.0-26.6	14.79 \pm 0.40	23.8
No. of fruits/plant	2.3-11.0	4.623 \pm 0.21	40.8
Days to maturity	110-151	125 \pm 1.25	8.8
No. of seeds/fruit	15.0-87.6	43.0 \pm 1.43	29.2
100 seed wt (g)	3.24-7.42	5.74 \pm 0.12	19.0

9.2 Maintenance of Germplasm

A total of 1,591 accessions were grown during Rabi and 5,763 accessions during *Kharif*. These included millets(719), vegetables(1385), oilseeds (3202), wild relatives (457) and multi-location trial (150) accessions. Crop-wise accessions included foxtail millet (233), barnyard millet (98), little millet (67), proso millet (19), kodo millet (73), finger millet (229), okra cultivated (427), winged bean (244), sesame (2085), ground nut (120), soybean (2070), niger (567), castor (223), *Setaria* spp (22), okra wild (427), *Cucumis hardwickii* (2), *Cucumis callosus* (1), *Momordica* spp.(1) and *Glycine* spp.(4).

9.3 Conservation of Germplasm

In the medium term storage module: A total of 15,681 accessions are being conserved in the MTS module at the center. Crop-wise accessions include chickpea (973), pigeon pea (2052), *Lathyrus* ((150), wingedbean (230), sesame wild (150), sesame (6447), safflower(1425), safflower wild (74), linseed (722), niger (747), sorghum (50), pearl millet (21), kodo millet (91), barnyard millet (65), little millet (53), foxtail millet (244), finger millet (233), horsegram (983), greengram

(641), mothbean (17), blackgram (15), castor(83), *Dolichos* (212), *Canavalia* (2) and *Mucuna* (1).

Conservation of germplasm in the NGB: A total of 570 accessions were sent for long-term conservation in the NGB at NBPGR, New Delhi. The germplasm included foxtail millet (11), finger millet (09), kodo millet (7), barnyard millet (8), proso millet (12), niger (137), linseed (138), *Lathyrus* (35), amaranth (84) and safflower (129).



Plant breeders observing millet germplasm on a field day on 25th October 2005

Field day- A field day was organized on 25.10.2005 for *kharif* crops for millets, soybean, sesame, niger and okra germplasm . Breeders and horticulturists of ICAR institutes and SAUs participated and selected the material.

9.4 Germplasm Supply

A total of 859 accessions were distributed for

research to various indentors/ agencies for crop improvement that included foxtail millet (50), barnyard millet (50), kodo millet (50), mungbean (21), chickpea (10), wingedbean (25), Dolichos bean (5), jackbean (1), *Abelmoschus tuberculatus* (4), *A. tetraphyllus* (4), *A.ficulneus* (4), *A.moschatus* (2), niger (50), wild okra (8) and sesame (575).

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

PGR/GEV-BUR-AKO-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of pulses (pigeon pea and chickpea), vegetables (winged bean, amaranth and okra) and under utilized crops (IP Singh; N Dikshit).

PGR/GEV-BUR-AKO-02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of oil seed (sesame, niger, castor, ground nut, safflower, soybean and linseed), millets and minor millets (N Dikshit; IP Singh).

10. REGIONAL STATION, BHOWALI

Summary: Four explorations were undertaken in parts of Uttaranchal and 207 accessions including landraces and primitive cultivars comprising cereals (12), pseudo-cereals (8), minor millets (11), oil seeds (14), pulses (33), vegetables (19), spices (58), fruits (12), M&AP (24), wild economically useful plants (7) and ornamentals (9) were collected under National Exploration Programme, Horticultural Technology Project Mini Mission I (HTP MM-I) and G-15 for M & AP. A total of 168 accessions were received for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material viz., *Artemisia annua*, garden sage, rose-geranium, lavender, *Marjorana hortensis*, rosemary, *Stevia rebaudiana*; kagzi lemon, Kiwi, plum, peach; wheat- HB-208, and cowpea- EC229967-B were supplied to different farmers / indentors. A total of 383 accessions were supplied to user scientists in the country and 1,898 accessions deposited in the National Genebank for conservation.

NBPGR regional station at Bhowali was established in 1943, as an Imperial Potato Research Station and known as "Hot Spot" for the development of wheat diseases. It was meant for potato seed multiplication work and also for brown rot (*Pseudomonas solanacearum*) testing. In 1956, with the commencement of Wheat Improvement Scheme under PL-480, it was transferred to Indian Agricultural Research Institute and its name was changed as Wheat Research Station, Bhowali. In 1984 it was again transferred to Vivekanand Parvatiya Krishi Anusandhan Shala (VPKAS), Almora and remained under the control of VPKAS, Almora for a period of two years. In April 1986, it was transferred to NBPGR, New Delhi as one of its Regional Station. Bhowali is situated at 29° 20' N latitudes 79° 30' E longitudes at an altitude of 1600 msl in cold humid, sub-temperate climate with an average annual rainfall of 1668 mm and temperature ranges from 0° to 29 °C (mercury drops even upto - 7 °C during December to February). The station is 15 km away from the district Headquarters, Nainital.



Site of construction for staff quarter at R/S Bhowali is in progress.

10.1 Plant Exploration and Germplasm Collection

A total of 207 germplasm accessions were collected through four explorations (two multi-crop and two crop-specific) from parts of Uttaranchal under National Exploration Programme, HTM- MM-I and G-15 for M & AP. During the period under report emphasis was given for the collection of germplasm of land races/primitive cultivars of various crops from the inaccessible and remote areas of



Rosmarinus officinalis: blue flowered-French type (NIC 23416)-a successful introduction established at Bhowali.

mid- hills and Tarai-bhabar regions. Two collaborative and hills crop- specific explorations were especially undertaken for the collection of mango from village Simlasu, Tehri Dam Catchment Area and chilli (hot and sweet) from Khatima, Dehradun, Kamalpur, Vikasnagar and Haridwar. The collected germplasm comprised cereals (12), pseudo-cereals (8), minor millets (11), oilseeds (14), pulses (33), vegetables (19), spices (58), fruits (12), M & AP (24), WEUP'S (7) and ornamental (9) as per the details given in Table 1.

Table 1: Plant exploration and germplasm collection during 2005

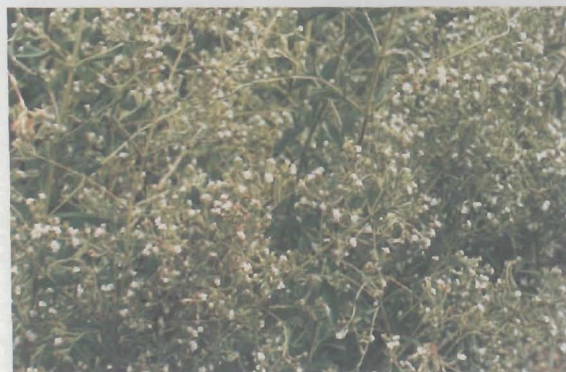
Period	Areas explored	Samples collected	Cereals	Pseudocereals	Minor Millets	Oil seeds	Pulses	Vegetables	Spices	Fruits	M & AP	WE-UP*	Ornamentals
May 19-27	Remote villages of Rath region of district Pauri Garhwal	75	06	03	—	12	03	10	26	—	08	02	05
July 15-19	Village Simlasu, Tehri Dam Catchement Area	12	—	—	—	—	—	—	—	12	—	—	—
Sept. 5-12	Tarai and Bhabar regions of district US Nagar, Haridwar, Dehradun	28	—	—	—	—	—	06	18	—	03	—	01
Oct. 21-28	Mountaneous regions of Kali Kumaon in Champawat & Nainital	92	06	05	11	02	30	03	14	—	13	05	03
Total		207	12	08	11	14	33	19	58	12	24	07	09

*WEUP- Wild economically useful plants species

10.1.1 Enrichment: Besides collection, a total of 168 accessions comprising wild okra- 22, ricebean (AVT-Hills)-8, clover-2, winter wheat-23, *Triticum* spp.-100, wheat-3, released varieties-10 (coriander, bottlegourd, spongegourd, ridgegourd) were received from NBPGR, New Delhi; R/S Hyderabad and IARI, R/S Tutikandi, HP for evaluation and maintenance at this station.

10.2 Germplasm Evaluation

10.2.1 Germplasm characterization/ initial seed increase: The germplasm accessions collected from Kumaon and Garhwal regions of Uttaranchal were sown at Bhowali for characterization, initial seed



Stevia rebaudiana (IC449511)- a successful introduction established at Bhowali.

increase and multiplication during Kharif and Rabi seasons 2004-2005 (Tables 2 to 6).

Table 2: Germplasm characterization during Kharif 2005

Crop	No. of acc.	Checks used
Amaranth	254	Annapurna, Swarna, VL44, PRA1 and PRA9401
Barnyard millet	56	VL177, VL29, Local Chamoli, Local Pithoragarh, Local Almora
Fingermillet	99	VL146, VL149, Local Almora and Local Pithoragarh
Frenchbean	719	VL1, VL 63, PLB 10-1, PLB 14 -1, Chaffi local and Ramgarh local
Ricebean	62	PRR01, PRR02, BRS01 and Naini
Chilli	175	Pant C1, Pant C3, JCA263, LCF206

Table 3: Multiplicaion/ seed increase for long term storage

Crop	No. of Accessions
Blackgram	31
Buckwheat	15
Cowpea	44
Foxtailmillet	04
Greengram	01
Groundnut	18
Horsegram	120
Maize	22
Mothbean	01
Pigeonpea	04
Prosomillet	12
Soybean	36
Sunflower	01

Table 4: Promising accessions identified in various crops during Rabi 2004-2005 and Kharif 2005

Crop	Main attributes	Accessions identified for specific/desired traits
Amaranth (254) Checks: VL44, PRA9401, PRA01, Annapurna, Swarna	Early flowering (< 67days) Plant height (>101 cm) Early maturity (<118 days) Inflorescence length (> 43 cm) 100 Grain weight (>0.72 g)	IC95353 (45), NC58615 (56), NC59928 (56) NC58608 (178), NC58609 (176), IC95355 (157) IC146511 (107), EC153062 (107), IC386984 (107) EC35940 (72), IC469805 (53), NC58609 (53) IC21941 (0.90), EC289406 (0.89), EC146495 (0.85)
Barley (179) Checks: VLB60 and LB64	Days to 75% ear emergence (<128) Days to maturity (<183) 100 Grain weight (>4.0 g)	IC406568 (116), IC406575 (116), IC444245 (117), VLB1, IC406703 (121), IC392603 (123) IC406691 (167), IC418377 (167), IC392603 (169), IC406703 (173), IC444245 (173) IC393143 (4.88), IC436962 (4.92), EC492166 (6.73), EC492172 (6.63), EC492172 (6.63), EC492177 (6.43)
Barnyard millet (56) Checks: VL172, VL-29, Chamoli local, Pithoragarh local and Almora local	Early maturity (<52 days) Ear length (>18.8 cm) Plant height (>116 cm) Early maturity (<98.5 days) 1000 Grain weight (>4.09 g)	IC391425 (50), IC356395 (50), IC355769 (50) IC393021 (32.5), IC436950 (30.3), IC383686 (27.4) IC391375 (164), IC469879 (160.6), IC391494 (160) IC418409 (93), IC356395 (93), IC261999 (94) IC383686 (5.24), IC391472 (4.96), IC 418409 (4.80)
Chilli (175) Checks: Pant C1, Pant C2, JCA283	Early flowering (<135 days) Plant height (>80 cm) Early maturity (<150 days) IC469854 (148) No. of fruit/ plant (>80) Fruit yield/ plant (>200 g)	IC361627 (132), IC381471 (132) IC391359 (92.3), IC391441 (89.2), IC391194 (86) IC381471 (132), IC361687 (148), IC469844 (148), and LCF206 IC333306 (112), IC430010 (109) IC333306 (348), IC276571 (270), IC265050 (255)
Fingermillet (101) Checks: VI146, VL149, Local Almora and Local Pithoragarh	Early flowering (<78) Plant height (>113.8 cm) Early maturity (<122 days) 100 Seed weight (>2.58 g)	IC393029 (62), IC393028 (65), IC393037 (65) IC382639 (148.3), IC393027 (145), IC391396 (141.6) IC356000 (101), IC391332 (110), IC391334 (110) IC393060 (3.8), IC316048 (3.68), IC469877 (3.6)
Frenchbean (613) Climber/ Pole type Checks: PLB10-1, Chaffi local, Ramgarh local and Bhowali local	Early flowering (<45 days) No. of pod/ plant (>10) 100 Grain weight (>39 g) Early maturity (<110 days) Grain yield/ plant (>14 g)	EC512816 (25), EC500936 (27), EC500658 (30) IC419849 (22), IC356033 (20), IC417353 (19) EC500879 (58.7), EC500644 (54.7), EC500344 (51.4) IC422029 (76), EC500952 (79), EC500473 (78) EC500249 (31.6), IC340822 (29.5), IC436958 (26.55)
French bean Dwarf / Bush type (106) Checks: VL-1, VL-63, PLB-14-1 and Champawat local	Early flowering (<39 days) No. of pods/ plant (>11) 100 Grain weight (> 32 g) Early maturity (<95 days) Grain yield/ plant (>15 g)	IC383654 (26), IC338701 (29), EC500798 (30) EC500736 (14), EC500382 (13.3), EC500694 (13.2) EC500768 (49.7), IC444098 (45.6), EC500386 (46.38) EC500280 (70), IC417350 (70), IC370764 (69) EC500694 (22.6), EC500687 (20.5), EC500749 (19.3)
Rapeseed/mustard (177) Checks: <i>B.</i> <i>juncea</i> - Kranti, Pusa Jai Kishan, RH-30, VarunB. toria- T-9, PT-30, PT-303; <i>B.</i> <i>campestris</i> var. yellow sarson-Local- 05; <i>B. campestris</i> var. Brown sarson-RP -15, Pusa Kalyani, BSH-1; Napus-Italian Rai (<i>B. juncea</i> -57; Brown sarson-70; Toria-34; Yellow sarson -15, <i>B. napus</i> -01)	<i>Brassica juncea</i> (57) Days to 50% flowering (<126) No. of siliqua/ plant (>331) Days to 80% maturity (<175) 1000 grain weight (>1.64 g) <i>B. campestris</i> var. Brown sarson (70) Days to 50% flowering (< 66) No. of siliqua/ plant (>324) Days to 80% maturity (<164) 1000 grain weight (>1.76 g)	IC429992 (74), IC338725 (83), IC266765 (86) IC429989 (1668), IC255498 (1309), IC393215 (1136) IC393215 (166) IC393158 (1.84), IC393214 (1.70), IC429985 (1.66) IC355919 (49), IC393234 (55) IC391556 (627), IC418412 (584) IC355920 (162) IC392628 (1.93), IC392523 (1.87), IC393197 (1.85)
Rice bean (62) Checks: PRR, PRR2, BRS1 and Naini	Early flowering (< 67.5 days) Plant height (< 130.45 cm) 100 Grain weight (> 9.60 g)	IC444164 (67), IC444185 (67), IC436977 (67) IC444138 (73.3), IC444142 (81.0), IC444157 (79) IC342379 (13.7), IC444172 (10.4)

Wheat (263 acc.) Checks: HS240, HB208 and UP2382	Days to 75% ear emergence (<135) Days to maturity (<190) 100 Grain weight (>4.49 g)	IC406715 (104), IC393125 (122), EC514405 (123), IC430328 (126), IC436984 (128) EC463438 (182), IC393112 (183), IC262213 (183), IC430328 (183), IC398287 (184) IC392569 (5.83), EC493710 (5.71), IC430328 (5.38), IC345673 (5.37), EC514387 (5.75)
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Table 5: Range, mean and coefficient of variation in various crops during Rabi 2004-2005 and Kharif 2005

Crop (accessions)	Character	Range		Mean	PCV%
		Minimum	Maximum		
Amaranth (254)	Days to 50% flowering	06	90	66.4	3.56
	Plant height (cm)	8.6	178	67.94	6.86
	Days to 80% maturity	48	136	119.5	2.42
	Inflorescence length (cm)	05	72	29.57	5.62
	1000 seed weight (g)	0.04	0.90	0.71	3.75
Chilli (175)	Plant height (cm)	19.2	92.3	55.2	5.1
	Days to 50% flowering	132	149	142	1.63
	Days to 50% fruiting	148	183	157	1.77
	No. of fruit/ plant	07	112	18.2	7.11
	Fruit yield/ plant (g)	09	348	86.23	8.27
Barnyard millet (56)	Days to 50% flowering	50	68	57.64	2.99
	Ear length (cm)	17.1	32.5	21.62	3.85
	Plant height (cm)	112.3	164	136.54	3.10
	Days to 80% maturity	93	106	98.54	1.96
	1000 Seed weight (g)	2.52	5.24	3.89	3.77
	Grain yield/plant (g)	2.9	17.8	9.86	5.82
Ricebean (62)	Days to 50% flowering	67	95	81.00	2.88
	Plant height (cm)	59.3	300	179.65	6.15
	Pod length (cm)	8.4	15.8	12.10	3.64
	Days to 80% maturity	126	170	148.0	3.06
	100 Grain weight (g)	5	14	9.60	3.72
Cowpea (43)	Days to 50% flowering	41	77	59.3	3.65
	No. of pods/ plant	4.6	20.3	11.25	5.9
	100 Grain weight (g)	5.26	17.18	9.85	5.5
	Pod length (cm)	4.8	20	13.6	4.9
	Seed yield/ plant (g)	2.9	24.43	11.51	6.1
	Days to 80% maturity	87	128	108	3.0
Finger millet (99)	Days to 50% heading	62	78	72	2.4
	Plant height (cm)	76.6	148.3	114.7	3.69
	Ear head length (cm)	06	15.9	9.79	4.36
	Days to 80% maturity	101	132	117.99	2.53
	100 seed weight (g)	1.36	3.8	2.67	4.27
	Grain yield/plant (g)	2.3	23.8	11.93	6.45
French bean Dwarf/bush (106)	Days to 75% flowering	26	61	38.7	4.21
	Pods/ plant	1.3	14	3.5	6.4
	100 grain weight (g)	09	49.7	29.09	5.54
	Seed yield/plant	0.72	19.5	7.5	7.33
	Days to 80% maturity	68	129	84	3.5
French bean Climber/pole (613)	Days to 75% flowering	25	71	47.6	4.24
	Pod/plant	02	22	7.9	5.83
	100 grain weight (g)	7.96	58.74	26.63	5.93
	Pod length (cm)	3.5	23	10.33	4.3
	Seed yield/plant (g)	0.46	31.6	9.65	7.1
	Days to 80% maturity	70	143	107.2	3.7
Brassica juncea (57)	Days to 50% flowering	74	156	124.4	4.33
	No. of siliqua/ plant	38	1668	264.2	11.83
	Days to 80% maturity	166	218	235	1.82
	1000 Grain weight (g)	1.30	1.84	1.57	1.04
B. campestris var. Brown sarson (70)	Days to 50% flowering	49	143	72	4.34
	No. of siliqua/ plant	53	627	267	6.79
	Days to 80% maturity	162	200	179	2.32
	1000 Grain weight (g)	1.07	1.93	1.69	2.64
Barley (179)	Days to 75% ear emergence	116	159	137	2.84
	Days to 80% maturity	167	199	180	2.14
	100 Grain weight (g)	1.20	6.73	4.16	4.88
Wheat (263)	Days to 75% ear emergence	104	169	141	2.93
	Days to 80% maturity	180	210	194	1.81
	100 Grain weight (g)	1.28	5.88	3.55	5.10

Table 6: Germplasm Characterization During Rabi 2005-06

Crop	No. of Acc.	Checks Used
Wheat	184	VL616, VL719, VL738, VL829, VL832, HB208
Barley	94	VLB1, VLB60 and VLB64
Multiplication/ seed increase		
Spinach	77	Early green, Pusa Bharti, All green
Garlic	110	Lohit, Bhowali local
<i>Triticum</i> spp. (wild)	58	—
<i>Avena sativa</i>	18	—
Faba bean	16	—
Rapeseed/mustard	35	Rajat, Varun, Pusa Jai Kishan, Italian Rai, Kranti, GLS1, RH30, T9, PT303, PAC401
Chamsoor	01	—
Fenugreek	19	PEB, Bhowali local
Coriander	35	Pant Harit-1, Kashipur local, RCR41, ACR250, Bhowali local
Pea	08	Harbhajan, Lincon, Selection-18
Lentil	08	VL01, VL105, PL406, PL830
Onion	08	Bhowali local



Dr. T.P. Mal, Head, Department of Botany, Kisan P.G. College Bahraich and 43 students of M. Sc. (Botany) visited R/S Bhowali in the last week of December 2005 on PGR awareness.



Mobile team of Horticulture, Distt. Pithoragarh visited R/S Bhowali in the 3rd week of December 2005 and was shown herbal plants of Uttaranchal

10.2.2 Horticultural Plants : Horticultural germplasm evaluation was continuously done in the Field Gene Bank and all regular cultural operations

were undertaken from time to time. The summary of results is presented in Table 7.

Table 7: Horticultural Germplasm Characterizations/ Evaluation during 2005

Crop (Accs.)	Descriptors	Characters	Range of variation			Promising accessions
			Min.	Max.	Mean	
Apple (40)	45	Fruit length (cm)	3.62	6.76	5.11	IC363487-Large sized fruit, IC319086-very sweet having good flavour
		Fruit width (cm)	4.96	8.80	5.41	
		Fruit weight (g)	50.00	250.00	107.00	
		TSS ^a Brix	9.00	16.00	11.75	
Apricot (16)	41	Stem girth (cm)	2.222	7.16	3.42	IC319186- Tasty with good fragrance
		Stone length (cm)	2.29	2.29	2.29	
		Stone width (cm)	2.01	2.01	2.01	
		Stone weight (g)	10.0	10.0	10.0	
Cherry (3)	37	Stem girth (cm)	1.63	2.53	2.16	
		Leaf length (cm)	6.60	11.50	4.32	
		Leaf width (cm)	3.52	4.77	3.02	
Citrus (142)	69	Stem girth (cm)	0.10	15.36	3.95	IC319045- Uttaranchli Nimbu (Best Kagazi) 400 rooted plants were sent for multi locational testing IC319071- Large fruits
		Fruit length (cm)	3.84	16.31	7.30	
		Fruit width (cm)	2.74	11.64	6.37	

Kaku (3)	30	Stem girth (cm)	3.33	6.49	4.91	IC219062- Sweet in taste at unripe stage
		Leaf length (cm)	10.64	10.78	10.71	
		Leaf width (cm)	5.68	5.72	5.70	
Peach (19)	42	Fruit length (cm)	3.34	5.52	4.78	IC247430- Heavy bearer with good size fruits
		Fruit width (cm)	3.50	5.12	4.53	
		Fruit weight (g)	26.70	74.00	50.50	
		TSS ^o Brix	12.05	14.00	13.60	
Pear (22)	43	Stem girth (cm)	1.08	5.63	3.15	—
		Leaf length (cm)	3.96	11.50	6.90	
		Leaf width (cm)	3.52	4.77	4.27	
Plum (7)	42	Stem girth (cm)	2.10	12.00	5.40	—
		Fruit length (cm)	3.97	3.97	3.97	
		Fruit width (cm)	4.05	4.05	4.05	
		TSS ^o Brix	12.00	12.00	12.00	
Rubus (21)	20	Plant canopy (sq cm)	358.0	93133.00	28197.0	IC219046- Yellow hisalu; IC219057- Jogiya hisalu, Medium size fruits
		No. of fruit/vesicles	5.67	71.10	32.94	
		TSS ^o Brix	9.33	12.5	11.11	
Walnut (27)	32	Plant height (cm)	0.87	4.15	2.53	—
		Tree girth (cm)	1.44	17.10	5.90	
		Nut length (cm)	3.15	3.15	3.15	
		Nut width (cm)	2.63	2.63	2.63	

10.3 Germplasm Conservation

Conservation in Field Gene Bank: Fruits (433 accessions), vegetables (1201), chillies (1188), chowchow(13), flowering perennial plants (86), flowering annual plants and other horticultural crops (77) are maintained in glass house/ field genebank/ MTS at Bhowali.



French bean BBS-13 (EC-238461) identified for bold seed, maroon colour and bush type, high protein (21.46%)

Table 8: Fruit germplasm maintained in the field genebank at Bhowali

Crop	Botanical Name	Acc.	Crop	Botanical Name	Acc.
Almond	<i>Prunus amygdalus</i>	05	Nimbu	<i>Citrus sp.</i>	146
Apple	<i>Malus spp.</i>	40	Peach	<i>Prunus persica</i>	19
Apricot	<i>Prunus armeniaca</i>	16	Pear	<i>Pyrus spp.</i>	22
Cherry	<i>Prunus avium</i>	03	Phalsa (Wild)	<i>Grewia oppositifolia</i>	01
Chest nut	<i>Castanea sativa</i>	01	Plum	<i>Prunus domestica</i>	07
Cotoneaster	<i>Cotoneaster microphylla</i>	01	Pomegranate	<i>Punica granatum</i>	24
Ghiwai	<i>Elaeagnus latifolia</i>	03	Passion fruit	<i>Passiflora edulis</i>	01
Grape	<i>Vitis spp.</i>	05	Rasbhari	<i>Physalis peruviana</i>	02
Hazelnut	<i>Corylus avellana</i>	02	Raspberry	<i>Rubus spp.</i>	21
Kaku	<i>Diospyros kaki</i>	03	Strawberry	<i>Fragaria spp.</i>	82
Kiwi	<i>Actinidia spp.</i>	07	Walnut	<i>Juglans regia</i>	27
Loquat	<i>Eriobotrya japonica</i>	01		Grand total	433

Post harvest work: Citrus fruits (40 accs.) were supplied to Department of Horticulture, GBPUA&T, Pantnagar, Uttaranchal for bio-chemical analysis.

Transfer of Technology: Technical know how was

given to farmers for:

- Kiwi propagation through cuttings
- Citrus propagation through nucellar seedlings/ cuttings.

Accomplishments

- **Greenhouse maintenance (clonal repository):** All regular operations were timely attended for the maintenance of clonal repository / regeneration of the promising fruit material / collected materials (2500 pots).
- **Nursery management:**
 - Kiwi:** Grafting of Hayward and Allision scion and cuttings were maintained in field conditions.
 - Kiwi at farmer's field:** Kiwi nursery management at selected farmers in different places in Nainital, Uttaranchal.
- **Regeneration of promising accessions:** Plants / seeds of Kagazi: Promising Uttaranchali kagzi nimboo (*Citrus aurantifolia*) IC319045, much branched evergreen tree which bears more than 300 fruits in a tree was distributed to the progressive farmers of Uttaranchal. Fruit shape bright yellow-lemon colour, weight of a single fruit is 38 g, fruit length-4.14 cm, fruit width-4.18 cm, TSS^o-8 Brix. More than 500 plants were supplied to different indentors so far: Kiwi (EC64093, EC24672, EC64094, EC64090, EC137263, EC64092), P. Phlox (IC319010, IC319011, IC 319012); Kaku: Introduced Uttaranchali Kaku (*Diospyros kaki*- Japanese persimon) IC219062 promising, sweet and aromatic in taste, fruit length 4.92 cm, fruit width-4.50 cm, fruit weight-60 g, deep yellow in colour is being maintained in the Field Gene Bank of R/ S Bhowali. Accessions were regenerated through cuttings, grafting and other vegetative means and through seeds for onwards supply to different indentors.

Wild Economically Useful Plants

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

Maintenance of arborescent plants: A total of 190

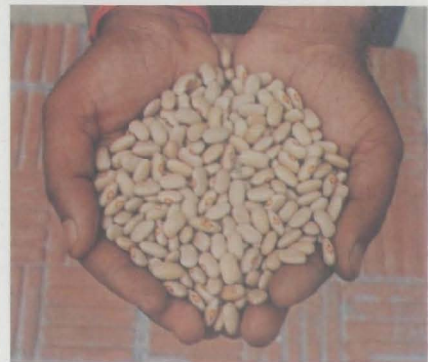
accessions of arborescent plants comprising of 150 species (92 genera of 50 families of both exotic and endemic origin) are being maintained in the station's Biodiversity Botanical Garden.

Maintenance of *Bamboosetum*: A total of 41 accessions comprising of 18 species belonging to seven are being maintained.

Maintenance of forage legumes and grasses: A total of 100 accessions of *Medicago* sp and 39 of *Trifolium* sp. are being maintained.

Temperate Grasses: A total of 51 accessions of temperate grasses are being maintained in the field gene bank.

Medicinal and aromatic Plants: A total of 330 accessions (vegetatively propagated-100; seed producing-230) comprising of 207 species belonging to 117 genera of 37 families have been conserved in field gene



French bean BBS-24 (EC15257) identified for high yield, bush type, multi-branched, small creamish- white grains and proteins (19.57%)

bank/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*, *Lavandula*, *Matricaria*, *Marjorana*, *Melissa*, *Mentha*, *Ocimum*, *Origanum*, *Pelargonium*, *Plantago*, *Pyrethrum*, *Rosa*, *Rosmarinus*, *Salvia*, *Spilanthus*, *Stevia*, *Tagetes*, *Thymus*, *Valeriana*, *Withania* and *Zanthoxylum* were multiplied for supply to the indentors. Steam distillation unit was operated in different seasons for extracting essential oil from aromatic plants including scented rose geranium, lemon grass and others.

Determination of percentage of essential oils: A total of 55 accessions of aromatic plants were extracted for percentage of essential oil in different seasons through steam and hydro (Clevenger apparatus)



Chilli (*Capsicum annuum*) germplasm grown at Bhowali for characterization.

distillation unit. A total of 33 samples of oil were sent to chemistry unit, NBPGR, New Delhi for further chemical analysis. Also 19 samples were analysed for chemical properties for Mittal Aromas Essential Oil, NOIDA, UP. The range of oil percentage observed in different species is as follows: Steam Distillation Unit: lemon grass (0.16- 0.26), rose geranium (0.07- 0.09), *Pistacia integerrima* (0.04- 0.05); Hydro Distillation Unit (Clevenger Apparatus): *Abies nordmaniana* (0.43), *Achillea millefolium* (0.10- 0.30), *Acorus calamus* (0.24- 1.20), *Alpinia galanga* (0.50), *Amomum aromaticum* (0.36), *Artemisia annua* (0.30- 0.32), *Artemisia dracuncululus* (0.29- 0.50), *Artemisia maritima* (0.76- 1.50), *Artemisia siversiana* (0.07- 0.08), *Callicarpa macrophylla* (0.10- 0.20), *Chenopodium ambrosoides* (1.25), *Cinnamomum camphora* (0.10- 2.00), *Cinnamomum tamala* (0.60- 0.80), *Coleus forskohlii* (0.03- 0.14), *Cryptomeria japonica* (0.32), *Curcuma zedoaria* (0.08- 0.36), *Cymbopogon flexuosus* (0.05- 1.36), *Cymbopogon winterianus* (1.42), *Elettaria cardamomum* (0.10-

0.16), *Elsholtzia strobilifera* (1.0), *Foeniculum vulgare* ssp. *purprascence* (0.20- 0.46), *Hedychium coronarium* (0.12- 0.50), *Hedychium spicatum* (0.10- 2.20), *Juniperus indica* (4.0), *Levesticum officinalis* (0.09- 0.10), *Lavendula angustifolia* syn *L. officinalis* (0.06- 3.82), *Ocimum basilicum* (0.02), *Marjorana hortensis* (0.20- 1.50), *Melissa officinalis* (0.02- 0.16), *Mentha arvensis* (0.10- 1.66), *Mentha cardiaca* (0.20- 1.50), *Mentha piperata* (0.94- 1.30), *Origanum vulgare* (0.28), *Pelargonium graveolens* (0.01- 0.20), *Pelargonium tomentosum* (0.05- 0.09), *Pistacia integerrima* (0.02), *Pogostemon cablin* (1.23- 2.77), *Rosmarinus officinalis* (0.16- 1.67), *Ruta graveolens* (0.18), *Salvia sclarea* (0.02), *Tagetes erecta* (0.02), *Thymus serpyllum* (0.45- 2.30), *Valeriana jatamansi* (0.01- 2.00), *Vetiveria zizanioides* (0.11- 1.10), *Zanthoxylum armatum* (0.20- 4.75), *Zingiber chrysanthum* (0.12).

10.4 Germplasm Conservation

A total of 1898 accessions of different crops viz. cereals: barley (69), maize (132), paddy (367), wheat (204); pseudocereals: amaranth (47), buckwheat (11), chenopods (02), sorghum (02); minor millets: barnyard (19), finger (85), foxtail (09); pulses: azukibean (03), black gram (26), cowpea (24), Frenchbean (156), gram (01), green gram (02), horse gram (14), khesari (08), lentil (12), mothbean (02), *Mucuna* sp. (04), pea (12), pigeon pea (03), rice bean (01), oil seeds: ground nut (12), rapeseed-mustard (171), soybean (104), sunflower (01), spices: chamsoor (07), coriander (31), fenugreek (23), vegetables: ash gourd (04), brinjal (01), carrot (01), chilli (167), okra (27), radish (09); ridge gourd (15), sem bean (08), spinach (22) M & AP (12); wild relatives: *Aegilops* spp. (23), *Avena sativa* (22), okra- wild (14),



Wheat (*Triticum aestivum*) germplasm grown at Bhowali for characterization.



Wild Barley (*Hordeum bulbosum*-EC 328175) identified as potential fodder source, resistant to yellow rust and powdery mildew.

Triticum spp. (07) and Triticale (02) were supplied to LTS (NGB) for their conservation .

A total of 31 accessions of M & AP were deposited to Cryobank for LTS. Following plant propagules (17 accessions) of horticultural (ornamental), M & AP and wild species of *Allium* spp. for establishing protocol were deposited to TCCP unit for *in-vitro* conservation i.e. *Gladiolus* (6 acc.); *Costus lappa* (1 acc.); *Allium* spp. (10 acc.); *A. auriculatum* (2 acc.); *A. cernuum* (1 acc.); *A. griffithianum* (5 acc.); *A. royleii* (1 acc.); *A. senescense* (1).

10.5 Germplasm Supply

A total of 383 accessions of different crops were supplied to various Research Organisations/Indentors under MTA. *Allium* sp. (14), French bean (5), lentil (26), *Mentha* spp. (2), M&AP (176), *Ocimum* spp. (4), rice bean (1), *Setaria italica* (4), *Stevia* (3), *Triticum* spp. (7), WEUPS (24), wheat (1), wild okra (2) **Horticultural crops:** Strawberry (28), *Tagetes* spp. (36) and 50 accessions of fruit crops viz., aonla (4), bael (7), Ficus (7), kamarakh (1), karonda (6), Labera (4), loquat (1), mulberry (2), phalsa (1), pomegranate (9), Passion fruit (1), rasbhari (2), shahjan (2), kathal (1), badhar (1) and ber (1). Seed samples and live rooted plant material viz., M & AP and WEUPS: *Allium* spp.

(72), *Aloe barbadensis* (32), *Amomum subulatum* (2), *Anacyclus pyrethrum* (20), *Artemisia annua* (650 g + 10 nos.), *Asparagus* sp., (3), *Bergenia ligulata* (5), *Berberis* sp. (2), *Callicarpa macrophylla* (1 kg), caraway (50 g), *Conium maculatum* (50 g), *Curcuma zedoaria* (5), *Digitalis purpurea* (14), garden sage (940), rose geranium (6135), *Ginkgo* sp. (7), Lavender (8234), lemon grass (85), *Marjorana hortensis* (2275), *Mentha* sp. (10), *Matricaria chamomile* (250 g), nelumbo (3), *Polygonatum verticillatum* (10), *Potentilla fulgens* (50), *Pyrethrum cineriacifolium* (2), rosemary (1470 g), *Silybium marianum* (50 g), *Spilanthus acmella* (20 g), *Stevia rebandiana* (388), *Valeriana jatamansi* (50), *Viola serpens* (25), yarrow (20 nos.); Horticultural Plants: kagzi lemon (81), *Cryptomeria japonica* (3), Kiwi (294), Passion fruit (3), peach (240.4kg), plum (62.5 kg), strawberry (3 kg+ 55), almond (1.75 kg), grape (13.5 kg + 19 nos.) and gladiolus spikes (55); agricultural crops: wheat (7 kg), cowpea (500 g), French bean (1 kg) were supplied to different farmers/ indentors.

All India Co-ordinated Trial: Rice bean: All India Co-ordinated (Initial Varietal Trial–Hills) of rice bean consisting of seven varieties was conducted. PRR2, VRB1 and BRS01 performed better in grain yield than other entries.

Research Projects (Code; Title, Project leader, associates)

PGR/PGC-BHO-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of the Northern Himalayas and Adjoining Plains (K S Negi; All scientists).

PGR/PGC-BHO-02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of field crops with emphasis on ethno-botanical aspects (KC Muneem).

PGR/PGC-BHO-03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of temperate horticultural crops (SK Verma; KS Negi).

PGR/PGC-BHO-04: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of medicinal and aromatic, wild economically useful, rare and endangered species (KS Negi; KC Muneem)

11. EXPLORATION BASE CENTER, CUTTACK

Summary: A total of 1,395 accessions comprising cultivated rice (1,190), turmeric (165) and mungbean (40) were multiplied and 200 accessions of rice and 165 accessions of turmeric germplasm received from NBPGR, Thrissur were evaluated under multi-local trial. A total of 298 accessions comprising cultivated rice (204) and turmeric (94) were grown for preliminary characterization and 882 accessions of different agri-horticulture crops were deposited in NGB for conservation and 119 accessions of different crops were sent to regeneration sites for maintenance. A set of 57 accessions of aromatic rice was supplied to CRRI, Cuttack for research purposes and another set of 16 accessions of aromatic rice to GBPUAT, Pantnagar.

The NBPGR, Base Centre, Cuttack was established in July, 1986 with the responsibility for exploration and collection of indigenous agri-horticultural crops of Orissa and adjoining regions along with the characterization and conservation of rice genetic resources of northern and eastern plains of India. The center is located in the campus of Central Rice Research Institute, Cuttack (Orissa) between latitude/longitude of 20°40' N, 85°52' E and altitude of 23.5 m above mean sea level. It has a farm area of 5.5 acres including the office space.

11.1. Preliminary Characterization of Germplasm

A total number of 1,395 accessions comprising cultivated rice 1,190 accessions, turmeric 165 accessions and mungbean 40 accessions were grown for preliminary characterization and seed multiplication. Out of 1,190 accessions of cultivated rice, 493 accessions were grown for characterization including 200 accessions received from NBPGR, Thrissur for multi-local trial and rest 697 accessions for seed multiplication. Besides, 165 accessions of turmeric were planted for characterization.

Cultivated rice (*Oryza sativa*): A total of 1,190 accessions of rice germplasm were sown in raised nursery bed and one-month-old seedlings were transplanted in augmented design with checks at regular intervals. Each accession was maintained in four rows of three-meters length. Standard cultural practices were followed with normal recommended dose of N:P:K (60:30:30). Herbicides/ pesticides were not applied during any stage of crop growth. Observations on various morpho-agronomic traits viz., basal leaf, sheath pigmentation, colour of the leaf blade, auricle, collar, internode, lemma & palea, plant height (cm), days to maturity, leaf length and width (cm), EBT and panicle length (cm) were recorded during vegetative, late vegetative, flowering and maturity stages of crop growth.

Wide range of variability was observed at inter- and intra-varietal level with regards to qualitative traits i.e. basal leaf, sheath pigmentation, leaf blade colour, pubescence, ligule, auricle, collar, inter node, lemma and palea colour etc. and quantitative traits i.e. plant height, days to maturity, leaf length & width, EBT, panicle length (Table 1).

Table 1: Characterization of collected rice germplasm

Characters	Minimum	Maximum	Mean
Plant height (cm)	65.90	195.40	140.73
Leaf length (cm)	25.75	77.52	51.71
Leaf width (cm)	0.60	1.68	1.06
No. of effective tillers/ plant	3.66	17.00	7.27
Panicle length (cm)	15.15	33.12	25.90
Days to 50% flowering	41	118	79.47
Days to maturity	74	150	111.93
Grain length (mm)	2.65	8.00	5.87
Grain width (mm)	1.50	3.00	2.26
L/W ratio	1.29	3.96	2.62
100 grain wt. (g)	1.02	3.59	2.31
Grain yield/ plot (g)	26.49	1545.60	355.37
Grain yield/plant (g)	1.55	37.32	9.97

No. of accessions-288, Source-NBPGR, Cuttack, Design-Augmented, Spacing-20X15 cm., Checks-Pani dhan, Jaya, Mahsuri, Tulasi, Traits observed-26

Table 2: Characterization of rice under multi-locational trial

Characters	Range		Mean
	Minimum	Maximum	
Plant height (cm)	75.70	211.92	129.40
Leaf length (cm)	30.02	73.28	49.87
Leaf width (cm)	0.56	1.48	1.03
No. of effective tillers/ plant	3.60	12.20	6.92
Panicle length (cm)	16.54	37.04	25.94
Days to 50% flowering	30	119	66.96
Days to maturity	65	151	98.84
Grain length (mm)	3.90	7.40	5.98
Grain width (mm)	1.55	3.05	2.19
L/W ratio	1.76	3.82	2.75
100-grain wt. (g)	1.09	3.17	2.21
Grain yield/ plot (g)	10.79	1166.48	328.69
Grain yield/ plant (g)	2.51	18.30	7.46

No. of accessions-194, Source-NBPGR, Thrissur, Design-Augmented, Spacing-20X15 cm, Checks-Jaya, Jyoti, Ahalya, Tulasi, Traits observed-26

Promising lines identified better than the best check-IC210148, IC210151, IC 211163, IC211164, IC211169, IC211176, IC211178, IC211169, IC211182, IC 211196, IC264725 and IC264734

Turmeric: A total of 165 accessions along with 4 checks were planted in Augmented Randomized Block

design for multi-locational trial. Each accession was maintained in one row with spacing 30X75 cm. Observation on morpho-agronomic traits was recorded according to minimal descriptor (Table 3). The planting material was received from NBPGR, Thrissur. Satisfactory germination was observed in 132 accessions.

Table 3: Characterization of turmeric under multi locational trial

Characters	Range		Mean
	Minimum	Maximum	
Plant height (cm)	22.30	120.33	77.08
Petiole length (cm)	3.00	20.40	12.16
Sheath length (cm)	3.50	42.66	22.25
Leaf length (cm)	16.90	62.50	42.15
Leaf width (cm)	1.10	25.90	14.30
Sucker number per plant	1.00	5.50	2.61
Basal diameter (cm)	3.60	20.50	12.67
Mother length primary (cm)	2.30	9.20	5.73
Mother medium (cm)	1.60	5.15	3.08
Secondary mother no./ plant	1.00	7.00	2.07
Secondary mother length (cm)	2.90	6.20	4.57
Secondary mother thickness (cm)	1.40	3.25	2.41
Primary finger no./ plant	1.60	23.00	8.00
Primary finger length (cm)	1.50	8.00	4.72
Primary finger thickness (cm)	0.70	4.20	1.51
Secondary fingers/ plant	1.00	36.50	8.69
Secondary finger length (cm)	0.60	5.90	2.58
Secondary finger thickness (cm)	0.50	2.05	1.16
Mother wt./ plant (g)	3.70	111.32	33.45
Tuber wt./ plant (g)	0.63	22.33	8.18
Mother dry wt. (%)	66.38	98.10	81.25
Tubers dry wt. (%)	31.74	109.34	73.28
Mother dry wt./ plant (g)	2.83	81.75	27.08
Tuber dry wt./ plant (g)	0.20	13.84	5.99
Total fresh wt./ plant (g)	6.27	329.66	117.70
Total dry wt./ plant (g)	4.15	230.31	87.72

No. of accessions-165, Source-NBPGR, Thrissur, Design-Augmented RBD, Spacing-75X30 cm, Traits observed-28, Check-Sobha, Kanthi, Suvama

Rice: A total of 204 accessions of rice germplasm were sown in nursery bed. Out of which, 174 accessions were characterized and 30 accessions were grown for multiplication observation on morphological traits viz. basal leaf colour, leaf blade colour, leaf pubescence, panicle exertion, stigma colour, days to 50% flowering, plant height, leaf length etc. were recorded in the farm field. Post

harvest data i.e. 100 grain wt., L/W ratios etc. were also recorded as per minimal descriptor.

Mung bean: A total of 40 accessions of mungbean received from HQs was sown in rice fellow in the month of December, 2004 using three local checks for characterization. Satisfactory germination was observed in all germplasm.

Characters	Minimum	Maximum	Mean
Days to flowering	53	65	56.97
Plant height (cm)	17.34	34.72	25.26
No. of branches/ plant	1.00	2.50	1.35
No. of clusters/ plant	2.00	5.00	3.35
No. of pods/ cluster	4.60	14.40	8.60
No. of pods/ plant	6.40	16.20	10.76
Days to maturity	83	93	86.77
No. of seeds/ pod	8.40	13.20	10.48
100 seed wt. (g)	2.45	5.01	3.36
Pod length (cm)	5.70	8.10	6.30
Seed yield/ plant (g)	2.55	11.27	6.80
Seed yield/ plot (g)	12.75	56.38	34.05
Biological yield/ plant (g)	151.67	669.05	389.09
Harvest index	2.19	12.14	7.68

Turmeric: A total of 114 accessions of turmeric germplasm were planted in augmented RBD using 3 checks with spacing of 30x75 cm for characterization. Out of which, 20 accessions failed to sprout. Observation on morphological traits viz., plant height, petiole length, sheath length, leaf length, leaf width etc. were recorded in the farm field as per the minimal descriptors.

were deposited for LTS in the National Genebank at NBPGR, New Delhi.

Sesame: A total number of 500 accessions of sesame germplasm received from NBPGR, Akola were sown for multiplication.

Cryo-preservation: A total of 5 accessions of M&AP were deposited in Cryo-preservation.

11.2 Germplasm Conservation

11.3 Germplasm Supply

Medium Term Storage (MTS): A total of 28 accessions comprising M&AP (25), rice (1), pigeon pea (1) and chilli (1) were deposited as voucher specimen for MTS at NBPGR, New Delhi.

A total of 192 accessions comprising aromatic rice (73), turmeric (17), taro (37), M&AP (64) and chilli (1) were sent to different regeneration sites for maintenance and research purpose.

Long Term Storage (LTS): A total of 849 accessions comprising rice (765), wild rice (83) and pigeon pea (1)

11.4 Germplasm Maintenance

A total of 1,477 accessions comprising 204 accessions of cultivated rice, 180 accessions of wild relatives of crop plants, 194 accessions of turmeric, 17 accessions of banana, 19 accessions of betel vine, 329 accessions of M&AP, 24 accessions of forest plant, 40 accessions of mungbean, 464 accessions of sesame, 6 accessions of horticultural crops are maintained at NBPGR Base Centre, Cuttack.

Research Project (Code, Title, Project leader)

Project PGR/EXP-BUR-CUT-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources in Orissa and adjoining regions (D P Patel).

12. REGIONAL STATION, HYDERABAD

Summary: During the period under report, a total of 11,390 samples consisting of 6,632 import samples and 4,758 export samples were processed for quarantine clearance and 121 phytosanitary certificates were issued to samples meant for export. Several pathogens of quarantine importance were intercepted. The import samples (987) that were found infested/infected with pests/pathogens could be salvaged and released to the consignees. In exports, 104 samples were rejected due to the association of quarantine pests/pathogens. Quarantine service was extended to more than 30 organizations in South India including ICRISAT. A total of 13 explorations were conducted to collect germplasm of pigeonpea, *Sesbania* spp., *Madhuca latifolia*, *Pongamia* spp., and *Jatropha* spp., and 570 accessions of different crops and their wild relatives were collected. A total of 3239 accessions of different agri horticultural crops comprising brinjal, chillies, blackgram, finger millet, maize, sorghum, tomato and other crops/wild species were grown for characterization, evaluation, rejuvenation and multiplication. A total of 4,020 samples were added during the year to the medium term module raising the total holdings to 55,979 germplasm samples. A total of 1613 accessions of various crops comprising millets, pulses and vegetables were sent for long-term conservation whereas 522 accessions comprising of pulses, vegetables and medicinal plants were sent to GHU. A total of 775 accessions of the mandate crops (chillies, brinjal, tomato) and other vegetable crops were distributed to the indentors.

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

12.1 Quarantine Processing and Clearance of Germplasm

A total of 11,390 samples [6,632- imports & 4,758 - exports] were received for quarantine processing. Out of these, 6,632 samples (paddy- 4,185, maize- 1,386, sorghum-696, chickpea- 26, groundnut-47, sunflower-68, chilli-124, okra- 10, cowpea-2 and tobacco-88) were imported from different countries and the rest 4,758 (sorghum-1,081, pearl millet-775, chickpea-1,732, pigeonpea-142, groundnut-504 and small millets-524) were meant for export to different countries.

12.1.1 Imports processed and released: During the period under report, 6,122 samples comprising paddy samples (4,133), maize (1,354), sorghum (213), chickpea (103), groundnut (38), sunflower (68), chilli

(113), okra (10), cowpea (2) and wild tobacco (88) were released to the respective consignees after giving the mandatory treatments. Multiplied seed of two groundnut accessions (one each from Zimbabwe and Cyprus) were released after testing once again against bacterial wilt (*Ralstonia solanacearum*) using tetrazolium chloride agar medium and were found free from infection.

Total number of samples infested/infected in imports	- 987
Samples found infested/infested with pathogens	- 769
Samples found infested with insects	- 62
Samples found infested/infested with nematodes	- 156
Number of samples salvaged	- 987
Number of samples detained	- Nil
Number of samples rejected	- Nil

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

Pathogen	Crop	Country
<i>Fusarium solani</i>	Sunflower Maize	France Philippines
<i>Fusarium oxysporum</i> and <i>Phoma medicaginis</i>	Chickpea	Syria
<i>Macrophomina phaseolina</i>	Sorghum	France
<i>Macrophomina phaseolina</i> , <i>Colletotrichum graminicola</i> , <i>Drechslera setariae</i> , <i>Periconia</i> sp., <i>Phoma sorghina</i>	Sorghum	Niger

12.1.3 Post-entry quarantine observations:

Chickpea germplasm (129 accs.), imported from Australia, which were found moderately resistant to *Ascochyta* blight and *Botrytis cinerea* infection under growth chamber conditions, were grown for multiplication in the post-entry quarantine isolation area at ICRISAT. Disease observations on *Fusarium* wilt incidence, *Cucumber mosaic virus* and *Alfalfa mosaic virus* incidence were recorded. Disease free accessions (121) were harvested for seeds.

Sorghum germplasm (210 accs.), imported from France and grown at PEQIA of ICRISAT was inspected at weekly intervals. All accessions were found free from exotic diseases. However, diseases of local occurrence such as zonate leaf spot (*Gloeocercospora sorghi*) and anthracnose (*Colletotrichum graminicola*) were observed.

Paddy germplasm, (450 accessions) imported from Belgium were grown on the farm of M/s Hybrid Rice International Ltd and were regularly observed for pests and diseases. All the accessions were found healthy.

A Scientist from this station visited Metahelix farm in Bangalore and inspected imported germplasm of maize (19), chilli (5), tomato (6), brinjal (4), cauliflower (17) and *Cucumis* spp (8) being grown there as a part of post-entry quarantine inspection.

Sowing of pesticide treated sunflower germplasm (24 accs.) from France at Monsanto India Ltd., Bangalore was also inspected. Another inspection was conducted during active crop growth stage. All accessions were found healthy.

Inspection of transgenic cotton accessions (13) grown in the greenhouse of Pro-Agro Seed Company Ltd., Hyderabad was done. All accessions were found healthy.

A Quarantine Scientist from this station inspected the sowing of treated maize consignment (565 accs) in the field of Bioseed Research India Pvt. Ltd., Hyderabad.

The same consignment was inspected during active crop growth stage by an Entomologist and two Pathologists of the station. No accession was found infected with exotic pest or pests of quarantine significance.

An accession of transgenic cotton germplasm (EC559688) grown in the greenhouse of Ankur Seeds Pvt. Ltd., Nagpur was inspected by a Quarantine Scientist of the station during active crop growth stage. All the plants of the accession grown in 11 pots were healthy and free from exotic pests. Few plants were infested with sooty mold, thrips and whiteflies. Fortnightly sprays with systemic insecticides controlled the insect infestation.

Chickpea (24 accs) from Syria and groundnut (11 accs.) from Ghana and Malawi, grown in the glasshouse at ICRISAT, were inspected at weekly intervals and found healthy. Chickpea (51 accs.) from USA and one accession of groundnut from Niger, grown in the glasshouse, were harvested. They will be released after testing against bacterial wilt infection.

One wild accession of groundnut was released to grow in glasshouse as post-entry quarantine measure. Twelve samples of groundnut imported from Ghana, Niger and Malawi were harvested after growing for one generation in PEQIA. The released accessions of groundnut (1 from Vietnam and 3 from USA) and chickpea (17-cultivated species from Syria and 4-wild from Australia) grown in the glasshouse of PQL, ICRISAT were inspected at weekly intervals and found free from exotic diseases.

12.2 Export Quarantine

Out of 4,758 export samples (sorghum-1,081; pearl millet-775; chickpea-1,732; pigeonpea-142; groundnut-504 and small millets-524), 104 samples were rejected due to the association of various pests and pathogens. In all, 121 phytosanitary certificates were issued to pest free germplasm during the reporting period. The details are given as under:

Crop	Number of samples		
	Received	Rejected	Released
Sorghum	1081 (1081)	26(26)	1055 (1055)
Pearlmillet	775 (775)	28(28)	747(747)
Chickpea	1732 (1140)	33 (32)	1699 (1108)
Pigeonpea	142 (142)	5 (5)	137(137)
Groundnut	504 (494)	11 (11)	493 (483)
Small millets	524 (524)	1 (1)	523 (523)
Grand Total	4758 (4156)	104 (103)	4654 (4053)

Figures in parentheses indicate number of accessions.

12.2.1 Interceptions of pests from germplasm meant for export: The rejections in the export germplasm of ICRISAT mandate crops were mainly due to pathogens such as *Acremonium strictum*, *Exserohilum turcicum*, *Phoma* sp., *Peronosclerospora sorghi* and *Sphacelotheca sorghi* on sorghum; *Tolyposporium penicillariae*, *Rhizoctonia* spp. and bacteria with nil germination on pearl millet; *F. oxysporum* and Gram negative bacteria on chickpea; *Lasiodiplodia theobromae*, *Fusarium udum*, *Rhizoctonia solani*, *Verticillium* spp., Gram negative bacteria and insect infestation on pigeonpea; *Rhizoctonia bataticola*, *R. solani*, *Sclerotium rolfsii* and *Macrophomina phaseolina* on groundnut and *Fusarium chlamydosporum* on finger millet. Some samples were rejected due to lack of necessary documents like DARE certificate.

12.2.2 Pre-export field inspection: Chickpea germplasm grown for seed multiplication (5.5 ha), International trial nursery (1.22 ha) and other purposes (2.0 ha) at ICRISAT was inspected. Incidence of *Sclerotium rolfsii* (2%) and *Fusarium wilt* (1%) in seed multiplication fields and stunt incidence (< 2%) in the trial nursery was noticed.

Groundnut accessions that are being multiplied on 9.8 ha of ICRISAT fields meant for international trials and seed multiplication were inspected. Incidence of bud necrosis, *Sclerotium rolfsii* and *Aspergillus niger* rot were noticed in seed multiplication plots and early leaf spot, late leaf spot and leaf folder damage were observed to an extent of 0.1% in the International trial plot.

Plant quarantine services from NBPGR, Hyderabad to other organizations

ICAR institutes	SAUs/ State Govt. Organizations	Private Industries/ Organizations	International
<ul style="list-style-type: none"> -DOR, Hyderabad - DRR, Hyderabad - NRCS, Hyderabad - IIHR, Bangalore -CTRI, Rajahmundry 	<ul style="list-style-type: none"> - Annamalai Univ., Chidambaram, TN - ARS of ANGRAU, Hyderabad - AD Agril. Coll. & Res. Inst., Trichy - TNAU, Coimbatore, TN - ARS, TNAU, Timpatiswaram, TN - ARS, Paramakudi, TN - UAS, Bangalore - JN Coll. Agri., Karaikal, Pondicherry - Hort. Coll. & Res. Inst., Periyakulam - Center for Cellular and Molecular Biology, Hyderabad - Rice Research Station, Kerala 	<ul style="list-style-type: none"> - Advanta India Pvt. Ltd., Bangalore - Barwale Research Foundation, Hyderabad - Bioseed Research (I) Pvt. Ltd., Hyderabad - JK Agrigenetics, Hyderabad - MAHYCO Ltd., Medak, Andhra Pradesh - Metahelix Life Sciences Pvt. Ltd., Bangalore - Monsanto India Ltd., Bangalore - Pioneer Overseas Corp. Pvt. Ltd, Hyderabad - Pro-Agro Seed Co Pvt. Ltd., Hyderabad - Syngenta India Ltd., Pune, Maharashtra - Seed Works India Pvt. Ltd., Hyderabad - Nuziveedu Seeds Pvt. Ltd., Hyderabad - Vibha Agrotech Ltd., Hyderabad - Vikki's Agrotech Ltd., Hyderabad - Zuari Seeds Ltd., Bangalore 	<ul style="list-style-type: none"> ICRISAT - Patancheru, Hyderabad

12.3 PGR Activities

12.3.1 Exploration and collection of germplasm:

A total of 13 explorations were undertaken during the period and 570 germplasm accessions of various crops were collected. Details of explorations and crop diversity collected are as follows:

Cajanus cajan: Tandur region of Ranga Reddy district of Andhra Pradesh was surveyed and a total of 76

accessions comprising pigeonpea (73 accs.) and others (3 accs.) were collected.

Sesbania species and other crops: Krishna, Guntur, Prakasam and Nellore districts of South Coastal region (including some Tsunami affected areas) and Cuddapah and Kurnool districts of Rayalaseema region, Andhra Pradesh were surveyed for *Sesbania grandiflora* and other crops. A total of 38 accessions were collected including *Sesbania grandiflora* (25), *Pedalium murex*,

Centella asiatica, *Vigna trilobata*, *Sesamum alatum* and others (9). Good diversity was observed in plant height, branching, leaf biomass, pod and seed characters in *Sesbania grandiflora*.

Madhuca latifolia: A crop specific exploration was conducted in collaboration with Directorate of Oilseeds Research, Hyderabad for the collection of Mahua germplasm from parts of Khammam district of Andhra Pradesh and Dantewada and Bastar districts of Chhattisgarh. A total of 31 accessions of Mahua were collected and processed for cryopreservation.

Sorghum: A crop specific exploration was conducted in Nalgonda and Khammam districts of Andhra Pradesh and germplasm of sorghum (37 accs.) and other crops (5) was collected. Landraces collected during the survey included **pacchha jonna**, **tella jonna**, **konda jonna**, **pilijowar**, **kakijonna** and **choppa jonna**. Main races observed were **durras** and **durra-bicolors**. Diversity was observed in plant height, panicle length, width and compactness, seed colour and size, glume covering and colour and presence of awns.

Brinjal: Under the DBT project, two surveys were undertaken for brinjal and wild *Solanum* one in coastal districts of Orissa covering Cuttack, Mayurbhanj, Balasore, Bhadrak, Jopjur and Puri and the other in parts of Mahaboobnagar, Kumool, Cuddapah, Chittoor and Anantapur districts of Andhra Pradesh. In all, 137 accessions of brinjal germplasm were collected. Wild species collected included *Solanum surratense* (2 accs.), *S. torvum* (1 accs.), *S. incanum* (27 acc.), *S. insanum* (1 acc.), *Solanum* sp. (8 accs.) and other crops (9 accs.).

Pongamia and Jatropha: Under the AP cess fund project, two explorations were undertaken in North coastal and Rayalseema region of Andhra Pradesh in collaboration with Central Research Institute for Dryland Agriculture, Hyderabad. A total of 61 accessions comprising of *Pongamia* (33) and *Jatropha* (28) were collected:

Jatropha: Under the AP Govt funded project on *Jatropha*, seven explorations were undertaken for the collection of *Jatropha curcas* germplasm from Adilabad, Ranga Reddy, Prakasam and Medak districts of Andhra Pradesh and Bastar, Dantewada and Kanker districts of Chhattisgarh. A total of 185 accessions of

Jatropha diversity were collected. Of these, one exploration was conducted in collaboration with DOR, Hyderabad to collect *Jatropha* from Adilabad.

12.3.2. Germplasm Evaluation

Rabi 2004-05

Dolichos bean: A total of 176 accessions of *Dolichos* bean germplasm was evaluated for 11 quantitative characters. IC383091, IC383216, IC383197, IC383176, IC383166, IC383115, IC384071, IC261305 recorded no incidence of anthracnose and accessions IC313536, IC261257, IC261254 recorded less than 10% incidence in the field condition. IC383091, IC383115, IC383197, IC384071 were found to be free from natural incidence of both aphids and anthracnose.

Chilli: A total of 126 accessions of chilli germplasm was evaluated and promising accessions were identified for different traits. IC413794 (73 days), IC413443, IC413414 and IC413734 (79 days) flowered earlier than the check (99 days), while IC413443, IC413414 and IC413417 matured earlier (119 days) than check (153 days). IC411625 (21.2 g) and IC446523 (16.8 g) recorded better 10 dry fruits weight over check (6.3 g)

Sorghum: A set of 275 accessions of sorghum germplasm lines comprising repatriated material (216) and NATP (PB) material (50) were characterized and evaluated during *Rabi* 2004-05. M 35-1 and CSV 216 were used as local and national checks respectively. A total of 18 characters were recorded. Accessions IS26947, IS36100, IC413282, IC413291 flowered early compared to the check (75 days).

Cowpea: Preliminary characterization and evaluation of 135 cowpea accessions was completed. IC519603 (36 pods/ plant) and IC257836 (36 pods/ plant) were better than the check (25 pods/plant) while IC519624 (30 cm) recorded higher pod length than check (19 cm).

Kharif 2005

A total of 1,740 accessions of blackgram, brinjal, chilli, tomato, horsegram, cowpea, and millets were grown in the field along with checks for characterization, evaluation/ multiplication.

Crop	Accession (no.)	Checks	Activity
Brinjal	351	Bhagyamathi, Shyamala & Pusa Purple Long	Characterization/ multiplication
Chilli	90	CA-960, G-4, LCA-334 & Pusa Jwala	Rejuvenation, characterization and multiplication
Tomato	96	Marutham & Pusa Ruby	Multiplication
Horsegram	216	Palem-1 & Palem-2	Characterization
Dolichos bean	157	RND-1, Arka Vijay, Arka Jay	Multiplication
Cowpea	198	C-152, COVU-702 & G-153	Characterization/ multiplication
Blackgram	427	PU-19, T-9 & LBG-20	Evaluation/ multiplication
Barnyard millet	4	K-1, VL-29	Evaluation
Finger millet	189	PR-202 & VL-149	Multiplication/ evaluation
Little millet	4	CO-2 & OLM-203	Evaluation
Italian millet	15	Prasad, Lepakshi, Krishnadevaraya, Narsimharaya, Srilakshmi,, Si-A-2829 & Si-A-2871	Evaluation

Chilli: EC399575 with 56 days and EC399574 with 57 days were the earliest to flower out of all the accessions and four checks.

Tomato: Forty-two accessions, which were not represented in the national genebank (NGB), were multiplied and processed for the genebank.

Cowpea: IC282036 was observed to be superior (with 11 clusters) over best check C-152 (10) for the number of clusters/ plant.

Blackgram: IC436809 was a late flowering genotype with 55 days as compared to the check varieties, which flowered in 35 days. IC436538 and IC398956 with luxuriant vegetative growth and foliage appeared to be promising both for grain and fodder. Accession IC281990 was rare morphotype with purple stem. In blackgram, IC56048 with 15.4 g was superior over the best check T-9 with 6.2 g for single plant yield.

Fifty-four accessions of blackgram received from NBPGR, New Delhi were multiplied for preliminary

characterization and evaluation in 2005 *Kharif*.

In Italian millet, IC413272 (*Nalla Korra*) collected from Raipalli village, Zaheerabad Mandal, Medak District, Andhra Pradesh was found promising for early flowering (41-42 days) as compared to seven national and regional checks (Si-A-2829, Si-A-2871, Prasad, Lepakshi, Krishnadevaraya, Narsimharaya and Srilakshmi).



An extra early Italian millet germplasm accession (IC413272) in flowering

Rabi 2005-06

The following crops have been sown for characterisation, evaluation and multiplication.

Crop	Accession (no.)	Checks	Activity
Sorghum	204	CSV 216, M35-1	Characterization/ multiplication
Blackgram	159	PU-19, T-9 & LBG-20	Characterization, evaluation and multiplication
Brinjal	24	Shyamala, Bhagyamati & Pusa Purple	Multiplication
Horsegram	20	Palem-1 & Palem-2	Evaluation
Cherry tomato	20	Marutham & Punjab Chauhara	Characterization & Evaluation
Chilli	251	Pusa Jwala, CA-960,G-4 & LCA 334	Characterization/ multiplication

12.3.3 Germplasm Conservation

Long-term storage in the National genebank: A total of 1,613 accessions of diverse germplasm including finger millet (64), Italian millet (57), little millet (51), barnyard millet (19), kodo millet (4), pearl millet (1), blackgram (244), chilli (140), horsegram (152) and cowpea (55), collected under the NATP programme were multiplied and sent for long term storage at NGB, New Delhi. In addition, pigeon pea (121) multiplied by IIPR, Kanpur; castor (305) multiplied by DOR, Hyderabad and 111 accessions of different crops multiplied by ANGRAU were also sent for long-term storage at NGB, New Delhi.

Voucher seed samples of 95 accessions along with 10 accessions of live plants of diverse medicinal and aromatic plants were sent to the NBPGR, New Delhi for long-term storage, evaluation and maintenance. Thirty-one accessions of mahua germplasm were sent for cryopreservation at NGB, New Delhi.

Exotic paddy germplasm (464 accs. from Philippines) submitted by Hybrid Rice International Pvt. Ltd., Hyderabad and Nuziveedu Seeds Ltd., Hyderabad was sent to the NGB, New Delhi for long term conservation.

Medium term storage, New Delhi: A total of 522 accessions of diverse germplasm collected under the NATP (PB) including vegetables (287), horsegram (153), and medicinal plants (6) and pigeon pea and other crops (76) were sent to GHU for storage in the MTS and accessioning. In addition, voucher samples of 81 accessions of *Jatropha* germplasm collected under the AP Govt. funded project, were also sent for medium-term conservation and accessioning.

MTS at Hyderabad: A total of 3,060 accs. of import voucher samples of diverse crops including paddy (2,135), maize (90), sorghum (696), chilli (124), okra (10), cowpea (2) and chickpea (3) was added to the medium term module.

Status of the repatriation of germplasm from ICRISAT as in December 2005

	Groundnut	Pigeonpea	Chickpea	Sorghum	Pearl millet	Small millets	Total
Total germplasm identified	6060	5988	7488	14637	7189	3460	44822
Restored to NGB	4984	5067	7429	14255	7032	3429	42196
Voucher samples sent to Coordinator for multiplication	413	128	-	-	-	-	541
Voucher samples with NBPGR (to be multiplied)	115	268	33	16	21	-	453
To be obtained from ICRISAT	548	525	26	366	136	31	1632

A total of 960 samples of germplasm collected during exploration (*Jatropha*, sorghum, *Sesbania*, pulses and vegetables) were added to the MTS.

12.3.4 Germplasm distribution: A total of 775 accessions of chilli, brinjal and tomato were distributed to different indentors for evaluation and crop improvement research. In addition, the following germplasm was also distributed to indentors

- 50 accs. of blackgram to IIPR, Kanpur for evaluation.
- 65 accs. of live medicinal plant species to NBPGR HQ, New Delhi.
- 67 accs. of *Jatropha* germplasm collected in exploration surveys were sent to the collaborators viz., CRIDA, ANGRAU and ICRISAT.
- 11 accs. of *Jatropha* germplasm received from NBPGR Regional Station, Thrissur were sent to the Agroforestry center of ANGRAU, Hyderabad for evaluation
- 34 accs. of *Jatropha* germplasm received from NBPGR, New Delhi were sent to RARS, Tirupati for evaluation.

Germplasm shared with NAGS: Seventy-three accessions of pigeonpea collected under the collaborative exploration programme were shared with IIPR, Kanpur and ANGRAU, ARS-Tandur. Further, 45 accessions of kenaf germplasm collected from South East Coastal zone were supplied to the National Active Germplasm Site, CRIJAF, Kolkata for evaluation and maintenance.

Herbarium specimens: Herbarium specimens of 45 accs of wild and cultivated brinjal were sent to NHCP, New Delhi.

12.3.5 Germplasm Restoration Activities: A total of 3,302 accessions (sorghum-216, chickpea-612, pigeonpea-1,329, pearl millet-319, groundnut-826) were repatriated from ICRISAT and multiplied/ regenerated at appropriate site and deposited in the NGB for long-term conservation.

12.4 Supportive Research

12.4.1 Salvaging treatment for finger millet: Finger millet germplasm, meant for export to Kenya, was found infected with seed borne pathogens, viz., *Bipolaris*, *Curvularia* and *Phoma* species. Seed treatment with benomyl, thiram and their combinations was tested and thiram treatment was found effective to eliminate the infection completely.

12.4.2 Eradication of grain molds of sorghum: New fungicides viz., Tricyclozole (Beam 95% WP) and Iprodione 25% + Carbendazim 25% (Quintal 50% WP) were tested with a view to identify a suitable fungicide which is effective for longer period against sorghum grain mold fungi. Results indicated that both the new fungicides were found effective on par with benomyl + thiram treatment. However, tricyclozole affected the germination due to its phytotoxicity.

Bio-agent formulations viz., *Trichoderma viride*, *T. harzianum*, *Pseudomonas fluorescens* and *Bacillus* spp., obtained from Sri Biotech Pvt. Ltd., Hyderabad were tested against grain mold infected sorghum seed with an intention of promoting non-chemical seed treatment in Quarantine laboratories. Both the fungal bioagent formulations (*Trichoderma viride* and *T. harzianum*) could effectively inhibit the grain mold pathogens by overgrowing on the seed. However, there was not much difference in the germination percentage of treated and untreated control. Bacterial bioagent formulations (*Pseudomonas fluorescens* & *Bacillus* spp.) were found ineffective.

12.4.3 Seed health testing of *Jatropha* germplasm:

A total of 211 accessions collected from Adilabad, Medak, Ranga Reddy and Prakasam districts of Andhra Pradesh

(1 1 6) ;
N B P G R
Bhowali (1)
and Thrissur
(9) ;
Chhattisgarh
(68), and
Mettupalem
district of
Tamil Nadu
(17) were
received for



Jatropha plant from Adilabad showing virus disease symptoms

seed health testing. Accessions were found infected with *Alternaria alternata*, *Cercospora* sp., *Cladosporium* sp., *Chaetomium* sp., *Colletotrichum acutatum*, *C. graminicola*, *Drechslera* sp., *Fusarium solani*, *F. verticilloides*, *Lasiodiplodia theobromae*, *Pestalotia* sp., *Phoma* sp. etc. Twenty-two accessions were found infested with nematodes, which are to be identified.

Jatropha mosaic virus infected twigs, collected during exploration in the Ranga Reddy district were grafted onto healthy *Jatropha* plants for transmission and establishment of virus for carrying out further studies. The virus could be established on two out of seven plants with typical symptoms.

Information on 32 weed species of quarantine importance is being compiled to bring out a monograph, which will be useful for easy identification in Quarantine laboratories.

12.4.4 TSV transmission studies: *Parthenium* seeds (646 numbers) collected from *Tobacco streak virus* (TSV) infected plants were sown in aluminum trays. Germinated seeds (260) were assayed for seed transmission by ELISA. None of them was found infected with TSV. Similarly, six out of 27 Tridax seeds germinated did not contain TSV. Pollen collected from TSV infected *Parthenium* sprinkled onto cowpea, groundnut and sunflower and caging the plants by releasing 10 adults of *Frankliniella schultzei* transmitted TSV.

Thirteen-groundnut cultivars alongwith JL-24 (control) received from ARS, Kadiri were tested against TSV (dilutions 10^{-2} , 10^{-3}) and PBNV (dilutions 10^{-1} , 10^{-2}). All the 13 cultivars were susceptible to TSV at 10^{-2} and 10^{-3} dilutions. However, all cultivars including JL-24 were susceptible to PBNV at 10^{-1} but not at 10^{-2} .

None of the 14 sunflower samples received from Allahabad, was positive to TSV in infectivity assays on to cowpea and French bean.

12.4.5 Identification of tobacco streak virus on cotton: On the request of an expert team, Commissioner of Agriculture, cotton samples collected from Warangal were ELISA tested. Seven out of 33 were positive for TSV. Cotton fields around Warangal were also visited by Drs Prasada Rao and. Sarath Babu to assess the



Cotton plants from Warangal (AP) showing *Tobacco streak virus* incidence

situation. The incidence of TSV was up to 60% in RCH 2 and 20% in Bunny Bt. Seventeen out of 44 samples collected were positive to TSV in ELISA tests. Cotton-TSV isolate was established in the green house and comparative host range studies alongwith groundnut-TSV isolate are in progress. Cotton-TSV produced severe symptoms on most of the hosts inoculated. Thirty-six cotton hybrids/varieties sap inoculated with TSV-C produced local lesions on inoculated leaves.

However, no systemic symptoms were observed in any one including RCH2 and Bunny Bt. even after 45 days of inoculation. ELISA test also indicated that the virus was not systemic in the inoculated hybrids/varieties.

The host range studies of TSV-cotton indicated that the isolate is not much different from TSV-groundnut and TSV-sunflower. Fifty-eight out of 282 samples of cotton suspected for TSV collected from Warangal (90), Karimnagar (90) and Khammam (102) districts were found positive to TSV in ELISA.

12.4.6 Blackeye cowpea mosaic virus (BICMV) incidence on cowpea germplasm: Observations were recorded on 168 lines of cowpea grown for evaluation, the incidence of BICMV varied between 10-83% in most of the lines except 17 lines, which are completely free, and 10 lines having < 10% incidence.

New Projects/Schemes/ Programmes initiated

The Government of Andhra Pradesh sanctioned a Project in collaboration with ANGRAU, CRIDA, DOR and ICRISAT, entitled "Collection, evaluation of germplasm, standardization of agrotechniques and pilot demonstrations for *Jatropha curcas* L. in rain shadow districts of Andhra Pradesh".

Nine out of 23 plants of cowpea aphid (*Aphis craccivora*) inoculated non-persistently produced *Black eye cowpea mosaic virus* (BICMV) symptoms.

12.4.7 Peanut bud necrosis virus (PBNV) incidence on tomato: All 112 lines of tomato grown in the field showed PBNV incidence ranging from 12-100%.



Collar rot infected horsegram accession along with healthy plants

12.4.8 Laboratory screening of chilli germplasm against PBNV: Twenty-five accessions of chilli germplasm were sap inoculated with PBNV. None of the accessions were found resistant and the infection ranged between 52-93%.

12.4.9 Screening of horsegram germplasm against collar rot: Observations on collar rot incidence (*Macrophomina phaseolina*) were recorded on 255 accessions of horsegram (including checks), of which 23 accessions were completely free from the disease.

ANNEXURE 1: Status of Germplasm holdings at NBPGR RS Hyderabad – as on 31.12.05

Crop / Category	Number of samples in MTS
Brinjal	6116
Blackgram	710
Chilli	3021
Tomato	304
Voucher samples of maize received from NBPGR, New Delhi	99
Voucher samples of NATP evaluated sorghum received from NRCS	377
Import voucher samples	27,258
Export voucher samples	3,301
NBPGR collection (Pre-NATP)	1789
NATP collection & augmented samples from collaborating institutes	10,233
NPTC collection	947
Released & Research Material (Restoration from ICRISAT)	
Sorghum	244
Chickpea	1168
Pigeonpea	846
Collaborating Institutes	
ANGRAU – paddy, vegetables, sunflower	32
DOR – sunflower	74
DRR – paddy	258
CTRI – Rajahmundry (tobacco)	139
Grand Total	55,979

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

PGR/ PQR-BUR-HYD-01: Quarantine processing of plant germplasm under exchange and supportive research (KS Varaprasad; RDVJ Prasada Rao, SK Chakrabarty, Anitha Kodaru, B Sarath Babu).

PGR/ PQR-BUR-HYD-02: Detection, identification and control of pests associated with import and export of seed/ plant material (Anitha Kodaru; SK Chakrabarty).

PGR/ PQR-BUR-HYD-03: Developing a database on pests and pathogens of quarantine significance (B Sarath Babu).

PGR/ PQR-BUR-HYD-04: Developing detection techniques and treatment schedules for seed borne pathogens (SK Chakrabarty; Anitha Kodaru).

PGR/ PQR-BUR-HYD-05: Post-Entry Quarantine processing of imported germplasm (RDVJ Prasada Rao; SK Chakrabarty; Anitha Kodaru).

PGR/ PQR-BUR-HYD-06: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and distribution of genetic resources of horticultural crops (vegetables, fruits, spices, medicinal and aromatic plants etc.) and their wild relatives (SR Pandravada).

PGR/ PQR-BUR-HYD-07: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and distribution of genetic resources of agricultural crops (Cereals, Millets, Pulses And Oilseeds) and Their Wild Relatives (V Kamala).

PGR/ PQR-BUR-HYD-08: Characterization and evaluation of wild edible crops of leguminosae (N Sivaraj)

Externally Funded Projects

1. Creating Awareness On Conservation, Utilization and Benefit Sharing In The Light Of Biodiversity Act (KS Varaprasad).
2. Analysis Of Genetic Diversity and Phylogenetic Relationships In *Solanum melongena* and Related Wild and Weedy Taxa (DBT Funded Project) (N Sivaraj).
3. Collection, Evaluation Of Germplasm, Standardization Of Agro-Techniques and Pilot Demonstrations For *Jatropha curcus* In Rain Shadow Districts Of Andhra Pradesh (N Sunil).

13. REGIONAL STATION, JODHPUR

Summary: Four crop specific explorations were undertaken to various parts of Gujarat and Rajasthan and 136 collections comprising millets (45), legumes (1), spices (9), fruits (64), medicinal and aromatic plants (7), ornamentals (9) and others (1) were made. Vegetatively propagated material (17) was also collected which is being maintained in the field and in pots. Observation were recorded on morpho-agronomical traits of 631 accessions sown during Rabi, 2004 and 2,682 accessions sown during Kharif, 2005. A set of 374 accessions comprising amaranth, barley, *Brassica* spp., chickpea, fennel, fenugreek, maize and wheat were sown along with checks during rabi, 2005 for characterisation. Blocks of horticultural plants and plants of economic importance were maintained and data were recorded in aonla, bael, *Capparis decidua*, jamun, mulberry, *Salvadora* sp., *Aloe barbadensis*, *Jatropha curcas* and jojoba germplasm. In all 5,563 accessions were processed and kept in MTS facility and 1,680 accessions were sent to NGB for LTS. Seed samples (1,668 accessions) were supplied to various indentors and for multilocational trials.

13.1 Plant Exploration and Collection of Germplasm

Four crop specific explorations trips including one local trip were undertaken in parts of Gujarat and Rajasthan (Table 1). In all, 136 collections comprising millets (45), legumes (1), spices (9), fruits (64), medicinal and aromatic plants (7), ornamentals (9) and others (1) were made. Vegetatively propagated material (17 collections) is being maintained in the field genebank. The details

of crop diversity collected during these explorations is described hereunder.

13.1.1 Exploration and collection of *Capsicum annum* germplasm from Mathania and adjoining areas: In all, 9 collections of chillies were made from areas of Mathania during February, 2005. Variability was observed in fruit length, colour, size, shape (Fig. 1 & 2) and number of seeds/fruit.

Table 1: Germplasm exploration and collections undertaken during 2005

Areas surveyed	Period	Crops/ plants collected	Total collections
Mathaniya and adjoining villages of Jodhpur district	February, 2005	<i>Capsicum annum</i> (39)	39
Parts of Aravalli Ranges (Dahod, Panchmahal, Kheda, Sabarkantha districts of Gujarat and Ajmer, Alwar, Banswara, Chittaurgarh, Dungarpur, Jaipur, Kota, Tonk, Udaipur districts of Rajasthan).	May 26 to June 6, 2005	<i>Aegle marmelos</i> (7), <i>Carissa grandiflora</i> (5), <i>Cordia myxa</i> (5), <i>Cucumis melo</i> (27), <i>Cucumis melo</i> var. <i>momordica</i> (1), <i>Cucumis melo</i> var. <i>utilissimus</i> (1), <i>Cucumis sativus</i> (1), <i>Diospyros melanoxylon</i> (2), <i>Embllica officinalis</i> (8), <i>Grewia subinequalis</i> (3), <i>Phoenix dactylifera</i> (1) and <i>Syzygium cuminii</i> (3)	64
Parts of Gujarat covering Amreli, Banaskantha, Bhavnagar, Kachchh, Jamnagar, Junagadh and Porbandar districts	September 28 to October 8, 2005	<i>Pennisetum glaucum</i> (44), <i>Cyamopsis tetragonoloba</i> (1), <i>Aloe barbadensis</i> (5) and <i>Cissus quadrangularis</i> (1)	51
Jodhpur district of Rajasthan	May to November 2005	<i>Pennisetum glaucum</i> (1), <i>Opuntia elatior</i> (1), <i>Aloe barbadensis</i> (1) and <i>Bougainvillea spectabilis</i> (9)	12
		Total	136

13.1.2 Exploration and collection of minor fruits and muskmelon from parts of Aravali ranges in Gujarat and Rajasthan: In all, 64 collections of fruits including bael (*Aegle marmelos* -7), karonda (*Carissa grandiflora* -5), lasoda (*Cordia myxa* -5), muskmelon (*Cucumis melo* -27), snapmelon (*Cucumis melo* var. *momordica* -1), snake cucumber (*Cucumis melo* var. *utilissimus* -1), cucumber (*Cucumis sativus* -1),

coromandel ebony persimmon (*Diospyros melanoxylon* -2), aonla (*Embllica officinales* -8), phalsa (*Grewia subinequalis* -3), datepalm (*Phoenix dactylifera* -1) and jamun (*Syzygium cuminii* -3) were collected from Aravali hills of Gujarat and Rajasthan during May - June, 2005. Considerable amount of variability for different fruit characteristics such as fruit shape (round/oblong), size (small, medium, big) in bael;

fruit colour (dark pink / light red), size (small/ big) and shape (oblong/ round) in karonda and fruit colour (red/ green/ white with different coloured stripes/netted patterns), fruit shape (oblong/round/ elongated), fruit size (small/ medium/ big) (Fig.3), pulp colour (green/ white/ red) (Fig. 4) and pulp taste (very sweet/ sour/ sour sweet) in muskmelon were recorded.

13.1.3 Collection of pearl millet and minor millet from parts of Gujarat: An exploration trip for the collection of pearl millet and minor millets from parts of Gujarat was undertaken in collaboration with SDAU, S K Nagar and Millet Research Station, KAU, Jamnagar from September 28-October 8, 2005. Fifty-one collections comprising of pearl millet (*Pennisetum glaucum* -44), clusterbean (*Cyamopsis tetragonoloba* -1), Indian aloe (*Aloe barbadensis*- 5) and edible stemmed vine (*Cissus quadrangularis*-1) were made from Amreli, Banaskantha, Bhavnagar, Kachchh, Jamnagar, Junagadh and Porbandar districts of Gujarat. The maximum diversity in pearl millet was observed in the coastal belt of Saurashtra, which includes the region in and around Una, Jaffrabad, Mahuva and Rajula taluks. This region has enormous variability in spike length, shape and grain characteristics. The spike length of the collections ranged from 10.2 cm to 63.8 cm and the spike girth ranged from 0.9 cm to 3.7 cm (Fig. 6). Most of the farmers in the coastal Saurashtra cultivate landraces with longer spikes and tall plant habit while in Banaskantha the landraces cultivated are of dual purpose called as “Rijka bajri” for grains as well as for forage. *Aloe barbadensis* found in natural habitat were of sour type while a sweet type collection was made from Agricultural Research Station, SDAU, Kotara. A collection of clusterbean called as “Vakodia guar” (IC 538002) collected from Jam Kunariya (Kachchh) is

considered as superior vegetable type by the local farmers.

13.1.4 Local Exploration trip: Nine collections of bougainvillea and one collection each of pearl millet (*Pennisetum glaucum*), opuntia (*Opuntia elatior*) and Indian aloe (*Aloe barbadensis*) were made from in and around Jodhpur. Variability in leaf colour, variegation and perianth colour was noted in bougainvillea (*Bougainvillea spectabilis*) germplasm.

13.2 Characterisation and Evaluation

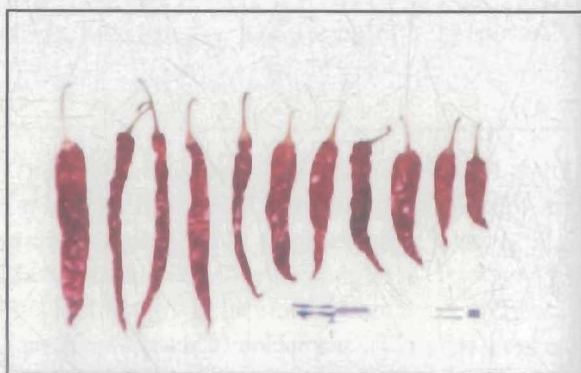
13.2.1 Agricultural crops: A total of 509 accessions sown in the *rabi*, 2004 comprising amaranth (30), barley (192), *Brassica* sp. (35), chickpea (12), fennel (1), fenugreek (2), maize (14) and wheat (223 accessions in two sets) for various parameters and the data were recorded as per the descriptor list. Harvested material was kept in the MTS and also sent to the NGB, New Delhi. The promising accessions identified are depicted in Table 2.

In all, 2,682 accessions comprising pearl millet (101), cowpea (110), guar (710), mothbean (577), mungbean (343), castor (160), sesame (622) and *Cucumis* spp. (59) were sown in *kharif*, 2005 for characterisation/ evaluation/ and seed multiplication. The promising accessions for desired traits in different crops are given in Table 2.

In all, 374 accessions comprising amaranth (39), barley (5), *Brassica* (7), chickpea (33), cumin (1), coriander (9), fenugreek (10), wheat (270) were sown in *rabi*, 2005 for characterisation, evaluation and seed multiplication. Data recording is in progress.



Collection of Chilli from Mathania



Variability in pod shape and colour of the chilli

Table 2: Promising accessions identified in various crops during Kharif, 2005

Crop	Main Attributes	Accessions identified for specific/ desired traits
Pearl millet (101 accessions)	50% flowering (< 42 days)	IC329034 (41 days), IC333121 (41 days)
	1000 seed weight (> 11 g)	IC370529 (11.04), IC373424 (11.11)
	Spike length (> 40 cm)	IC449466 (40.1), IC449448 (43.3), IC449450 (45.3)
Cluster bean Grain type (81 accs.)	Plant height (>122 cm)	IC415168 (124.6), IC415110 (125.4), IC402306 (126.0), IC370741 (128.2), IC258171 (135.2)
	50% maturity (< 68 days)	IC415153 (66), IC415154 (66), IC415157 (67)
	Seed yield (> 30 g)	IC432128 (52.38)
	100 Seed weight (> 3.1 g)	IC249696 (3.21), IC310630 (3.22), IC370712 (3.24)
Vegetable type (22 accs.)	50% flowering (<30 days)	IC11354 (25), IC33705 (28), IC51063 (29), IC421855 (29), IC421860 (29), IC10345 (29)
	Green pod yield (> 55 g) (108.0)	IC13496 (55.4), IC40021 (56.8), IC421858 (60.2), IC432117
Mothbean (45 accs.)	Plant height (> 40 cm)	IC415147 (40.8), IC432139 (43.8)
	Branches/ plant (> 9)	IC451124 (9.2), IC258104 (9.4)
	50% flowering (< 53 days)	IC402285 (52), IC402289 (51), IC415127 (52), IC415164 (51)
	Seed yield/ plant (> 30 g)	IC415132 (32.3), IC415116 (33.1), IC402283 (36.9)
	100 seed weight (> 3.9)	IC402285 (3.92), IC415103 (3.98)
Mungbean (187 accs.)	Branches/ plant (> 5)	EC424988 (5.0), EC520020 (5.2), IC311426 (5.6)
	50% flowering (< 30 days)	IC415616 (28), IC520035 (28), IC520039 (28), IC528607 (28), IC520038 (29)
	Seed yield/ plant (> 28 g)	EC511388 (28.1), IC333122 (28.3), IC333253 (36.3)
	100 seed weight (> 8.5 g)	EC 528091 (8.51), EC 512790 (8.52), EC 28089 (8.53), EC 528607 (8.71), EC 424987 (8.89), EC 512793 (9.0)
Castor (110 accs.)	Seed yield/ plant (>200 g)	EC 95900 (205.0), IC 298614 (203.3), EC168486 (293.3), IC 298616 (430.0)
	100 seed weight (> 40g)	NIC 202441 (42.2), IC 422131 (42.9), IC343269 (43.4), IC 422120 (70.0)

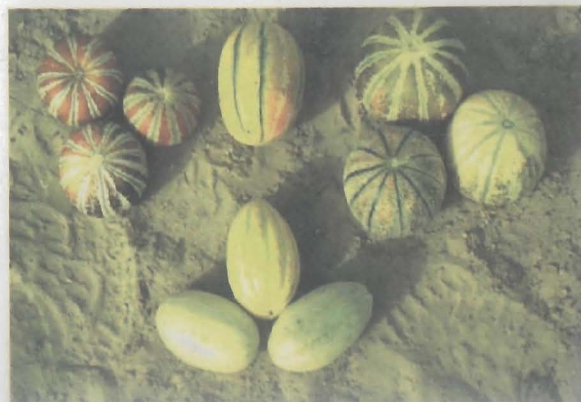
13.2.2 Horticultural plants

Establishment of germplasm: Seeds of pomegranate (EC 546737), *Moringa oleifera* (1), wild ber, *Thevetia* sp.(1), *Capparis decidua* (IC103393) were sown in pots for raising saplings. In addition, bael (7 accessions), karonda (5), lasora (5), coromandel ebony persimmon (2), aonla (8), phalsa (3), date palm (1) and jamun (2 accessions) were sown for raising saplings. Cuttings of Bougainvillea (5), *Capparis decidua* (5) and phalsa (5) were raised in the nursery while saplings of *Carissa grandiflora* (EC37515), phalsa (5 collections) and *Cordia myxa* (NIC 2109) were transplanted in the field.

Monthly observations on plant height and tree spread was recorded on aonla (32), bael (12), ber (7), custard apple (2), guava (7), jamun (8), lasoda (11), lemon (2) and pomegranate (8).

Economically important plants: Seeds of *Acacia catechu* (1), *A. crassicaarpa* (1), *A. dictyophleba* (1),

A. difficilis (1), *A. holosericea* (1), *A. leucophloea* (1), *A. lysifolia* (1), *A. mangium* (1), *A. pachycarpa* (1), *A. senegal* (38), *A. stenophylla* (1), *A. tumida* (1), *A. victorae* (1), *Aloe candelabrium* (1), *Atriplex vesicaria* (1), *A. hostata* (2), *Calotropis procera* (2), *Cassia auriculata* (2), *C. fistula* (2), *C. helmsii* (1), *C. italica* (1), *C. occidentales* (4), *C. sturtii* (1), *C. tora* (1), *Cassia* sp. (1), *Casuarina cunnighamina* (1), *C. equisetifolia* (1), *C. grandis* (1), *C. junghuhniana*



Variability in fruit shape and size of muskmelon

(1), *Desmodium* spp. (5), *Lawsonia inermis* (39), *Jatropha gossypifolia* (7), *J. curcas* (79), *Ocimum americanum* (13), *O. gratissimum* (1), *O. sanctum* (4), *Lesquerella fandleri* (1), *Prosopis cineraria* (49), *Tylophora indica* (1) and *Withania somnifera* (13) were sown in beds, polythene bags and earthen pots.



Variability in fruit pulp colour of the muskmelon

Plants of *Agave* spp. (5 accessions), *Aloe barbadensis* (9), *Asparagus racemosus* (4), *Catharanthus roseus* (1), *Cissus quadrangularis* (2), *Euphorbia* spp. (2), henna (1), and *Jatropha curcas* (1; 94 plants) were transplanted in the field. Saplings of *Cassia sturtii*, (1 accession), *C. helmsii* (1), *C. occidentalis* (1), *C. italica* (1), *C. auriculata* (1) and *Calotropis procera* (1) were also transplanted in the field for maintenance. *Aloe barbadensis* (5 accessions) suckers and *Cissus quadrangularis* (1) plantlets collected were planted in pots in the net house.

Cuttings of *Tinospora cordifolia* (5 accessions) were sown in pots and under neem trees.

13.3 Conservation and Maintenance of Germplasm

13.3.1 Germplasm conservation in MTS: A total of 5,563 accessions of different crops/plant species were processed and kept in the MTS facility. This included material collected during exploration trips (119), characterized material of amaranth (39), *Brassica* (38), fenugreek (2), clusterbean (1045), mothbean (590), wild *Pennisetum* spp. (9), exotic castor (1) and fruits (63). Seeds of *Jatropha curcas* (12) received from NBPGR (HQs) were also kept after sowing a part of it in pots. In addition 3,645 accessions of pearl millet received from



Collection of pearl millet from farmers field

PC (AICPMIP), ARS, RAU, Mandore were also kept in the MTS. The germplasm holdings (as on December 31, 2005) in the MTS is 26,781.

13.3.2 Germplasm conservation in field gene bank:

A total of 655 accessions of 100 crops/ taxa are being maintained in the field genebank at the regional station which includes millets (2), fruits (236), ornamentals (32), oil yielding plants (196), medicinal and aromatic plants (133), multi-purpose trees (28), fibre yielding plants (8), forage grasses (14) and other economically important species (6).

13.3.3. Germplasm conservation in national genebank:

A total of 1,680 accessions of different crops were processed and sent to the National Genebank, NBPGR, New Delhi for long term conservation. This material includes rabi crops harvested in 2005 i.e. *Amaranthus* (39), maize (14), *Brassica* (38), fenugreek (2), *kharif* crops i.e., pearl millet (27), cluster bean (571), mung bean (346), moth bean (402), sesame (37), castor (150), *Citrullus colocynthis* (15), *Cucumis* spp. (34) and other economically important plants (5).

13.4 Supply of Germplasm

A total of 682 accessions of following germplasm were supplied to the various indentors which included *Acacia nilotica* (1), *Acacia senegal* (22), *Achyranthus aspera* (1), *Andrographis paniculata* (1), *Asparagus dumosus* (2), *Asparagus racemosus* (1), *Baliospermum montanum* (2), *Calotropis procera* (1), *Capparis decidua* (3), clusterbean (157), *Convolvulus microphylla* (1), cowpea (29), *Cymbopogon martini* (2), *Echinochloa crusgalli* (1),

Eluesine coracana (5), *Jatropha curcas* (30), jojoba (2), moth bean (129), mung bean (102), *Ocimum sanctum* (4), *O. americanum* (8), *O. canum* (7), *O. indicum* (1), *Ocimum* spp. (1), *Paspalum scrobiculatum* (5), *Panicum miliaceum* (5), *P. miliare* (3), pearl millet (80), *Prosopis cineraria* (25), *Salvadora oleoides* (3), *Setaria italica* (5), *Tecomella undulata* (23), tikadi ber (1), *Urginea indica* (4) and *Withania somnifera* (14).

A total of 986 sample packets of crop plants were sent for multi location trials to coordinators of respective crops. These comprised of castor (100), guar (400-4 sets of 100 accessions), mung bean (50), moth bean (400-4 sets of 100 accessions) and pearl millet (36).

Research Projects (Project Code, Title, Project leader; Associate/s)

PGR/GEV-BUR-JOD-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources in arid and semi arid regions (NK Dwivedi; Neelam Bhatnagar, Gopala Krishnan S).

PGR/GEV-BUR-JOD-02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of cereals, pearl millet, minor millet and horticultural crop (Gopala Krishnan S; NK Dwivedi).

PGR/GEV-BUR-JOD-03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of legumes and oilseeds (NK Dwivedi; Neelam Bhatnagar).

PGR/GEV-BUR-JOD-04: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of fodder, forage, fuel, medicinal and aromatic and other economic plants (Neelam Bhatnagar; NK Dwivedi, Gopala Krishnan S).

14. EXPLORATION BASE CENTER, RANCHI

Summary: Six plant explorations were undertaken in parts of Bihar, Jharkhand, Assam, Meghalaya, and Uttar Pradesh and 445 germplasm collections of various agri-horticulture crops and their wild relatives were made. Out of the collected germplasm, 16 collections of jackfruit were sent for cryopreservation and remaining for medium term storage in NGB. A total of 376 accessions of 162 plant species of wild relatives of crop plants, medicinal and aromatic plants and economically important plants were maintained in the field genebank while 430 germplasm of fruit plants were characterized and maintained at the station.

NBPGR Base Center, Ranchi is located at latitude 23°N and longitude 85°E in the tribal belt of Chotanagpur plateau. It has an altitude of about 625 m above the mean sea level. The average rainfall is about 1300 mm. The region is well known for its immensely rich primitive crop plant diversity including wild related species of many crop plants. The primary responsibility of this station is exploration and collection of crop diversity in Bihar and Jharkhand.



Collection of makhana germplasm from Purnea district of Bihar

14.1. Plant Exploration and Germplasm Collection

A total of six plant explorations were undertaken and 445 accessions of different agri-horticultural crops including the wild types were



Flower variability in Makhana

collected. Major emphasis was given on the collection of *Artocarpus hirsutus* and *Artocarpus integra* and their establishment / maintenance at center along with medicinal, aromatic, dye yielding, gum yielding and other plants of economic importance. The details of explorations, duration, and collections are given in table 1.

Table 1. Plant exploration and collection of germplasm during 2005

#	Regions and duration	Crops/ plants collected	Collections
1.	Dumka, Jamtara, Godda, Deoghar & adjoining districts of Jharkhand 16.3.05 to 24.3.05	<i>Brassica</i> sp. (28), <i>Cajanus cajan</i> (22), <i>Cicer arietinum</i> (4), <i>Crotalaria juncea</i> (1), <i>Eleusine coracana</i> (1), <i>Guizotia abyssinica</i> (2), <i>Hibiscus sabdariffa</i> (2), <i>Lathyrus sativus</i> (4), <i>Lens esculenta</i> (5), <i>Linum usitatissimum</i> (8), <i>Macrotyloma uniflorum</i> (8), <i>Pisum arvense</i> (2), <i>Terminalia bellerica</i> (1), <i>Vicia faba</i> (2), <i>Vigna unguiculata</i> (3), <i>Vigna mungo</i> (3), <i>Zea mays</i> (2)	98
2.	Sahebganj, Pakud, Godda & adjoining districts of Jharkhand 22.3.05 to 31.3.05	<i>Aegle marmelos</i> (4), <i>Amaranthus</i> sp (2), <i>Annona reticulata</i> (2), <i>Brassica</i> sp. (19), <i>Cajanus cajan</i> (17), <i>Capsicum annum</i> (3), <i>Cicer arietinum</i> (9), <i>Dolichos lablab</i> (5), <i>Eleusine coracana</i> (2), <i>Hordeum vulgare</i> (1), <i>Lathyrus sativus</i> (5), <i>Lens esculenta</i> (7), <i>Linum usitatissimum</i> (17), <i>Luffa cylindrica</i> (3), <i>Macrotyloma uniflorum</i> (4), <i>Oryza sativa</i> (14), <i>Pisum arvense</i> (3), <i>Ricinus communis</i> (4), <i>Sorghum vulgare</i> (2), <i>Vigna unguiculata</i> (5), <i>Vigna mungo</i> (1), <i>Vigna radiata</i> (1), <i>Zea mays</i> (9)	138
3.	Samastipur, Muzaffarpur, Hazipur, Chapra, Darbhanga districts of Bihar (in collaboration with RAU, Pusa, Samastipur, Bihar 4.4.05 to 9.4.05	<i>Oryza sativa</i> (2), <i>Linum usitatissimum</i> (4), <i>Lens esculenta</i> (1), <i>Ricinus communis</i> (2), <i>Zea mays</i> (1), mung bean (1), <i>Brassica</i> sp. (13), <i>Cajanus cajan</i> (37), <i>Dolichos lablab</i> (2), <i>Vicia faba</i> (5), <i>Capsicum annum</i> (1), <i>Sorghum vulgare</i> (1), <i>Hibiscus</i> sp. (1), <i>Carthamus tinctorius</i> (2), <i>Pisum sativum</i> (1), <i>Helianthus annuus</i> (1), <i>Annona reticulata</i> (1), cotton (1)	77

4.	Kishanganj, Araria, Katihar & Purnia (in collaboration with ICAR Res. Complex for Eastern Region, & Makhana Res. Center, Darbhanga) 9.04.05 to 15.04.05	<i>Euryale ferox</i> (15) <i>Acorus calamus</i> (1)	16
5.	Meghalaya & Assam 16.7.05 to 22.7.05	<i>Arecanut</i> sp. (1), <i>Artocarpus hetrophyllus</i> (18), <i>Artocarpus hirsutus</i> (2), <i>Artocarpus integra</i> (1), <i>Baccaurea sapida</i> (1), <i>Capsicum</i> sp.(5), <i>Cucurbita moschata</i> (2), <i>Jatropha curcas</i> (1), <i>Momordica dioica</i> (1), <i>Passiflora edulis</i> (1), <i>Vanilla planifolia</i> (1), <i>Wadelia calendulacea</i> (1)	35
6.	Mirzapur, Balia, Sonbhadra, Varanasi, & Chanduli districts of UP 28.11.05 to 10.12.05	<i>Arachis hypogaea</i> (2), <i>Allium sativum</i> (1), <i>Brassica juncea</i> (2), <i>Cajanus cajan</i> (3), <i>Carthamus tinctorius</i> (1), <i>Capsicum annuum</i> (5), <i>Crotalaria alata</i> (2), <i>Hibiscus</i> sp. (2), <i>Lens esculenta</i> (3), <i>Linum usitatissimum</i> (2), <i>Macrotyloma uniflorum</i> (3), <i>Momordica charantia</i> (1), <i>Oryza sativa</i> (2), <i>Pennisetum typhoides</i> (6), <i>Sorghum vulgare</i> (22), <i>Vicia faba</i> (1), <i>Vigna unguiculata</i> (2), <i>Vigna mungo</i> (4), <i>Vigna radiata</i> (2), <i>Zea mays</i> (15)	81

Species-wise details of germplasm collections-

<i>Amaranthus</i> sp. (2)	<i>Annona reticulata</i> (3)	<i>Capsicum</i> sp. (14)
<i>Arecanut</i> (1)	<i>Artocarpus hetrophyllus</i> (18)	<i>Artocarpus hirsutus</i> (2)
<i>Artocarpus integra</i> (1)	<i>Acorus calamus</i> (1)	<i>Arachis hypogaea</i> (2)
<i>Brassica</i> sp. (62)	<i>Cajanus cajan</i> (79)	<i>Cicer arietinum</i> (13)
<i>Crotalaria alata</i> (2)	<i>Carthamus tinctorius</i> (1)	<i>Wadelia calendulacea</i> (1)
<i>Crotalaria juncea</i> (1)	<i>Eleusine coracana</i> (3)	<i>Guizotia abyssinica</i> (2)
<i>Cucurbita moschata</i> (2)	<i>Baccaurea sapida</i> (1)	<i>Jatropha curcas</i> (1)
<i>Dolichos lablab</i> (7)	<i>Hordeum vulgare</i> (1)	<i>Luffa cylindrica</i> (3)
<i>Euryale ferox</i> (15)	<i>Pennisetum typhoides</i> (6)	<i>Momordica charantia</i> (1)
<i>Hibiscus</i> sp. (5)	<i>Lathyrus sativus</i> (9)	<i>Lens esculenta</i> (16)
<i>Linum usitatissimum</i> (31)	<i>Macrotyloma uniflorum</i> (15)	<i>Pisum arvense</i> (5)
<i>Momordica dioica</i> (1)	<i>Passiflora edulis</i> (1)	<i>Vanilla planifolia</i> (1)
<i>Oryza sativa</i> (18)	<i>Ricinus communis</i> (6)	<i>Sorghum vulgare</i> (25)
<i>Pisum sativum</i> (1)	<i>Helianthus annuus</i> (1)	Cotton (1)
<i>Terminalia bellerica</i> (1)	<i>Vicia faba</i> (8)	<i>Vigna unguiculata</i> (10)
<i>Vigna mungo</i> (8)	<i>Zea mays</i> (26)	<i>Aegle marmelos</i> (4)
<i>Vigna radiata</i> (4)	Mung bean (1)	<i>Carthamus tinctorius</i> (2)



Dorsal view of makhana leaf



Ventral view of makhana leaf

Flow of germplasm (Exploration wise)

Collector No.	Accessions No.	Sent to MTS	Field gene bank	NAGS
JBT 41/-	98	98	9	89
VKG 31/-	138	138	15	123
JBT 42/RP-3/-	77	77	3	74
JBT 43/-	16	-	1	15 (ICAR Res. Complex for East. Reg. Darbhanga)
VKG 32/-	35	16- Cryo	35	-
VKG 34/-	81	81	3	78

14.2 Germplasm Maintenance and Characterisation

Fruit crops: Jackfruit (154), barhal (14), jamun (46), bael (53), tamarind (51), aonla (17), custard apple (37), mango (19), *Artocarpus lakoocha* (14) and *Lawsonia*

alba (25).

Wild relatives, economically important crops, medicinal and aromatic plants: The following species of plants are established and maintained in the field genebank at the station.

Botanical Name	Acc. No.	Botanical Name	Acc. No.
<i>Abroma augusta</i>	3	<i>Glycosmis pentaphylla</i>	2
<i>Abrus precatorius</i>	7	<i>Gmelina arborea</i>	4
<i>Abutilon indicum</i>	1	<i>Grewia hirsuta</i>	1
<i>Acacia nilotica</i>	1	<i>Gymnema sylvestre</i>	2
<i>Acacia concinna</i>	2	<i>Helicteres isora</i>	1
<i>Achyranthes aspera</i>	1	<i>Hemidesmus indicus</i>	4
<i>Acorus calamus</i>	4	<i>Holarrhena antidysenterica</i>	1
<i>Adhatoda vasica</i>	2	<i>Hygrophila salicifolia</i>	1
<i>Adiantum capillus-veneris</i>	1	<i>Indigofera tinctoria</i>	1
<i>Albizia procera</i>	1	<i>Jatropha curcas</i>	9
<i>Aloe barbadensis</i>	5	<i>Jatropha gossypifolia</i>	1
<i>Alpinia galanga</i>	4	<i>Kaempferia galanga / Hedychium spicatum</i>	3
<i>Alstonia scholaris</i>	1	<i>Lagerstroemia speciosa</i>	2
<i>Andrographis paniculata</i>	8	<i>Leea macrophylla</i>	1
<i>Aristolochia oncocephalotus</i>	1	<i>Leucas aspara</i>	1
<i>Artemisia scoparia</i>	1	<i>Litsaea polyantha</i>	1
<i>Artemisia annua</i>	3	<i>Lycopodium clavatum (Syn. L. flexuosum)</i>	1
<i>Asparagus racemosus</i>	10	<i>Madhuca indica</i>	1
<i>Atylosia scarabaeoides</i>	2	<i>Martynia diandra</i>	1
<i>Azadirachta indica</i>	4	<i>Melia azadirach</i>	1
<i>Bacopa monnieri</i>	2	<i>Mimosa pudica</i>	1
<i>Barleria prionitis (Kata karanch)</i>	4	<i>Mirabilis jalapa</i>	3
<i>Bauhinia purpurea</i>	2	<i>Moringa oleifera</i>	3
<i>Bauhinia sp.</i>	2	<i>Mucuna prurita</i>	2
<i>Bombax ceiba</i>	2	<i>Murraya koenigii (Kari pata)</i>	1
<i>Bryonopsis laciniosa</i>	1	<i>Neolitis sp.</i>	1
<i>Bryophyllum sp.</i>	2	<i>Nigella sativa (Kala jira)</i>	2
<i>Buchanania lanzan</i>	6	<i>Nyctanthes arbortristis</i>	1
<i>Bulbophyllum sp.</i>	2	<i>Ocimum basilicum</i>	1
<i>Butea monosperma</i>	3	<i>Ocimum sanctum</i>	2
<i>Caesalpinia crista</i>	3	<i>Ocimum sp.</i>	8
<i>Calotropis procera</i>	1	<i>Oroxylum indicum</i>	4
<i>Canavalia ensiformis</i>	1	<i>Pachyrrhiza angulatus (Misrikand)</i>	2
<i>Canna indica</i>	3	<i>Paederia maxima</i>	1
<i>Cassia alata</i>	1	<i>Pentapetes phoenicea</i>	1
<i>Cassia angustifolia</i>	1	<i>Phyllanthus amarus</i>	1
		<i>Phyllanthus niruri</i>	2

<i>Cassia fistula</i>	2	<i>Piper longum</i>	3
<i>Cassia occidentalis</i>	1	<i>Plumbago zeylanica</i>	4
<i>Cassia sophera</i>	2	<i>Pongamia pinnata</i>	3
<i>Cassia tora</i>	1	<i>Portulaca oleracea</i>	1
<i>Catharanthus roseus</i>	4	<i>Premna herbacea</i>	2
<i>Celastrus paniculatus</i>	2	<i>Psoralea corylifolia</i>	1
<i>Centella asiatica</i>	2	<i>Pterocarpus marsupium</i>	2
<i>Chlorophytum sp.</i>	9	<i>Pterospermum acerifolium</i>	1
<i>Cinnamomum tamala</i>	1	<i>Pueraria tuberosa</i>	1
<i>Cinnamomum zeylanica</i>	2	<i>Putranjivi roxburghii</i>	1
<i>Cissus quadrangularis</i>	2	<i>Randia dumatorium</i>	1
<i>Clerodendrum indicum</i>	2	<i>Rauvolfia serpentina</i>	5
		<i>Rauvolfia tetraphylla</i>	3
<i>Clerodendrum infortunatum</i>	1	<i>Santalum album</i>	1
<i>Clerodendrum serratum</i>	1	<i>Sapindus mukurossi</i>	1
<i>Clitoria ternatea</i>	3	<i>Schleichera oleosa</i>	1
<i>Coix lacryma-jobi</i>	1	<i>Scoparia dulcis</i>	1
<i>Colchicum luteum</i>	2	<i>Semecarpus anacardium</i>	2
<i>Coleus amboinicus</i>	2	<i>Sida acutifolia</i>	1
<i>Commiphora wightii</i>	1	<i>Smilax procera & S. ovalifolia</i>	4
<i>Costus speciosus</i>	5	<i>Shorea robusta</i>	4
<i>Curculigo orchoides</i>	7	<i>Solanum khasianum / Solanum viarum</i>	1
<i>Curcuma amada</i>	2	<i>Solanum torvum</i>	1
<i>Curcuma aromatica</i>	1	<i>Solanum xanthocarpum (Katrangni)</i>	1
<i>Curcuma caesia</i>	2	<i>Sphaeranthus indicus</i>	1
<i>Curcuma sp.</i>	9	<i>Spilanthes paniculata</i>	2
<i>Cymbopogon martinii (Palmarosa)</i>	1	<i>Spondias pinnata</i>	1
<i>Cymbopogon winterianus (Citronella java)</i>	1	<i>Sterculia sp.</i>	1
<i>Cymbopogon flexuosus (Lemon grass)</i>	1	<i>Tectona grandis</i>	9
<i>Cyperus rotundus (Nagar motha)</i>	1	<i>Terminalia arjuna</i>	6
<i>Dalbergia sissoo</i>	1	<i>Terminalia bellerica</i>	5
<i>Datura alba</i>	1	<i>Terminalia catappa</i>	2
<i>Desmodium gangeticum</i>	2	<i>Terminalia chebula</i>	3
<i>Dioscorea pentaphylla</i>	1	<i>Terminalia tomentosa</i>	1
<i>Dioscorea sp.</i>	5	<i>Thespesia lampas</i>	2
<i>Diospyros tomentosa</i>	1	<i>Tinospora cordifolia</i>	11
<i>Eclipta alba</i>	1	<i>Tribulus terrestris (Gokhuru)</i>	1
<i>Elephantopus scaber</i>	1	<i>Typhonium trilobatum</i>	4
<i>Embelia ribes</i>	1	<i>Urginia indica</i>	4
<i>Entada scandens</i>	1	<i>Vanda tassela</i>	3
<i>Erythrina indica</i>	1	<i>Vitex negundo</i>	1
<i>Euphorbia hirta</i>	1	<i>Withania somnifera</i>	4
<i>Ficus benghalensis</i>	1	<i>Zingiber sp.</i>	5
<i>Ficus religiosa</i>	1	<i>Gloriosa superba (Kalihari)</i>	1
Total			376

14.3 Germplasm Distribution

To National Active Germplasm Sites: Besides NBPGR, the following NAGS were supplied the collected germplasm of concerned crop/ plant species.

- IPR, Kanpur: *Cajanus cajan* (79), *Lens esculenta* (16), *Cicer arietinum* (13), *Vigna mung* (4), *Lathyrus sativus* (9)

- NRC Sorghum: *Sorghum vulgare* (24)
- DOR Hyderabad: *Carthamus tinctorius* (3), *Helianthus annuus*, *Ricinus communis* (6)
- NRC Onion & Garlic: *Allium sativum* (1)
- CRI for Groundnut: *Arachis hypogaea* (1)
- CICR Nagpur: Cotton (1)
- CRIJA&F: *Hibiscus sp.* (3)
- UUC, New Delhi: *Vicia faba* (8), *Amaranthus sp* (2)



Jatropha germplasm collected from Jharkhand



Promising collection of jack fruit collected from Jharkhand

- CRI for Jute & Allied Fibers, Kolkata: *Crotalaria alata* (1), *Hibiscus sabdariffa* (2), AICSMIP, Bangalore: *Eleusine coracana* (3), ICAR,

Research Complex for Eastern Region, Darbhanga: *Euryale ferox* (15)

Research Projects (Project code, Title, project leader, Associate)

PGR/PGC-BUR-RAN-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources in Bihar, Jharkhand and adjoining areas (JB Tomar).

PGR/PGC-BUR-RAN-02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of agriculture crops, their wild relatives and economic species including medicinal plants (JB Tomar; VK Gupta).

PGR/PGC-BUR-RAN-03: Augmentation characterization, evaluation maintenance, regeneration, conservation and documentation of genetic resources of horticultural crops (VK Gupta; JB Tomar).

15. REGIONAL STATION, SHILLONG

Summary: A total of 389 accessions of various crop plants and their wild relatives were collected during the four plant explorations conducted in Assam, Meghalaya, and Arunachal Pradesh. Good diversity was collected in germplasm of rice, maize, French bean, ginger, turmeric and *Allium* species. During the year, a total of 2,381 germplasm accessions belonging to 12 crops were characterized and the promising genotypes for various attributes were identified. A total of 324 accessions of various crop germplasm, including the medicinal plants were distributed to various research institutes, while 95 accessions were received for characterization. A total of 364 accessions comprising rice, maize, *Perilla*, buckwheat, *Coix* and 13 species of medicinal plants were sent for LTS, while 12 accessions of jackfruit germplasm were sent for cryopreservation.

15.1 Plant Exploration and Collection of Germplasm

Six exploration trips were conducted and a total of 389 accessions were collected from Nagaon, Jorhat, Dhemaji, North Lakhimpur, districts of Assam; Dimapur, Mokokchong, Tuensang districts of Nagaland; Tawang, West Kameng, Kurung Kumey and Changlang districts of Arunachal Pradesh and Jaintia Hill district of Meghalaya. Out of these, 146 accessions were sent for MTS at the National Genebank for conservation, while 243 accs. of mandate crops were retained at this station for necessary multiplication and characterization. Germplasm collected in collaboration with other institutes was shared with the collaborators. The details of germplasm diversity collected during these explorations are given in Table 1 and 2.

15.1.1 Crop diversity collected from Arunachal Pradesh: One exploration was conducted in this state for the first time. In Kurung Kumey district located in very interior area, where rice, millets, amaranths,

Alliums and *Colocasia*, are the major crops. The district of Tawang and West Kameng were explored for the *Allium* and vegetables. 22 accessions of *Allium* spp. and 30 accessions of French bean were assembled. A noteworthy accession of rice genotype was collected from Changlang district.

15.1.2 Crop diversity collected from Assam: Relatively less explored areas of Dhemaji and Lakhimpur were explored for local landraces of rice including the deep-water rice. A total of 23 accessions of deep water paddy were assembled from this area. Species of *Artocarpus chama* and *A. hirsutus* were collected from Nagaon-Jorhat region of Assam. Sixteen different species of medicinal plants were also gathered in this trip.

15.1.3 Crop diversity collected from Meghalaya: Only the interior areas of Jaintia Hills were explored for the purpose of collection of ginger (8), turmeric (10) and various *Citrus* spp. (11). All these have been introduced in the field gene bank of the station.



Fruit of *Dillenia indica*, collected from Dhemaji, Assam

Table 1: Plant exploration and germplasm collection of various crop

Area surveyed	Period of tour	Collaborator	Plants explored	Total collected	Sent to MTS	Retained at Shillong	Remarks
Upper Assam (Nagaon, Jorhat) and Nagaland (Dimapur)	16.7.05 to 22.7.05	NBPGR Reg. Station, Ranchi, Bihar and G-15 Project.	Jackfruit and their wild relatives, and medicinal plants	65	23	17	25 accs. retained by NBPGR, Ranchi
Kurung Kumey district (Arunachal Pradesh)	15.10.05 to 24.10.05	ICAR Res. Complex for NEH, Umiam, Meghalaya and G-15 Project	Multicrop and medicinal plants	175	63	112	Introduction & propagation
Mokokchong and Tuensang districts (Nagaland)	18.11.05 to 2.12.05	-	Rice, maize, <i>Coix</i> and <i>Allium</i> spp.	109	-	109	Multiplication & characterization
Jaintia Hills (Meghalaya)	14.12.05 to 19.12.05	SRF from G-15 Project	Citrus, turmeric, ginger	31	-	31	Multiplication & characterization

Table 2: Exploration and collection of crop germplasm

Crop(s)	Upper Assam & Dimapur of Nagaland	Kurung Kumey of Arunachal Pradesh	Mokokchong & Tuensang districts of Nagaland	Jaintia Hills of Meghalaya	Total
Cereals	-	Rice (32), maize (22)	Rice (64), maize (27)	-	145
Pseudo cereals	-	Sorghum (1), finger millet (9), foxtail millet (1)	<i>Coix</i> (9)	-	1
Oilseeds	-	Soybean (5), castor (1), <i>Perilla</i> (1)	-	-	19
Grain Legumes	-	Ricebean (6), French bean (8); <i>Phaseolus</i> sp. (1)	-	-	56
Vegetables	<i>Momordica</i> (2), <i>Cucumis</i> (2), <i>Cucurbita</i> (2), <i>Solanum gilloo</i> (1)	Cucurbits (32), brinjal (2), okra (2), tomato (1) and <i>Solanum gilloo</i> (2)	-	-	109
Fibre	-	-	-	-	01
Crops Spices and Condiments	Chillies (6); <i>Mentha</i> (1) and arecanut (2)	Chillies (11), ginger (3)	<i>Allium</i> spp. (9)	Turmeric (10), ginger (8)	93
Tuber crops	<i>Amorphophallus</i> (1) sweet potato (1)	<i>Dioscorea</i> (5),	-	-	16
Fruits	<i>Artocarpus</i> spp. (23), banana (1), <i>Baccaurea</i> (2), <i>Flacourtia</i> (1) and <i>Passiflora</i> (2)	-	-	<i>Citrus</i> (11)	49
Medicinal plants	<i>Abroma</i> (2), <i>Costus</i> (1), <i>Phyllanthus</i> (2), <i>Bixa</i> (1), <i>Andrographis</i> (1), <i>Stevia</i> (1), <i>Rauvolfia</i> (1), <i>Ocimum</i> (1), <i>Baccopa</i> (1), <i>Mimosa</i> (1), <i>Piper</i> (1), <i>Pogostemon</i> (1), and others (2)	<i>Stemona</i> (1), <i>Acorus</i> (1), <i>Berberis</i> (1), <i>Houttuynia</i> (2), <i>Clerodendron</i> (2), <i>Swertia</i> (2), <i>Valeriana</i> (1), others (17)	-	<i>Piper</i> (1), <i>Nepenthes</i> (1)	48
Ornamentals	-	Orchid (1)	-	-	01
Miscellaneous	<i>Jatropha</i> (3)	-	-	-	03

15.2 Germplasm Characterization and Maintenance

Germplasm (2,381 accessions) of different agri-horticultural crops collected from this region were grown for preliminary evaluation. In addition to this, germplasm of mandate crop, received from outside the region was also characterized under the prevailing agro-climatic condition of Umiam, Meghalaya. Based on yield and stress tolerance parameters, the promising genotypes were identified (Table 2).



A promising landrace of upland paddy, characterized at the station



An upland rice landrace, characterized at the station



Variability of Job's tear (*Coix lacryma jobi*) under maintenance at the station



Variability of Job's tear (*Coix lacryma jobi*) under maintenance at the station

Table 3: Identification of promising accessions in different crops

Crop	Accessions evaluated	Yield (q/ha)	Superior genotypes
Upland Paddy	198	43.75	IC-524601
Lowland Paddy	202	40.50	IC-521252
Maize	218	180.00	IC-526762
Ricebean	567	19.19	IC-140811
<i>Perilla</i>	79	15.25	IC-006441
Buckwheat	98	12.50	IC-324244
Job's tear	45	37.5	IC-089384
Ginger	194	467.00	IC-414901
Turmeric	141	580.00	IC-022143
<i>Colocasia</i>	307	435.00	IC-010971
<i>Dioscorea</i>	87	11.3 kg/ plant	IC-012585

15.3 Germplasm Distributed

Ricebean (*Vigna umbellata*)-30 accessions to SASRD, Meolziphema, Nagaland; 17 accessions to UBKV, Cooch Bihar (WB); 50 accessions to Professor of Botany, College of Agriculture, Pune (Maharashtra); banana (*Musa acuminata*)-9 accessions to NRC on Banana, Trichy, Tamil nadu; *Acorus calamus*-3 accessions, *Aloe barbadensis*-1 and *Asparagus racemosus*-1 to NBPGR (Hqs); *Perilla frutescens* - 43 accessions and *Vigna umbellata*-26 accessions to NRC DNAF; maize (*Zea mays*: Sikkim primitive)- 1 accession and *Coix lacryma-jobi*-10 accessions to Project Director, DMR, Pusa Campus, New Delhi; rice (*Oryza sativa*)-10 accessions to RARS, Gerua, Kamrup, Assam; Banana (*Musa spp.*)-10 accessions to NRC on Banana Trichy, Tamil nadu; buckwheat (*Fagopyrum esculentum*)- 5 accessions to LFIMP, ICAR for Eastern Region, Walmi Complex, Patna (Bihar); 14 accessions to Head, Botany Dept., NEHU, Shillong (Meghalaya); maize (*Zea mays*)-21 accessions to National Fellow, DMR, Pusa, New Delhi; upland rice (*Oryza sativa*)-20 accessions to Sr. Scientist, PB Dept.,

AAU, Jorhat (Assam); maize (*Zea mays*)- 50 accessions to Head, Plant Breeding, ICAR (NEH), Umiam, Meghalaya; 1 accession (Sikkim primitive) to Director of Research, Punjab Agril University, Ludhiana.

15.4 Germplasm Conservation

A total of 376 accessions (12 in cryobank and 364 in seed genebank) were conserved in LTS in National genebank

Crop	No. of Accessions	Mode of Conservation
Jack fruit (<i>Artocarpus heterophylla</i>)	12	Cryopreservation
Upland rice	42	LTS
Maize	60	LTS
Lowland rice	106	LTS
Perilla	29	LTS
Job's tear	45	LTS
Buckwheat	69	LTS
Medicinal Plants	13 spp.	LTS

Research Projects (Project Code, Title, Project leader; Associate/s)

PGR/PGC-BUR-SHL-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of plant genetic resources in North-eastern India (D K Hore).

PGR/PGC-BUR-SHL-02: 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-03: 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 fruit. (Rakesh Srivastava).

Externally funded project (By DBT)

National Gene Bank for medicinal and aromatic plants (G-15)

16. REGIONAL STATION, SHIMLA

Summary: Six explorations were conducted and 573 accessions comprising cereals (55), pseudocereals (43), millets (83), pulses (33), oilseeds (40), vegetables (71), fruits (95), ornamentals (14), spices & condiments (26), M & AP (31). Wild relatives of crop plants and other economic plants (82) were collected from Himachal Pradesh and Uttaranchal. A total of 2096 accessions of various agri-horticultural crops were characterized and multiplied for conservation. Two-hundred-twenty-four accessions were sent for medium term storage as voucher specimens, 244 accessions for long-term storage, 26 for *in vitro* conservation and 8 accessions to the cryobank in National Genebank while 1086 accessions of fruit crops, their wild relatives, medicinal plants and ornamentals were conserved and maintained in field genebank. Nine-hundred-fifty-seven (new germplasm accessions) were added to the MTS maintained at Shimla and 254 were rejuvenated. Germplasm accessions of agricultural crops (724) and horticultural crops (265 rooted plants and 296 bud sticks) were supplied to various indenters.

16.1 Plant Exploration and Collection of Germplasm

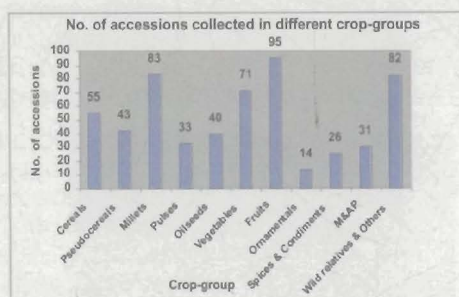
Six explorations were undertaken during the period under report and 573 germplasm accessions were collected

from different parts of Himachal Pradesh and Uttaranchal (Table 1). Eighty-nine herbarium specimens were prepared and submitted to the National Herbarium of Cultivated Plants (NHCP) at NBPGR (HQs).

Table 1: Germplasm explorations undertaken from January to December, 2005

Exploration for	Area explored	Germplasm collected
Multi-crop	Nilgiri and Kodaikanal hills of TN	119
Multi-crop	Solan, Bilaspur, Una, Hamirpur, and Kangra in HP and Ropar in Punjab	220
Medicinal & Aromatic plants	Shimla	30
Wild <i>Allium</i> spp.	Lahaul-Spiti and Pangri	61
Amaranth and minor millets	Shimla	56
Amaranth and minor millets	Uttarkashi, Bageshwar, Pithoragarh, Almora (Uttaranchal)	87

The major emphasis was given to collect temperate fruits, wild *Allium* spp. and high value medicinal and aromatic plants and as a result, 158 germplasm accessions were collected and conserved in the field genebank including fruits and/or ornamentals. Species of *Prunus*, *Pyrus* and *Malus*, five species of wild relatives of onion and garlic and eight astavarg plants viz., *Habenaria edgeworthii* (Vrdhi), *Habenaria intermedia* (Rdhi), *Malaxis acuminata* (Jeevk), *Malaxis muscifera* (Rshbak), *Roscoea alpina* (Kakoli), *Lilium polyphyllum* (Kashirakakoli), *Polygonatum verticillatum* (Meda), and *Polygonatum cirrifolium* (Mahamedia) were collected.



16.2 Germplasm Characterization and Evaluation

(i) **Agricultural crops:** Two-thousand and ninety-six germplasm accessions comprising French bean (814), adzuki bean (91), horse gram (71), cowpea (180), pea (165), ricebean (169), amaranth (204), chenopod (100) and buckwheat (402) were characterized and evaluated. The germplasm was characterized in Augmented block design along with standard checks. The



A. corolinianum (Important *Allium* species)

data were recorded as per the descriptors developed by NBPGR. The data recorded were analyzed for mean

and range and given in table 2 along with promising accession identified for important traits.

Table 2: Range, mean and promising accession identified

Crop	Character	Range	Mean \pm SE	Promising accessions
French bean	Days to flowering	42-100	58.15 \pm 4.01	EC530856, EC530875, EC500412
	Pod length (cm)	8.1 -17.5	11.40 \pm 1.04	EC500462, EC500509, EC531074
	Days to maturity	90 - 145	106.25 \pm 4.23	EC530910, EC530912, EC531003
	100-seed weight (g)	11.64 -58.20	28.70 \pm 2.47	EC500397, EC500303, EC531076
	Seed length (mm)	8.14 - 18.07	11.25 \pm 1.14	EC500452, EC500303, EC531074
	Yield / plant (g)	4.42 - 42.20	20.52 \pm 2.50	EC530907, EC530913, EC540794
Adzuki bean	Plant height (cm)	55 - 60	57.8 \pm 4.69	EC15256, EC263, EC8707
	Days to flowering	54 - 80	59.17 \pm 3.58	EC108080, IC47427, EC120460
	Days to maturity	140 - 155	146.52 \pm 6.12	EC120460, EC340166, EC108080
	100-seed wt. (g)	16 - 20	18.28 \pm 2.25	HPAB-29, EC263, HPAB-21
Cowpea	Plant height (cm)	58.3- 272.6	162.54 \pm 5.6	IC326998
	Days to flowering	45 - 70	55.28 \pm 3.98	IC363793, IC328967, IC347370
	Days to maturity	80 - 115	105 \pm 6.5	IC421891, IC346095
	100-seed wt. (g)	4.94 -19.68	11.25 \pm 1.25	IC326958, IC326634, IC326958
Horse gram	Days to flowering	53 - 76	61.28 \pm 3.65	IC347356, IC467864, IC467866
	Pod length (cm)	3.2 - 6.5	4.02 \pm 0.8	IC278826, IC347356, IC341292
	Days to maturity	114 - 125	117.49 \pm 5.8	IC278826, IC467865, IC347356
	100-seed wt. (g)	2.12 - 4.38	3.15 \pm 0.98	IC328918, IC313366, IC469267
Pea	Days to maturity	145 -189	161.5 \pm 2.45	IC279138, IC311070, IC394030
	Pod length (cm)	3.3 - 8.6	5.5 \pm 0.89	IC299013, IC427188, IC342026
	No. of pods/ plant	7.0 - 62.0	22.0 \pm 2.98	IC469162, IC279142, IC291541
	No. of seeds/pod	3.0 - 8.0	5.00 \pm 1.08	IC342028, IC469160, IC258261
	100-seed wt. (g)	8.5 - 50.1	19.78 \pm 1.99	IC279125, IC469164, IC279138
	Seed yield/ plant (g)	6.2 - 38.9	26.5 \pm 3.10	IC326345, IC469164, IC347387
Amaranth	Days to flowering	60-101	78.98 \pm 5.89	EC519556, EC519533, EC519521
	Plant height (cm)	96-329	159 \pm 7.43	IC95308, IC95314, IC95315, IC95320
	Leaf height (cm)	9.2-26.0	15.30 \pm 2.20	IC95320, IC467888, IC467896, IC95284
	Lateral spike length (cm)	3.9-27.2	14.88 \pm 1.90	IC95308, IC37153, IC95249
	Inflorescence length (cm)	32.4-100.0	58.22 \pm 3.30	IC37149, IC37148, IC95308, IC95253
	Yield/plant (g)	20.2-98.4	50.45 \pm 3.77	IC467879, IC467887, IC37153, IC37316,
	1000-seed wt (g)	0.4 -0.8	0.64 \pm 0.07	IC37148, IC34749, IC38313, IC467897
	Buckwheat	Days to flowering	41-65	14.24 \pm 1.80
Leaf length (cm)		4.7-13.7	7.28 \pm 1.21	IC42401, IC37284, IC18864, IC17370
Leaf width (cm)		4.3-15.7	125.04 \pm 4.20	IC17370, IC107116, IC109233, IC49679
Petiole length (cm)		1.5-15.8	11.50 \pm 1.80	IC42401, IC41627, IC18664, IC17379
No. of cymes		5.5-27.0	14.0 \pm 3.30	ICEC18740, EC12537, IC37291
No. of leaves/ plant		7.5-61.0	35.24 \pm 3.60	IC107974, IC107968, EC12537
Plant height (cm)		36-201	119.58 \pm 4.65	IC386668, IC107285, IC26606
1000-seed wt (g)		11.9-40.6	21.32 \pm 2.25	EC216635, EC159499, EC386671
Chenopod	Days to flowering	69-163	123.50 \pm 5.50	IC-258253, IC258254, EC507740
	Inflorescence length (cm)	17.3-66.5	34.88 \pm 2.25	IC258253, IC328877, EC341695
	Leaf length (cm)	2.3-16.2	10.08 \pm 1.01	NIC22498, NIC22576, EC359451
	Leaf width (cm)	1.0-14.6	9.54 \pm 0.9	NIC22498, EC359456, IC108816
	Plant height (cm)	90.5-270.9	140.88 \pm 5.23	EC359451, IC341710, IC328877
	Yield/ plant (g)	3.8-91.5	35.80 \pm 3.09	IC258332, IC341701, IC415477
	1000 seed weight (g)	0.3-2.7	1.45 \pm 0.04	EC507739, EC507740, EC507741



A. schoenoprasum (an important *Allium* species)

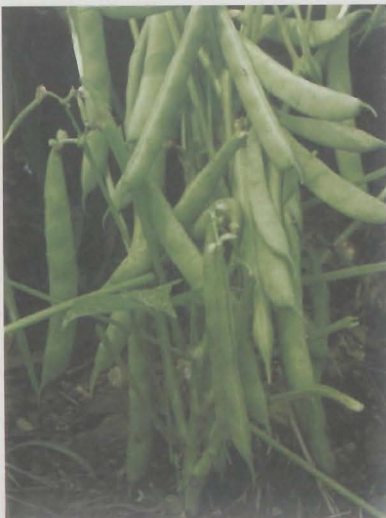


Frenchbean (EC530886) - high poding, resistant to anthracnose

ii) Horticultural crops: During the year following germplasm were characterized

Crop	Accessions	Descriptors	Crop	Accessions	Descriptors
Apple	52	29	Apricot	10	33
Pear	13	35	Walnut	26	28
Plum	21	33	Pecan nut	6	31
Peach	38	36	Persimmon	2	19

The data were analyzed for range, coefficient of variability (CV) and promising accessions identified. In apple, maximum CV was found for fruit weight (42.6%) followed by pedicel length (41.23%); fruit weight ranged from 30 to 215 g of which 34 accessions have small fruit weight (30-95 g); 16 medium (96-125 g) and 2 large (161-225 g). In pear, fruit weight ranged from 37.1 to 220 g and seven accessions had good eating quality. In plum, fruit weight ranged from 5.35 to 101.83 g. In peach, average fruit weight ranged from 37.4 to 137.2 g and eight accessions had good fruit eating quality. In apricot, fruit weight ranged from 9.63 to 42.9 g and TSS from 14.3-30.50%. In walnut,



French bean (EC530894) - Erect, high poding, resistant to anthracnose



IC258253, an accession of chenopod registered for seed colour.

variation was observed for nut shape (round, long trapezoid, broad elliptic, ovate, short trapezoid and elliptic), nut width from 1.94–3.73 cm, nut length from 1.81–4.6 cm, nut weight from 4.10–16.22 g and kernel percentage from 21.03–56.36. In husk tomato, variability was observed for leaf colour (light green, green, dark green), leaf shape (oblong, roundish oblong, lanceolate, hastate), leaf margin (dentate, serrate, crenate), berry shape (round, globose, oblong) and pulp colour (orange, dark yellow, light green, cream, yellowish orange) among qualitative characters. Promising accessions recorded for some important characters in fruit crops are given in table 3.

Table 3: Promising accessions in different fruit crops

Crop	Character	Promising accessions
Apple	Earliness	EC044007, EC043639, EC044217, EC044007
	Fruit weight (>150 g)	EC044217, EC044005
	TSS (>15%)	EC104809, EC100144, EC144038, EC044003
	High productivity	EC127112, EC144038, EC028540
Pear	Earliness	EC027809
	Fruit length (>75 mm)	EC027810, EC057516, EC552675
	Fruit width (>70 mm)	EC552675, EC552668
	TSS (>14 %)	EC552668, EC038739, EC552676
Plum	Earliness	EC034052, EC552689
	Fruit weight (>50 g)	EC552684, EC552688, EC034052, EC552693
	TSS (>18%)	EC034048, EC393740, IC020827, IC020825
Peach	Earliness	EC027791, EC280765, IC349929
	Fruit weight (>100 g)	EC321412, EC468326, EC027791, EC552645, EC115563, EC110859
	TSS (>13 %)	EC552640, EC552639, EC027791, EC110859, EC019377, EC331812
Apricot	Earliness	EC552701
	Fruit weight (>40 g)	EC552701, EC140316, Triumph Severngii
	TSS (19%)	IC349968, IC349933
Walnut	Nut weight (>13 g)	EC038834, EC020070, IC019369
	Kernel weight (>4 g)	EC036476, IC020067, IC019369
	Thin shelled (<1.5 mm)	EC082384, EC038830, EC026891, EC024562

16.3 Germplasm Conservation

(i) *Ex situ* germplasm conservation: A total of 7,469 accessions of various crops were conserved in MTS, at Regional Station, Shimla and 5,153 accessions were deposited at National Genebank, New Delhi (table 4).

Table 4: Status of germplasm holdings as active collections in MTS as on 31/12/05

Crop name	In NGB (as voucher samples)	In MTS at Shimla
Amaranth	2606	2958
Buckwheat	388	743
Chenopod	78	98
French bean	1501	2926
Rice bean	159	231
Adzukibean	144	158
Horse gram	24	38
Pea	162	222
Lentil	50	54
Cuphea	16	16
Meetha karela	25	25
Total	5153	7469



IC279125 - identified for 100-seed weight

*Lilium polyphyllum* – very rare medicinal plant collected from HP

(ii) **Germplasm conserved in the LTS:** A total of 233 accessions of various crops were sent to the NGB for long-term storage in the seed gene bank; 7 accessions of bael (seeds) in cryobank and 28 accessions in *in vitro* facility. Besides, 1,086 accessions of perennial crops are also conserved in the field gene bank. Crop-wise details are given below in table 5 and 6.

Table 5: Germplasm deposited for long term storage

Facility	Crop	No. of accessions
LTS (at -20°C)	French bean	126
	Pea	73
	<i>Allium</i> spp.	27
	<i>Vicia sativa</i>	2
	<i>V. hirsuta</i>	1
	<i>V. tetrasperma</i>	1
	<i>Cicer microphyllum</i>	3
	<i>Linum perenne</i>	6
<i>In vitro</i>	<i>Allium</i> spp.	19
	<i>Valeriana wallichii</i>	8
	<i>Lilium polyphyllum</i>	1
Cryobank	<i>Aegle marmelos</i>	7
	<i>Prunus</i> sp.	1
Total		275



IC342026 - identified for powdery mildew resistance & number of pods per plant

Table 6: Status of germplasm holdings in the field gene bank at Shimla as on 31/12/05

Crop	No. of Acc.	Crop	No. of Acc.	Crop	No. of Acc.
Apple	221	Plum	28	<i>Rubus</i> spp.	28
Pear	54	Pecan nut	11	<i>Ribes</i> spp.	5
Apricot	36	Walnut	180	Persimmon	5
Cherry	9	Hazelnut	19	Pomegranate	129
Almond	14	Kiwi	8	Wild relatives & other economic species	98
Peach	47	Grape	11	M&AP	51
Rose	31	Strawberry	44	Ornamentals	27
TOTAL					1086



Solanum muricatum (Pepino) - introduced from Kodaikanal

(iii) **Conservation of wild relatives of crop plants:** A special emphasis was given on the conservation of wild relatives in the field gene bank. The important wild relatives that are being maintained at the station are given in Table 8.



Shimla B1' of buckwheat (*Fagopyrum tataricum*) - a high yielding genotype

Table 8: Wild relatives of agri-horticultural crops, minor fruits and some important medicinal plants conserved in the field gene bank

Crops/ Items	Wild relatives/ 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>himalaicum</i> and <i>F. giganteum</i>
Chenopod	<i>Chenopodium amaranticolor</i> , <i>C. botrys</i> , <i>C. murale</i> and <i>C. ambrosioides</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>dirangensis</i> and <i>M. sikkimensis</i> , <i>Malus glaucensis</i> , <i>M. spectabilis</i> , <i>M. hillebrandii</i>
Pear	<i>Pyrus pyrifolia</i> , <i>P. jacquemontiana</i> , <i>P. pashia</i> , <i>P. serotina</i> , <i>P. ussuriensis</i>
Prunus	<i>Prunus nepaulensis</i> , <i>P. armeniaca</i> , <i>P. cerasoides</i> , <i>Prunus</i> sp. (behmi), <i>P. prostrata</i> , <i>P. mume</i> , <i>P. cerasifera</i>
Walnut	<i>Juglans nigra</i> , <i>J. mandshurica</i> , <i>J. ailantifolia</i>
Hazelnut	<i>Corylus jacquemontii</i> , <i>C. ferox</i>
Kiwi	<i>Actinidia arguta</i>
Grapes	<i>Vitis ficifolia</i> , <i>V. arizonica</i> , <i>V. riparia</i> , <i>V. acerifolia</i> , <i>V. gerdina</i> , <i>V. aestivalis</i> , <i>V. amurensis</i> , <i>V. cinerea</i>
Pistachio	<i>Pistacia atlantica</i> , <i>P. terebinthus</i> , <i>P. chinensis</i>
<i>Rubus</i> spp.	<i>Rubus ellipticus</i> , <i>R. niveus</i> , <i>R. paniculatus</i> , <i>R. assamensis</i> , <i>R. reticulatus</i> , <i>R. fruticosus</i>
<i>Allium</i> spp.	<i>A. carolinianum</i> , <i>A. schoenoprasum</i> , <i>A. tuberosum</i> , <i>A. przewalskianum</i> , <i>A. fistulosum</i>
<i>Solanum</i> spp.	<i>S. viarum</i> , <i>S. xanthocarpum</i> , <i>S. sisymbriifolium</i>
Minor fruits	<i>Punica granatum</i> , <i>Cotoneaster acuminata</i> , <i>C. frigida</i> ; <i>Crataegus wenlandii</i> , <i>C. melanocarpa</i> , <i>C. oxycantha</i> , <i>Feijoa sellowiana</i> , <i>Cydonia oblonga</i> , <i>Docynia hookeriana</i> , <i>D. indica</i> , <i>Viburnum cotinifolium</i> , <i>V. lanata</i> , <i>V. mullaha</i> , <i>Pyracantha crenulata</i> , <i>Ceratonia siliqua</i> , <i>Cornus oblonga</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>Ficus palmata</i> , <i>Cyphomandra betacea</i> , <i>Solanum muricatum</i> , <i>Morus alba</i> , <i>Ficus carica</i> , <i>Mespilus germanica</i> , <i>Myrica nagi</i> ,
Medicinal plants	<i>Tinospora cordifolia</i> , <i>Centratherrum anthelminticum</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>Viola serpens</i> , <i>Hedychium spicatum</i> , <i>Taxus baccata</i> , <i>Heracleum candicans</i> , <i>Thymus serpyllum</i> , <i>Dioscorea deltoidea</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. alpina</i> , <i>Achillea millefolium</i> , <i>A. filipendula</i> , <i>Betula utilis</i> , <i>Ephedra Gerardiana</i> , <i>Lilium polyphyllum</i> , <i>Satyrium nepalense</i> , <i>Picrorhiza kurroo</i> , <i>Stevia rebaudiana</i> , <i>Gentiana kuroo</i> , <i>Saussurea costus</i> , <i>Arctium lappa</i>

16.4 Germplasm Supply

Germplasm of agricultural crops (724 accessions) and horticultural crops (265 rooted plants and 296 bud sticks) were supplied to various indenters as follows:

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

spp. (6), walnut (14), quince (10), ornamentals (13)

- **Bud sticks:** Pecan nut (14), apple (70), kiwi (14), pear (50), peach (8), persimmon (100), walnut (40)

Registration of germplasm: One accession viz. IC258253 (No. 04093) of chenopod registered for brown seed colour.

Variety identified for release: Shimla B-1, a variety of buckwheat (*Fagopyrum tataricum*) was identified for its release in alpine zone of Himalayan region. The Varietal Identification Committee on 23.9.2005 identified this variety for its release.

Research Projects (Code, Title, Leader; Associates)

PGR/GEV-BUR-SHM-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and supply of plant genetic resources of north-western indian himalayan region (VD Verma; JC Rana; K Pradheep).

PGR/GEV-BUR-SHM-02: Augmentation, characterization, evaluation, conservation, maintenance, documentation and supply of germplasm of pseudocereals, pulses and other lesser-known hill crops (JC Rana; VD Verma; K Pradheep).

PGE/GEV-BUR-SHM-03: Augmentation, characterization, evaluation, conservation, maintenance, documentation and supply of germplasm of temperate fruits, vegetables and medicinal and aromatic plants (VD Verma; JC Rana; K Pradheep).

Externally funded projects

1. Assessment and data collection on bio-resources of agriculture and forestry for three watersheds in Himachal Pradesh - Funded by DST (JC Rana)
2. Germplasm conservation (*ex situ* and *in situ*) of minor millets and pseudo-cereals in participatory mode in Himachal Pradesh - Funded by Govt. of Himachal Pradesh (JC Rana)
3. Mass propagation and promotion of cultivation of geranium (*Pelargonium graveolens*) and English lavender (*Lavendula angustifolia*) in Himachal Pradesh - Funded by ICAR under Horticulture Technology Mission (JC Rana)

17. REGIONAL STATION, SRINAGAR

Summary: Two plant explorations were undertaken in different areas of Jammu and Kashmir and a total of 187 germplasm accessions comprising various agri-horticultural crops were collected. Wheat (40 accessions), barley (100) and mustard (40) were characterized and evaluated during *rabi* 2004- 2005 and 226 accessions were sown in *rabi* 2005-2006 for evaluation.

NBPGR Regional Station, Srinagar was established in 1989 with major responsibility of plant exploration and germplasm collection of crops and their wild relatives in the region and their characterization and evaluation. It is located about 14 km away from Srinagar city at KD Farms near old airfield Rangreth. In spite of unfavourable socio-political environment in the region, PGR activities were carried out and progress report is presented below.

17.1 Plant Exploration and Germplasm Collection

Two explorations were undertaken in different parts of Jammu and Kashmir region. A total of 187 accessions

comprising wild *Cucumis* species (7), sponge gourd (24), bottle gourd (9), pumpkin (13), muskmelon (5), chilli (41), carrot (3), kale (5), knol-khol (5), radish (6), rajma (5) and tomato (2) were collected.

17.2 Germplasm Characterization and Evaluation

A total of 191 accessions comprising wheat (40), barley (100) and mustard (40) were characterized and evaluated for the standard descriptors during *rabi* 2004-05. A total of 226 accessions comprising wheat (108), barley (68) and mustard (50) were sown during *rabi* 2005 -06 for characterization and evaluation.

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

PGR/PGC-BUR-SRI-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of germplasm resources of various crops from Jammu & Kashmir region (Om Vir Singh; D Gautam).

18. REGIONAL STATION, THRISSUR

Summary: A total of 442 accessions were collected in nine explorations including one under the DBT project. This included cereals (46 accessions), millets (2), fibres (4), fruits (8), minor fruits (11), grain legumes (31), oilseeds (4), tree-borne oilseeds (21), spices (2), tubers (4), vegetables (190), wild relatives (72), M & A plants (18), ornamental (3) and others (26). These were collected from Kerala (175 accessions), Tamil Nadu (24), Karnataka (62), Goa (54) and A & N islands (127). In all, 348 accessions of collected material were sent to the MTS facility at NBPGR, New Delhi. Rice (306 accessions), horsegram (55), Chinese spinach (23), Malabar spinach (11), snake gourd (20), okra (97), field bean (63), taro (7), turmeric (142) were grown for evaluation and taro (17), jack fruit (23), black pepper (26), Malabar tamarind (19), kokam (3), *Mucuna pruriens* (15) and 32 of 3 species namely, *Solanum incanum*, *S. insanum* and *S. melongena* were grown for characterization. A total of 134 accessions of exploration material, 945 accessions of multiplied germplasm and 127 accessions received from co-operating centres under NATP-PB was deposited in LTS, NGB, New Delhi. A total of 47 accessions was sent to TCCP Unit, NBPGR, New Delhi for cryopreservation and *in vitro* conservation. A total of 652 accessions of various crops was added to the MTS facility at the station making a total holding of 12,430. Eight hundred accessions were supplied to 18 indentors for use in crop improvement programs. A total of 236 accessions of herbarium prepared from primary (98 accessions) and secondary sources (138) was deposited in NHCP, New Delhi.

The NBPGR Regional Station at Vellanikara, Thrissur is responsible for plant genetic resources related activities in the southern peninsular region of India comprising the states of Kerala, Tamil Nadu, Karnataka and Goa and the Union Territories of Pondicherry, Lakshadweep and Andaman & Nicobar Islands.

18.1 Exploration and Collection

A total of 442 accessions were collected during nine explorations including one under the DBT funded project carried out in Kerala, Karnataka, Goa, Tamil Nadu and Andaman and Nicobar Islands. This included cereals (46 accessions), millets (2), fibres (4), fruits (8), minor fruits (11), grain legumes (31), oilseeds (4), tree-borne oilseeds (21), spices (2), tubers (4), vegetables (190), wild relatives (72), medicinal and aromatic plants (18), ornamentals (3) and others (26). These were collected from Kerala (175 accessions), Tamil Nadu (24), Karnataka (62), Goa (54) and A & N Islands (127). In all, 348 accessions of collected material were sent to the MTS facility at NBPGR, New Delhi.

During one exploration to the *Kurichiar* and *Kattunaikkar* tribal settlements in Wynad district of Kerala, rice (2 accessions), taro (3) and one each of cowpea and amaranth were collected.

In a trip to Cotigao Wild Life Sanctuary, collected one accession of traditional rice and from Bondla Wild Life Sanctuary, and one each of *Amaranthus blitum*, melon, cucumber, cowpea, maize and finger millet from the *Gowli* tribe of Goa.

In a trip to north Kerala, collected 43 accessions of 25



Wild species of *Piper* maintained in the shade house

traditional landraces comprising 6 accessions of 2 medicinal rice varieties (**Njavara**, **Thonnooran**) and 12 accessions of 3 aromatic rice varieties (**Gandhakasala**, **Jeerakasala** and **Kunjunellu**) and other 20 named landraces. In another trip to north Kerala, collected 23 named rice landraces viz., one accession each of **Vellamthangi**, **Chuvanna kuruka**, **Sulochana**, **Chettadi**, **Vella**, **Vella kodiyan**, **Mysori**, **Kattamodan**, **Nayaruvella**, **Chuvanthutti**, **Ulantha**, **Palakkadan matta**, **Kunjukunju**, **Malamutti** and **Thekkan**; two accessions each of **Chuvanna chitteni**, **Mundakan vella**, **Mundaka cheera**, **Njavara**, **Vellaryan**, **Kuttadan**, **Aayiram meni** and four of **Karutha njavara**.

In a trip to the eastern slopes of Western Ghats, collected 25 accessions of *Solanum incanum*. Tribal people in Tamil Nadu (*Malasar* and *Irular*) and Kerala (*Irular*) use the bitter unripe fruit of *S. incanum* after removing seeds and washing the rest of the berry as a fresh vegetable with tamarind. The same is also dried and used to make a fried preparation in oil. People of

Tamil Nadu especially, those living in the foothills of eastern slopes of western Ghats in Madurai district and the *Malasar* tribe in Coimbatore district use the smoke from burning the berry to relieve toothache and to remove maggots from tooth. Ayurveda medicine manufacturers in Kerala use whole plant of *S. incanum* as an ingredient in the preparation of 'Dashamoolarishta'. It is also sold in the crude drug

markets in Kerala. The dry eastern slopes of western Ghats region are the home for this species.

Germplasm supplied as voucher samples for MTS at New Delhi: In all, 348 accessions of exploration material collected by this station were sent to MTS facility at NBPGR, New Delhi during the year.

Unique accessions collected:

Collector No.	IC No.	Crop / Botanical name	Importance
JA/05-5	IC522284	<i>Ipomoea pes-caprae</i>	Wild relative of sweet potato, highly resistant to saline water
JA/05-10	IC522289	<i>Launaea sarmentosa</i>	A wild leafy vegetable, with nutraceutical potential, having resistance to salinity
JS/05-74	IC536721	Okra	Extra long fruits (29 cm), good yield in farmers field
JA/05-14	IC522293	<i>Portulacca oleracea</i>	Salinity resistance
MS-05-23, MS-05-43	—	<i>Vigna marina</i>	Salt tolerance

Herbarium specimens: A total of 236 accessions of herbaria prepared from primary (98 accessions) and secondary sources (138) was deposited in the NHCP, New Delhi.

18.2 Maintenance, Characterisation and Evaluation

Cereals and millets

Rice: Six-hundred accessions of rice were transplanted for seed multiplication for long-term storage including 330 accessions meant for evaluation in *Kharif*. An Augmented Block Design with four check varieties namely Ahalya, Jaya, Jyothi and

Thulasi was used. Out of this 306 were evaluated for 8 qualitative and 11 quantitative characters. Variability was noticed in all the characters except in panicle type and leaf pubescence, which was intermediate in all accessions. Among these, 22 were found to be superior to the best check Jyothi (6.8 g) in grain yield per plant. The following 6 accessions were the best among the superior accessions with more than 10 g grain yield per plant:

IC No.	Local name	Place of collection	Grain yield/ plant (g)
IC085879	Rambhog sikib	Gayzing, Sikkim	10.7
IC086334	Panpum	Kandale, Bastar	10.8
IC086388	Chakya-59	Atrana, Muzaffarnagar	11.6
IC086395	—	Shadaber, Muzaffarnagar	10.3
IC350702	Madhu	Vasahalli, Mysore	13.8
IC203752	Omana-kkuttan	Edavanna, Malappuram	10.0



GPA Meeting held at Thrissur station from 16-17 November 2005

Grain legumes

Horse gram: A total of 100 accessions of horse gram was sown in *rabi* 2004-05 in an Augmented

block design with 6 check varieties (AK-21, AK-26, AK-38, HGGP, PHG-9 and DPI 2278). Fifty-five accessions of horse gram were analysed for 8 quantitative characters and superior accessions identified, which included IC022781 (from Madhya Pradesh) for number of primary branches (10), IC041224 (from Punjab) for number of pods per plant (167) and IC139352 (from Rajasthan) for pod length (6.2 cm). Mean values of the best check AK-38 for these traits were 5.1, 51.1 and 4.3, respectively.

Vegetables

Leafy Amaranth: Fifty-four accessions of leafy amaranth namely *Amaranthus tricolor* (23 accessions), *A. dubius* (11 accs.), *A. blitum* (7 accs.), *A. graecizans* (2 accs.) and dual purpose amaranth (11 accs.) were characterized for 16 qualitative and 12 quantitative traits in summer. High variability between accessions was found in Chinese spinach for morphological and quantitative traits. IC469607 and 469725 were unique in extra late bolting and robust plant type. IC469564 had bright red large leaves and robust growth habit.

Superior genotypes that excelled national checks Arka Arunima and Arka Suguna for herbage yield are given in table below:

IC no. / variety	Total herbage yield/ plant (g)	District	State
469521	35	Hassan	Karnataka
469530	35	Mysore	Karnataka
469658	35	North Goa	Goa
469599	45	Tumkur	Karnataka
469621	45	Tumkur	Karnataka
Arka Arunima	25	NA	NA
Arka Suguna	30	NA	NA



Okra Field Day conducted on 9 September 2005



Variability in *Amaranthus* species maintained for establishing taxonomic identity and for seed multiplication for LTS supply

Similarly, IC469680 of Malabar spinach collected from Devanahalli, Davanagere, Karnataka, excelled with 40 g total herbage yield per plant compared to the best check variety CO-1 with 32 g. IC469711 and 469722 were distinct for the reddish pink pigmentation and slightly bitter taste.

Snake gourd: Twenty accessions of snake gourd were characterized during *rabi* 2004-05, along with two check varieties Kaumudi and Baby in an Augmented block design for 14 qualitative and 9 quantitative traits. IC347377-A was unique for its miniature fruit size of 14 cm length and 90 g fresh weight.

Okra: Multi-location evaluation of 100 accessions of okra at 7 locations across the country was initiated. Augmented block design with 4 check varieties (Arka Anamika, Pusa Sawani, South Canara Local and Salkeerthi) was followed and data recorded on 10 quantitative traits and on 4 biotic stresses on 97 accessions. Superior accessions for yield namely, fresh fruit weight, combining yield and fruit number per plant and fruit yield per plant are given in tables below:



Variability in fruit size, colour and shape in field bean accessions

Trait	IC no.	Village	District	State	Mean fresh fruit weight (g)	
Freshfruit weight	218873	Mattannur	Kannur	Kerala	47.0	
	282288	Bellayur	Dakshin Kannada	Karnataka	56.0	
The best check variety (South Canara local): 25 g						
Trait	IC no.	Village	District	State	Mean fruits/plant	Mean marketable fruit yield/plant (g)
Combining high fruit yield and fruit number/plant	045806	Hamsavaram	—	Tamil Nadu	12.6	332.00
	232232	Vijayadukka	Dakshin Kannad	Karnataka	8.0	241.29
	128883	—	—	Maharashtra	14.6	351.00
	218874	Thattadu	Kannur	Kerala	12.8	341.00
The best check variety (South Canara local): 8.0 and 248 g/ plant						
Trait	IC no.	Village	District	State	Mean marketable fruit yield/plant (g)	
Highest fruit yield/plant	282241	Sinnakallipatti	Coimbatore	Tamil Nadu	424.0	
	282288	Bellayur	Dakshin Kannad	Karnataka	413.0	
The best check variety (South Canara local): 248 g						

Field bean: Sixty-three accessions of field bean were evaluated in an Augmented block design along with 4 check varieties namely RND-1, CO-12, CO-13 and DL-40 during *rabi* 2004-05. Eleven quantitative and 11 qualitative characters were recorded. Among the 11 qualitative characters recorded variations were

observed in pod colour and pod suture colour. The pod colour was light green (in 3 accessions), greenish (in 35 accessions), purple (in 3 accessions) and greenish purple (in 6 accessions). Pod yield was recorded in 47 accessions.

Superior accessions identified for pod yield

IC number	Pod yield/plant (g)	% Increase over best check	Source of collection
IC426983	6055	199.01	L.N. Puram, Anavayal, Pudukkottai, TN
IC426970B	3875	91.36	Madurai, TN
IC427413C	3825	88.89	Pachalanayakkanpatti, Dindigul, TN
IC426980	2800	38.27	Poonamanayakkanur, Karur, TN
IC426960	2448	20.89	Poigai, Vellore
IC426961	2440	20.49	Periyamedu, Villupuram, TN
IC427462	2330	15.06	Trichy, TN

Tuber crops

Taro: Under a multi-location trial conducted in collaboration with CTCRI, Thiruvananthapuram, 7 accessions were evaluated for 7 above ground and 12 below ground quantitative characters in a Randomised block design in 3 replications along with 4 check varieties namely Sree Reshmi, Sree Pallavi and Sree Kiran and a local variety. IC343042 (TCR-920) with 1.24 kg/plant fresh cormel weight out yielded all the checks (Sree Reshmi, Sree Pallavi and Sree Kiran). With respect to total rhizome fresh

weight, IC343042 (TCR-920) and Lohardhaga local (TCR-921) with 2.17 and 2.18 kg fresh rhizome weight, respectively, out yielded all the checks. IC283349 (TCR-902), IC336475 (TCR-917) and IC331730 (TCR-937) were of shorter duration (16 to 19 days) than the checks.

Characterization of 17 new accessions received from NBPGR, Ranchi was done in an Augmented Block Design along with 4 check varieties namely Sree Reshmi, Morphotype-1, Morphotype-2 and a local variety. Data on 30 quantitative and 2 qualitative

characters were recorded. IC 259994-A (TCR-887A) with 4.24 kg total rhizome weight per plant out yielded the highest yielding check (Morphotype-1) with 1.6 kg total rhizome weight. IC 259994-A (TCR-887A) with 0.94 kg cormel weight per plant was the topper among the accessions evaluated.



Amaranthus graecizans ('Rajkheera') - a very distinct colourful morphotype - collected from Karnataka

Fruits

Jackfruit: Forty-two trees comprising twenty-three accessions were observed for female inflorescence position. Thirteen accessions had fruits in all the branches and main trunk; five had fruits only on main trunk and primary branches; and five had fruits only on main trunk. Among them, IC91836-3A was found to be superior in terms of yield (7.85 kg) and number of flakes (250).

Spices

Turmeric: A total of 159 accessions grown in an Augmented block design along with 4 checks (Sobha, Kanthi, Suvarna, Pattikkad local) were observed for 16 quantitative characters. Among the 142 accessions evaluated, IC406489, -212587, -212580, -137051 and -310563 were found to be superior over the best check variety (Sobha) as follows:

IC number	Total fresh rhizome weight/ plant (g)	Total mother rhizome weight/ plant (g)	Fresh tuber weight (g)	Dry tuber weight (g)	Total dry Tuber weight (g)
406489	235	100	135	31.02	72.9
212587	165	65	100	28.75	47.4
212580	170	65	105	31.13	52.9
137051	150	55	95	30.85	46.3
310563	125	60	65	43.93	54.9
Sobha	110	67	42	32.84	27.1

A wild accession of turmeric known as '*kasturi pasupu*' in Telugu collected from Araku, Vishakhapatnam, Andhra Pradesh (SJ-4055, IC360212) by the NBPGR RS, Hyderabad flowered and was observed for all the plant and spike characters. It proved to be a very distinct accession with evolutionary significance exhibiting scented rhizome flesh and purple colour on the leaf midrib.

Black pepper: Twenty-six accessions were characterized for 15 quantitative and 6 qualitative spike and berry characters. With respect to dry weight, 8 accessions (IC85415, -85339, -85427, -373825, -372754, -373830, -266419 and -373836) were found to be superior giving above 40% dry berry weight.

Malabar tamarind: In Malabar tamarind, 24 fruiting trees comprising 19 accessions were characterized for 3 fruit yield traits namely, total number of fruit yield/

year, total fresh weight of fruit yield/year (kg) and mean weight of individual fruit (g). IC244110, 244113-1, 244100-2, 244111-1 and 136681 yielded 1099, 1239, 1751, 1994 and 2284 fruits per plant respectively. Total fresh weight of fruit yield/ year (kg) of IC244110, 244111-1



Rumex vesicarius ('Hulisappu') - an under-exploited vegetable collected from Karnataka



Samadera indica - seed oil, used in rheumatism - collected from south Kerala

and 244100-2 was 104.7, 164.7 and 165.6 kg respectively. IC24497-3, 244106-2, 136683, 244115, 244100-3, 244101-3 and 244101-2 weighed 103, 105, 110, 113, 119, 123 and 135 g/ fruit respectively. IC244100-2, 244111-1 and 244110 combined two superior traits like total number of fruit yield/year and total fresh weight of fruit yield/ year (kg).

Kokam: Four trees comprising 3 accessions were characterized for 3 quantitative yield traits. IC136687-3 continued to out yield the others in number of fruits (2603) and yield of fruits (30.4 kg) and IC136682-2 in mean weight of single fruit (12.2 g). IC136687-3 is early seasonal bearing with most fruits reaching harvestable stage in February itself (1488 fruits).

Medicinal and aromatic Plants

***Mucuna pruriens*:** Fifteen accessions of *Mucuna pruriens* raised in 3 replications during *rabi* 2004-05 were characterised for 11 qualitative and 15 quantitative characters. IC471871 was found to be superior for combined attributes viz., early maturity, seeds per pod, seed yield, 100 seed weight and single seed weight. The superior accessions identified were as follows:

Traits	Unit	Accessions
Early maturing	<165 days	IC471865, 471868, 471871,
No. of seeds per pod	>5.3	IC31996-A1, 471870, 471871, 471872, 471873
Seed yield per plant	>325 g	IC471871, 471872, EC25334-2
100 seed weight	>160 g	IC471871, 471873
Single seed weight	>1.6 g	IC471871, 471873

Wild relatives

***Curcuma* species:** IC210296 collected by NBPGR RS, Cuttack from Khandmal district of Orissa proved to be the first accession to bear central spike in mango ginger that tallied with the original description of *C. amada* by Roxburgh (1810).

Analysis of genetic diversity and phylogenetic relationship in *Solanum melongena* L. and related wild and weedy taxa (DBT funded project)

In an exploration and collection mission conducted to the eastern slopes of the Western Ghats in Kerala and Tamil Nadu, collected 28 accessions of 3 species of *Solanum* namely *S. incanum* (25), *S. pubescens* (1) and *S. melongena* (2). A total of 32 accessions comprising 6 of typical *S. incanum*, 16 of typical *S. incanum*, 1 of intermediate *S. incanum* and 9 of typical *S. melongena* were characterized for 15 quantitative and 14 qualitative traits during 2004-05. Typical *S. incanum* is erect, very hairy or less hairy, unripe fruit colour either green with light green or light green with white in a netted distribution, corolla pale violet or light violet and fruits spherical. These were mostly collected from typical wild habitats or very rarely from disturbed habitats. Typical *S. incanum* is semi-erect, very hairy or less hairy or not hairy, unripe fruit colour either green with light green or light green with white in a netted or entirely white with uniform distribution, corolla light violet and fruits spherical. These were mostly collected from disturbed habitats or near farmlands. Intermediate *S. incanum* is semi-erect, very hairy, corolla light violet, fruit colour white with uniform distribution and fruit spherical. This was collected from disturbed habitats. Typical *S. melongena* is semi-erect, very hairy or less hairy, pale violet or light violet or bluish violet corolla,



Solanum incanum - collected from Kerala



Aegle marmelos - fruit variability collected from A&N Islands

unripe fruit colour milky white or green with light green or green with white or green with white and purple tinged and uniform or netted distribution, fruits spherical, oval or oblong. These were collected from farms.

ICAR ad-hoc network project on tree borne oilseeds (TBOs)

Supplied 23 accessions of *Jatropha curcas*, one of *J. gossypifolia* and four of kokam to Forest College & Research Institute (TNAU), Mettupalayam for establishment and morphological and chemical evaluation under the project. Out of these, 10 accessions of *Jatropha curcas* and one of *J. gossypifolia* were newly collected accessions. Six accessions of the *J. curcas* were sent for cryo-preservation and three for seed genebank at the NBPGR, New Delhi.

18.3 Germplasm Conservation

Sent to National Genebank: A total of 134 accessions of exploration material, 945 accessions from regenerated and multiplied germplasm at this station and 127 accessions received from three co-operating centres under NATP-PB were deposited in LTS, NGB, New Delhi.

Sent to TC & CP Unit for in-vitro conservation / cryopreservation: A total of 47 accessions was sent to TC & CP Unit, NBPGR, New Delhi for cryopreservation and *in vitro* conservation.

Medium term storage: During the year under report, 652 accessions of various crops were added to the MTS facility at the station making a total holding of 12,430 accessions.



Manilkara hexandra - edible fruit collected from A&N Islands

In vitro propagation and conservation: Tissue culture work was continued in ginger, *Dioscorea* species, Malabar tamarind, cassava, black pepper and kokam. Three accessions one each from the three species of *Dioscorea* (*D. bulbifera*, *D. hispida*, *D. tomentosa*) were added to the conservation medium after *in vitro* multiplication. One accession each of *Piper* viz., *Piper longum* (IC406483), *Piper argyrophyllum* (IC406464), *Piper attenuatum* (IC256245) was newly introduced into culture. In Malabar tamarind, in addition to the existing four accessions, two new accessions (IC244077-1, 244100-3) were added to the conservation medium. Similarly, in kokam, three new accessions (IC1336687-1, 1336682-3, 136685-2) were added making a total of seven.

18.4 Germplasm Supply

Supply to user agencies: A total of 800 accessions was supplied to 18 user agencies for crop improvement.

Supply for multi-location evaluation: One hundred



Mangifera sylvatica - collected from A&N Islands

accessions of horse gram were sent to each of four centres (UAS, Bangalore; RARS of KAU, Pattambi; MPKV, Rahuri; MPKV, Solapur) and 100 accessions of okra were sent to IIVR, Varanasi, for distribution to 6 centres other than NBPGR, RS, Thrissur.

Germplasm supply for maintenance / utilisation:

Four-hundred-and-nineteen accessions were transferred to 4 ICAR institutes for field maintenance and utilization as detailed below:

Institute	Crop	Genus	Species	Accessions
CTCRI, Trivandrum	Taro	<i>Colocasia</i>	<i>esculenta</i>	300
IISR, Calicut	Vanilla	<i>Vanilla</i>	<i>planifolia</i>	10
NRC (B), Trichy	Banana	<i>Musa</i>	<i>hybrida</i>	81
CHES (IIHR), Chettalli	Rambutan	<i>Nephelium</i>	<i>lappaceum</i>	24
	Mangosteen	<i>Garcinia</i>	<i>mangostana</i>	3
	Velvet apple	<i>Diospyros</i>	<i>biancol</i>	1
Total				419



Syzygium samaranjans - an edible fruit collected from A&N Islands



Baccaurea ramiflora - an edible fruit collected from A&N Islands

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

PGR/GEV-BUR-THR-01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of Plant Genetic Resources in southern India including Goa and Andaman & Nicobar Islands (Z Abraham; KC Velayudhan; M Abdul Nizar; KI Asha; M Latha; K Joseph John).

PGR/GEV-BUR-THR-02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of field crops (M Abdul Nizar, up to 5-7-2005 and KI Asha, from 6-7-2005).

PGR/GEV-BUR-THR-03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of horticultural crops (KC Velayudhan).

PGR/GEV-BUR-THR-04: 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 Latha).

PGR/GEV-BUR-THR-05: Augmentation, characterisation, evaluation, maintenance, regeneration, conservation and documentation of plant genetic resources from Goa (K Joseph John).

PGR/GEV-BUR-THR-06: Use of *in vitro* technology for mass propagation and conservation of clonally / vegetatively propagated crops and their wild relatives (Z Abraham).

PGR/GEV-BUR-THR-07: Augmentation, characterisation, evaluation, maintenance, regeneration, conservation and documentation of plant genetic resources of Andaman and Nicobar Islands (R Senthil Kumar).

Externally funded projects

DBT funded: Analysis of genetic diversity and phylogenetic relationship in *Solanum melongena* L. and related wild and weedy taxa (Z Abraham).

ICAR funded: ICAR *ad-hoc* Network Project on 'Tree borne oilseeds (TBOs)' (Z Abraham).

19. GENERAL INFORMATION

19.1 Institute Management Committee

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

Members:

- Assistant Director General (Seeds), ICAR, Krishi Bhawan, New Delhi-110001.
- Shri Surender Singh, C-33/84 Madhopur (Behind MCD Office), Varanasi (UP).
- Dr Sushma Chaphalkar, Director, School of Biotechnology, Vidya Nagari, Baramati, District-Pune (Maharashtra).
- Development Commissioner (Rural), Delhi Government, Delhi.
- Director (Agriculture), Government of Rajasthan, Jaipur.
- Dr RK Khetarpal. Head, Plant Quarantine Division, NBPGR, New Delhi-110012.
- Dr B Lal, Principal Scientist, Plant Quarantine Division, NBPGR, New Delhi-110012.
- Dr (Ms) K Srinivasan, Senior Scientist, NBPGR, New Delhi-110012.
- Shri KK Hamza, Finance & Accounts Officer, IASRI, Pusa Campus, New Delhi-110012.

Member Secretary: Senior Administrative Officer, NBPGR, New Delhi-110012.

The XXXI meeting of IMC was held on 29 January 2005 under the Chairmanship of Dr BS Dhillon, Director, NBPGR.

19.2 Research Advisory Committee

Chairman: Dr SS Baghel, Vice Chancellor, Assam Agricultural University, Jorhat-785013, Assam.

Members:

- Dr KN Ganeshiah, Professor, Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK, Bangalore –

560065.

- Dr PP Pushpangandan, Director, National Botanical Research Institute, Lucknow-226015.
- Dr N Anishetty Murthy, Retd. Sr. Officer (FAO), 888-Siddhartha Nagar, Plot 91, PO-Vengalrao Nagar, Hyderabad, AP.
- Dr A Seetharam, Ex- Project Coordinator, AIC Small Millets Improvement Project, UAS, GKVK Campus, Bangalore – 560065.
- Dr SK Sen (Ex-Director, Bose Research Institute, Kolkata), BREF Block, Indian Institute of Technology, Kharagpur- 721302, West Bengal
- Dr S P Tiwari, ADG (Seeds), ICAR, Krishi Bhawan, New Delhi – 110001.
- Dr B S Dhillon, Director, NBPGR, New Delhi-110012.

Member Secretary: Dr RK Khetarpal, Head, Division of Plant Quarantine, NBPGR, New Delhi-110 012.

A meeting of RAC was held under the Chairmanship of Dr SS Baghel on 2nd and 3rd May, 2005 at NBPGR, New Delhi.

19.3 Staff Research Council

Chairman: Director, NBPGR

Member Secretary: Dr RK Tyagi, Senior Scientist

The first meeting of SRC was held from May 4-7, 2005 under the Chairmanship of Dr BS Dhillon, Director and attended by 86 members of SRC including scientists and technical officers associated with projects from the NBPGR headquarters and regional stations. The Secretary, SRC presented the action taken report based on the recommendations of previous SRC and the house approved the proceedings. Progress reports of 13 Projects (57 Sub-projects) from headquarters and 14 Projects (25 Sub-projects) from regional stations were presented and discussed.

In order to utilize the experience of Senior Scientists more effectively and keeping in view the present evaluation system for promotion, it was decided to

restructure the projects and sub-projects of the Bureau. Accordingly, Senior Scientists associated in the projects were designated as Principal Investigators/ Project Leaders and sub-projects were named as Projects. Further, it was also decided that the main project of each division might be termed as Programme and the Principal Investigator of the main project of each division may be designated as Programme Leader. The revised projects, particularly in PQ Division were discussed and approved so that each Senior Scientist becomes the PI/ PL of at least one project.

The second meetings of the SRC was held from December 7-8, 2005 under the Chairmanship of Dr JL Karihaloo, Director. A total of 93 members of SRC including scientists and technical officers from NBPGR headquarters and regional stations attended the meeting. Progress report of 65 Projects from headquarters and 25 Projects from regional stations were presented and discussed. One new project entitled 'Characterization and evaluation of wild relatives and wild edible crops of

Leguminosae' was presented and approved in principle with some modifications in the project title and objectives.

19.4. Institute Joint Staff Council

Chairman: Dr BS Dhillon, Director

Secretary (Official side): Dr (Ms) Veena Gupta, Senior Scientist

Secretary (Staff side): Shri Lalu Rai, SS Gr. II

Members (Official side): Dr Shamsher Singh, Principal Scientist; Dr SK Malik, Senior Scientist; Senior Administrative Officer, and Finance & Accounts Officer.

Members (Staff side): Shri Rakesh Singh, T-5; Shri Yogesh Kumar Gupta, Sr. Clerk (CIJC member), Shri Girish Chandola, Sr. Clerk; Shri Mahesh Ram, SS Gr. I.

19.5. Staff Reservations

Total number of employees in position and number of scheduled castes, scheduled tribes and OBC among them as on 31.12.2005 are as follows:

Category	Total number of Employees	Total number of Scheduled Caste (SC) Employees	Total number of Scheduled Tribe (ST) Employees	Total number of OBC Employees
Scientist	107	12	1	16
Technical	120	17	14	5
Administrative	61	14	4	1
Supporting	149	39	4	13

19.6. Personnel

(i) Scientific Staff

Name	Designation	Discipline
Dr BS Dhillon	Director (Up to 26-7-2005)	Genetics & Plant Breeding
Division of Germplasm Evaluation		
1 Dr SK Mishra	Head wef 21-9-2005	Genetics & Plant Breeding
2 Dr RK Mahajan	Principal Scientist	Agricultural Statistics
3 Dr SK Pareek	Principal Scientist	Agronomy
4 Dr S Mandal	Principal Scientist	Biochemistry
5 Dr Ranbir Singh	Principal Scientist	Economic Botany
6 Dr (Ms) Saroj Sardana	Principal Scientist	Plant Breeding
7 Dr IS Bisht	Senior Scientist	Plant Pathology
8 Dr Ashok Kumar	Senior Scientist	Plant Breeding
9 Dr RC Agarwal	Senior Scientist	Agricultural Statistics
10 Dr Vandana Joshi	Senior Scientist	Economic Botany
11 Dr Dinesh Kumar	Senior Scientist	Plant Breeding
12 Dr Ambrish Sharma	Senior Scientist	Plant Breeding

13	Dr KK Gangopadhyay	Senior Scientist	Horticulture
14	Mr NK Gautam	Scientist (Selection Grade)	Economic Botany
15	Mr Gunjeet Kumar	Scientist	Horticulture
16	Mrs Sangeeta Yadav	Scientist	Biochemistry
17	Dr (Ms) Archana Peschin	Scientist	Agricultural Chemistry
18	Dr Satish Kumar Yadav	Scientist	Horticulture

Division of Plant Exploration and Germplasm Collection

1	Dr DC Bhandari	Head & Principal Scientist	Economic Botany
2	Dr SS Malik	Principal Scientist	Economic Botany
3	Dr (Ms) E Roshini Nair	Principal Scientist	Economic Botany
4	Dr (Ms) Anjula Pandey	Senior Scientist	Economic Botany
5	Dr KC Bhatt	Senior Scientist	Economic Botany

Division of Germplasm Conservation

1	Dr AK Singh	Head	Plant Breeding
2	Dr Sidheshwar Prasad	Senior Scientist	Electrical Engineering
3	Dr (Ms) Neeta Singh	Senior Scientist	Plant Physiology
4	Dr Sanjeev Saxena	Senior Scientist	Plant Physiology
5	Dr (Ms) Kalyani Srinivasan	Senior Scientist	Plant Physiology
6	Dr (Ms) Veena Gupta	Senior Scientist	Economic Botany
7	Dr (Ms) J Radhamani	Senior Scientist	Plant Physiology
8	Ms Anjali Kak	Scientist (Sr. Scale)	Economic Botany
9	Dr (Ms) Chitra Devi	Scientist	Seed Technology

Division of Plant Quarantine

1.	Dr RK Khetarpal	Head & Principal Scientist	Plant Pathology
2.	Dr Arjun Lal	Principal Scientist	Nematology
3.	Dr Shamsheer Singh	Principal Scientist	Plant Pathology
4.	Dr PC Aggarwal	Principal Scientist	Plant Pathology
5.	Dr Beche Lal	Principal Scientist	Agricultural Entomology
6.	Dr (Ms) Usha Dev	Principal Scientist	Plant Pathology
7.	Dr (Ms) Manju Lata Kapur	Principal Scientist	Agricultural Entomology
8.	Dr Rajan	Senior Scientist	Nematology
9.	Dr DB Parakh	Senior Scientist	Plant Pathology
10.	Dr Baleshwar Singh	Senior Scientist	Plant Pathology
11.	Dr (Ms) Shashi Bhalla	Senior Scientist	Agricultural Entomology
12.	Dr (Ms) Ceilia Chelam V	Senior Scientist	Plant Pathology
13.	Dr (Ms) Kavita Gupta	Scientist (Senior Scale)	Agril. Entomology

Germplasm Exchange Unit

1.	Dr Ranvir Singh	Principal Scientist & Head	Economic Botany
2.	Dr IP Singh	Principal Scientist	Plant Breeding
3.	Mr Deep Chand	Scientist (Selection Scale)	Economic Botany
4.	Dr Vandana Tyagi	Scientist (Sr. Scale)	Economic Botany
5.	Ms Nidhi Verma	Scientist (Senior Scale)	Economic Botany
6.	Dr Anil Kumar Singh	Scientist	Economic Botany

Policy Planning Unit

1	Dr (Ms) Pratibha Brahmi	Senior Scientist	Economic Botany
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Tissue Culture & Cryopreservation Unit

1.	Dr BB Mandal	Principal Scientist	Genetics & Cytogenetics
2.	Dr (Ms) Rekha Chaudhary	Senior Scientist	Economic Botany
3.	Dr RK Tyagi	Senior Scientist	Economic Botany
4.	Dr (Ms) Ruchira Pandey	Senior Scientist	Economic Botany
5.	Dr (Ms) Neelam Sharma	Senior Scientist	Economic Botany
6.	Dr (Ms) Anuradha Agarwal	Senior Scientist	Economic Botany
7.	Dr (Ms) Sandhya Gupta	Scientist (Senior Scale)	Economic Botany
8.	Dr SK Malik	Scientist (Senior Scale)	Economic Botany
9.	Dr Zakir Hussain	Scientist	Genetics

Under Utilized & Under Exploited Plants Project

1	Dr RP Dua	Principal Scientist	Plant Breeding
2	Dr BS Phogat	Senior Scientist	Agronomy
3	Dr Hanuman Lal Raigar	Scientist	Agricultural Statistics

National Research Center on DNA Fingerprinting

1.	Dr JL Karihaloo	Project Director	Genetics & Cytogenetics
2.	Dr (Ms) Gurinderjit Randhawa	Senior Scientist	Plant Physiology
3.	Dr KV Bhat	Senior Scientist	Plant Breeding
4.	Dr Mukesh Kumar Rana	Scientist (Senior Scale)	Plant Breeding
5.	Mr Sunil Archak	Scientist	Bio – Technology
6.	Ms Lalit Anand	Scientist	Bio-Chemistry
7.	Ms Madhu Bala	Scientist	Computer Application
8.	Dr Ambika Baldev	Scientist	Bio-Technology (Plant Sciences)
9.	Dr Rakesh Singh	Scientist	Bio-Technology

Regional Station, Shillong

1.	Dr DK Hore	Principal Scientist & In-charge	Economic Botany
2.	Dr Rakesh Srivastava	Senior Scientist	Horticulture
3.	Dr WL Barwad	Senior Scientist	Agriculture Entomology

Regional Station, Thrissur

1.	Dr Z Abraham	Principal Scientist & In-charge	Economic Botany
2.	Dr KC Velayudhan	Principal Scientist	Economic Botany
3.	Dr Joseph John K	Scientist (Selection Grade)	Economic Botany
4.	Dr Mohd. Abdul Nizar	Scientist (Senior Scale)	Economic Botany
5.	Dr (Ms) Asha KI	Scientist (Senior Scale)	Economic Botany
6.	Dr (Ms) M Latha	Scientist (Senior Scale)	Plant Breeding
7.	Dr R Senthil Kumar	Scientist	Horticulture

Regional Station, Jodhpur

1.	Dr NK Dwivedi	Principal Scientist & In-charge	Economic Botany
2.	Dr (Ms) Neelam Bhatnagar	Senior Scientist	Economic Botany
3.	Dr Gopala Krishnan S	Scientist	Plant Breeding

Exploration Base Centre, Ranchi

1.	D. JB Tomar	Principal Scientist & In-charge	Economic Botany
2.	Dr VK Gupta	Senior Scientist	Plant Breeding

Regional Station, Shimla

1.	Dr VD Verma	Principal Scientist & In-charge	Economic Botany
2.	Dr JC Rana	Senior Scientist	Plant Breeding
3.	Dr K Pradheep	Scientist	Economic Botany

Regional Station, Akola

1.	Mr Nilamani Dikshit	Scientist (Sel. Grade) & In-charge	Economic Botany
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Regional Station, Bhowali

1.	Sh KC Muneem	Principal Scientist	Plant Pathology
2.	Dr KS Negi	Senior Scientist & In-charge	Economic Botany
3.	Dr SK Verma	Senior Scientist	Horticulture

Exploration Base Center, Cuttack

1.	Dr DP Patel	Principal Scientist & In-Charge	Economic Botany
2.	Mr Diptiranjnan Pani	Scientist	Economic Botany

Regional Station, Hyderabad

1.	Dr KS Varaprasad	Principal Scientist & In-charge	Nematology
2.	Dr RDVJ Prasada Rao	Principal Scientist	Plant Pathology
3.	Dr SK Chakraborty	Senior Scientist	Plant Pathology
4.	Dr B Sarath Babu	Senior Scientist	Agriculture Entomology
5.	Dr SR Pandrawada	Senior Scientist	Economic Botany
6.	Dr (Ms) Kamla Venkateshwaran	Senior Scientist	Economic Botany
7.	Dr Natrajan Sivaraj	Senior Scientist	Economic Botany
8.	Dr (Ms) Anitha Kodaru	Senior Scientist	Plant Pathology
9.	Ms T Rama Srinivasan	Scientist (Senior Scale)	Horticulture
10.	Mr Neelam Sunil	Scientist	Economic Botany

Regional Station, Srinagar (J & K)

1.	Dr Om Vir Singh	Principal Scientist & In-charge	Plant Breeding
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(ii) Technical Staff (T-5 and above)

#	Name	Category	#	Name	Category
1	Mr. BP Dahiya	T-7	28	Mr. Ashok Kumar Maurya	T-6
2	Dr Om Prakash Dahiya	T-6	29	Mr. Surender Singh Ranga	T-6
3	Mr. Jitender Mohan	T-6	30	Mr. J.K. Ingle	T-6
4	Mr. Harinder Singh	T-6	31	Mr. Babu Ram	T-5
5	Dr PS Mehta	T-6	32	Mr. Narendra Singh Panwar	T-5
6	Miss Poonam Suneja	T-6	33	Ms. Rita Gupta	T-5
7	Dr Anil Kumar Singh	T-6	34	Mr. Ram Singh	T-5
8	Dr (Ms) Manju Upreti	T-6	35	Miss Anshu	T-5
9	Ms. Rita Rani	T-6	36	Mr. Devendra Kumar Nerwal	T-5
10	Mr. Ram Prasad Yadav	T-6	37	Mr. Rakesh Singh	T-5
11	Mr. Satya Pal Singh	T-6	38	Mr. V.K. Pant	T-5
12	Smt. Indra Rani	T-6	39	Mr. G.L. Arya	T-5
13	Mr. Charan Singh	T-6	40	Mr. A.S. Rana	T-5

14	Mr. K.D. Joshi	T-6	41	Mr. Bhikka Ram Saini	T-5
15	Mr. Rajiv Mathur	T-6	42	Mr. Kheta Ram	T-5
16	Dr Rajveer Singh	T-6	43	Mr. Ashok Kumar Gupta	T-5
17	Dr Ranbir Singh Rathi	T-6	44	Mr. R. R Arya	T-5
18	Mr. Rajiv Gambhir	T-6	45	Mr. Kishan Nath	T-5
19	Mr. Bharat Lal Meena	T-6	46	Mr. Sat Narayan Rai	T-5
20	Miss Sheela Kumari	T-6	47	Mr. S. Mani	T-5
21	Mr. Babu Abraham	T-6	48	Mr. R. S. Yadav	T-5
22	Mr. B.C. Bachhawandia	T-6	49	Mr. Y. S. Rathi	T-5
23	Mr. Brij Pal Singh	T-6	50	Mr. Anang Pal	T-5
24	Mr. R. Ashokan Nair	T-6	51	Ms. Sangeeta Tanwar	T-5
25	Mr. Mahabir Singh Rathore	T-6	52	Mr Abhay Sharma	T-5
26	Mr. Axma Dutt Sharma	T-6	53	Mr Bhopal Singh Panwar	T-5
27	Dr. Dinesh Chand	T-6			

(iii) Administrative Staff

#	Name	Designation
1.	Sh. Suresh Kumar	Sr. Administrative Officer
2.	Mrs. Sanjeeven Prakash	Finance & Accounts Officer
3.	Sh. Mahender Kumar Ahuja	Jr. Accounts Officer
4.	Sh. M.L. Bagga	Assistant Administrative Officer
5.	Sh. Umesh Chandra Sati	Security Officer
6.	Ms. Archana Raghav	Assistant Director (OL)
7.	Sh. D.D. Sharma	Assistant Administrative Officer

19.7 New Appointments

#	Name and designation	Joined NBPGR at	Date of joining
1.	Ms Smita Jain, T-3	HQs, New Delhi	2.4.2005
2.	Sh Suresh Kumar, Sr. Admn. Officer	HQs, New Delhi	11.4.2005
3.	Smt. Sanjeevan, Finance & Account Officer	HQs, New Delhi	20.6.2005
4.	Dr S.K. Mishra, Head, Germplasm Eval. Div.	HQs, New Delhi	21.9.2005
5.	Smt. Rukmani, SS Gr. I	HQs, New Delhi	17.10.2005

19.8 Promotions

#	Name and designation	Promoted as	Date of promotion
Administrative staff promotion			
1	Sh. Dinesh Prasad, Senior Clerk	Assistant	w.e.f. 25.11.2004
2	Smt. Lakshmillian Kharnary, LDC	UDC	w.e.f. 19.11.2005
3	Sh. J.K. Singh, LDC	UDC	w.e.f. 6.12.2005
4	Sh. Subhash Chander, UDC	Assistant	w.e.f. 6.12.2005
5	Sh. DD Sharma, Assistant	A.A.O	w.e.f. 27.12.2005
Technical staff promotion			
1	Sh. B.C. Baccharwada, T-5	T-6	w.e.f. 1.07.2003
2	Sh. M.S. Rathore, T-5	T-6	w.e.f. 1.1.2004
3	Dr. P.S. Mehta, T-5	T-6	w.e.f. 1.1.2005

4	Sh. Bharat Lal Meena, T-5	T-6	w.e.f. 1.1.2005
5	Sh. J.K. Ingle, T-5	T-6	w.e.f. 1.1.2005
6	Sh. Axma Dutt Sharma, T-5	T-6	w.e.f. 1.1.2005
7	Sh. Rajeev Gambhir, T-5	T-6	w.e.f. 1.3.2005
8	Sh. Surender Singh Ranga, T-5	T-6	w.e.f. 1.1.2005
9	Dr. Rajvir Singh, T-5	T-6	w.e.f. 1.1.2005
10	Dr. Dinesh Chand, T-5	T-6	w.e.f. 1.1.2005
11	Sh. Ashok Kumar Maurya T-5	T-6	w.e.f. 1.1.2005
12	Sh. R.S. Yadav, T-4	T-5	w.e.f. 17.2.2005
13	Sh. Y.S. Rathi, T-4	T-5	w.e.f. 1.1.2005
14	Sh. Bhopal Singh Panwar, T-4	T-5	w.e.f. 1.1.2005
15	Sh. Babu Ram, T-4	T-5	w.e.f. 11.10.2003
16	Sh. Devender Kumar Nerwal, T-4	T-5	w.e.f. 18.01.2004
17	Sh. Ashok Kumar, T-4	T-5	w.e.f. 1.01. 2005
18	Smt. Sangeeta Tanwar, T-4	T-5	w.e.f. 27.10.2005
19	Sh. Sat Narayan Rai, T-4	T-5	w.e.f. 1.1.2005
20	Sh. Kishan Nath, T-4	T-5	w.e.f. 1.1.2005
21	Sh. R.R. Arya, T-4	T-5	w.e.f. 1.1.2005
22	Sh. Satya Prakash, T-III	T-4	w.e.f. 25.1.2004
23	Sh. Om Prakash, T-II-3	T-4	w.e.f. 7.02.2004
24	Sh. Diksha Gautam, T-II-3	T-4	w.e.f. 11.12.2002
25	Sh. Sanjeev Kumar Singh, T-II-3	T-4	w.e.f. 11.12.2002
26	Sh. Ram Kumar Sharma, T-3	T-4	w.e.f. 1.01.2005
27	Sh. Bhatta Ram, T-III	T-4	w.e.f. 3.2.2005
28	Sh. M. Goswami, T-III	T-4	w.e.f. 3.2.2005
29	Sh. T.T. Velayudhan, T-III	T-4	w.e.f. 3.2.2005
30	Sh. Gopi Chand, T-III	T-4	w.e.f. 3.2.2005
31	Sh. Ram Chander Yadav, T-III	T-4	w.e.f. 3.2.2005
32	Sh. Bhawmesh Kumar, T-III	T-4	w.e.f. 3.2.2005
33	Sh. Ramesh Chander, T-III	T-4	w.e.f. 3.2.2005
34	Sh. Dinesh Kumar Pokhriyal, T-I	T-2	w.e.f. 5.2.2004
35	Sh. Rohtas Singh, T-I	T-2	w.e.f. 5.2.2004
36	Sh. Ram Chander, T-I	T-2	w.e.f. 11.2.2004
37	Sh. Vipin Kumar, T-I	T-2	w.e.f. 12.2.2004
38	Sh. Sunil Kumar, T-I	T-2	w.e.f. 17.2.2004
39	Sh. Naresh Kumar, T-I	T-2	w.e.f. 24.7.2004
40	Sh. Hardeo Prasad, T-I	T-2	w.e.f. 11.10.2004
41	Sh. Ram Nandan, T-I	T-2	w.e.f. 11.10.2004

Supporting staff promotion

1	Sh. Arvind Kumar, S.S.Gr-I	LDC	w.e.f. 11.11.2004
2	Sh. Krishan Chand Kundu S.S.Grade-I	LDC	w.e.f. 11.11.2004

19.9 Transfers

- Dr. K.K. Gangopadhyay, Senior Scientist transferred from NBPGR, New Delhi to Srinagar.
- Sh. P. Suleman, LDC NBPGR, Regional Station, Hyderabad transferred from New Delhi to

NBPGR, Regional Station, Hyderabad w.e.f. 22.10.2005 (AN).

- Shri. M. Abdul Nizar, Scientist (Sr. Scale) was transferred from NBPGR Regional Station, Thrissur to Akola w.e.f. 05.07.2005 (AN)

19.10 Retirements

- Sh. Brij Mohan, Driver, NBPGR, New Delhi retired on 28.2.2005.
- Mrs. Indra Rani, T-6 retired on 30.11.2005.
- Dr. Shamsher Singh, Principal Scientist, Plant Quarantine Division retired on 31.12.2005.
- Sh. M.L. Bagga, AAO retired on 31.12.2005.
- Sh. K.P. Velayudhan, S.S.Gr-III NBPGR, Regional Station, Thrissur retired on 31.12.2005.

19.11 Library and Documentation Services

NBPGR library is a special library on plant genetic resources management. Scientists, technical staff, research associates, students and trainees were regular users of the library. Library maintained its designated services and activities of acquisition of books and journals, exchange of literature, cataloguing and documentation. During the year, 359 books related to

various aspects of PGR management and Hindi literatures were added to Headquarter and Regional Station libraries through purchase and exchange basis. Library procured 67 journals including 39 foreign and 38 Indian through subscription/ gift and exchanges for the use at the Headquarters and different regional stations. Newspaper clipping services related to PGR and its related subjects were provided to readers regularly. The library provided reprography services to its internal as well as external readers. A monthly list of new arrivals was also provided to the readers at headquarters. Library possesses AGRIS, AGRICOLA, CABSAC, CAB-CD and PLANT GENE databases. Bureau's publications were provided to over 250 different organizations in India and abroad and in return 300 publications as gratis from various organizations. NBPGR Annual Report, Newsletters, Crop Catalogues, Brochures and other publications were distributed to various trainees and visitors from India and abroad..

19.12 Participation of Staff in Seminars/ Symposia/ Workshops/Conferences/ Trainings / Meetings etc.

Name of employee	Title of Seminar/ Symposium/ Conference	Place and period
Anjula Pandey and Ruchira Pandey	National Conference on Alliums	BHU Varanasi February 24-25, 2005
Anuradha Agrawal	International Conference on 'Human Centred Sustainable Development Paradigm'	MSSR Foundation, Chennai August 8-11, 2005
Archana P Raina	National Seminar on "Value addition of Agro-horti-medicinal produce"	College of Agri. Nagpur October 25-26, 2005
Archana P Raina	Training on "Advanced Biochemical and Molecular Techniques"	IARI, New Delhi March 1-21, 2005
Arjun Lal	Biennial Workshop of AICRP on nematodes	Agriculture College (KAU), Vellayani, Kerala November 7-9, 2005
Arjun Lal, RK Khetarpal and Rajan	National Symposium on Recent Advances and Research Priorities in Indian Nematology	IARI, New Delhi December 9-10, 2005
Arjun Lal, RK Khetarpal, V Celia Chalam, Kavita Gupta, Dinesh Chand and Anju Jain	Global Conference on Plant Health- Global Wealth	MPUA&T, Udaipur November 25-29, 2005
Ashok Kumar	Workshop on "Intellectual Property Rights (IPR) on Herbs and Herbal Products"	India Internl. Centre, New Delhi, December 14, 2005
Ashok Kumar, KC Bhatt and BS Phogat	Winter School on "Advances in Medicinal, Aromatic and Under-utilized Plant Research"	CCS HAU, Hisar Sept. 29 - Oct. 19, 2005
Ashok Kumar, KC Bhatt and Poonam Suneja	National Seminar on "Role of Medicinal and Aromatic Plants in Ayurveda Unani and Siddha System of Medicine"	CCS HAU, Hisar March 4-5, 2005
B Sarath Babu	Scientific Advisory Committee meeting of Krishi Vigyan Kendra	KVK Farm, Hayathnagar, Hyderabad, May 13, 2005

B Sarath Babu, SR Pandravada and N Sivaraaj	Workshop on 'Strengthening Research Extension Linkages'	Department of Agriculture & Centre for Good Governance, Hyderabad, July 7, 2005
Babu Abraham	Training on "Effective technical assistance in management of agricultural research"	NAARM, Hyderabad, Feb 3-19, 2005
Babu Abraham	Training on "DUS testing-Principles and Procedures"	NSP, Rajendranagar, Hyderabad October 17- 22, 2005
Charan Singh	Training Course on Collection, Preservation and Identification of Insect Bio-agents	PDBC, Bangalore December 1-7, 2005
DB Parakh and V Ceila Chalam	Launching Workshop on Network Project on Diagnostics of Emerging Plant Viruses	KAB- II, New Delhi February 1, 2005
DC Bhandari	National Seminar on Commercialization of Horticulture in Non-traditional Areas	CISH, Bikaner February 5-6, 2005
Scientists-53 and Technical staff-25	International Symposium on "Plant Introduction, Achievements and Opportunities in South Asia"	NBPGR, New Delhi February 15-17, 2005
DK Hore	48 th Annual Maize Workshop	ICAR (NEH), Umiam, Meghalaya, April 8, 2005
DK Hore	Meeting of farmers' commission on 'Input for farming-time bound programme in agriculture and allied section'.	ICAR (NEH), Umiam, Meghalaya, 26-27 April, 2005
DK Hore	Meeting on Integrated Development of value added products from ginger and turmeric for the economic development of NE Region	ICAR (NEH), Umiam, Meghalaya, April 29, 2005
DK Hore	'ABS, PIC and farmers rights to livelihood'.	CUTS, Calcutta June 3-4, 2005
DK Hore	Meeting on Bio diesel cultivation programme	NEDFI, Ulubari, Guwahati December 24, 2005
ER Nayar, RK Khetarpal, SK Mishra, S Mandal, S Sardana, S Bhalla, JC Rana, C Chalam V	4 th International Food Legumes Research Conference	IARI, New Delhi October 18-22, 2005
ER Nayar	First Consultative Meeting on Issues related to Plant Variety Protection	NASC Campus, New Delhi December, 12 2005
Gurinder Jit Randhawa	International conference on foods derived from genetically modified crops: Issues for consumers, Regulators and Scientists	New Delhi September 26, 2005
Gurinder Jit Randhawa	International conference on Indo-EU seminar on protection and promotion of geographical indications of goods	New Delhi November 23 - 24, 2005
Gurinder Jit Randhawa	National Conference on Biodiversity related International Conventions: Role of Indian Scientific Community	INSA, New Delhi March 8-10, 2006
Gurinder Jit Randhawa Rekha Chaudhory and Sandhya Gupta	National Conference on IPR and Management of Agricultural Research	NASC Complex, New Delhi August 27- 29, 2005
Gurinder Jit Randhawa	National Seminar on Genetically Modified Organisms- Biosafety aspects	Delhi University March 11, 2005
Gurinder Jit Randhawa	National workshop on management of field trials of genetically modified crops	NASC Complex, New Delhi August 9, 2005
Gurinder Jit Randhawa	Ten years after Beijing: Gender, Science and Technology	NASC Complex, New Delhi November 18-19, 2005
Gurinder Jit Randhawa	Workshop on "The safety assessment of Genetically Modified Foods"	New Delhi April 11 - 12, 2005
Gurinder Jit Randhawa	Workshop on Capacity Building on Biosafety Delhi,	Ambassador Hotel, New Delhi March 24, 2005

Hanuman Lal	Refresher Course on "Information Technology in Agriculture"	NAARM, Hyderabad June 1-21, 2005
J B Tomar	Brain Storming Session on Lac Production	ILRI, Namkum, Ranchi Sept. 9, 2005
J B Tomar and VK Gupta	National Symposium on Molecular Ecology & Biodiversity	Ranchi June 6-7, 2005
JC Rana	Review meeting of the Technology Mission on Integrated Development Horticulture in North Eastern States, Sikkim, JK, HP and Uttaranchal	CPRI, Shimla July 11, 2005
JC Rana, VD Verma and K Pradheep	National Symposium on Current Scenario in Temperate Horticulture	IARI, Regional Station, Shimla, July 6-7, 2005
K Joseph John	National Programme Steering Committee Meeting of UNEP/GEP Project on Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity Promoting Sustainable Livelihoods, Food Security and Ecosystem Services	IHR, Bangalore August 12-14, 2005
K Joseph John and SK Verma	Winter school on 'Advances in Vegetable Breeding'	IIVR, Varanasi December 1-21, 2005
K Joseph John and R Senthil Kumar	State level sensitisation programme on "Intellectual Property Rights (IPR) and Patent Protection"	Thrissur, Kerala March 2, 2005
K Pradheep and KI Asha	Training/refresher course on "Intellectual Property Management of Genetic Resources - Dimensions and Tools"	College of Horticulture, KAU, Thrissur, November 9-29, 2005
Kamala Venkateswaran	35 th All India Coordinated Sorghum Improvement Project	NRCS, Hyderabad, April 21-23, 2005
Kamala Venkateswaran	Training on " Alien introgression and wide hybridization"	PAU, Ludhiana, Feb 2-22, 2005
Kavita Gupta	Workshop on Researchable Issues in Safe Storage and Export in the Present WTO Regime	GBPUAT Pantnagar August 4-5, 2005
KC Bhatt	National Seminar on Medicinal Plants	K V Pendharkar College (Univ. of Mumbai), Dombvili January 22-24, 2005
KK Gangopadhyay	National Symposium on SYMSAC-II-Current Trends in Onion, Garlic, Chilies and seed spices – Production, Marketing and Utilization	NRC Onion and Garlic, Pune November 25-27, 2005
KS Negi, KS Varaprasad and Z Abraham	First National Workshop of FAO project on Establishment of information sharing mechanism for monitoring the implementation of Global Plan of Action	NBPGR, New Delhi January 23-28, 2005
KS Negi	Ist Regional Workshop and Training on use of data collection format for the project for Region (North and East India)	NBPGR, New Delhi March 15-17, 2005
KS Varaprasad and K Anitha	Meeting on "Provisions of the Biological Diversity Act, 2002 vis-a-vis allocated business of ICAR/DARE"	NAARM, Hyderabad September 9, 2005
M Abdul Nizar	Seminar on Seeds Bill 2004	KAU, Thrissur February 16, 2005
Madhu Bala	National Seminar on "Green to Evergreen: Challenges to Extension Education"	IARI, New Delhi December 15-17, 2005
Manju Lata Kapur	National Seminar on Prevention of Redressal of Sexual Harassment at Workplace organized by National institute of Public Administration	Bangalore February 25-26, 2005
N Sivaraj and N Sunil	Group meeting on "Biotechnological interventions on <i>Pongamia</i> , <i>Jatropha</i> and <i>Simarouba</i> ".	NAARM, Hyderabad May 17, 2005
N Sivaraj and N Sunil	Training course on "GIS Application in Natural Resource Management"	NIRD, Hyderabad December 12-17, 2005
N Sivaraj and N Sunil	Training programme on "Technological options in cultivation and processing of medicinal and aromatic plants"	NIRD, Hyderabad June 13-18, 2005

Neelam Sharma	National Symposium on "Emerging Technologies and their Application in Assessment, Conservation and Management of Threatened Wild Medicinal Plants and their Habitats"	State Forest Research Institute, Jabalpur February 23-24, 2005
Neelam Sharma and Ruchira Pandey	Brain Storming Session on "Role of Science and Society Towards PGR Management-Emerging Issues"	IARI, New Delhi January 7-8, 2005
NK Dwivedi	"National Consultation on Arid zone farming" organized by National Commission on Farmers (NCF) and ICAR	CAZRI, Jodhpur April 22 - 23, 2005
NK Dwivedi	Training programme on "Human Resource Strategy for Agricultural Research Organizations"	NAARM, Hyderabad December 13 - 23, 2005
NK Dwivedi, Neelam Bhatnagar and S Gopala Krishnan	National Seminar on "Strategies for enhancing production and export potential of Sesame and Niger"	ARS, RAU Mandore April 7-9, 2005
Ranbir Singh	Annual kharif oil seeds workshop on Sunflower and castor	CCS HAU, Hisar May 19-21, 2005
Ranbir Singh	XII Annual AICRP Research Workers group meet on rape seed-mustard	GBPUA&T, Pantnagar August 11-13, 2005
RDVJ Prasada Rao, SK Chakrabarty, B Sarath Babu and N Sivaraj	Conference on "Creating sustainable frameworks for PPPs in rural infrastructure"	Confederation of Indian Industries, Hyderabad July 28-29, 2005
Rekha Chaudhury	20 th Congress of the International Sericultural Commission	Bangalore December 15-18, 2005
RK Khetarpal and Kavita Gupta	Centenary Symposium on Plant Pathology	CPRI, Shimla April 7-8, 2005
RK Khetarpal, Usha Dev, Baleshwar Singh, DB Parakh, V Celia Chalam, Kavita Gupta, Dinesh Chand, Ashok Maurya and K D Joshi	IPS Delhi Zone Annual Meeting	IARI, New Delhi December 13, 2005
RP Dua, BS Phogat, Hanuman Lal, S Gopala Krishnan and RS Rathi	Annual Workshop on Underutilized Crops	TNAU, Mettupalayam April 17-19, 2005
RP Dua, NK Gautam	Kharif Annual Group Meet on Pigeonpea and MULLARP	ANGRAU, Hyderabad May 4-6, 2005
S Gopala Krishnan	40th Annual workshop on pearl millet	ARS, RAU, Beechwal Bikaner, April 27-29, 2005
S Gopala Krishnan	CAS training programme on "Statistical techniques for Agricultural Research with Special emphasis on use of softwares"	IASRI, New Delhi, December 21 - January 10, 2006
Sanjeev Kumar Singh	Training on Jute and allied fibre crops: Agro-biodiversity and sustainable in crop production	CRIJAF, Barrackpur Sept. 30-Oct. 1, 2005
SK Chakrabarty	RAC meeting of Central Sericulture Germplasm Resources Centre	Hosur, Tamil Nadu December 7, 2005
SK Mishra, RP Dua, S Sardana	Annual Group Meet on Chickpea and MULLARP Crops	BCKVV, Kolkatta September 9-11, 2005
SK Mishra, S Sardana	Annual Workshop on Arid legumes	ANGRAU, Trirupati 3-4 June, 2005
SK Pareek	National Seminar on "Medicinal and Aromatic Plants-Biodiversity, Conservation and Processing"	IGAU, Raipur February 26-27, 2005
SK Verma	National Seminar on cucurbits	GBPUA&T, Pantnagar September 22-23, 2005
SK Verma	Second Regional Workshop of FAO sponsored project on Establishment of National Information Sharing	NBPGR, New Delhi November 23-24, 2005

	Mechanism on the Implementation and Monitoring of the Global Plan Action (GPA)	
SS Malik	National Symposium on Basmati Rice Research: Current Trends and Future Prospects	SVBP Uni. Agri. & Tech., Meerut, September 6-7, 2005
SS Malik and NS Panwar	National Conference on Plant Science Research in India: Challenges and Prospects	BSI, Dehradun October 24-26 2005
V Celia Chalam	Agricultural Summit 2005 organized by FICCI	Vigyan Bhawan April 9-10, 2005
V K Gupta	Multi Stakeholder Consultation on Customary Laws and Practices and Protection of Indigenous Knowledge	Ranchi, May 27-28, 2005
Vandana Tyagi	Awareness Programme on Intellectual Property Rights	IARI, New Delhi May 17-18, 2005
Vandana Tyagi	First Refresher Course in Bioscience	JM Islamia Univ., New Delhi Aug.18-Sept. 8, 2005
Vandana Tyagi	Training Course on Management Development Programme on Intellectual Property Rights in Agriculture	NAARM, Hyderabad July 26-30, 2005
Vandana Tyagi	Workshop on Capacity Building on Bio-safety	MoEF, New Delhi March 23-24, 2005
Veena Gupta and AK Singh	National Seminar on "Indian system of Medicine-Buyers and Sellers meet and Sixth Swastha Mela"	R.K. Mission, Kolkata
Z Abraham	First meeting of ICAR AP Cess Fund Ad-hoc Project "Network Project on Tree Borne Oilseeds"	DOR, Hyderabad March 2, 2005
Z Abraham	Launching meeting of ICAR Network Project on TBOs	NBPGR, New Delhi September 9, 2005
Z Abraham	Regional Seminar on Ecology and Economy of Plant Biodiversity	Ernakulam, Kerala February 3, 2005
Z Abraham and R Senthil Kumar	Southern Regional Stakeholders Workshop of FAO Sponsored Project on "Establishment of the Information Sharing Mechanism for Monitoring the Implementation of Global Plan of Action (GPA)"	NBPGR, Hyderabad March 7-8, 2005

19.13 Human Resource Development

Teaching PGR to M.Sc. and Ph.D. students:

Students enrolled with Post Graduate School, IARI, New Delhi were taught various courses in plant genetic resources and allotted research work related to PGR.

Trainings imparted/organized

- Three months training was imparted to one M. Sc. (Agriculture) student from College of Agriculture, M.A.U. Parbhani, Maharashtra on aspects related to "multiplication and conservation of *Rauvolfia serpentina* (L.), a threatened medicinal plant using tissue culture techniques"
- Two months training was imparted to one M. Sc. (Biosciences) student from Department of Biosciences & Biotechnology, Banasthali Vidyapeeth, Banasthali (Rajasthan) on aspects related to tissue culture techniques for propagation of medicinal plants.

- A one-week's training was imparted to a researcher trainee from Department of Biosciences & Biotechnology, Banasthali Vidyapeeth, Banasthali (Rajasthan) on aspects related to "cryopreservation of medicinal plants, using *in vitro* techniques" under the DST young Scientist Project.
- Six months (January-July 2005) training was imparted to one M. Sc. (Biotechnology) student from Government Post-Graduate College, Guna, Madhya Pradesh on aspects related to genetic diversity assessment of *in vitro*-conserved *Curcuma* germplasm using RAPD and ISSR markers.
- Six months (January-July 2005) training was imparted to one M. Sc. (Biotechnology) student from Government Post-Graduate College, Guna, Madhya Pradesh on aspects related to hormone free *in vitro* conservation of taro (*Colocasia esculenta* L. Schott).

- One month's (February-March, 2005) training was imparted to one M. Sc. (Biotechnology) student trainee from H.N.B. Garhwal university, Dehradun, Uttaranchal on aspects related to *in vitro* clonal multiplication and conservation in bulbous crops.
- Four months (April-August 2005) training was imparted to one M. Sc. (Biotechnology) student trainee from College of Science and Technology, Dehradun, Uttaranchal on aspects related to *in vitro* clonal multiplication of gladiolus germplasm.
- Three months (May-August 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, Apex Institute of Management and Science, University of Rajasthan, Jaipur, Rajasthan on aspects related to assessment of genetic diversity of *Curcuma* germplasm using Random Amplified Polymorphic DNA (RAPD) markers.
- Three months (May-August 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, University of Rajasthan, Jaipur, Rajasthan on aspects related to molecular characterization of *Curcuma* species using Random Amplified Polymorphic DNA (RAPD) markers".
- Four months (May - September 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, University of Rajasthan, Jaipur, Rajasthan on aspects related to molecular and biochemical characterization of *Colocasia esculenta* (L.) Schott. germplasm collected from North-east region.
- One month (June-July 2005) training was imparted to three B. Tech students, one each from Seedling Academy of Design Tech. & Management, Jaipur, Maharishi Arvind Inst. of Eng. & Tech, Jaipur, ILAM, Noida (UPTU) on aspects related to cryopreservation of non-orthodox seed species.
- Three months (June -August 2005) training was imparted to two M. Sc. students one each from AAIDU, Allahabad and another from Multanimal Modi College, Modinagar, (U.P.) on aspects related to cryopreservation of diverse non-orthodox seed species.
- Three months (June -August 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, Multanimal Modi (P.G) College, Modinagar, (U.P.) on aspects related to genetic stability analysis of *in vitro*-conserved germplasm of *Curcuma* spp. using RAPD markers.
- Three months (June -Sept. 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, C.C.S. University, Meerut (U.P.) on aspects related to genetic stability analysis of *in vitro*-conserved germplasm of some *Curcuma* accessions using RAPD markers.
- One month (July -August 2005) training was imparted to one B. Tech. (Biotechnology) student from Career Institute of Technology & Management, Faridabad, Haryana on aspects related to various techniques of biotechnology.
- Three months (July -Sept. 2005) training was imparted to one M. Sc. (Biotechnology) student from Department of Biotechnology, M. M. College, Modinagar, C.C.S. University, Meerut, (U.P.) on aspects related to clonal propagation of mulberry (*Morus indica* L.) using tissue culture technology.
- Six months (July 2005- January 2006) training was imparted to one B.Sc student from College of Science & Technology, Dehradun, Uttaranchal on aspects related to cryopreservation of diverse non-orthodox seed species.
- Two months (3rd January to 28th February 2005) training was imparted to Ms. M.S. Nimitha, II year M.Sc. student (Biotechnology), Seethalakshmi Ramaswamy College, Tiruchirapalli on aspects related to shoot multiplication in *Dioscorea intermedia* Thw., a wild relative of edible yams (*Dioscorea* spp.) at NBPGR, Thrissur
- One month (1st to 30th June 2005) imparted to two M. Sc. 2nd year Plant Science students of MES Asmabi College, Kodungallur, Thrissur- one in the study of Floral Morphology of three species of *Garcinia*, namely, *G. cambogia*, *G. indica* and *G. xanthochymus* and the other in Characterisation of Juvenile Traits in Greater yam (*Dioscorea alata*) at NBPGR, Thrissur.
- One month training was imparted to five B. Sc. (Biotechnology) students of CMS College, Kottayam on aspect related to *in vitro* multiplication of Malabar tamarind, kokam, *Piper longum*, *P. attenuatum* and *P. argyrophyllum* at NBPGR, Thrissur.

- Six months training was imparted to five M. Sc. (Biotech.) students (Chandan Kumar, Ms Shubham Kiro, Ms Upasana Shukla, Pravasa Kole, Shubhanjali Saxena) from Orissa University of Agriculture and Technology, Bhubaneswar, Agricultural University, Parbhani and Jiwaji University Jhansi in PCR based techniques for crop genetic diversity analysis in urd bean, Frenchbean, ricebean, Vigna species respectively.

Training cum awareness programmes for farmers

- Sh. KC Muneem delivered a lecturer on Role of indigenous germplasm and its proper conservation to 20 women participants of Aajeevika Vikas Samiti of district Chamoli, Uttaranchal at R/S Bhowali on October 28, 2005.
- Dr KS Negi and Dr SK Verma gave PGR awareness talk to fifty farmers of district Pithoragarh with Sh. MS Rawat visited R/S Bhowlai under HTP-MM on dated December 24, 2005.
- Dr. K.S Negi and Dr SK Verma gave PGR awareness talk to fifty farmers of district Pithoragarh with Sh. JS Dhaila visited R/S Bhowlai under HTP-MM on dated December 30, 2005.
- Dr. K.S. Negi and Dr. S.K. Verma gave PGR awareness talk to Forty three students of Department of Botany, Kishan P.G. College, Bahraich with Dr. T.P. Mall and Dr. S.C. Shukla visited R/S Bhowali under their educational Tour on dated December 28, 2005.

19.14 Field Days Organised

1. A germplasm field day for pigeonpea was organized on 6th January 2005 by Rgional Station Hyderabad and ICRISAT. Eight hundred and sixty seven accessions were displayed in the field and 8 participants from NARS participated in the field day.
2. Field Day for Germplasm Awareness was organized on the September 24, 2005 at the Regional Station, Jodhpur in which 121 participants including farmers (91), scientists, research scholars and technical officers (36) participated.

3. A field day was organized at RS Akola on 25.10.2005 for *kharif* crops for millets, soybean, sesame, niger and okra germplasm. Breeders and horticulturists of ICAR institutes and SAUs participated and selected the material.
4. A field day on wheat, barley and triticale was organized on 29 March 2005 at the Headquarters, in which, wheat/ barley breeders and other scientists participated and selected materials of their choice. Another field day was organized on medicinal and aromatic plants and vegetables crops on 30 November 2005. In this, 30 participants from different parts of country belonging to ICAR institutes, SAUs, Central Council for Research in Unani Medicine (CCRUM), Central Council for Research in Ayurveda and Siddha (CCRAS) participated and variability was observed for agromorphological traits. The scientists/research workers selected the material of their choice.
5. A field day on okra germplasm was conducted on 9.9.2005 for the benefit of crop improvement scientists. A total of 629 accessions of okra including 50 accessions of *Abelmoschus caillei* in fruiting condition were exposed to the participants. Nine scientists and PG students representing ICAR institutes and Kerala Agricultural University participated.
6. A field day was organized for amaranth, buckwheat, chenopod, French bean, adzuki bean, ricebean, cowpea, horsegram and kiwi fruits on September 12, 2005 at Regional Station, Shimla. Fifteen scientists participated in the field day



Dr S P Tiwari, Director, NAARM and Dr Anisetty Murthy, RAC member, NBPGR addressing the Stakeholders at the Second Regional Workshop of FAO sponsored project

19.15 Workshops/ Group Meetings/ Trainings Organized by NBPGR

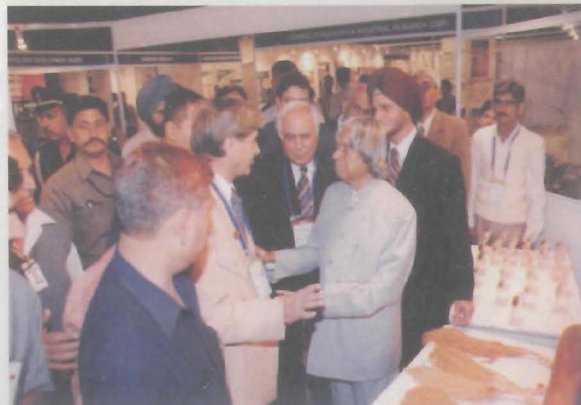
#	Title of the programme/Topic	Duration	Venue
1	Training Programme on "Biosafety Concerns of Transgenics and Detection of LMOs" sponsored by Ministry of Environment and Forests, Govt. of India	March 14 - 21, 2005	NBPGR, New Delhi
2	Statistical techniques useful for DUS testing"under Development and Digitalization of Extant-Notified Plant Varieties	January 10-15, 2005	NBPGR, New Delhi
	Six regional level training programmes were held as detailed below on "Statistical techniques useful for DUS testing"under Development and Digitalization of Extant-Notified Plant Varieties	Feb 28-Mar 1, 2005	CICR, Nagpur
		March 7-8, 2005	NBPGR, Hyderabad
		March 14-15, 2005	NBPGR, New Delhi
		March 13-14, 2005	NBPGR, Thrissur
		May 13, 2005	Rice Research Station, Chinsurah,
		Kolkata	
		May 31, 2005	NBPGR, New Delhi
3	First National Stakeholder workshop	January 24-25, 2005	NBPGR, New Delhi
4	Second meetings for data validation and to discuss the draft report on monitoring the implementation of the NISM	November, 2005	NBPGR, RS Hyderabad, Thrissur and NBPGR, New Delhi
5	The second regional meeting of stakeholders on "Establishment of Information Sharing Mechanism for Monitoring of the Implementation of Global Plan of Action for Management and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA), in which 19 persons from 16 stakeholders including NBPGR, Thrissur and New Delhi were present.	November 16-17, 2005	NBPGR, Thrissur
6	Second Regional Workshop of FAO sponsored project on Establishment of National Information Sharing Mechanism on the Implementation and Monitoring of the GPA for the Conservation and Sustainable Utilization of PGR for F & A	9-10 November, 2005	NBPGR, RS, Hyderabad
7	Training on "Microsatellites for Genetic Diversity Assessment and Cultivar Identification".	January 28 - 5 February, 2005	NRC on DNA Fingerprinting, NBPGR, New Delhi

19.16 Participation in Exhibition

- Bureau participated in an exhibition on "India R&D 2005, The World's Knowledge Hub of the Future" organized by FICCI at Vigyan Bhawan, New Delhi on 7 November. The President of India and several dignitaries who visited the exhibition were apprised about the activities and accomplishments of the NBPGR pertaining to management of plant genetic resources.

19.17 Award of Ph.D. Degree

1. Shri. K. Joseph John, Scientist (SG) was awarded Ph. D. degree in Botany by Mahatma Gandhi University on 18-07-2005



His Excellency, The President of India Dr AP J Abul Kalam, in discussion with Dr SS Malik during "India R&D 2005" exhibition at Vigyan Bhavan, New Delhi on 7 November 2005

2. Smt. Asha K.I., Scientist (Sr. Scale) was awarded Ph. D. degree by the University of Kerala, Thiruvananthapuram on the date of syndicate resolution on 12.05.2005

19.18 Deputation / visit abroad

1. Dr. R.C.Agrawal, Sr. Scientist attended a meeting of the focal points to discuss the progress of the NISM held at Chaing Mai, Thailand from 21 to 22 February 2005.
2. Dr. R.C.Agrawal, Sr. Scientist, attended "In situ Conservation Workshop and GIS Training Course" at Bangkok from 29 August to 2 September 2005.
3. Dr. J.L.Karihaloo, officiating Director presented the progress of the implementation of NISM at FAO, Rome on 25th October 2005 during Inter-governmental Technical Working Group on PGRFA.
4. Dr. R.K. Khetarpal proceeded for an FAO assignment on *Strengthening Plant Quarantine Facilities in Nepal* (TCP/ NEP/ 2903 A) to Kathmandu, Nepal as a TCDC Consultant from February 19 to March 19, 2005.
5. Dr. V. Celia Chalam and Mr. Ashok Kumar Maurya underwent *training on operational and maintenance aspects of Transmission Electron Microscope* at JEOL Ltd., Tokyo, Japan. from July 3 to 10, 2005.
6. Dr. R.K. Khetarpal proceeded for an FAO assignment on *Strengthening Plant Quarantine Facilities in Nepal* (TCP/ NEP/ 2903 A) to Kathmandu, Nepal as a TCDC Consultant from August 5 to September 4, 2005.
7. Dr. Gurinder Jit Randhawa participated in a "High Level Policy Dialogue on Biotechnology for Food Security and Poverty Alleviation: Opportunities and Challenges" from 7 to 9 November 2005 at Bangkok, Thailand.

19.19 Awards / Honours Received

- The Plant Protection Association of India conferred Smt. Kavuri Sarada Memorial Award upon Drs. RDVJ Prasada Rao, B.Sarath Babu, M. Sreekant and Mr. V. Manoj Kumar for the best research paper entitled, "*ELISA and infectivity assay based survey for the detection of peanut bud necrosis virus in mungbean and urdbean in Andhra Pradesh*" published in the Indian Journal of Plant Protection Vol.31, 2003.

- Dr Gupta Kavita and Dr RK Khetarpal received Second Best Paper Award for their poster paper on "Policies Influencing Crop Production and Trade" presented in Second Global Conference on Plant Health- Global Wealth, November 25-29, 2005 at MPUA&T, Udaipur.
- Dr. RK Khetarpal was awarded the prestigious *N Prasad Memorial Lecture Award for outstanding contribution in Plant Pathology in 2004* during the Global Conference on Plant Health- Global Wealth organized by the Indian Society of Mycology and Plant Pathology (ISMPP) at Maharana Pratap University for Agriculture and Technology, Udaipur from November 25-29, 2005.
- Dr. RK Khetarpal was awarded the prestigious *E J Butler Centenary Lecture Award* of ISMPP for delivering a talk on the *Road Map of Plant Pathology* during the Global Conference on Plant Health- Global Wealth organized by the Indian Society of Mycology and Plant Pathology (ISMPP) at Maharana Pratap University for Agriculture and Technology, Udaipur from November 25-29, 2005.
- Dr. V Celia Chalam, Dr. RK Khetarpal, Dr. DB Parakh, Mr. AK Maurya, Dr. A Jain and Dr. Shamsher Singh received 3rd Best Poster Award for the paper "*Interception of plant viruses in exotic germplasm imported during 2000-2004*" presented in International Symposium on Plant Introduction: Achievements and Opportunities in South Asia held on February 15-17, 2005 at National Bureau of Plant Genetic Resources, New Delhi.
- Drs. V Celia Chalam, RK Khetarpal, HS Prakash and A Mishra received Best Poster Award for the paper "*Prevalence of Pea seed-borne mosaic virus in Pea growing areas in India and its role in epidemiology*" presented in the Global Conference on Plant Health- Global Wealth organized by the ISMPP at Maharana Pratap University for Agriculture and Technology, Udaipur from November 25-29, 2005
- Kavita Gupta and R K Khetarpal received 2nd Poster Award for the paper "*Biosecurity and Biosafety policies influencing crop production and trade*" presented in the Global Conference on Plant Health- Global Wealth organized by the ISMPP at Maharana Pratap University for Agriculture and Technology, Udaipur from November 25-29, 2005

19.20 Consultancy

- Dr. ER Nayar participated as a member of the Technical Advisory Group constituted by Plant Variety Protection and Farmer's Rights Authority of the Govt. of India, New Delhi from December 13-23, 2005.

19.21 Patent Applications Filed

1. Randhawa G J., Firke P K and Karihaloo J L. (2005) Process enabling simultaneous detection _____ in transgenic soybean. (File No. 3452L/DEL/2005).
2. Randhawa G J., Firke P K and Karihaloo J L. (2005) Process enabling simultaneous detection _____ in transgenic maize. (File No. 3451L/DEL/2005).
3. Randhawa G J., Firke P K and Karihaloo J L. (2005) Process enabling simultaneous detection _____ in transgenic wheat. (File No. 3530/DEL/2005).

19.22 Publications

I. Research papers

1. Agarwal PC, Baleshwar Singh, Usha Dev, Indra Rani, KD Joshi and RK Khetarpal (2005) *Fusarium solani* (Mart.) Sacc. intercepted in introduced germplasm during last twenty five years. *Indian Journal of Plant Genetic Resources* **18**: 130-131.
2. Agarwal, PC, Baleshwar Singh, Usha Dev, Indra Rani, KD Joshi and RK Khetarpal (2005) *Fusarium solani* (Mart.) Sacc. intercepted in introduced planting material. *Indian Journal of Plant Genetic Resources* **18**: 131-133.
3. Anitha K, SK Chakrabarty, RDVJ Prasada Rao, B Sarath Babu, Babu Abraham, KS Varaprasad and RK Khetarpal (2005) Quarantine processing of exotic cereals and millets germplasm during 1986-2003. *Indian Journal of Plant Protection* **33**: 105-110.
4. Anitha, K, SK Chakrabarty, GA Girish, RDVJ Prasada Rao and KS Varaprasad (2004) Detection of bacterial wilt infection in imported groundnut germplasm. *Indian J. Plant Prot* **32**: 147-148.
5. Anitha, K, SK Chakrabarty, N Sunil, N Sivaraj, and RDVJ Prasada Rao (2005) Evaluation of sunflower germplasm against *Alternaria* blight and rust diseases. *J. Mycol. Pl. Pathol.* **35**: 262-264.

6. Arjun Lal and Rajan (2005) Nematodes intercepted in introduced germplasm of horticultural crops. *Indian Journal of Plant Protection* **33**: 282-285.
7. Asha KI and Maya C Nair (2003) Characterization and Evaluation of an indigenous Collection of Greater Yam (*Dioscorea alata* L.). *Indian Journal of Plant Genetic Resources* **16**: 13-17.
8. Bala, M. (2005) Agriculture databases and Online facilities to disseminate information. *Indian Journal of Extension Education* **40**:103-106.
9. Bhalla Shashi, B Lal, Manju Lata Kapur, Kavita Gupta and Charan Singh (2005) Interception of bruchids in introduced *Phaseolus* germplasm. *Indian Journal of Plant Genetic Resources* **18**: 51-52.
10. Bhat KV, S Lakhanpaul and S Chadha (2005) Amplified Fragment Length Polymorphism (AFLP) analysis of genetic diversity in Indian mungbean [*Vigna radiata* (L.) Wilczek] cultivars. *Indian Journal of Biotechnology* **4**:56-64.
11. Bhat KV, Y Amaravati, PL Gautam and KC Velayudhan (2004) AFLP characterisation and classification of Indian banana and plantain cultivars. *Plant Genetic Resources: Characterisation and Utilization* **2**: 121-130.
12. Bhatnagar Neelam, NK Dwivedi and Gopala Krishnan, S (2005) The exotic shrubs and trees in Indian arid regions. *Indian J. Plant Genet. Resour.* **18**:146-148.
13. Bisht IS, KV Bhat, S Lakhanpaul, M Latha, PK Jayan, BK Biswas and AK Singh (2005) Diversity and genetic resources of wild *Vigna* species in India. *Genetic Resources and Crop Evolution* **52**: 53-68.
14. Brahmi Pratibha and Kavita Gupta (2005) International and national regulations for access to plant genetic resources. *Indian Journal of Plant Genetic Resources* **18**: 150- 152.
15. Chakrabarty SK, AG Girish, K Anitha, RDVJ Prasada Rao, KS Varaprasad, RK Khetarpal and RP Thakur (2005) Detection, seed-borne nature, disease transmission and eradication of seed borne infection by *Rhizoctonia bataticola* (Taub) Butler in groundnut. *Indian Journal of Plant Protection* **33**(1): 85-89.
16. Chakrabarty, SK, AG Girish, K Anitha, RDVJ Prasada Rao, KS Varaprasad, RK Khetarpal and RP Thakur (2005) Detection, seedborne nature, disease transmission and eradication of seedborne

- infection by *Rhizoctonia bataticola* (Taub) Butler in groundnut. *Indian Journal of Plant Protection* **33**:85-89.
17. Chakrabarty, SK, K Anitha, RDVJ Prasada Rao, B Sarath Babu, GA Girish, KS Varaprasad, RK Khetarpal and RP Thakur. (2004) Post-entry quarantine detection of high-risk plant pathogens in exotic seed material. *Journal of Mycology and Plant Pathology* **34** : 634-637.
 18. Chakrabarty, SK, K Anitha, RDVJ Prasada Rao, KS Varaprasad and RK Khetarpal (2005) Pathogenic fungi intercepted in introduced germplasm. *J. Mycol. Pl. Pathol.* **35**: 313-316.
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 20. Chalam VC, RK Khetarpal, DB Parakh, AK Maurya, A Jain and Shamsher Singh (2005) Interception of Plant viruses in exotic germplasm imported during 2000- 04. *Indian Journal of Plant Genetic Resources* **18**: 152.
 21. Chalam VC, RK Khetarpal, DB Parakh, AK Maurya, Anju Jain and Shamsher Singh (2005) Interception of seed-transmitted viruses in French bean germplasm imported during 2002 and 2003. *Indian Journal of Plant Protection* **33**: 134-138.
 22. Chaudhury R, SK Malik, RK Kalia and S Kumar (2005) Methodologies for safe movement of highly perishable plant germplasm during international exchange. *Indian Journal of Plant Genetic Resources* **8**: 145-146.
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 26. Dhillon, BS and JC Rana (2004) Temperate fruits genetic resources management in India - issues and strategies. *Acta Hort.* **662**:139-146.
 27. Dixit-Sharma S, Ahuja-Ghosh S, BB Mandal and PS Srivastava (2005) Metabolic stability of plants regenerated from cryopreserved shoot tips of *Dioscorea deltoidea*-an endangered medicinal plant. *Scientia Horticulturae* **105**: 513-517.
 28. Dua RP, Pratibha Brahmi and BS Dhillon (2004) International Treaty on Plant Genetic Resources for Food and Agriculture: An Assessment. *Indian Journal of Plant Genetic Resources.* **17**: 53-60.
 29. Dwivedi NK, DP Yadav and BK Pareek (2005) Diversity in guar and mothbean in arid and semiarid regions in India. *J Arid Legumes* **2**: 325-327.
 30. Dwivedi, NK, Neelam Bhatnagar and Gopala Krishnan, S (2005) Collecting and characterising cowpea (*Vigna unguiculata*(L.) Walp.) germplasm in arid region. *J Arid Legumes* **2**: 328-329.
 31. Dwivedi NK, Neelam Bhatnagar and Gopala Krishnan, S (2005) Performance of exotic pulses in arid and semi arid region of India. *Indian Journal of Plant Genetic Resources* **18**: 54-55.
 32. Gautam RK, Om Vir Singh and TS Bharaj (2005) Breeding bacterial blight resistant rice. *Indian J Genet* **65**: 104-105.
 33. Gopakumar, KM and Sanjeev Saxena (2005) Seeds Bill 2004: For Whom? *Journal of Indian Law Institute* **47**:483-501.
 34. Gupta Kavita and RK Khetarpal (2005) Facilitating trade in fresh fruits and vegetables by developing disinfestation protocols- a case study. *EPPO Bulletin* **35**: 505-509.
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 36. Gupta, Veena, Lalit Arya, Chitra Pandey and Anjali Kak (2005) Effect of accelerated ageing on seed vigour in Pearl millet (*Pennisetum glaucum*) hybrids and their parents. *Indian Jour. Agri. Sciences* **75**: 346.
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- GL Arya (2003) Preliminary screening of exotic wheat germplasm for rust and powdery mildew diseases. *Indian J. Hill Farm.* **16**: 126. (Appeared in 2005).
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 40. Khetarpal RK, Manju Lata Kapur, V Celia Chalam, Shashi Bhalla, Baleshwar Singh, Rajan, Naresh Kumar, Rajiv Som and Anju Jain (2005) Pests intercepted in imported transgenic planting material during 2002-2004. *Indian Journal of Plant Genetic Resources* **18**(1): 148-149.
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 47. Mishra SK, A Sarkar, BB Singh, D Basandrai and A Basandrai (2005) Slow rusting and its potential donors for resistance in lentil (*Lens culinaris* Medik). *Indian J. Genet.* **65**: 319-320.
 48. Mishra SK, BB Singh, Daya Chand and KN Meena (2005) Sources for high temperature tolerant germplasm in cowpea (*Vigna unguiculata* L. Walp.). *J. Arid Legumes* **2**: 78-80.
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 50. Nageswara Rao, GV, D Raja Ram Reddy and RDVJ Prasada Rao (2004) Host range of the virus causing blackgram leaf crinkle disease in Andhra Pradesh. *Indian J. Plant Prot.* **32**: 107-110.
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 53. Pandey R, A Das, SR Apte and KS Negi (2005) *In vitro* conservation of exotic *Allium scorodoprasum* germplasm. *Indian Journal of Plant Genetic Resources* **18**: 99-100.
 54. Parakh DB, RK Khetarpal, V Celia Chalam, AK Maurya and Shamsher Singh (2005) Risk of Seed-transmitted viruses associated with exchange of soybean germplasm and the South Asian scenario. *Indian Journal of Plant Genetic Resources* **18**: 63-64.
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- infection in rice. *Nematologica Mediterranea* **33**: 191-194.
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- II. Chapters in books, proceedings, bulletins, manuals, etc.**
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 2. Abraham Z, M Latha, KI Asha, R Senthil Kumar, S Lakshmi Narayanan and Cherian Varghese (2004) Plant Genetic Resources of Southern Western Ghats. In: *Proceedings of the National Seminar on Plant Genetic Resources Management* (ed. Thomas Mathew P), Dept. of Botany, Union Christian College, Aluva, Kerala, pp1-21.
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19.23 Budget Estimates and Expenditure incurred (Rs. in lakhs) for 2005-2006

A: Non- Plan

Head	Allocation	Revised Allocation	Total Expenditure
Estt. Charges	764.00	935.00	930.99
Wages	45.00	31.00	28.78
OTA	0.20	0.20	0.20
TA	3.00	8.00	8.00
Other Charges	237.10	240.00	231.68
ARMO	46.00	59.80	59.80
Works	8.70	20.00	19.99
Total	1104.00	1294.00	1279.44

B: Plan

Head	Allocation	Revised Allocation	Total Expenditure
TA	12.00	12.00	12.00
HRD	2.00	0.92	0.92
Other Charges including Equipment	315.30	316.38	316.32
Works	150.00	80.00	74.20
Total	479.30	409.30	403.440

C: Plan-Shillong (NEH Region)

Head	Allocation	Revised Allocation	Total Expenditure
TA	1.00	1.00	0.96
Contingencies	4.00	3.79	3.79
Woks	3.00	3.21	3.21
Total	8.00	8.00	7.96
Total (B+C)	487.30	417.30	411.40

NRC on DNA Fingerprinting

Head	Allocation	Revised Allocation	Total Expenditure
Estt. Charges	0.00	0.00	0.00
TA	2.00	2.00	1.96
HRD	0.00	0.00	0.00
Other Charges	99.80	99.80	99.80
Total	101.80	101.80	101.76

AICRP UUC

Head *	Allocation	Revised Allocation	Total Expenditure
Estt. Charges	80.60	70.60	0.00
TA	3.55	3.55	1.17
Other Charges	20.75	16.75	0.55
Remittance			88.00
Total	104.90	90.90	89.72

Annexure I: Meteorological data (temperature in degree Celsius and rainfall in mm) of NBPGR stations during 2005

Station	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Akola	Max temp	29.1	31.9	36.4	40.3	42.3	39.8	31.6	28.8	31.2	31.9	30.8	28.4
	Min Temp	12.8	14.7	20.0	23.8	28.5	27.9	24.0	22.3	23.0	18.8	11.1	10.2
	Rainfall	27.3	4.0	40.4	3.4	0.0	25.5	222.0	227.6	151.5	70.4	0.0	0.0
Bhowali	Max temp	11.5	11.6	22.1	25.6	26.7	29.4	23.5	24.7	24.7	25.5	20.2	15.7
	Min Temp	0.7	1.5	5.8	8.8	11.3	18.5	18.3	17.0	15.5	9.8	2.5	2.5
	Rainfall	143.2	32.0	32.0	37.0	46.0	174.0	279.2	77.6	770.4	7.0	0.0	0.0
Cuttack	Max temp	26.9	30.1	32.9	36.9	37.5	35.5	31.7	30.8	32.1	30.3	29.9	28.1
	Min Temp	14.7	19.5	21.7	25.7	26.9	27.0	25.6	25.9	25.5	23.5	18.5	15.8
	Rainfall	0.0	12.6	15.2	2.4	9.5	105.4	340.7	322.7	156.8	231.6	0.0	0.0
Hyderabad	Max temp	30.0	32.2	35.3	36.4	39.6	38.2	29.9	29.6	29.4	30.3	28.5	28.4
	Min Temp	15.7	16.6	19.0	24.0	25.6	26.7	23.6	23.3	22.8	21.8	15.0	12.7
	Rainfall	1.1	4.9	2.9	10.2	5.8	3.3	72.1	19.7	54.3	34.5	28.4	0.0
Jodhpur	Max temp	23.4	26.9	34.6	38.1	40.5	41.5	36.6	34.5	36.2	36.7	33.1	26.4
	Min Temp	10.0	12.8	19.7	21.7	27.0	28.9	26.9	25.4	26.0	19.6	15.4	11.0
	Rainfall	0.0	4.0	0.3	5.3	23.3	14.1	32.9	77.2	25.9	0.0	0.0	0.0
Shillong	Max temp	19.2	23.3	25.8	27.3	27.1	28.2	28.9	29.1	29.1	25.7	23.9	22.1
	Min Temp	7.2	11.1	14.3	16.0	17.2	20.2	20.8	20.9	19.8	16.3	11.8	7.5
	Rainfall	12.6	3.3	161.7	91.4	495.8	298.9	360.9	308.9	333.7	183.4	48.3	10.8
Shimla	Max temp	11.7	11.8	17.9	24.1	27.4	26.3	22.6	23.5	22.8	21.0	17.2	16.3
	Min Temp	0.4	3.1	7.3	13.8	16.4	17.5	16.3	16.2	15.2	11.7	8.1	6.8
	Rainfall	102.8	144.8	116.2	35.7	11.5	135.7	723.1	164.2	163.8	0.2	0.0	0.0
Thrissur	Max temp	33.2	35.1	36.7	33.7	33.6	30.0	28.7	29.9	29.4	31.0	30.7	31.5
	Min Temp	22.6	22.3	24.6	24.8	25.0	23.5	23.0	23.3	23.3	23.2	22.9	22.1
	Rainfall	7.6	0.0	8.6	171.4	89.2	711.4	727.5	346.5	416.1	178.4	11.6	3.2

