NBPGR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2006-2007

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)
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ACRONYMS

AFLP	Amplified Fragment Length Polymorphism
AICRP	All India Coordinated Research Project
ARIS	Agricultural Research Information System
AVRDC	Asian Vegetable Research and Development Center
AVT	Advance Varietal Trial
BARC	Bhabha Atomic Research Center
BPH	Brown Plant Hopper
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CMS	Cytoplasmic Male Sterility
CPGR	Commission on Plant Genetic Resources
CSCNRVC	Central Sub-Committee on Crop Standards, Notification and Release of Varieties of Agricultural Crops
CSIR	Council of Scientific and Industrial Research
DAC	Department of Agriculture and Cooperation
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DFID	Departmental Fund for International Development
DPPQS	Directorate of Plant Protection, Quarantine & Storage
DRDO	Defense Research and Development Organization
DST	Department of Science and Technology
DWR	Directorate of Wheat Research
EC	Exotic Collection
ELISA	Enzyme Linked Immuno Sorbent Assay
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
GHU	Germplasm Handling Unit (of NBPGR)
GIS	Geographical Information System
GPA	Global Plan of Action
HYV	High Yielding Variety
IARC	International Agricultural Research Center
IARI	Indian Agricultural Research Institute
IC	Indigenous Collection
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IFPGR	International Fund for Plant Genetic Resources
INIBAP	International Network for the Improvement of Banana and Plantain
INPGRS	Indian National Plant Genetic Resources System
IPGRI	International Plant Genetic Resources Institute
IPR	Intellectual Property Rights
IRRI	International Rice Research Institute
ISPGR	Indian Society of Plant Genetic Resources
ITK	Indigenous Traditional Knowledge
IUPGR	International Undertaking on Plant Genetic Resources
LTS	Long Term Storage
MoU	Memorandum of Understanding
MTA	Material Transfer Agreement
MTS	Medium Term Storage
NAAS	National Academy of Agricultural Sciences
NAGS	National Active Germplasm Sites
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NBPGR	National Bureau of Plant Genetic Resources
NGO	Non-Governmental Organization
NHCP	National Herbarium of Cultivated Plants
NRC	National Research Center
NRCWA	National Research Centre for Women in Agriculture
PAGE	Polyacrylamide Gel Electrophoresis
PEQN	Post-Entry Quarantine Nursery
PGRFA	Plant Genetic Resources for Food and Agriculture
RFLP	Restricted Fragment Length Polymorphism
SAU	State Agricultural University
STMS	Sequence Tagged Microsatellite Site
TGMS	Temperature-sensitive Genic Male Sterile
TRIPS	Trade Related Intellectual Property Rights

PREFACE

It gives me immense pleasure to place before you the Annual Report (2006-2007) of the National Bureau of Plant Genetic Resources (NBPGR), a nodal organization of the country mandated with planning, execution and coordination of all activities concerned with germplasm collection, introduction, quarantine, evaluation, conservation and documentation at national level. Since its establishment in 1976 by the Indian Council of Agricultural Research (ICAR), NBPGR has played a pivotal role in the management and sustainable utilization of plant genetic resources.

Considering the suggestions of Germplasm Advisory Committees (GACs) on various crop groups, plant explorations were undertaken to collect the trait specific germplasm and wild relatives of crop plants, which constituted 40 % of the total collections made during the period under report. Similarly trait specific germplasm (for quality, biotic and abiotic stresses) was introduced from abroad and made available to indenters/ researchers after the quarantine clearance. A large number of accessions of agri-horticultural crops were grown for characterization, evaluation, regeneration and maintenance at New Delhi and various regional stations of Bureau located in different agro-climatic zones of the country. Besides, multilocation evaluation of rice, wheat, chickpea and pigeonpea involving AICRP/ ICAR crop based institutes/ SAUs resulted in the identification of promising accessions for yield, quality attributes and tolerance to biotic stresses.

Following the genebank standards, 26,571 accessions of orthodox seeds of different crops were added to the base collections raising the total germplasm holding to 3,39,194 accessions in the national genebank. Significant progress was made in the development of protocols for cultivars identification in crops of national importance using molecular techniques like STMS, AFLP and ISSR. A total of 2,215 varieties in 33 crops were fingerprinted and software was also developed for the fingerprinting database.

I take this opportunity to place on record my sincere thanks and gratitude to Dr Mangala Rai, Director General, ICAR & Secretary, DARE, Govt. of India and to Dr S P Tiwari, Deputy Director General (Education and Crop Sciences), ICAR for their continued guidance and support in executing the mandate of NBPGR.

I thankfully acknowledge the contributions of all scientists, technical, administrative and supporting staff of NBPGR in this endeavour.

Sincere efforts of Drs Arjun Lal, Saroj Sardana, Anjula Pandey and Kavita Gupta for compilation, editing and bringing out the report are appreciated.

SK Sharma

30 May 2007
New Delhi

SK Sharma
Director

प्रतिवेदन सारांश

राष्ट्रीय स्तर पर पादप आनुवंशिक संसाधनों के उचित प्रबन्ध हेतु पादप ब्यूरो ने निरंतर अगुआई करते हुए सफल पथ प्रदर्शन किया पादप आनुवंशिक संसाधनों के प्रबन्धन से संबंधित सभी गतिविधियों पर वर्ष 2006-2007 के अन्तर्गत अर्जित उपलब्धियों का संक्षिप्त विवरण इस अध्याय में दिया गया है जो इस प्रकार है।

पादप अन्वेषण तथा जननद्रव्य संग्रहण

देशभर में कुल 35 अन्वेषण किए गए जिनमें विविध पादप प्रजातियों के 2514 नमूने (जिसमें फसलीय तथा जंगली प्रजातियां सम्मिलित है) संग्रहित की गई। इनमें से मुख्यालय, नई दिल्ली द्वारा 10 अन्वेषणों के दौरान 523 प्राप्तियॉ संग्रह की गई। बाकि 25 अन्वेषण ब्यूरो के क्षेत्रीय केन्द्रों द्वारा किए गए। संग्रहित पादप प्राप्तियों को संग्रहण स्थल के निकट अनुकूल जलवायु में उगाया गया एवं उचित मात्रा में एकत्रित बीज को राष्ट्रीय जीनबैंक में दीर्घावधि भण्डारण हेतु संग्रहित किया गयां राष्ट्रीय वनस्पति संग्रहालय कृष्ट पादप में कुल 866 नमूने सम्मिलित किए गए।

वन्य प्रासंगिक पादप संग्रह: विलुप्त होती जंगली प्रजातियों के अन्वेषण एवं संग्रह पर विशेष ध्यान दिया गयां असम, अरूणचल प्रदेश,अण्डमान एवं निकोबार द्वीप, आंन्ध्र प्रदेश, बिहार, हरियाणा, हिमाचल, जम्मू-काश्मीर, मध्य प्रदेश, महाराष्ट्र, उड़ीसा, पंजाब, राजस्थान, तामिलनाडू, उत्तराखण्ड तथा उत्तर प्रदेश के विभिन्न स्थानों से कुल 1016 प्राप्तियां एकत्रीत की गई। कुछ मुख्य वन्य प्रजातियां इस प्रकार है-भिण्डी की प्रजातियां क्रमश: अबलमोशचस फिकलनस (30 प्राप्तियां), अ. टयूबरकुलेटस (16); अरहर की प्रजाती-केजानस स्कारबिलाइंडस (6); कददूवंश की प्रजातियां क्रमश: कुकुमिस केलासस (37); कु. सटाइवस (हार्डविकी-33), कु. प्राफेटम (10); तिल-ससेमम मलायानम (11); विगना ट्राईलोबेटा (49), वि. रेडियाटा-सबलोवेटा(23), वि. खण्डालेंसिस (6), वि. मुंगो- सिल्वेसट्रीस (23), सर्पगंधा की वन्य प्रजाति-विधानिया कोगलेंस की एक प्राप्ति जोधपुर से एकत्र की गई।

संग्रहित भू-जातियां (लैण्ड-रेसेज): धान की भू-जातियां क्रमश: भालधान,थापाचीनी, ननधान, जूलिया, दूधिया, राजूला, चिनभूरी, कत्रीसाल, इन्द्रासन, बनबासा आदि उत्तराखण्ड से तथा वाल करंग करूवाइ तामिलनाड से एकत्र की गई। आंध्रप्रदेश के अदिलाबाद, करीमनगर तथा खमाम जिलों से रबी दालों की चीन्ना, मिनुमूला, नटटू मिनामूला, नल्ला पेसारालु तथा इरा सेनागलु एकत्र की गई।

केले की प्रमुख भू-जातियां क्रमश: अम्रतापानी, अम्रतालु, बोन्ता अराती, बान्था, बुडिडा बोन्था, इर्रा अराती, कांडा आरती, कूरा बोन्था, टेलाचेक्राकेली आदि पूर्वी गोदावरी, विशाकापट्टनम, विजयानगरम तथा श्रिकाकुलम से एकत्र की गई। इसी प्रकार मिर्च की भू-जातियां क्रमश: बोंडू मिरपा, बिडीगे, विडिगे, कडडी, डोडू कया, मेका सन्नालु, सन्नाकया, सिंगलेपट्टी, टोमेटो मिर्ची, बारंगल आदि बारंगल तथा तेलंगना क्षेत्र से एकत्र की गई।

फसल विशेष अन्वेषण: फसल विशेष अन्वेषण के अन्तर्गत रतन जोत (जेट्रोपा करकस) की 167 प्राप्तियां राजस्थान (बांसवाडा, चित्तोड़गढ़, डूंगरपुर, राजसमंद, सिरोही तथा उदयपुर), उत्तराखण्ड (अल्मोड़ा, देहरादून, नेनीताल, कोटद्वार, पोड़ी गढ़वाल तथा पिथोरागढ़), आंध्रप्रदेश (बारांगल, निजामाबाद, करीमनगर, महबुबनगर, खमाम, विशाखापट्टनम, विजयानगरम तथा श्री काकुलम) से एकत्र किए गए।

जननद्रव्य विनिमय

आयातित जननद्रव्य: विभिन्न फसलों के कुल 26925 प्राप्तियां (63917 नमूने) 45 देशों से आयात किए जिनमें 1646 प्राप्तियां जनन द्रव्यों की तथा 10779 प्राप्तियां परीक्षण (ट्रायल) सामग्री के लिए आयात की गई। हमारे देश के अनुसंधान कर्ताओं के आवेदनानुसार विभिन्न फसलों के कुल 9537 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 = एक्जोटिक कलेक्सन):-

धान: इसी 571081 से 571155, 571211 से 571227- सूखा प्रतिरोधी प्राप्तियां, इसी 571228 से 581123-जलमग्न प्रतिरोधी; सी एम एस तथा मेनटेनर प्राप्तियां (इसी 571539 से 571548, 582493, 582500, 588896 से 588935, 588992 से 589027), टी जी एम पंक्तियां (इसी 571553 से 571558), अधिक लोह युक्त (इसी 572269), ब्राउन प्लांट हापर प्रतिरोधी प्राप्तियां (इसी 58580364 से 580373,582484), ब्लास्ट प्रतिरोधी (इसी 580374 तथा 580375), जीवाणु झुलसा रोग प्रतिरोधी कतारें (इसी 582443 से 582447,582449 से 582453, 582486 से 582492, 580376 से 580390), तना छेदक प्रतिरोधी कतारें (इसी 582455 से 582461), जीवाणु झुलसा रोग एवं टुंगरो विषाणु प्रतिरोधी (इसी 583878 से 583910), ग्रासी स्टंट विषाणुं प्रतिरोधी (इसी 583411 से 583453)। उपरोक्त सभी प्राप्तियां अ. धान अ.सं., फिलीपींस से

आयात की गई। इसी प्रकार धान की अधिक उपज तथा रोग एवं कीट रोधी प्राप्तियां अमेरिका तथा श्रीलंका से आयात की गई।

गेहूँ: शाफ्लाई प्रतिरोधी (इसी 580485 से 580486) कनाडा से, डबल हेप्लोइड, शुद्ध आइसोजनिक (इसी 580487 से 850489)जर्मनी से, अधिक उपज, नान-शटरींग, पाला रोधी, तथा पीला रतुआ, भूरा रतुआ एव छाधिया रोग प्रतिरोधी (इसी 852225 से 582441), सफेद दाने, अधिक उपज, पीला एवं भूरा रतुआ रोग प्रतिरोधी (इसी 589025), ओरोपोस किस्म (इसी 589421) अधिक पैदवार, बोनी, लाजीगं प्रतिरोधी, रतुआ रोग (काला, भूरा, पीला) प्रतिरोधी; चोटेव किस्म (इसी 586941) अच्छी उपज, शाफ्लाई एवं लाजिंग प्रतिरोधी; जेरोम किस्म (इसी586942) जल्दी पकने वाली, लाजिंग एव पीला रतुआ प्रतिरोधी-उपरोक्त सभी किस्में अमेरिका से आयात की गई। जिंमनमाइ किस्म (इसी 592591) तीनो रतुआ रोग प्रतिरोधी, जल्द पकने वाली, सूखा एवं सर्दी सहिष्णु-चीन से आयात की गई।

जो: पोस्ट- 90 किस्म (इसी 586943) अधिक उपज, व्यापक रूप में अनुकूल, ग्रीनबग (सभी ज्ञात बायोटइप्स) प्रतिरोधी, बोना पौधा, अच्छी भूसा विशेषता वाली; रेडियन्ट किस्म (इसी 586944) माल्टिंग जो जिसमें बीटा अमाईलेज जीन मौजूद हैं-अमेरिका से आयात की गई।

मक्का: इसी 592161- अफलाटाक्षीन प्रतिरोधी, पीले दाने, सफेद भूट्टे, अधिक अमाईलेज, अधिक तेल की मात्रा, अधिक प्रोटीन; इसी 586945 से 586947- वेक्षी तथा विशेष स्टार्च वाली, वेजिटेबल गुण वाली -अमेरिका से; इसी 583148 से 583167- ट्रापिकल, मध्यम ऊंचाई तक उगाई जाने वाली तथा ग्रेलीफ स्पोट, मेज स्ट्रीक विषाणु, नार्दन लीफ झुलसा एवं कामन रस्ट (रतुआ) रोग प्रतिरोधी- नाईजेरिया से आयात की गई।

ज्वार: इसी 582502 से 582508- ब्राउन मिडरीब जीन्स की आइसोजनिक तथा मेल स्टेरायल लाईन (इसी 582509 से 582513) अमेरिका से आयात की गई।

सूरजमुखी: इसी 851515 से 581519- मृदा लवणता सहिष्णु, अधिक उपज तथा अधिक तेल देने वाली शंकर किस्में बनाने के लिए उपयोगी जीन्स; इसी 586971- अच्छी लाजिंग प्रतिरोधी, कम ऊंचाई वाली; इसी 586972- डाउनी मिल्डयू प्रतिरोधी तथा इसी 586973- फरटीलिटी रेस्टोरर लाईन- सभी अमेरिका से आयात की गई।

सोयाबीन: इसी 592181 से 592212- वेजिटेबल टाईप, सफेद मक्खी एवं डाउनी मिल्डयू रोग प्रतिरोधी, इसी 592211से 592219- अधिक तेल मात्रा वाली ताईवान से; देशा किस्म-जल्दी पकने वाली, स्टेम कैंकर तथा सोयाबीन मोजेक विषाणु रोग प्रतिरोधी और लोनोक किस्म अधिक पैदवार देने वाली, सेटरींग प्रतिरोधी,तथा सदर्न स्टेम केंकर, सोयाबीन सिष्ट कृमि, रेनिफोर्म कृमि एवं फ्राग आइ लीफ स्पाट आदि रोग प्रतिरोधी अमेरिका से आयात की गई।

चना: इसी 571855 से 572003- बड़े आकार के दाने वाली प्राप्ति सीरिया से तथा इसी 583236- बहुत बड़े दानों वाली काबुली किस्म अमेरिका से आयात की गई।

राजमा: (फिजियोलस वुलगरिस) : बीन कामन माजेक नेक्रोसिस विषाणु प्रतिरोधी, तथा बी सी एम वी की सभी स्ट्रेन्स प्रतिरोधि, जड़ सड़न रोग प्रतिरोधी एवं अधिक उपज वाली क्वीन्सी किस्म (इसी 589388); सिल्वर क्लाउड किस्म (इसी 589468) अधिक उपज तथा बीन रतुआ सहिष्णु सभी अमेरिका से आयात किए गए; इसी 590327-नान-नाडयूलेसन जेनेटिक स्टाक कनाडा से आयात किए गए।

मटर: डिफरेंशियल लाइने (इसी 581505 से 581514) अमेरिका से आयात की गई।

चवंला (विगना अंगुइकलेटा): इआइएन- इ 1 धाजल किस्म (इसी582501) शुष्क खेती मे अच्छी उपज देने वाली अमेरिका से तथा इसी 587822- सी एबी एमवी विषाणु एवं जिवाणु झुलसा रोग प्रतिरोधी शेनेगल से आयात की गई।

ब्रेसिका आलेरेसिया: बोट्राइटिस (इसी 572748) जल्दी पकने वाली (40-45 दिन) तथा अधिताप सहिष्णु ताईवान से आयात की गई।

मिर्च: सी एम एस/मेनटेनर्स (इसी 571257 से 571266), मिर्च वेनल मोजेक विषाणु एवं पोटी विषाणु-वाई प्रतिरोधी लाईने (इसी 572236 से 572239) तथा अन्थ्रेकनाज प्रतिरोधी लाईने (इसी 572238,572243-45) ताईवान से; तनजेरिन किस्म -नान पन्जेट सर्दी एवं गर्मी के प्रति सहिष्णु, लम्बे समय तक ताजा रहने वाली तथा आचार के लिए उपयुक्त (इसी 582593) अमेरिका से आयात की गई।

तरबूज: इसी 572745 से 572747- अण्डे के आकार वाले फल, छोटे बीज, चीनी (11-12%) तथा रोग प्रतिरोधी प्राप्तियां ताईवान से आयात की गई।

खीरा: पी एम आर डिलेसियस-51 किस्म जो कि छाछिया रोग प्रतिरोधी है अमेरिका से आयात की गई।

टमाटर: सफेद मक्खी द्वारा फैलने वाले जेमनी विषाणु रोग, बैक्टेरियल बिल्ट, टमाटर माजेक विषाणु एवं फ्यूजेरियम विल्ट रोग प्रतिरोधी (इसी 571821 से 571829, 580001, 580988 से 580020) सभी ताईवान से, प्रचूर केरोटीन, अधिक लाइकोपिन एवं मेल सटेरायल (इसी 572692से 572708) अमेरिका से

आयात की गई।

कपास: मेल स्टेरायल लाइने (इसी 561526) अमेरिका से आयात की गई।

स्ट्राबेरी: अरकिंग किस्म (इसी 571812) बड़े आकार के फल देने वाली,पत्ती धब्बा, छाछिया तथा रेड स्टेल प्रतिरोधी, इसी 571816, 571817- बाट्राइटिस, वरटीसिलीयम सूखा, छाछिया रोग एवं धब्बेदार स्पाईडर माईट प्रतिरोधी, अच्छी खूशबू एवं उत्तम फल विशेषता वाली - सभी अमेरिका से आयात की गई।

जननद्रव्य निर्यात: विदेशों में जननद्रव्यों की अनुसंधान हेतु कुल 7840 प्राप्तियां (151 दिल्ली से तथा 7689 हैदराबाद से मुख्यता इकरीसेट फसलों की) निर्यात की गई। इन जनन द्रव्यों का निर्यात भा.कृ.अ. परिषद् की स्वीकृति के उपरान्त स्वस्थता प्रमाण पत्र के साथ किया।

पादप संगरोध

अनुसंधान कार्यो के लिए विनिमय (आयात+निर्यात) होने वाले सभी जननद्रव्यों की संगरोध जाँच पादक ब्यूरो के मुख्यालय,नई दिल्ली तथा क्षेत्रीय केन्द्र हैदराबाद में की जाती है। जाँच एवं परीक्षणों के आधार पर स्वस्थ पाई गई पौध सामग्री एवं बीज मांगकर्त्ताओं को भेजी जाती है।

मुख्यालय, नई दिल्ली में कुल 27,076 प्राप्तियां संगरोध जाँच हेतु प्राप्त हुई जिनमें 26,925 प्राप्तियां आयात हुई तथा 151 प्रप्तियां निर्यात की गई। इन प्राप्तियों मे विभिन्न फसलों के बीज, जड़ सहित पौधे,कलम,कंद, तथा टिश्यू कल्चर के पौधे शामिल थे। पौध संगरोधालयों में विस्तृत जाँच निरीक्षण करने पर 648 नमूने रोग/कीट द्वारा ग्रसित पाये गये। इनमें से 296 नमूने कीटों द्वारा, 120 नमूने सूत्रकृमियों से तथा 232 नमूने फफूंद/ जीवाणुओं द्वारा ग्रसित पाये गये/ कुल 648 ग्रसित/ संक्रमित नमूनो में से 647 नमूनों को विभिन्न विधियों जैसे धूमन, एक्सरे रेडियोग्राफी, उष्ण जल उपचार, फफूंदनाशक एवं कीटनाशक रसायनों द्वारा उपचारित कर स्वस्थ बीज/पौध सामग्री को मांगकर्त्ताओं को भेजा गया। सोयाबीन का एक नमूना जो अमेरिका से आयात किया गया था, डाऊनी मिल्डयू फफूंद से ग्रस्त पाया गया जिसे जलाकर नष्ट कर दिया गया। निर्यात के लिए 151नमूनों को परीक्षण पश्चात स्वस्थ पाया गया जिन्हे स्वस्थता प्रमाण पत्र जारी कर निर्यात कर दिया गया। इसके अतिरिक्त 17,212 प्राप्तियां (भारतीय मूल की)प्राप्त हुई जिन्हे परीक्षण पश्चात स्वस्थ अवस्था में जीन बैक में संरक्षण हेतु भेजा गया।

क्षेत्रीय केन्द्र, हैदराबाद द्वारा कुल 21,736 नमूने (आयात-11,940, निर्यात-9,796) पादप संगरोध जाँच के लिए प्राप्त हुए। आयातित नमूनों में कुल 2,203 नमूने कीटों / रोगों द्वारा ग्रस्त / संक्रमित पाये गये जिनमें से 2,194 को रोग / कीट मुक्त करके, मांग कर्त्ताओं को भेजा गया। निर्यात किए जाने वाले 227 नमूने रोग / कीट ग्रसित पाये गये जिन्हे जलाकर नष्ट कर दिया गया तथा बाकि 7,889 नमूनों को स्वस्थ्यता प्रमाण पत्र के साथ निर्यात कर दिया गया।

जननद्रव्य लक्षणवर्णन, मूल्यांकन तथा अनुरक्षण

पादप ब्यूरो के मुख्यालय, ईसापुर फार्म, नई दिल्ली तथा ब्यूरो के क्षेत्रीय केन्द्रों तथा भारतीय कृषि अनुसंधान परिषदकी विभिन्न संस्थानों के साथ तैयार साझा कार्यक्रम के अन्तर्गत विभिन्न फसलों के जननद्रव्यों को लक्षण वर्णन, मूल्यांकन एवं अनुरक्षण / पुनरूत्पादन हेतु उगाया गया जो निम्नवत है:-

मुख्यालय एवं ईसापुर फार्म,नई दिल्ली में 14,459 प्रप्तियां (धान्य- 6,624, मोटे अनाज एवं चारे की फसलें-320, दलहन फसलें-2,378, तिलहन फसलें-153) मुख्यता लक्षण वर्णन एवं मूल्यांकन हेतु उगाई गई। इनके अतरिक्त, 3416 प्राप्तियां (धान्य 137, दलहन-515, तिलहन-250, सब्जियां-769, औषधीय एवं सगंधीय पौधे-345) अनुरक्षण तथा पुनरूत्पादन हेतु उगाई गई। कुल 130 प्राप्तियां फलदार पोधों की अनुरक्षित की गई। सरसों की 200 प्राप्तियों का तेल मात्रा एवं गुणवत्ता के लिए बायोकेमिकल मूल्यांकन किया गया तथा अरहर (1,932 प्राप्तियां), गेहूं (17), रामदाना (30), जेट्रोफा (6), पेरीला (20), अखरोट (9)तथा बादाम (9) को प्रोटीन तथा अन्य गुणों के लिए मूल्यांकन किया गया। गेहूँ, धान, चना तथा अरहर की आशजनक प्राप्तियों को कई स्थानों पर साथ उगाकर मूल्यांकन किया गया। विभिन्न गुणों के लिए आशाजनक प्राप्तियों को (1,828 प्राप्तियां) को देशभर में 69 मांगकर्त्ताओं को भेजा गया।

क्षेत्रीय केन्द्र, आकोला में 4,685 प्राप्तियां (मोटे अनाज-636, तिलहन-3,617, कमउपयुक्त फसलें -244, वन्य जातियां-188), क्षेत्रीय केन्द्र, भुवाली में 1,369 प्रातियां, कटक में 1850 प्राप्तियां (धान-1,238, तिल-498,हल्दी-114), हैदराबाद में 699 प्राप्तियां (ज्वार,उड़द बैंगन, मिर्च,चेरी टमाटर एवं हार्सग्राम) मूल्यांकन हेतु तथा 1014 प्राप्तियां वृद्धि / अनुरक्षण हेतु, शिलांग में 1941 प्राप्तियां (12 फसलों की), शिमला में 2514 प्राप्तियां (धान्य / दाने वाली फसलें 2,289, सब्जियां-125 शीतोष्ण फल-100) मूल्यांकन के लिए तथा 601 प्राप्तियां बीज वृद्धि के लिए, त्रिशूर में धान की 346 प्राप्तियां, हार्सग्राम की 100 प्राप्तियां, अन्य फसलों की 755 प्राप्तियां मूल्यांकन हेतु तथा 1,143 प्रप्तियां बीज वृद्धि के लिए उगाई गई। सभी स्थानों पर विभिन्न गुणों के लिए आशाजनक प्राप्तियों की पहचान की गई। वानस्पतिक संवर्धन से उगाई जाने वाली फसलों / पौधों को फील्ड जीन बैंक में उगाकर अनुरक्षण किया गया।

मुख्यालय तथा क्षेत्रीय केन्द्रों पर रबी एवं खरीफ फसलों

तालिका 1: राष्ट्रीय जीन बैंक में दीर्घावधि हेतु संरक्षित जननद्रव्यों की यथास्थिति (31-12-2006 तक)

फसल वर्ग	1 जनवरी से 31 दिसम्बर 2006 तक संरक्षित प्राप्तियां	कुल प्राप्तियों की वर्तमान स्थिति
धान	3857	78714
गेहूँ	2115	38046
मक्का	615	6912
अन्य धान्य	578	10749
कुल धान्य	**7165**	**134421**
ज्वार	1118	18655
बाजरा	191	7436
मोटे अनाज	591	19025
अन्य	731	3541
मोटे अनाज तथा चारे की फसलें	**2631**	**48657**
रामदाना	290	4549
कूटु	235	638
अन्य	126	305
कूट धान्य	**651**	**5492**
चना	39	15972
अरहर	782	10798
मूंग	134	3499
अन्य	3570	22575
दलहन	**4525**	**52844**
मूंगफली	319	13414
सरसों	1168	8980
कुसुम	297	7246
अन्य	3413	17825
तिलहन	**5197**	**47515**
कपास	87	4710
जूट	229	2837
अन्य	88	1999
रेशदार फसलें	**404**	**9546**
बैंगन	464	3724
मिर्च	7	1997
अन्य	1869	15480
सब्जियां	**2340**	**21201**
सरीफा	1	58
पपीता	–	23
अन्य	90	184
फलदार फसलें	**91**	**265**
पोस्ता	–	349
तुलसी	101	342
तम्बाकू	12	1460
अन्य	1528	3182
औषधीय, सगंधीय एवं नशीले पौधे	**1641**	**5333**
धनिया	27	412
सोवा	–	59
अन्य	471	1161
मसाले	**498**	**1632**
पोंगम तेल वृक्ष	265	327
अन्य	1163	1726
कृषि वानिकी	**1428**	**2053**
मसूर	–	7712
अरहर	–	2523
द्वितियक नमूने	–	**10235**
योग	**26571****	**339194***

* इनमें 2,535 निर्मुक्त किस्में तथा 1,312 आनुवंशिक धरोहर शामिल हैं।
** इस संख्या में 263 निर्मुक्त किस्में तथा 607 आनुवंशिक धरोहर शामिल हैं।

पर फसल दिवसों का आयोजन किया गया जिनमें उन्नतशील किसानों एवं अनुसंधानकर्त्ताओं ने भाग लेकर वांछित गुणों के आधार पर मूल्यांकन कर अच्छी प्राप्तियों का चयन किया।

जननद्रव्य संरक्षण

बीज जननद्रव्य संरक्षण: राष्ट्रीय जीन बैंक में दीर्घकालीन संरक्षण हेतु विभिन्न फसलों की कुल 28,888 प्राप्तियां प्राप्त हुई। इन सभी प्राप्तियों को जीन बैंक द्वारा निर्धारित मापदण्डों के अनुसार संशोधित किया गया इनमें से 26,571 प्राप्तियों को आधार संग्रहों में सम्मिलित किया गया जिसके फलस्वरूप राष्ट्रीय जीन बैंक में आधार संग्रहों की कुल संख्या बढ़कर 3,39,194 हो गई है (तालिका-1)। इसी दौरान जननद्रव्य संचालन यूनिट ने 2,621 प्राप्तियां प्राप्त की जिनमें से 1,744 प्राप्तियों को दीघविधि भण्डार में संरक्षण किया गया तथा 877 प्राप्तियों को मध्यावधि भण्डार में संदर्भ सामग्री के रूप में रखा गया। कुल 2,050 संरक्षित प्राप्तियों को मानिटर किया गया एवं 864 प्राप्तियों की पासपोर्ट सूचना को पूर्ण किया गया। अरण्ड, तिल, मूंगफली, अरहर तथा कपास के बीज जिन्हे 3% से कम बीज नमी पर सूखाया गया था एवं नो वर्ष तक सामान्य (एमबिएन्ट) तापमान पर भण्डारित किया गया उनमें दीर्घायु पाई गई।

पादप उत्तक कल्चर संरक्षण: वानस्पतिक संवर्धन वाली पादप प्रजातियां जिनमें बीज नहीं बनता जैसे बागवानी, प्रकन्दीय, औषधीय एवं संकटापन्न पौधे एवं नई औद्योगिक फसलों की कुल 1904 प्राप्तियों को उत्तक संवर्धन विधि द्वारा कमरे के तापक्रम अथवा निम्न तापक्रम (4 डिग्री से.) पर संरक्षित किया गया। प्रजातियों के अनुसार संवर्धन का अन्तराल 4 से 24 माह रहा। विभिन्न प्रजातियों के कलचर हेतु प्राटोकाल विकसित किए गए। विभिन्न विधियों द्वारा उप संवर्धन की अवधि को बाकोपा मोनीरी,दहलिया तथा जेनटियाना कुरो में बढ़ाया गया विभिन्न पौधों की 85 प्राप्तियां उत्तक कल्चर रूप में मांगकर्त्ताओं को भेजी गई।

हिम परिरक्षण: विभिन्न पौधों की कुल 657 प्राप्तियों (जिनमें आर्थोडोक्ष तथा रिकलसीट्रेंट बीज, परागकण, सुषुप्त कोंपलें सम्मिलित थी) को तरल नाइट्रोजन में -160 से -180 डिग्री से. पर परिरक्षण किया गया। इस प्रकार हिम-परिरक्षण में संरक्षित प्राप्तियों की संख्या 7,922 पहुंच गई। डेसीकेसन-फ्रीजिंग विधि का उपयोग करके सिमारूबा ग्लूका, अखरोट तथा प्रूनस आरमेनियाका के हिम-परिक्षण प्राटोकाल विकसित किए गए। सिट्रस पराडेसी एवं ट्राइफोलियेट आरेंज के ऐम्ब्रियो एक्षेस को सफलतापूर्वक परिरक्षित किया गया। खिरनी के बीजों को सर्वप्रथम हिम-परिरक्षित किया गया।

डी एन ए फिंगर प्रिटिंग

राष्ट्रीय अनुसंधान केन्द्र फार डी एन ए फिंगर प्रिटिंग ने अब तक 33 फसलों की किस्मों की पहचान करने के लिए उनके प्राटोकाल विकसित किए हैं। इन प्राटोकाल को विकसित करने में एस टी एम एस, ए एफ एल पी तथा आई एस एस आर आणविक चिन्हक विधियों का उपयोग किया गया। ये फसलें इस प्रकार हैं-धान, गेहूँ , जौ, ज्वार, फिंगर मिलेट, बाजरा, राजमा, चना, हार्सग्राम, लेंटिल, मटर, अरहर, मूंग, राइसबीन, उड़द, सोयाबीन, सरसों, कुसुम, तिल, नाईगर, कपास, जूट, टमाटर, मिर्च, केला, आम, काजू, नीबू, सफेदमूसली, नीम तथा वेटीवर। अब तक 33 फसलों की कुल 2,215 किस्मों को फिंगर प्रिंट किया जा चुका है। मुकुना प्यूरिऐंस की 20 प्राप्तियों में व्याप्त आनुवंशिक विविधता का आंकलन किया गया। एस डी एस-पेज विधि द्वारा प्रोटीन प्रोफाईल ज्ञात कर विविधता का विश्लेषण किया गया तथा पाया गया कि केवल एक प्राप्ति (आई सी 127363) सभी प्राप्तियों से भिन्न है।

अन्य प्रमुख गतिविधियां

संस्थान प्रबन्धन समिति, अनुसंधान सलाहकार समिति तथा संस्थान अनुसंधान समिति की समयानुसार सभायें आयोजित की गई एवं पादप आनुवंशिक संसाधनों के उचित प्रबन्ध संबधी सभी पहलुओं पर चर्चा कर आवश्यक सुझावों को क्रियान्वित किया गया।

ब्यूरो के वैज्ञानिकों, अनुसंधान सहायकों, तकनीकि तथा प्रशासनिक कर्मचारियों ने देश-विदेश में आयोजित कार्यशालाओं, सम्मेलनों एवं प्रशिक्षण कार्यक्रमों में भाग लेकर ज्ञान का आदान-प्रदान किया।

विशिष्ट वैज्ञानिकों, प्रगतिशीत किसानों, नीति नियन्ताओं तथा विधार्थियों ने राष्ट्रीय जीनबैंक,डी एन ए फिगरप्रिंटिग प्रयोगशाला, संगरोध प्रयोगशाला, शीशघर एवं सी-4 स्तर की राष्ट्रीय नियन्त्रित सुविधा तथा पादप उत्तक संवर्धन प्रयोगशालाओं को देखा और जानकारी प्राप्त की।

प्रायोगिक प्रक्षेत्र ईसापुर, नई दिल्ली एवं अन्य क्षेत्रीय केन्द्रों पर रबी तथा खरीफ फसलों पर सात फसल दिवस आयोजित किए गए जिनमें फसल विशेषज्ञों ने भाग लिया एवं फसल सुधार हेतु जननद्रव्यों का चयन किया।

ब्यूरो द्वारा पादप आनुवंशिक संसाधन विषय पर स्नातकोत्तर तथा पी एचडी पाठयक्रम भी सफलता पूर्वक चलाए जा रहे हैं। स्नातकोत्तर छात्रा कुमारी सुनयना सिंह को पूसा संस्थान के 44वें दीक्षान्त समारोह पर सर्वोत्तम विद्यार्थी का अवार्ड दिया गया। कुमारी सुनयना सिंह को स्वर्ण पदक तथा दस हजार रूपये पुरस्कार स्वरूप दिए गए।

हिन्दी अनुवाद: डा. अर्जुन लाल, प्रमुख वैज्ञानिक

EXECUTIVE SUMMARY

NBPGR continued its role of leadership for the management of plant genetic resources in the country. Several significant achievements were made during 2006-07 in plant exploration and collection of germplasm; germplasm introduction, plant quarantine inspection, treatment and release of germplasm; characterization, evaluation, identification of promising accessions and maintenance; *ex situ* conservation of accessions in National Genebank and DNA Fingerprinting of crop cultivars and are summarized hereunder.

PLANT EXPLORATION AND COLLECTION OF GERMPLASM

In all, 35 explorations were undertaken across the country and a total of 2,514 accessions of various agri-horticultural crops, wild relatives of crops and other economic plants were collected. Of these, 523 accessions were collected by the NBPGR Headquarters, New Delhi through 10 explorations from parts of Himachal Pradesh, Haryana, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Punjab, Uttarakhand and Uttar Pradesh. A total of 866 herbarium specimens, 159 seed samples and 9 economic products were processed and added to National Herbarium of Cultivated Plants (NHCP).

Wild relatives of crop plants collected: Major emphasis was given for collection of wild species including wild relatives of crops. A total of 1,016 accessions were collected from Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, J&K, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttarakhand and Uttar Pradesh. Some important collections included *Abelmoschus ficulneus* (30), *A. tuberculatus* (16), *Cajanus scarabaeloides* (6), *Cucumis callosus* (37), *C. sativus* var. *hardwickii* (33), *C. prophetarum* (10), *Sesamum mulayanum* (11), *Vigna trilobata* (49), *V. radiata* var. *sublobata* (23), *V. khandalensis* (6) and *V. mungo* var. *silvestris* (23). One collection of *Withania coagulens* was made from Jodhpur.

Crop specific explorations: Prevailing diversity in *Jatropha curcas* was collected from parts of Rajsthan (Banswara, Chittorgarh, Dungarpur, Rajsamand, Sirohi and Udaipur districts), Uttarakhand (Almora, Dehradun, Nainital, Kotdwar, Pauri, Garhwal and Pithoragarh districts); Andhra Pradesh (Warangal, Nizamabad, Karimnagar, Mahbubnagar, Khammam, Vishakhapatnam, Vijayanagaram and Srikakulam districts), and Chattishgarh (Bilaspur, Durg, Ambikapur, Jashpur, Mahasamsunda and Raipur districts). A total of 167 accessions of *J. curcas* were made from different parts of India.

A unique ridged gourd (*Luffa actuangula*, family Cucurbitaceae), accession (collector no. NSKA/06/195) was collected from the Adilabad district of Andhra Pradesh during a germplasm survey conducted by the NBPGR R/S Hyderabad. It is characterized by smallest fruit size (4.8 cm in length with a circumference of 10.5 cm) and is round-ovate in shape. The cultivated species of *Luffa* are believed to have originated in India.

Landraces collected: In paddy, landraces namely *laldhan, Thapachini, Nandhan, Jaulia, Dudhiya, Rajula, Chinbhuri, Katyri-saal, Indrasan, Banbasa* were collected from Uttarakhand. *Vaal karung karuvai* was collected from Tamil Nadu. Important landraces of *Rabi* pulses collected from Adilabad, Karimnagar and Khamam districts of Andhra Pradesh included *chinna minumulu, nattu minumulu, nalla pesaralu, chinna pesaralu* and *erra senagalu*. Important landraces of banana namely *Amruta Paani, Amrutaalu, Bonta Arati, Bontha, Budida Bontha, Erra Arati, Konda Arati, Kura Arati, Kura Bontha, Pasiri Bontha, Tella Chekkarakeli* etc. were collected from East Godavari, Vishapkapatnam, Vijayanagaram and Srikakulam districts of AP. Important landraces of chillies namely *Bondu mirapa, Bydige, Byadige kaddi, Doddu kaya, Meka sannalu, Sanna kaya, Single patti, Tomato mirchi, Warangal kaya,* etc. were collected from parts of Warangal district and Telangana Region of Andhra Pradesh.

EXCHANGE OF GERMPLASM

Introduction of germplasm: During the period under report 26,925 accessions (63,917samples) were imported from 45 countries, which included germplasm 16,146 accessions (17,731samples) as well as trial material 10,779 entries (46,186 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were met by arranging material from different Indian sources and 151 samples including CIMMYT transit material were sent to six countries. A

total of 9,537 samples of different crops were supplied to various users for utilization in the various crop improvement programmes in the country based on requests received from research workers in the country under Material Transfer Agreement (MTA).

Promising trait specific germplasm introduced:

- ***Oryza sativa:*** Drought tolerant lines (EC571081-155, EC571211-227) from Philippines; Submergence tolerant lines (EC571228-238, EC581120-23); Cytoplasmic Male Sterile (CMS) and maintainer lines (EC571539-48, EC582493-500, EC588896-935, EC588992-9027, EC573166-200); Early and late maintainer population (EC571549-52); Thermogenic Male Sterile (TGMS) lines (EC571553-58); Iron rich line (EC572269); Brown Plant Hopper (BPH) resistant lines (EC580364-373, EC582484); Blast resistant (EC580374-375); Bacterial blight resistant lines (EC582443-447, EC582449-53, EC582486-92, EC580376-390); High yielding (EC580391-396); Deep water lines (EC580501-509); QTL lines (EC581124-27); Stem borer tolerant lines (EC582455-61); Fe toxicity tolerant lines (EC582463-64, 68-69,71); Introgression lines for high yield (EC582473-81); Acid Sulfate tolerant line (EC582482); Resistant to bacterial blight and *Rice tungro virus* (EC583878-910); Resistant to *Grassy stunt virus* (EC583411-453); Aerobic, moderate drought tolerance (EC582211-24) all from IRRI, Philippines; Early maturing, resistant to blast disease, Kernel smut, rice water weevil and rice stalk borer (EC572259-67) from USA and High yielding, early maturing and resistant to bacterial leaf blight, brown plant hopper and blast (EC592058) from Sri Lanka.
- ***Triticum aestivum***: Sawfly resistant hexaploid spring wheat derived from durum useful for development of solid stemmed wheat cultivars (EC580485-86) from Canada; Double Haploid lines, true isogenic and homozygous having different cytoplasm (fodder type) (EC580487-489) from Germany; High yielding, non shattering type, tolerant to frost and lodging, resistant to yellow rust, brown rust and powdery mildew (EC582225-441); Clear white grained, high yielding variety, resistant to stripe rust and leaf rust with excellent bread and noodle making quality (EC589025); Isogenic for stripe rust resistance gene Yr 36, leaf rust resistance gene Lr 47 and leaf, stripe and rusts resistance gene complex (EC589389-91); cv. Oropos high yielding, semi dwarf, broad adaptation, resistant to lodging, low temperature and diverse climatic conditions, resistant to stem, leaf and stripe rusts (EC589421); cv. Choteav, superior yield, resistant to wheat stem sawfly and lodging (EC586941); cv. Jerome, early maturing, resistant to lodging and stripe rust (EC586942) from USA and variety Jimnmai-50 high yielding, wide spread adaptation, early maturing, better quality for bread and noodle making, resistant to yellow, brown, black rusts, powdery mildew; tolerant to cold and drought (EC592591) from China.
- ***Hordeum vulgare***: Var. Post 90, high yielding, widely adapted, resistant to all known greenbug biotypes, short stature, good straw quality & winter hardness (EC586943); Var-Radiant proanthocyanidin free, potential malting barley and carry the gene that controls a high amount of thermostable b-amylase (EC586944) from USA.
- ***Zea mays***: EC592161-Resistant to aflatoxin contamination, yellow kernels, white cobs, good husk coverage and high amylase, high oil content, high protein quality and EC586945 to 47- waxy with specialty starches, populations of vegetable type from USA; EC583148 to167- tropical mid-altitude lines with resistance to foliar disease, gray leaf spot, maize streak virus, northern leaf blight and common rust from Nigeria.
- ***Sorghum bicolor***: Isogenic for brown midrib genes (EC582502-508) and Male sterile lines (EC582509-513) from USA.
- ***Helianthus annuus***: Tolerant to soil salinity and for genetic base broadening for agronomic and oil content characters in development of hybrids, parents or improved germplasm (EC581515-519); maintainer, high oleic fatty acid, short stature type (EC586970); excellent lodging resistance, short stature line (EC586971); Resistant to Downey mildew (EC586972) and restorer line having gene for fertility restoration (EC586973) from USA.
- ***Glycine max:*** Vegetable type, early and late maturing, white fly and downy mildew resistant (EC592181- 212) and high oil content (EC592211-19) from Taiwan and Var. Desha, early maturing, resistant to stem canker and *Soybean mosaic virus* (EC586966) and Var. Lonoke high yielding, good stand ability, shattering resistance and resistant to southern stem canker, soybean cyst nematode, reniform nematode, sudden death syndrome and frog

eye leaf spot (EC586967) from USA.

- ***Cicer arietinum****:* Large seeded kabuli type germplasm (EC571855-572003) from Syria and extra large kabuli variety (EC583236) from USA.
- ***Phaseolus vulgaris***: Var. Quincy resistant to all known strains of BCMV, *Bean common mosaic necrosis virus*, root rot and high yielding (EC589388) and Var. silver cloud, high yielding resistant to lodging, BCMV & CTV and tolerant to bean rust (EC589468) and Germplasm USDK-CBB-15 resistant to common bacterial blight (EC592938) from USA; Resistant to BCMV, tolerant to white mold, semi determinate growth habit with very short vines or no vines, upright plant and canopy, higher podding nodes on stems (EC590327) and non-nodulation genetic stocks (EC590328) from Canada.
- ***Pisum sativum***: Differential lines (EC581505-514) from USA.
- ***Vigna unguiculata***: Var. EIN-E1 Ghazal Good for grain production under rainfed conditions (EC582501) from USA and resistant to *Cowpea aphid borne mosaic virus* (CABMV), bacterial blight and early maturing (EC587822) from Senegal.
- ***Gossypium hirsutum***: Male Sterile lines (EC561526) from USA.
- ***Brassica oleracea* var *botrytis***: Early maturing (40-45 days), globe shaped and heat tolerant (EC572748) from Taiwan.
- ***Capsicum annuum****:* CMS lines and maintainers (EC571257-266); *Chilli veinal mosaic virus* and Poty Virus Y resistant lines (EC572236-39) and Anthracnose resistant lines (EC572238, 43-45) from Taiwan and Var. Tangerine dream, non pungent, banana type peppers, heat and drought tolerant, excellent keeping quality suitable for ornamental & culinary applications (EC582593) from USA.
- ***Capsicum baccatum* var. *pendulum:*** Anthracnose resistant lines (EC572240-42) and *Capsicum chinense*-resistant to anthracnose & bacterial wilt (EC589469) from Taiwan.
- ***Citrullus lanatus****:* Globe shaped, firm fleshed, small seeded, sugar content 11-12% and disease resistant (EC572745-47) from Taiwan.
- ***Cucumis melo***: Var. PMR Delicious 51, resistant to powdery mildew (EC589374) from USA.
- ***Lycopersicon esculentum***: Resistant to whitefly transmitted gemini virus, bacterial wilt, *Tomato mosaic virus* and fusarium wilt (EC571821-829); resistant to bacterial wilt, tomato mosaic virus, gray leaf spot, fusarium wilt (race 1) (EC580001); resistant to bacterial wilt, *Tomato mosaic virus*, fusarium wilt and gray leaf spot, late blight, white fly transmitted gemini virus, early blight (EC580988-020); Heat tolerant, globe shaped (EC581035-1043); resistant to Geminivirus, bacterial wilt, *Tomato mosaic virus*, fusaruim wilt, gray leaf spot pathogen & early blight (EC586975) and resistant to late blight, bacterial wilt, *Tomato mosaic virus*, fusarium wilt (EC588212-230) from Taiwan; Carotene rich and high lycopene content, male sterile lines (EC572692-708) from USA and heat tolerant (EC581525*,* EC592058-59) from Sri Lanka.
- ***Fragaria ananassa* subsp. *ananassa****:* Variety Arking large fruited, tolerant to leaf spot, leaf scorch, powdery mildew and red stele (EC571812); Resistant to botrytis, verticillium wilt, red stele, powdery mildew and spotted spider mite (EC571816); Large fruited, good flavor, outstanding fruit quality (EC571814, 571817) and Early ripening, resistant to red stele races A-1, A-3, A-4 and tolerant to fruit rots (EC571820) from USA.
- ***Trifolium repense****:* Var. Freedom, free from pubescence, good for hay making, faster drying and reduced dustiness (EC578957) from USA.
- ***Papaver* sp.**: Resistant to downy mildew (EC587085-88) from Denmark.
- ***Apium graveolens****:* Tolerant to high temperatures (EC587045) from China.
- ***Glaucium flavum****:* High glycyrrhizic content (EC 587081) from Denmark.

Export of Germplasm: The plant material intended for export was procured from known Indian sources (mostly from National Active Germplasm Sites) and made available to the indenters of foreign countries after the approval of ICAR/ DARE and clearance from Plant Quarantine Division by issuing Phytosanitary Certificate. A total of 7840 samples (151 from New Delhi and 7689 from Hyderabad of ICRISAT crops) were exported to several countries.

QUARANTINE OF GERMPLASM

At New Delhi, a total of 27,076 accessions (64,068 samples) comprising 26,925 exotic accessions

(63,917samples) [germplasm= 16,146 accessions (17,731 samples); nurseries/ trial breeding material (10,779 entries; 46,186 samples)] of various crops were imported and 151 accessions/ samples under export were processed for quarantine clearance. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 648 samples were found infested/ infected contaminated with various pests viz., insects/ mites -296 samples including 91 with hidden infestation; nematodes- 120 and fungi/ bacteria- 232. Of the 648-infested/ infected/-contaminated samples, 647 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip and mechanical cleaning. One samples of *Glycine max* from USA was rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. In addition, 17,212 accessions of Indian origin repatriated were processed for pest-free conservation. Of these 262 samples found infected and were salvaged. Seven Phytosanitary Certificates were issued for consignments meant for export. In addition, three hundred and eighty samples of transgenic crops viz., *Brassica oleracea* var. *capitata* (cabbage), *Brassica oleracea* var. *botrytis* (cauliflower), *Gossypium* spp., *Oryza sativa* and *Zea mays* were processed for quarantine clearance. The cultures of BCMV, SMV and ULCD are being multiplied under greenhouse conditions. The BCMV was purified and purification of SMV is in progress.

At Hyderabad, a total number of 21,736 samples [11,940-imports & 9,796 -exports] were received for quarantine clearance. Of the 2,203 imported samples found infected/ infested/ contaminated with pests *viz*., insects (75), nematodes (84), pathogens (2044), 2194 were salvaged. Prophylactic treatments were given to 5,242 samples. Pests intercepted included *Aphelenchoides besseyi, Callosobruchus chinensis, Drechslera maydis, Fusarium oxysporum, F. solani, Macrophomina phaseolina, Peanut mottle virus* and *Peanut stripe virus*. A total of 1,629 samples processed in PEQN and interceptions were zonate leaf spot, Anthracnose, Downy mildew, *Maize streak virus, Peanut stripe virus*. Of the 9,796 samples processed for quarantine clearance under export, 11 pests were intercepted on six crops, 227 samples rejected and 7,689 samples were released. Experiments were conducted for elimination of external contamination of smut spores (*Tolyposporium penicillariae*) in pearl millet seed as supportive research.

GERMPLASM CHARACTERIZATION EVALUATION AND MULTIPLICATION

A total of 14,459 accessions of various agri-horticultural crops comprising cereals (6,624); millets & forages (320); pulses (2378), oilseeds (1383); vegetables (3040); underutilized crops (561), medicinal and aromatic plants (153) were grown for characterization and evaluation at experimental farm, Issapur and IARI Farm, New Delhi. Besides, 3,416 accessions of various crop, *viz*. cereals (1,537); pulses (515), oilseeds (250), vegetables (769), medicinal and aromatic plants (345) 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 have been identified. The biochemical evaluation was made in oilseed crop namely, rapeseed mustard (200) for oil content and other quality parameters. Similarly, protein content and other quality attributes were studied in pigeonpea (932), elite synthetic wheat (17), amaranth (30), *Jatropha* (6), *Perilla* (20), walnut (9) and almond (9). Medicinal and aromatic plants were phyto-chemically 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, quality attributes and tolerance to biotic stress. Collaborative evaluation of germplasm was undertaken involving AICRP/ICAR/SAUs. Six Germplasm Field Days for various crops (oilseeds, rabi pulses, wheat, barley and triticale, kharif pulses, maize and medicinal & aromatic plants and vegetables) were organized to promote germplasm utilization by the plant breeders/user scientists. A total of 1828 accessions of different crops were supplied to 69 indenters belonging to different institutes for their use in crop improvement programmes. The germplasm characterized and evaluated at the various regional stations are as follows:

Akola: A total of 4,685 accessions comprising millets (636), oilseeds (3,617), under utilized crops (244) and wild relatives of crop plants (188) were grown and maintained at the centre out of which 198 accessions of winged bean and 142 accessions of soybean were evaluated for nine and twelve agro-morphological traits respectively. A total of 669 accessions of germplasm comprising barnyard millet (78), little millet (58), kodo millet (40), foxtail millet (165), niger (280) and soybean (48) were sent for long-term conservation in the National Gene Bank. A total of 2,533 accessions were supplied to various indenters. Crop-wise details of material

supplied include Soybean (62), sesame (706), okra (729), horse gram (983), *Abelmoschus moschatus* (7), foxtail millet (9), barnyard millet (10), little millet (3), proso millet (1), winged bean (20), *Glycine curvata* (1), *Glycine tabacina* (1) and *Glycine latifolia* (1).

Bhowali: A total of 1,349 accessions were grown for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material *viz.* M & AP and WEUPS: Rose- Geranium (7,729 plants), Lavender (554), *Marjorana hortensis* (807), *Ocimum* spp. (181); Rosemary (3,782), *Stevia rebudiana* (3,284); Horticultural Plants: Kiwi (621); Agricultural Crops: Wheat – HB208, Cowpea-EC229967-B were supplied to different farmers/ indentors. A total of 260 accessions were supplied to user scientists in the country and 765 accessions deposited in National Gene Bank for conservation.

Cuttack: A total of 1,850 accessions comprising cultivated rice (1,238), sesame (498) and turmeric (114) were grown for preliminary characterization and seed multiplication. Two hundred and four accessions of cultivated rice and of turmeric (94) were characterized and cultivated rice (1,034) and sesame (440) were multiplied. A total of 253 accessions comprising cultivated rice (94), sesame (145), chilli (1), Jatropha (1), wild brinjal (1) and medicinal plant (11) were deposited at NBPGR, New Delhi. In addition 16 accessions comprising cultivated rice (10) and medicinal plant (6) were supplied to different research and educational institutes. A total of 1,949 accessions comprising cultivated rice (1,034), medicinal and aromatic plants (300), sesame (295), wild *Oryza* species (152), turmeric (84), other wild relatives of crop plants (34), sylviculturally economic plants (24), banana (17), horticultural crops (06) and betel vine (03) are being maintained in the field gene bank of the center.

Hyderabad: A total of 699 accessions of sorghum, blackgram, brinjal, chillies, cherry tomato, and horsegram were grown in the field along with checks for characterization, evaluation/multiplication. A total of 1,014 accessions including horsegram (165), finger millet (150) and small millets (54), brinjal (115), chillies (353), dolichos bean (130), tomato (34) and *Lycopersicon pimpinellifolium* (13) were multiplied and sent to NGB for long-term storage. A total of 953 accessions of diverse germplasm collected during explorations including cereals and millets (144), vegetables (360), pulses (181), oilseeds (25), spices (95), M&AP (12), wild relatives (58) and others (47) were sent to GHU for storage in the MTS and accessioning. During multiplication of sesame germplasm at Regional Station, Hyderabad, an early maturing (<55 days) accession (IC413257) was identified while Swetha, a check variety, flowered even after 70 days. The accession was collected from Edulapally village, Jarasangham Mandal, Mehak district of Andhra Pradesh. A coriander accession, collected during 1993 in a collaborative exploration with ANGRAU, AP was released as a variety **SUDHA** as per the State varietal release committee recommendations by ANGRAU, AP. A naturally occurring purple landrace accession (IC436231) of Capsicum was found to be promising as a morphological marker. The plants in this accession have purple pigmentation in whole/stripes on stem, node, leaf, pedicel, calyx, corolla, filament, style, and fruit. Its erect flowers and fruits characterize the accession. This accession assumes importance in the plant variety protection regime (N-DUS) as it can be used for developing new varieties with the purple morhphological marker as a trait for distinctiveness.

Jodhpur: Observations were recorded on morpho-agronomic traits of 319 accessions raised during *Rabi*, 2005 and 1,303 accessions raised during *Kharif* 2006. Trait specific accessions for determinate habit, foliaceous bracts and male sterility were identified in guar germplasm during *Kharif* 2006. Blocks of horticultural plants and plants of economic importance were maintained and data were recored in *Aloe barabadensis*, anola, bael, *Capparis decidua*, jamun, mulberry, *Salvadora* spp., *Jatropha curcas* and jojoba germplasm. In all 28,977 germplasm accessions are conserved in the MTS facility, including 1,761 accessions processed and kept in MTS facility during 2006. A total of 936 accessions were sent to NGB for LTS. Eighty-one accessions of horticultural and economically important plants were added to the field gene bank making a total of 758 accessions in the field gene bank at the station. A set of 25 varieties released for Rajasthan state has been received along with 14 other germplasm accessions and conserved at the MTS facility of the station. Seed samples of 445 accessions were supplied to various indentors.

Shillong: A total 2,084 accessions of 12 crops were sown and out of which 1,941 accessions were characterized. Promising accessions were identified based on the yield characteristics of the genotype for each crop. Germplasm of various crops (360 accs.) was provided to 11 indenting institutes while 23 accessions of rice bean were received from the BCKVV, Kalyani. A total of 350 accessions of paddy, maize, ricebean, medicinal plants, endangered and rare species have been

conserved in LTS/ Cryobank.

Shimla: A total of 2,514 accessions of various agri-horticultural crops comprising grain crops (2289), vegetables (125) and temperate fruit crops (100) were characterized and evaluated while 601 accessions grown for seed increase. Germplasm accessions viz. IC469165, IC394026, IC469155, IC394027, IC381057, IC381054, IC311066 of pea and EC537998, EC537975, EC537996, EC537990 of French bean were found resistant to powdery mildew and anthracnose, respectively. A total of 752 accessions were sent for long-term conservation in the NGB, 7866 maintained in the MTS and 1,167 maintained in field gene bank and 428 accessions of various crops were supplied to different institutes for research purpose. Herbarium specimens of 103 plants were submitted to NHCP.

Thrissur: Characterized/ evaluated rice (346 accessions), horsegram (100), Chinese spinach (21), okra (120), snake gourd (30), sesame (134), Chinese potato (33), mango (17), jack fruit (10), turmeric (10), black pepper (9), Malabar tamarind (26), *Abelmoschus angulosus* (10), five species of wild *Vigna* (36), long pepper (14), three species of *Solanum* (48), kokam (9) and 228 accessions of *Curcuma* species for biotic stresses. Deposited seeds of 1148 multiplied accessions for long-term storage and 23 of black pepper for cryo-preservation. In addition, submitted 34 accessions of three species of *Solanum* under the DBT Project and 59 of tree-borne oilseeds were also submitted for conservation. Seeds of 950 accessions of various crops/wild relatives were added to the MTS facility of the station. A total of 250 accessions of 5 crops and 16 wild related species were maintained *in vitro* conservation media. Five new accessions were initiated into *in vitro* culture. Supplied 307 accessions of various crops/wild relatives to 16 user agencies and sent 100 accessions of horsegram to three institutes under AICRP on Arid Legumes for multi-location evaluation. For field genebank maintenance and utilization, transferred 39 accessions of turmeric to IISR, Kozhikkode. One field day was conducted on okra for the benefit of vegetable breeders. The station has identitifed nine promising accessions of bittergourd for one or more character. Of these IC438417, a collection from Haridwar, Uttarakhand out yielded the check variety "**Priye**" and has field resistant gene for leaf blight.

GERMPLASM CONSERVATION

a. Conservation in Seed Genebank

A total of 28,888 germplasm accessions of various crops were received for long-term conservation in the National Genebank. These were processed following the genebank standards adding another 26,571 accessions to the base collection raising the total germplasm holding to 3,39,194. A total of 1744 accessions out of the 2621 accessions received at the Germplasm Handling Unit were stored in the long-term storage module, and 877 in the medium-term storage (MTS) as voucher samples. Another 2523 accessions of exotic material were stored in the MTS as voucher specimen. Monitoring of stored germplasm (2,050 accessions) and updating of passport data (864 accessions) continued for effective upkeep. Studies on seed storage of three species of *Cassia* viz. *C. angustifolia, C. tora*, and *C. holoserica* and *Dalbergia sisso* were carried out. Longevity of castor, sesamum, groundnut, pigeonpea and cotton stored for nine years at ambient temperatures was found to be better in seeds dried to less than 3% moisture content. Methods for breaking seed dormancy were developed in wild *Allium* spp., *Acacia leucophloea, A. nilotica, A. tortilis, Eleusine indica, Prunus mira, Perilla frutescence, Haldina cordifolia* and *Swertia chirata*.

b. *In vitro/* Tissue Culture Conservation

A total of 1,904 accessions belonging to fruit crops, bulb and tuber crops, medicinal, aromatic and rare/endangered plants, spices, plantation and industrial crops, and others were conserved as *in vitro* cultures under culture room conditions and/or at low temperature. The average subculture duration ranged from 4-24 months, depending on the species. Research work was carried out on aspects related to *in vitro* slow growth and cryopreservation in aforementioned group of crops. Employing various strategies, subculture duration could be enhanced to varying periods in *Bacopa monnieri, Dahlia* and *Gentiana kurroo*. Following modulation of pre-growth conditions, varying degree of survival after cryopreservation was observed in *Allium tuberosum, Centella asiatica, Dioscorea bulbifera*, *Gentiana kurroo* and *Zingiber officinale*. Employing RAPD and/ or ISSR markers, there were no significant differences between *in vitro*-conserved cultures and their respective mother plants, in *Curcuma longa* cv Pratibha, *Colocasia esculenta, Plumbago zeylanica* and *Zingiber officinale*. A total of 85 accessions comprising *Musa* spp. (65), *A. tuberosum* (1), *Fragaria* spp. (1), *Gladiolus* cv. (2), *Morus* spp. (15) and *Zingiber officinale* (1) were supplied as *in vitro* cultures to various indentors.

c. Cryopreservation

A total of 657 accessions comprising orthodox,

intermediate and recalcitrant seed species, dormant buds and pollen were cryoconserved during the year totaling to 7,922 accessions in the cryogenebank. Air desiccation-freezing protocols were developed for embryonic axes of *Simarouba glauca*, *Juglans regia* and *Prunus armeniaca* and for seeds of *Manillkara hexandra, Carissa* sp. and *Salvadora* sp. using desiccation-freezing methods. Embryonic axes of *Citrus paradisi* and trifoliate hybrids were successfully cryopreserved using vitrification and encapsulation-dehydration techniques.

Cryopreservation of Khirni germplasm

Khirni (*Manilkara hexandra*) a member of the family Sapotaceae, is a tree-borne oilseed plant. A sizeable diversity of khirni was collected from parts of Rajasthan and Madhya Pradesh. The seeds were cryostored for the first time at the cryogenebank.

DNA FINGERPRINTING

NRC on DNA Fingerprinting has so far developed protocols for cultivar identification in 33 crops of national importance using the molecular marker techniques like STMS, AFLP and ISSR. The crops include cereals (rice, wheat, barley), millets (fingermillet, sorghum, pearlmillet), pulses (chickpea, Frenchbean, horsegram, lentil, peas, pigeonpea, mungbean, ricebean, urdbean, soybean), oilseeds (mustard, safflower, sesame, niger), fibres (cotton, jute), vegetables (tomato, chillies) fruits and nuts (banana, mango, cashew, citrus) and medicinal plants (*Chlorophytum*, neem, vetiver). A total of 2,215 varieties in different crops were fingerprinted till December 2006. The analysis of diversity in molecular markers of important crops like rice, mungbean, oilseed brassicas and tomato has provided insight into the genetic base of Indian crop varieties. Such information will form the basis for developing efficient strategies for their breeding and genetic resources management.

Genetic diversity analysis of 20 accessions of *Mucuna pruriens,* a species with medicinal importance, was carried out in the Conservation Division of NBPGR. Diversity was assessed by protein profiles using SDS-PAGE. A total of 11 bands varying in molecular weight (15 to 200 KDa) were obtained. Only one (IC127363) out of the 20 accessions tested was found to be distinct from the rest, at 65% similarity co-efficient. Further studies will be carried out on all the *Mucuna* accessions conserved in the NGB to assess to total genetic variability of the germplasm.

OTHER ACTIVITIES

- Meetings of the Institute Management Committee, Research Advisory Committee and Institute Research Council were held timely to review the progress of work related to PGR management and planning strategies for 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. 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.
- **Field days organized**: At Issapur Experimental Farm and IARI, New Delhi, six Germplasm Field Days for various crops (oilseeds, rabi pulses, wheat, barley and triticale, kharif pulses, maize and medicinal & aromatic plants and vegetables) were organized to promote germplasm utilization by the

Best Student of the Year Award: Ms. Sunaina Singh, student of M.Sc. (Plant Genetic Resources) was awarded the Best Student of the Year from the PG School of IARI for her thesis (grade- 9.15/10) as well as extra-curricular activities on the 44th Annual Convocation held on 10th February, 2006. She was awarded a gold medal, a citation as well as a cash prize of Rs. 10,000**.** Her thesis title was "*Analysis of clonal variation in some mango cultivars using anchored- inter simple sequence repeat (-ISSR) markers'*.

plant breeders/user scientists. A total of 1828 accessions of different crops were supplied to 69 indenters belonging to different institutes for their use in crop improvement programmes. One field day was conducted on okra at Regional station, Thrissur for the benefit of vegetable breeders.

- **Publications:** NBPGR Annual Report and quarterly Newsletter were published and distributed to all concerned with PGR management. Besides, research papers (75) on various subjects were published in national and international journals; book chapters (49) in various edited books; proceedings/ annual review/ books (7); plant germplasm reporter (4); crop inventories (1); information bulletins/ brochures (8); advisory leaflets on plant quarantine pests (3); and popular articles in Hindi/ English (13) 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 Institute 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, and an All India Coordinated Research Project on Under-utilized Plants. The total sanctioned staff strength is 504 comprising 128 scientific, 127 technical, 78 administrative and 171 supporting staff.

National Genebank

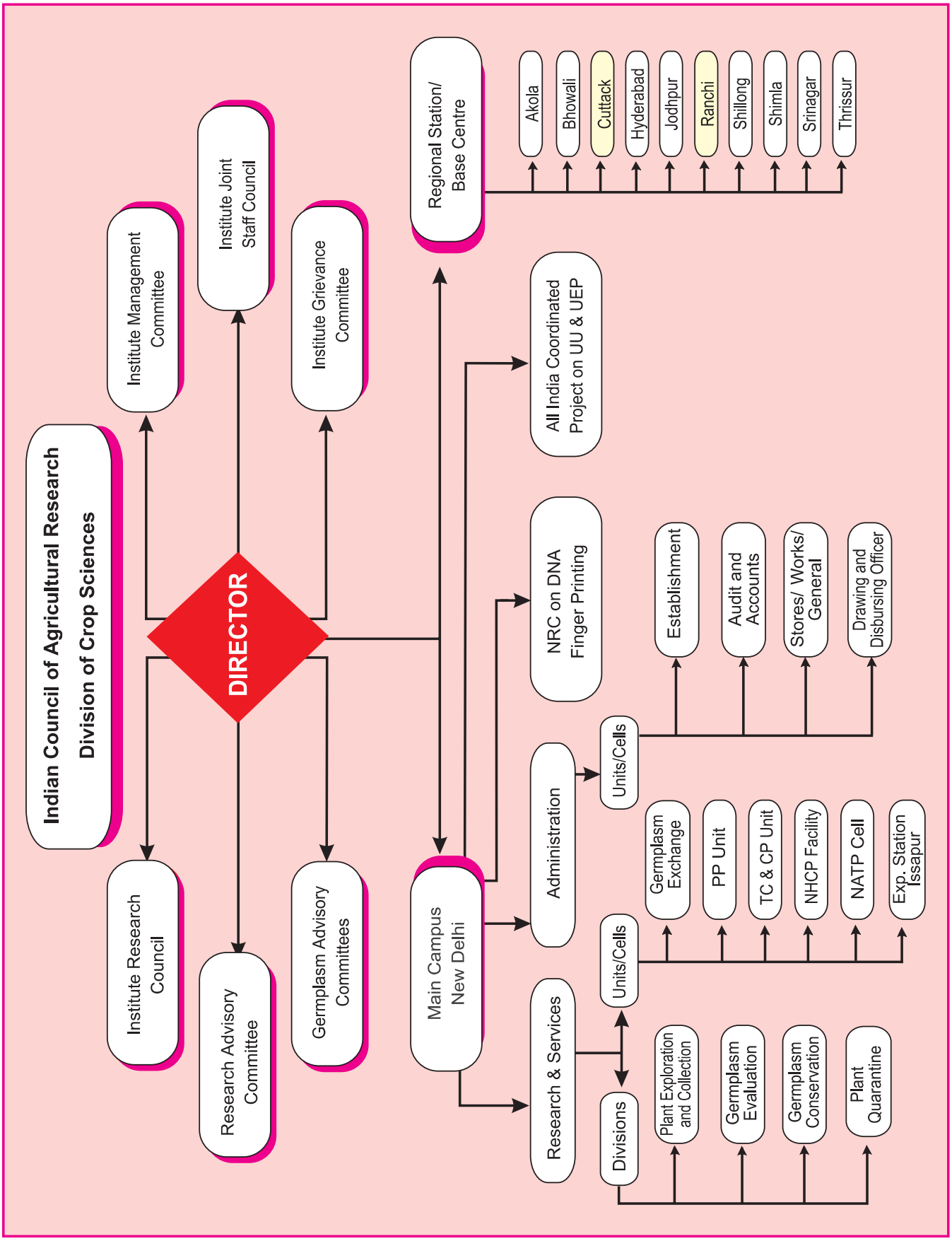
The Indian National Genebank was established by the council at NBPGR to conserve national heritage of germplasm collections in the form of seeds, vegetative

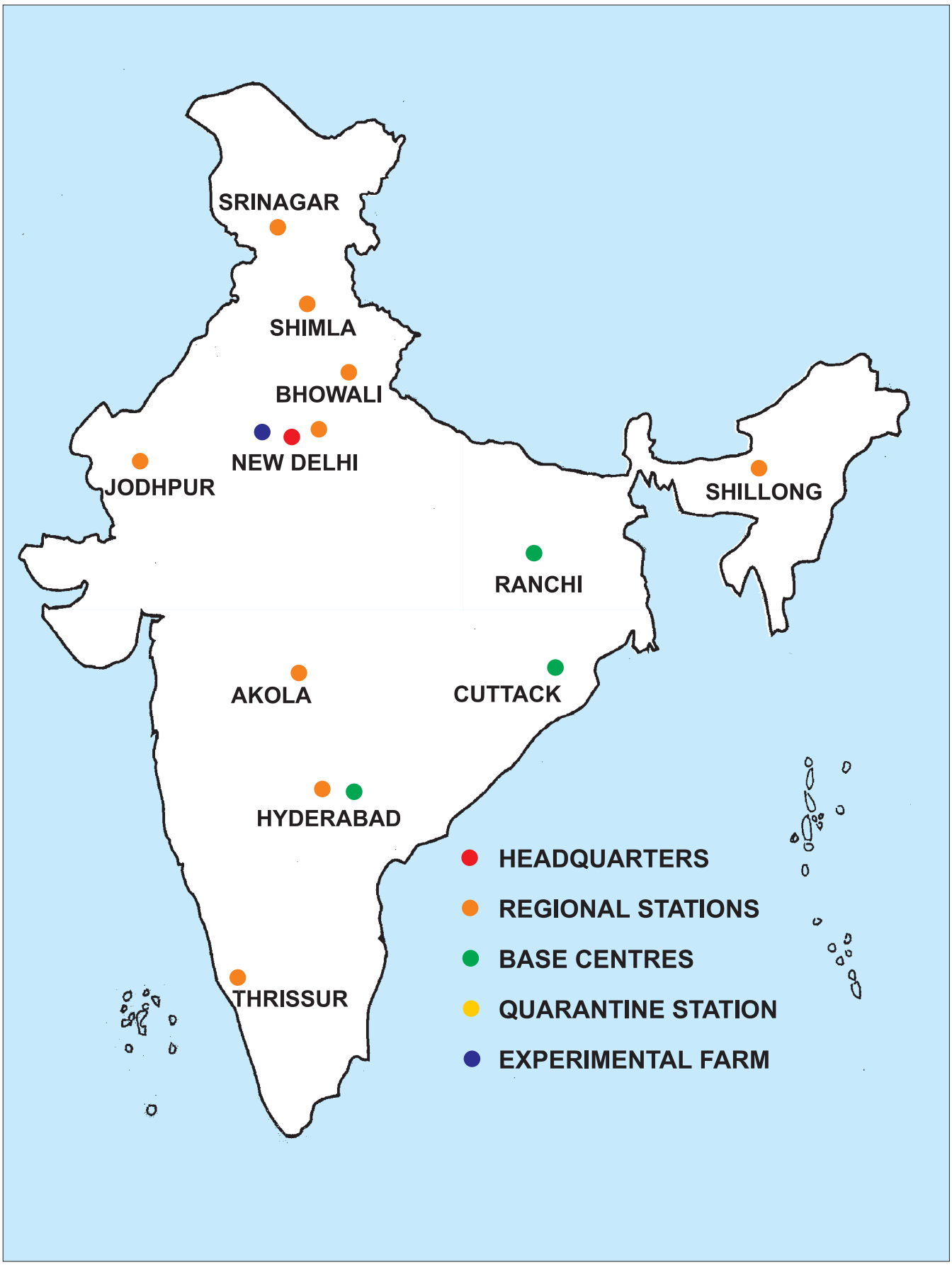
MANDATE

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

OBJECTIVES

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


Indian Council of Agricultural Research
Division of Crop Sciences
DIRECTOR
Institute Management Committee
Institute Joint Staff Council
Institute Grievance Committee
Institute Research Council
Research Advisory Committee
Germplasm Advisory Committees
Regional Station/ Base Centre
Akola
Bhowali
Cuttack
Hyderabad
Jodhpur
Ranchi
Shillong
Shimla
Srinagar
Thrissur
All India Coordinated Project on UU & UEP
NRC on DNA Finger Printing
Main Campus New Delhi
Administration
Units/Cells
Establishment
Audit and Accounts
Stores/ Works/ General
Drawing and Disbursing Officer
Research & Services
Units/Cells
Germplasm Exchange
PP Unit
TC & CP Unit
NHCP Facility
NATP Cell
Exp. Station Issapur
Divisions
Plant Exploration and Collection
Germplasm Evaluation
Germplasm Conservation
Plant Quarantine


SRINAGAR
SHIMLA
BHOWALI
NEW DELHI
JODHPUR
SHILLONG
RANCHI
AKOLA
CUTTACK
HYDERABAD
THRISSUR
HEADQUARTERS
REGIONAL STATIONS
BASE CENTRES
QUARANTINE STATION
EXPERIMENTAL FARM

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

The National 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 National 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 Committes for different crops advise the Bureau regarding improving the capability, efficiency and effectiveness of its services.

International Collaboration

NBPGR implements workplans developed under MoU between ICAR and IPGRI (now called as Bioversity International). 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 alongwith relevant literature on technical know-how for raising crops and management of PGR. Special emphasis is 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

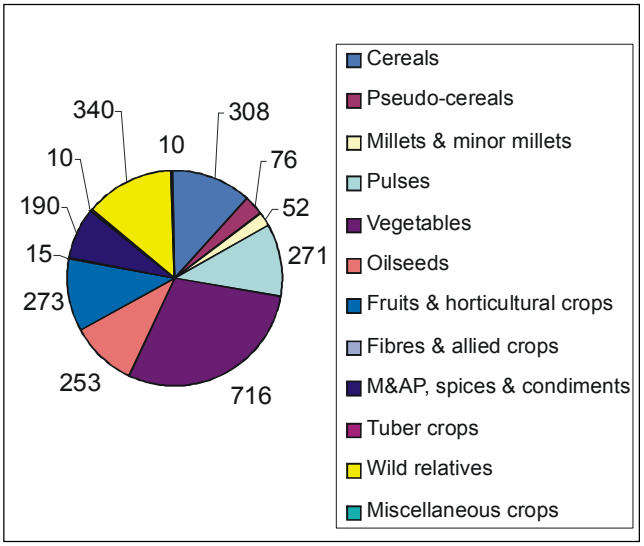
Summary: In all, 35 explorations were undertaken across the country and a total of 2,514 accessions of various agri-horticultural crops, wild relatives of crops and other economic plants were collected. Of these, 523 accessions were collected by the NBPGR Headquarters, New Delhi through 10 explorations from parts of Himachal Pradesh, Haryana, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Punjab, Uttarakhand and Uttar Pradesh. A total of 866 herbarium specimens, 159 seed samples and 9 economic products were processed and added to National Herbarium of Cultivated Plants (NHCP).

1.1 Plant Exploration and Germplasm Collection

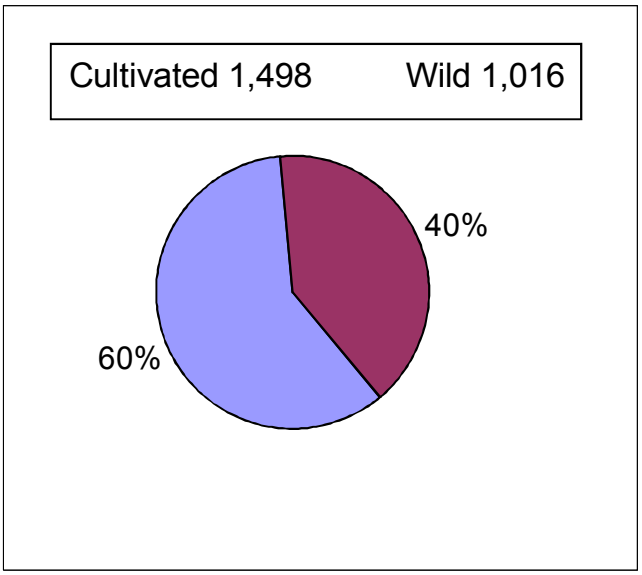
A total of 35 explorations were undertaken and 2,514 accessions of different agri-horticultural crops comprising 1,498 accessions of cultivated and 1,016 of wild species including wild relatives of crop plants were collected from parts of Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttarakhand and Uttar Pradesh (Table 1 & 2).

Table 1: Explorations undertaken and germplasm collected during 2006

Region	Explorations undertaken (No.)	Accessions collected (No.)
Thrissur (South west coastal region)	3	229
Cuttack (Humid/ moist tropical east coastal region)	1	52
Shillong (North east hill region)	2	320
Bhowali (Central Himalayan region)	2	132
Shimla (North west Himalayas and high altitude region)	4	187
New Delhi (North west plains)	10	523
Ranchi (Sub-tropical humid region)	3	101
Akola (Central Indian region)	2	260
Hyderabad (South east coastal region)	8	710
Total	**35**	**2,514**



Germplasm collected in different crop groups



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

Table 2: Details of crop diversity collected during 2006

Crop groups	Crops (accessionss)	Accessions (No.)
Cereals	Barley (3), maize (57), paddy (242) and wheat (6)	308
Pseudocereals	Amaranth (68) and buckwheat (8)	76
Millets and minor millets	Barnyard millet (17), *Coix* (4), finger millet (3), foxtail millet (3), little millet (1) and sorghum (24)	52
Pulses	Black gram (28), broad bean (12), chickpea (7), cowpea (50), field bean (2), French bean (39), green gram (47), *Lathyrus* (3), lentil (10), moth bean (2), pigeon pea (48), rice bean (3), soybean (15), sword bean (2) and winged bean (1)	269
Vegetables	Ash gourd (12), bitter gourd (52), bottle gourd (70), brinjal (57), carrot (2), chilli (107), cucumber (11), sem bean (11), faba bean (24), garlic (21), ivy gourd (3) jack bean (4), lablab bean (35), lima bean (1), methi (1), *Momordica dioica* (55), okra (61), onion (22), pea (8), pointed gourd (2), pumpkin (34), radish (4), ridged gourd (40), satputia (3), snake gourd (28), spinach (3) sponge gourd (31), tapioca (2), tomato (8), *Cyphomandra betacea* (1) and others (5)	718
Oilseeds	*Brassica* spp. (24), castor (12), groundnut (9), *Jatropha curcas* (167), linseed (11), *Perilla frutescens* (6) and sesame (24)	253
Fruits/ horticultural crops	Almond (17), aonla (2), apple (12), apricot (43), banana (22), bael (6), ber (3), betel vine (1), canna (1), chironji (3), citrus (16), date palm(2), jamun (2), karonda (8), khirni (13), lasora (9), mahua (2), passion fruit (1), peach (8), pear (17), persimmon (1), phalsa (3), pomegranate (12), rose (8), sea-buckthorn (6), strawberry (1), tamarind (2), walnut (14) and others (34)	269
Fibres and allied crops	Jute (6), kenaf (3), roselle (1), *Sesbania* (1), sunnhemp (3) and others (1)	15
Medicinal and aromatic plants, spices and condiments	*Abrus precatorius* (1), *Acorus calamus* (5), *Aloe barbadensis* (16), *Alpinia galanga* (4), *Andrographis paniculata* (4), *Asparagus adscendens* (2), *A. officinalis* (1), *A. racemosus* (4), *Bacopa monnieri* (4), *Bixa orellana* (1), *Caesalpinia bonducella* (6), *Cassia occidentale* (2), *Cleome viscosa* (6), *Clitoria ternatea* (1), coriander (4), *Coleus forskohlii* (3), *Citrullus colocynthis* (1), *Datura* sp. (3), ginger (8), *Gmelina arborea* (1), *Gymnema sylvestre* (1), *Hedychium spicatum* (2), *Mirabilis jalapa* (2), *Mucuna pruriens* (4), *Plumbago zeylanica* (3), *Podophyllum hexandrum* (2), *Polygonatum multiflorum* (1), *Saussurea costus* (3), *Solanum nigrum* (4), *Swertia chirayita* (3), *Tinospora cordifolia* (27), *Ocimum* spp. (7), *Curcuma domestica* (7), *Withania somnifera* (16), *Carum carvi* (1) and others (34)	194
Tuber crops	*Colocasia* (7) and *Dioscorea* (3)	10
Wild relatives	*Abelmoschus ficulneus* (30), *A. tuberculatus* (16), *Abelmoschus* spp. (5), *Amaranthus hybridus* (11), *A. tricolor* (5), *Cajanus scarabaeoides* (6), *Coccinia grandis* (1), *Crotalaria* spp. (7), *Cucumis callosus* (37), *C. sativus* var. *hardwickii* (33), *C. melo* var. *agrestis* (4), *C. prophetarum* (10), *C. trigonus* (4), *Cucumis* spp. (3), *Curcuma* sp. (1), *Lycopersicon pimpinellifolium* (4), *Sesamum mulayanum* (11), *Solanum indicum* (3), *Solanum* spp. (32), *Trichosanthes cucumerina* (7), *Trichosanthes lobata* (2), *Vigna trilobata* (49), *V. radiata* var. *sublobata* (23), *V. hainiana* (1), *V. dalzelliana* (1), *V. aconitifolia* (weedy form) (2), *V. minima* (1), *V. khandalensis* (6), *V. mungo* var. *silvestris* (23) and *V. vexillata* (2)	340
Miscellaneous crops	*Cotoneaster microphylla* (1), *Pongamia pinnata* (2), *Mallotus philippensis* (1) and others (6)	10
	TOTAL	**2,514**

1.2 Explorations undertaken by the Headquarters

Ten multi-crop and crop-specific explorations were undertaken by the Headquarters in parts of Himachal Pradesh, Haryana, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Punjab, Uttarakhand and Uttar Pradesh and a total of 523 accessions of different agri-horticultral crops were assembled. The details of areas explored and germplasm collected during explorations are given below:

1.2.1 Exploration for *Jatropha curcas* in Rajasthan: Under New Millennium Indian Technology Leadership Initiative (NMITLI) Project on Genetic Improvement of *Jatropha curcas* for Adaptability and Oil Yield, cuttings from thirteen identified accessions of *J. curcas* were collected from Banswara, Chittorgarh, Dungarpur, Rajsamand, Sirohi and Udaipur districts of Rajasthan. Diverse material of *J. curcas* and *J. gossypifolia* was collected mostly from roadside, wastelands, near railway track, field borders and outside villages. The variability was observed in number of branches, number of fruits per cluster, stem circumferences, etc. Local people in Udaipur are using seed oil for leather softening.

1.2.2 Exploration for *Jatropha curcas* in Uttarakhand: Cuttings from eleven identified accessions of *J. curcas* were collected from Almora, Dehradun, Nainital, Kotdwar, Pauri Garhwal and Pithoragarh districts of Uttarakhand under NMITLI project. The variability was observed in number of branches, number of fruits per cluster, stem circumferences, etc.

1.2.3 Exploration for minor fruits in parts of Rajasthan and adjoining Madhya Pradesh: An exploration was executed for the collection of minor fruits and 48 accessions comprising bael (5), chironji (3), date palm (2) lasora (9), karonda (8), khirni (12), mahua (2), phalsa (3), and others (4) were collected from Ajmer, Bhilwara, Chittorgarh, Sirohi and Udaipur districts of Rajasthan and Neemach district of Madhya Pradesh. An accession from Rajasthan was identified in *Madhuca indica* with profuse fruit bearing.

Profuse fruiting in *M. indica* collected from Rajasthan

1.2.4 Exploration for minor fruits in parts of Himachal Pradesh and Jammu & Kashmir: One hundred and five accessions comprising *Elaeagnus latifolia* (2), *Elaeagnus hortensis* (3), *Juglans regia* (4), *Malus* sp. (5), *Prunus amygdalus* (17), *P. armeniaca* (41), *P. cornuta* (2), *Ribes alpinum* (3) and others (26) were collected from inaccessible areas of Kinnaur, Kullu and Lahaul & Spiti districts of Himachal Pradesh, Kargil and Leh districts of Jammu & Kashmir. Variability was observed in *Prunus armeniaca* for fruit size, skin colour (orange, orange red, reddish), kernel colour and taste (bitter and non-bitter types).

Ribes alpinum: A minor fruit from cold desert of Ladakh

1.2.5 Exploration for *Vigna* spp. in Rajasthan: An exploration trip was executed for the collection of wild relatives of pulses in parts of Rajasthan and 25 accessions comprising *Vigna trilobata* (11), *V. radiata* var.

Vigna trilobata collected from Rajasthan

sublobata (2), *V. hainiana* (1), *Sesamum mulayanum* (9), *Cajanus scarabaeoides* (1) and *Cucumis sativus* var. *hardwickii* (1) were collected from Ajmer, Jalore, Jodhpur, Pali, Rajsamand and Sirohi districts. Efforts were made to further augment the prevailing diversity from newer localities of drought-prone areas. *Vigna radiata* var. *sublobata* and *V. hainiana* were collected for the first time from outside reported habitats (Mt. Abu and Chittorgarh Fort) in Rajasthan.

1.2.6 Multi-crop exploration in north-eastern Uttar Pradesh

Seventy-one accessions comprising bottle gourd (5), *Citrus* sp. (13), *Coix* (4), maize (22), pumpkin (4), ridged gourd (3), satputia (2), sponge gourd (5) and others (13)

Coix lacryma-jobi - An underutilized cereal collected from North Eastern U.P.

were collected from Bahraich, Gonda, Lakhimpur, Pilibhit and Sitapur district of Uttar Pradesh. The local landraces collected in paddy were *Kala namak* and *Satha dhan* being cultivated on a limited scale. In maize, variability was collected for seed colour (white, yellowish, reddish type) and plant height. In *Coix*, early maturing types were collected.

1.2.7 Multi-crop exploration in parts of Uttarakhand: A multi-crop exploration was executed in parts of Uttarakhand and 79 accessions comprising *Abelmoschus* spp. (4), *Cucumis sativus* var. *hardwickii* (8), paddy (45), *Solanum* spp. (3), and others (19) were collected from Almora, Bageshwar, Chamoli, Champawat, Nainital, Pauri Garhwal and Rudraprayag districts. In paddy, 45 local landraces like *Laldhan, Thapachini, Nandhan, Jaulia, Dudhiya, Rajula, Chinbhuri, Katyri-saal, Indrasan, Banbasa,* etc. including rare were collected. In *C. hardwickii*, natural hybrids were collected.

1.2.8 Exploration for Medicinal and Aromatic Plants in parts of Haryana, Rajasthan and Punjab: Sixty nine accessions comprising *Withania somnifera* (16), *Aloe barbadensis* (16), *Asparagus racemosus* (4), *A. adscendens* (1), *Tinospora cordifolia* (27), *Bacopa monnieri* (3) and others (2) were collected from Gurgaon, Bhiwani, Mahendragarh, Hisar, Fatehabad, Ambala, Sirsa and Yamunanagar districts of Haryana; Alwar, Hanumangarh, Jhunjhunu and Churu districts of Rajasthan and Mansa, Sangrur and Patiala districts of Punjab. Variability was observed in *Tinospora cordifolia* for warty and smooth stems; *Aloe barbadensis* for thick and thin leaves having variability in gel content, leaf colour (green, dark green and pale green), leaf margin and spine colour (green and red).

C. prophetarum being collected in farmer's field

1.2.9 Exploration for *Cucumis* spp. in Southwest Rajasthan: An exploration was undertaken exclusively for the collection of wild relatives of cucurbits in parts of Rajasthan in collaboration with NBPGR Regional station Jodhpur. Forty-one accessions comprising *Cucumis callosus* (21), *C. sativus* var. *hardwickii* (10), *C. prophetarum* (6) and *C. trigonus* (4) were collected from Dungarpur, Pali, Rajsamand, Sirohi and Udaipur districts. Rich variability in various agro-morphological traits was observed in collected germplasm of different

Vigna dalzelliana bearing pods

species of *Cucumis* especially in *C. callosus*. Information on distribution pattern and ethnobotany was also recorded.

1.2.10 Exploration for *Vigna* spp. in Western Ghats of Maharashtra: The Western Ghats in Maharashtra were explored for the collection of wild relatives of pulses and 61 accessions comprising *Vigna aconitifolia* (weedy form) (2), *V. dalzelliana* (1), *V. khandalensis* (6), *V. minima* (1), *V. mungo* var. *silvestris* (25), *V. radiata* var. *sublobata* (20), *V. vexillata* (2), *Cucumis sativus* var. *hardwickii* (3) and *Macrotyloma* sp. (1) were collected from Pune, Raigadh, Ratnagiri and Satara districts. Efforts were made to augment the prevailing diversity from hitherto unexplored areas of Western Ghats. The distribution of *V. khandalensis* was found to be distributed on a wider range in the Western Ghats than the earlier reports.

1.3 National Herbarium of Cultivated Plants (NHCP)

A total of 866 herbarium specimens, 159 seed samples and 9 economic products were processed and added during the period under report. These included a total of 142 taxa, which were not earlier represented in the NHCP (major ones listed in table 3). The total holdings of NHCP amount to 18,843 herbarium specimens, 2,481 seed samples and 496 economic products.

Landraces and cultivars of *Pennisetum glaucum* (L.) R. Br. and *Triticum aestivum* L. / *T. durum* Desf. (74) were represented from Delhi and Karnal (Haryana), respectively. Specimens were added from Delhi (234), Gujarat (2), Manali and Lahaul & Spiti region of Himachal Pradesh (21), Jammu and Kashmir (78), Sirohi, Rajasthan (13), Kumaon region of Uttarakhand (177), Coonoor, Tamil Nadu (22) and from Singapore (6). A total of 152 specimens received from Regional Stations at Shimla (106), Thrissur (45) and Bhowali (1) were processed and added to the NHCP.

Seed samples were collected and added from Delhi (20), Uttarakhand (81), Himachal Pradesh (13) and others (45). Fruits of *Calamus erectus* Roxb. and *Parkia roxburghii* G. Don from Nagaland, *Caesalpinia crista* L. from Maharashtra and container made from spathe of *Areca catechu* L. from Tamil Nadu were added as economic products.

Information was provided/ identification done (59) for students and researchers. Digitized images of crops and wild species and associated data (220) were added during the period.

Table 3: Some important taxa added to NHCP

Botanical Name	Family	Common Name	State
Anogeissus acuminata Wall. ex Bedd.	Combretaceae	*Chakwa	Delhi
Arnebia benthamii Wall ex G. Don	Boraginaceae	*Kashmiri gaozaban	Jammu & Kashmir
Buddleja davidii Franch.	Buddlejaceae	Summer Lilac	Himachal Pradesh
Cailliea cinerea Macb.	Mimosaceae	*Virtuli	Delhi
Caryopteris odorata (Hamil.) B. L. Robinson	Verbenaceae	*Chingari karne	Himachal Pradesh
Caryota urens L.	Arecaceae	Fish-tail Palm	Delhi
Crotalaria retusa L.	Fabaceae	*Ghunghunian	Karnataka
Debregesia hypoleuca Wedd.	Urticaceae	*Sansaru	Himachal Pradesh
Elaeagnus latifolia L.	Elaeagnaceae	Bastard Oleaster	Himachal Pradesh
Geum urbanum L.	Rosaceae	Herb Bennet	Jammu & Kashmir
Guaiacum officinale L.	Zygophyllaceae	Lignum Vitae	Tamil Nadu
Impatiens glandulifera Royle	Balsaminaceae	Himalayan Balsam	Himachal Pradesh
Lamium album L.	Lamiaceae	White Dead Nettle	Jammu & Kashmir
Ligustrum lucidum Ait.	Oleaceae	Chinese Privet	Himachal Pradesh
Michelia doltsopa Buch.-Ham. ex DC.	Magnoliaceae	*Sigugrip	Uttarakhand
Mollugo nudicaulis Lamk.	Molluginaceae	*Parppadagam	Delhi
Oreocnide frutescens Miq.	Urticaceae	*Gartushiara	Himachal Pradesh
Osmunda regalis L.	Osmundaceae	Royal Fern	Himachal Pradesh
Pentatropis spiralis Decne.	Asclepiadaceae	*Kauathodi	Delhi
Rheum webbianum Royle	Polygonaceae	*Archu	Jammu & Kashmir
Salix babylonica L.	Salicaceae	Weeping Willow	Himachal Pradesh
Saponaria officinalis L.	Caryophyllaceae	Soapwort	Himachal Pradesh
Securinega leucopyrus Muell.-Arg.	Euphorbiaceae	*Hartho, ainta	Delhi

Sorbus lanata (D. Don) S. Schauer	Rosaceae	*Galion	Himachal Pradesh
Strobilanthes kunthiana (T. Anders.)	Acanthaceae	*Kurunji	Tamil Nadu
Symplocos paniculata Miq.	Symplocaceae	Sapphire Berry	Uttarakhand
Trachelospermum lucidum (D. Don) K. Schum.	Apocynaceae	*Dudhi	Himachal Pradesh
Ulmus villosa Brandis	Ulmaceae	*Bhamri	Himachal Pradesh
Viburnum foetans Decne	Caprifoliaceae	*Guya,Guch	Jammu & Kashmir
Zoysia matrella (L.) Merr.	Poaceae	Manila-Grass	Singapore

*Names in local languages

1.4 Biosystematic Studies

Macrotyloma: (a) Variation within the cultigen species, *M. uniflorum* (359 accessions from 12 states) was worked out; (b) differences between Asian and African cultigens were used to delineate wild relatives and (c) *M. axillare,* an African species, was noted to be taxonomically distinct, though as widespread as *M. uniflorum*.

Vigna: Diagnostic characters of species was used for creating database of *Vigna* species, working out species relationships and resolving taxonomic confusion in selected species namely *V. trilobata-V. bourneae, V. trilobata-V.stipulacea-V. aridicola* and *V. minima-V. umbellata* var . *gracilis.* Cluster analysis was used for delineating traits showing variation in wild species; variation in flower keel and style and seed hilum and aril showed differences distinct from the cultivated species for species of the Indian region, particularly those belonging to the *V. mungo-V. radiata* group.

Research Projects (Project Code: Title, PI, Co-PIs and Associates)

PGR/PGC-BUR-01.00: Exploration for collection of germplasm of agri-horticultural crops, maintenance of herbarium and bio-systematic and ethno-botanical studies (DC Bhandari)

PGR/PGC-BUR-01.01: Exploration for collection of genetic resources of cultivated crops and their wild relatives (SS Malik (up to 17.7.06), DC Bhandari, KC Bhatt, Rajbir Singh and NS Panwar).

PGR/PGC-BUR-01.02: Exploration for collection of genetic resources of horticultural crops and their wild relatives (DC Bhandari (w.e.f. 18.7.06), Rakesh Srivastava, SK Malik, Gunjeet Kumar and AK Singh)

PGR/PGC-BUR-01.03: Exploration for collection of medicinal and aromatic plants diversity from different phyto-geographical regions (KC Bhatt and NS Panwar).

PGR/PGC-BUR-01.04: National Herbarium of Cultivated Plants (NHCP), establishment, maintenance, build-up and taxonomic studies on crop plants (E Roshini Nayar, Anjula Pandey and Rita Gupta).

PGR/PGC-BUR-01.05: Collection, conservation and documentation of wild/ weedy relatives of crop plants (WRCP) of North-western Himalayas (Anjula Pandey, KC Bhatt, KS Negi, JC Rana and J Radhamani).

Externally funded projects

- Systematic and molecular taxonomic studies in Asiatic *Vigna* and *Macrotyloma* (subtribe *Phaseolinae*) species (E Roshini Nayar, KV Bhat and IS Bisht).
- New Millennium Indian Technology Leadership Initiative (NMITL) project on Genetic improvement of *Jatropha curcas* for adaptability and oil yield (SK Sharma, JB Tomar, KV Bhat and KC Bhatt).

2. DIVISION OF GERMPLASM EVALUATION

Summary: A total of 14,459 accessions of various agri-horticultural crops comprising cereals (6,624); millets & forages (320); pulses (2378), oilseeds (1383); vegetables (3040); underutilized crops (561), medicinal and aromatic plants (153) were grown for characterization and evaluation. Besides, 3,416 accessions of various crop, viz. cereals (1,537); pulses (515), oilseeds (250), vegetables (769), medicinal and aromatic plants (345) 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 have been identified. The biochemical evaluation was made in oilseed crop namely, rapeseed mustard (200) for oil content and other quality parameters. Similarly, protein content and other quality attributes were studied in pigeonpea (932), elite synthetic wheat (17), amaranth (30), *Jatropha* (6), *Perilla* (20), walnut (9) and almond (9). Medicinal and aromatic plants were phyto-chemically 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, quality attributes and tolerance to biotic stress. Collaborative evaluation of germplasm was undertaken involving AICRP /ICAR/SAUs. Six Germplasm Field Days for various crops (oilseeds, rabi pulses, wheat, barley and triticale, kharif pulses maize and medicinal & aromatic plants and vegetables) were organized to promote germplasm utilization by the plant breeders/user scientists. A total of 1828 accessions of different crops were supplied to 69 indenters 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 14,459 accessions of various agri-horticultural crops comprising cereals: wheat, barley, triticale (6,624); millets & forages: pearl millet, oat (320); pulses: cowpea, urdbean, pea, lentil (2378), oilseeds: rapeseed-mustard, safflower, sunflower, linseed (1383); vegetables: brinjal, tomato, onion, garlic, bottle gourd, coriander, ridge gourd, sponge gourd, fenugreek (3040); under utilized crops: fababean, rice bean, amaranth (561) and medicinal and aromatic plants: vetiver, aloe, giloe, satavar, mucuna, kalmegh and basil (153) were grown for characterization and evaluation. Besides, a total of 3,416 accessions of various crop, viz. cereals (1,537), pulses (515), oilseeds (250), vegetables (769) and medicinal and aromatic plants (345) 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), lasora (1) etc. were also maintained in the field gene bank. The details of germplasm grown for characterization, evaluation, and regeneration, seed increase etc. are presented in Table 1.

Table 1: Germplasm characterized, evaluated, multiplied/ maintained during 2006

Crop (Botanical Name)	Accession Number	
	Characterization and Evaluation	Regeneration/ Multiplication & Maintenance
Cereals	**6,624**	**1,537**
Wheat* (*Triticum aestivum*)	2,883	-
Wheat* (*Triticum durum*)	511	-
Barley* (*Hordeum vulgare*)	1,185	-
Elite synthetics (wheat)	448	-
Triticale* (*Triticale*)	175	-
Wheat (*Triticum aestivum*)	763	1,537
Wheat* (*Triticum durum*)	156	-
Barley (*Hordeum vulgare*)	503	-
Millets and forages	**320**	
Pearl millet (*Pennisetum typhoides*)	284	-
Oat (*Avena sativa*)	36	-
Pulses	**2,378**	**515**
Cowpea (*Vigna unguiculata*)	**450**	230

Urdbean (*Vigna mungo*)	495	-
Pea (*Pisum sativum*)	450	285
Lentil (*Lens culinaris*)	**983**	**-**
Oilseeds	**1,383**	**250**
Rapeseed-mustard (*Brassica* spp.)	1040	250
Safflower (*Carthamus tinctorius*)	217	-
Sunflower (*Helianthus annuus*)	52	-
Linseed (*Linum usitatissimum*)	74	-
Vegetable Crops	**3,040**	**769**
Brinjal (*Solanum melongena*)	1,725	-
Tomato (*Lycopersicon esculentum*)	250	35
Onion (*Allium cepa*)	118	-
Garlic (*Allium sativum*)	678	-
Bottlegourd (*Lagenaria siceraria*)	55	20
Coriander (*Coriandrum sativum*)	45	-
Ridgegourd (*Luffa acutangula*)	55	15
Sponge gourd (*Luffa cylidrica*)	79	19
Fenugreek(*Trigonella foenum-graecum*)	35	-
Okra (*Abelmoschus esculentus*)	-	680
Under-utilized Crops	**561**	**-**
Fababean (*Vicia faba*)	176	-
Rice bean (*Vigna umbellata*)	239	-
Amaranth *(Amaranthus spp.*)	146	-
Medicinal & Aromatic Plants	**153**	**345**
Vetiver (*Vetiveria zizanioides*)	-	135
Aloe (*Aloe vera*)	32	32
Giloe (*Tinospora cordifolia*)	31	31
Sataver (*Asparagus racemosus*)	22	9
Mucuna (*Mucuna pruriens*)	16	8
Kalmegh (*Andrographis paniculata*)	22	10
Basil (*Ocimum basilicum*)	30	16
Palmarosa (*Cymbopogon martinii*)	-	55
Jangli piaz (*Urgenea indica*)		21
Ratti (*Abrus precatorius*)		18
Babchi (*Psoralea corylifolia*)		10
Total	**14,459**	**3,416**

***** International Nurseries grown for PEQN.

Wide range of variability was observed in the germplasm of different crops. Based on characterization and preliminary evaluation, promising accessions for various attributes, viz. earliness, pod length, pods per plant, seeds per pod and 100-seed weight, yield per plant etc. have been identified in different crops (Table 2).

Table 2: Promising germplasm accessions in different crops accessions for different traits

Crop	Promising traits	Accession No.
Cereals		
Wheat	Number of capsules/ spike and 1000-grain weight	IC397515, IC313147, IC398134, IC279322, IC313158, IC381006, IC421156, IC321159, IC319811, IC279320, IC398134, IC427217, IC279314, EC519494, EC493722, IC483032, IC514384, EC519500, IC540810, IC512662, IC540811, EC540812, EC483025, EC463398, EC463413, EC463392, EC463398, EC483022, EC483025, EC463393, EC520257, EC493734
Pulses		
Pea	Days to maturity (121days) No. of pods (> 40)	EC538003 IC424894, IC417878

	Yield /plant (>20g)	IC424896,
Lentil	Days to maturity (<100 days) Pod per plant (> 55)	L1128, L4374, L4390, L4412 L964, L985, L963, L862
Cowpea	Early maturity (<85 days), high yield and white seeds Black seeds and early maturity (<70 days) Vegetable type with long pods (>40 cm) Vegetable type with high green pods/plant (>300), high green pod yield (>1400 g)	IT97K-499-35, IT00K-901-5, IT97K-497-2, IT97K-506-1, IT93K-625, IT98K-428-3, IT00K-1197 T82E-09 N/05-112, N/05-48, N/05-106, N/05-113 IC202762, EC390257, EC390261
Oilseeds		
Toria	Early flowering (<30 days) Long siliqua (> 5.0 cm)	IC417890, IC424419, IC359340, C369236 IC417667, IC417890
Yellow sarson	Long siliqua (>5 cm)	IC521391, IC521392
Indian mustard	Early flowering (<40 days) High oil content (>42%)	IC424420, IC424421, IC426329, IC426354 IC411729, IC424768
Sunflower	Broad head size (>20.0 cm) Bold seeded	EC512688 EC512751
Safflower	Days to 50% flowering (<133 days) Primary branches/plant (>23) Capsule diameter (>29 mm)	IC095997, NIC07130 NIC 01780 IC095966, PI208362
Linseed	Days to 50% flowering (76 days) Plant height (<49 cm) Capsules/plant (>155) Seeds/capsule (>9)	IC268341, IC538812 IC278340 IC345467, IC426935 IC520819, IC538697
Under-utilized crops		
	Days to 50% flowering (<75 days) Days to maturity (< 152 days) Pods/ plant (> 58) 100-seed weight (>34 g) Yield/plant (>40 g)	IC361496, EC329691, EC550179, EC117724 IC361499 EC329725, EC343808, 329679 EC243756
Rice bean	Grain yield per plot (> 100g) Days to 50% flowering (< 80 days) Days to maturity (< 120 days)	LRB-297, LRB-278, LRB-275, LRB-234, LRB-236, LRB-240 LRB-229, LRB-238, LRB-148, LRB-180 LRB-279, LRB-233, DPRR-57, LRB-51, LRB-52, LRB-53, LRB-91, LRB-92, LRB-94, LRB-102
Vegetables		
Brinjal	Fruit weight (>200 g) Plant height (>99 cm)	IC090130 IC345740, IC249297
Tomato	Plant height (>165 cm) Primary branches (>19)	EC521074, EC527995 EC520046, EC538151
Fenugreek	Petiole length (< 3.2 cm) Flowers/ inflorescence (>9.5)	IC433586, IC371755 IC371731, IC276528
Sponge gourd	Fruit weight (> 512 g) Node no. at which 1st female flower appear (<11.8) Early flowering (< 36 days)	IC342823, IC355635 IC284844, IC284767 IC3367601, IC284897
Bottle gourd	Fruit per plant (> 14) Internodes length (<9.6 cm)	IC418456, IC276528 IC418456, IC331025
Ridge gourd	Fruit weight (> 187 g) Node no. at which 1st female flower appear (< 14)	IC276403, IC093393 IC427676, IC424548

Garlic	Plant height	IC375066, IC375039, EC158250
	Bulb weight (20 g)	IC49382, IC141310
	Cloves/bulb (>24)	IC318364, IC32286, IC374999
	Clove length (3 cm)	IC49381, IC375110
	Clove width (>1 cm)	IC49381, IC375039, EC158250
Onion	Days to maturity (<120 days)	IC373046, IC373120
	Bulb weight (>100 g)	IC373128, IC373059
	Bulb diameter (>5.5 cm)	IC373101, IC375128
Medicinal and Aromatic Plants		
Mucuna	Early flowering (<80 days)	IC471870, IC385935, IC385926
	Pod cluster /plant (>18)	IC471870, IC389144
	Pods/cluster (>10)	IC391885, IC260046
	Seed yield (>1200 g)	IC385925, IC471870, IC369144
Ocimum	Herbage yield/ plant (> 350g)	IC326711, EC388890
	Branches/ plant (>14)	IC344638, EC388895
	Days to maturity (<60 days)	IC110268, EC388890

2.2 Germplasm Enhancement in Sesame and Mungbean

Sesame: Progeny (F_2) advancement of five inter-specific crosses involving four wild *Sesamum* spp. continued for selection of superior types. Progenies of superior genetically enhanced germplasm and the exotic accession with non-shattering habit and white seed colour were grown for evaluation and further enhancement.

Mungbean: Progenies (F3) of inter-specific crosses between greengram (*Vigna radiata*) accessions and wild *Vigna* species (*V. radiata* var. *setulose*, *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 in *Brassica*: Two hundred (200) accessions of rapeseed-mustard consisting of yellow sarson (116) and toria (84) were analyzed for total oil content in the seed. Wide range of variation for oil content was observed in yellow sarson (30.96-45.53 %) and toria (39.65-45.25%). Promising accessions with high oil content (more than 44%) were identified in yellow sarson (IC334292, Ragini and IC342760) and toria (IC355412, IC343122, IC261650).

2.3.2 Protein content and amino acid profile of field crops: Nine hundred and thirty accessions of pigeonpea from multilocational trial experiment were studied for their protein content per cent and it varied from 16.34 to 23.74 per cent with mean value of 20.17 per cent. Accessions with higher protein (>22%) were IC208418, PLA405, IC208419, IC208420 and IC139754.

A total of seventeen collections of Elite Synthetic Wheat (high protein containing lines) and four control lines were analysed for their protein content. These lines showed wide range of variation in protein content (12.44-20.71 %) as compared to control (12.90-14.60 %)

Seed proteins of seventeen Elite synthetic wheat accessions with protein values of 13.17 to 20.15 per cent and four control lines were fractionated into albumin plus globulin, prolamin and glutelin depending upon protein solubility in water plus salt solution, aqueous alcohol (70%) and alkali solution, respectively (Table 3). The range of these three protein fractions for elite synthetic wheat lines were compared with the controls.

Table 3: Distribution of wheat seed protein

Protein Fractions	Total Protein (%)	
	Elite Synthetic	Control
Albumin plus globulin	32.43-50.92	30.32-47.36
Prolamin	11.91-29.63	11.75-21.59
Glutelin plus residue	33.23-50.90	33.82-57.90

Thirty samples of amaranth seed comprising three different species *i.e. A. hypocondriacus* (10), *A. caudatus* (10) and *A. cruentus* (10) were analysed for their oil percent, fatty acid profile, protein percentage (Table 4) and amino acid profile (Table 5).

Table 4: Quality traits of amaranth germplasm

Amaranth species	Oil (%)	Protein (%)	Palmitic acid (%)	Stearic Acid (%)	Oleic acid (%)	Linoleic acid (%)	Linolenic acid (%)
A. hypocondriacus	14.56- 15.59	13.87- 18.53	17.73- 21.47	3.66- 2.38	21.94- 27.90	47.97- 54.92	0.64- 1.21
Mean	14.97	15.84	18.59	2.88	24.40	51.30	0.88
A. caudatus	14.57-16.06	13.81-20.80	17.55-20.29	1.79-3.38	24.86-30.11	47.64-51.06	0.45-0.87
Mean	15.17	16.20	19.45	2.37	27.63	49.33	0.73
A. cruentus	14.72-16.06	15.40-0.28	18.41-20.41	2.01-4.51	26.55-37.88	39.27-50.17	0.12-1.05
Mean	15.35	17.46	19.65	3.12	31.85	44.36	0.61

Table 5: Essential amino acids of amaranth germplasm

Essential Amino acids (g/16g N)	*A. hypocondriacus* (10)		*A. caudatus* (10)		*A. crenatus* (10)	
	Range	Mean	Range	Mean	Range	Mean
Histidine	2.92-3.52	3.28	1.96-3.36	2.616	2.63-10.45	4.236
Arginine + Threonine	18.78-24.45	21.01	14.52-22.53	18.74	2.36-24.81	17.82
Half cystine	0.12-1.95	1.07	0.24-1.87	0.810	0.72-10.99	3.28
Tyrosine	4.89-5.58	5.42	1.88-6.14	4.444	3.44-5.16	4.368
Valine	3.18-4.92	4.37	3.99-4.45	4.189	2.98-5.04	4.146
Methionine	0.80-1.31	1.10	0.53-1.15	0.839	0.44-0.82	0.696
Lysine	2.94-4.63	3.57	3.68-3.68	5.000	3.38-5.65	4.306
Isoleucine	2.10-4.06	3.39	2.58-3.52	2.814	1.54-3.36	2.43
Leucine	4.62-6.64	6.02	4.63-6.32	5.250	3.92-6.83	6.052
Phenylalanine	4.17-8.98	6.97	3.82-6.73	4.760	3.07-8.88	5.734

Six accessions of *Jatropha* received from Manipur centre of NEH region were analysed for quality traits. High variation was observed for oil (55.04-61.35%), seed oil (34.10-40.77 %), Kernel (59.13-66.78 %), palmitic acid (12.32-14.59 %), stearic acid (5.08-6.34 %), oleic acid (37.64-44.28%) and linoleic acid (35.40-44.35 %).

Oil content of *Perilla frutescence* (20) were analysed along with quality parameters. The oil content varied from 40.61 % to 51.34 % with an average of 47.96 %.

2.3.3 Protein content and amino acid profile of nuts: Nine samples each of walnut and almond cultivars were studied for oil percentage and fatty acid profile of kernel oil. In almond, variation was observed for kernl oil (20.07-61.60 %), protein content (17.02-26.37) %) and fatty acid profile (Table 6).

Table 6. Oil and fatty acid content of walnut and almond collections

Mean	Oil (%)	Palmitic acid (%)	Stearic acid (%)	Oleic acid (%)	Linoleic acid (%)	Linolenic acid (%)
Walnut						
Range	66.91 –73.95	4.67– 6.42	1.8 – 6.50	17.53 – 41.69	40.00 – 59.77	9.21– 17.43
Mean	70.78	5.48	2.83	29.12	49.67	12.89
Almond						
Range	46.74 - 63.64	4.84 - 8.20	1.79 - 2.79	62.55 - 80.22	12.45 – 28.99	-
Mean	56.42	6.31	2.21	67.70	24.04	-

Twenty six samples comprising almond (9), apricot (6), pecan nut (6) and walnut (5) were analyzed for amino acid content by HPLC and amino acid analyzer. The range and mean values of eight amino acids for these accessions are presented in Table 7.

Table 7: Amino acid profile of temperate nuts

Essential Amino Acids (g/16g N)	Almond (9)		Almond (9)		Pecan nut (6)		Walnut (5)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Histidine	0.84 -3.04	2.00	1.5 - 2.98	2.10	1.79 - 2.79	2.08	1.4 - 2.68	2.14
Arginine + Threonine	16.19 - 20.33	18.64	16.58 - 18.71	17.46	19.06 - 24.63	21.95	17.78 - 23.81	21.28
Half cystine	0.44 - 1.07	0.73	0.65 - 1.34	1.02	0.54 - 1.55	1.05	0.79 - 1.82	1.15
Tyrosine	2.68 - 4.53	3.79	2.81 - 4.16	3.57	2.98 - 4.39	3.42	3.06 - 4.11	3.36
Valine	4.15 - 5.48	4.74	4.78 - 5.34	5.07	4.9 - 5.60	5.19	3.78 - 5.47	4.87
Methionine	0.22 - 0.41	0.31	0.23 - 0.49	0.41	0.57 - 0.78	0.69	0.56 - 0.89	0.76
Lysine	1.31 - 2.03	1.67	1.6 - 2.23	1.88	2.27 - 3.72	2.92	1.35 - 3.42	2.49
Isoleucine	2.98 - 3.59	3.28	3.35 - 3.72	3.50	3.18 - 4.13	3.59	2.16 - 3.90	3.30
Leucine	5.95 - 8.30	7.40	6.93 - 8.38	7.87	6.65 - 7.61	7.20	6.77 - 7.69	7.31
Phenylalanine	3.79 - 9.57	6.94	4.49 - 9.24	7.01	3.9 - 5.38	4.82	3.74 - 7.85	5.25

2.3.4 Standardization of analytical technique for individual curcuminoids present in total curcuminoids extracted from *Curcuma longa* L: HPLC based analytical method has been developed to study relative percentage of curcumin, bisdemethoxycurcumin and demethoxycurcumin present in total curcuminoids. Methanolic extract of *Curcuma longa* was analysed for individual curcuminoid, involving HPLC with Waters Empower software System and µ Bonded C18 reversed phase column. The individual components were detected using UV detector (Waters 2475) at 425nm wavelength. For separation of individual curcuminoids in HPLC column, two eluents were used. Eluent A: 2% acetic acid in 5% methanol (20ml Acetic acid + 50ml Methanol + 930ml DD water) and Eluent B: 100% Acetonitrile in 5% methanol (50ml Methanol+950ml Acetonitrile).

Fifty accessions of turmeric (*Curcuma longa* L.) were processed for the estimation of individual and total curcuminoids. The range of variations for bisdemeythoxycurcumin, demethoxycurcumin, curcumin and total curcuminoids present in turmeric were 0.127-0.60%, 0.007-.848%, 0.459-4.171 and 0.551-7.770%, respectively.

2.4 Phyto-chemical Evaluation of Medicinal and Aromatic Plants

A total of 442 samples of various aromatic (330) and medicinal plants (112) obtained from different sources were analyzed for their active compounds. Details of crops and range of active components along with promising accessions are presented in Table 8.

Table 8: Phytochemical analysis of medicinal and aromatic plants

Comman Name (Botanical Name)	Samples Analysed (No.)	Plant part used	Active compound	Range (%)	Promising Accessions
Ocimum (*Ocimum basilicum*)	122	Herbage	Essential oil	0.04-0.0.23 (FWB)	EC 338959, EC 388887, IC 112548 (>0.20%)
Vetiver (*Vetiveria zizanioides)*	150	Roots	Essential oil	0.08-0.57	IC 78675, Hybrid 8, NC 66408 (>0.50%)
Coriander (*Coriandrum sativum)*	20	Seeds	Essential oil	0.11-0.55	IC 421963, IC 471716 EC 363966 (>0.41%)
Greater galangal (*Alpinia galanga)*	7	Rhizomes	Essential oil	0.22-0.47	IC 336196, IC 373609 (>0.43%)
Lesser galangal (*Alpinia calcarata)*	6	Rhizomes	Essential oil	0.50-0.84	IC 210421 (0.84 %)
Tuberose (*Polianthus tuberosa*)	25	Flower	Concrete	0.05- 0.09	Sikkim selection
Ghrit kumari *(Aloe barbadensis)*	90	Leaf	Aloe gel	0.13-2.83	IC 112521, IC 112523, IC 112519 (>2.30%)
Satavar *(Asparagus racemosus*)	22	Root	Total saponins	0.54-3.52%	IC 471920, IC 471923 (>2.53%)

2.5 Documentation of Plant Genetic Resources

A document on Germplasm Characterization and Evaluation of Field Crops and Horticultural Crops (Rabi 2005-06) was 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 programme is an important aspect in sustainability of crop production. During the period, a total of 1828 seed samples of various crop groups namely, cereals (755), legumes (535), oilseeds (103), vegetables (283), and medicinal and aromatic plants (152) were supplied to 69 research workers of ICAR Institutes, State Agricultural Universities and other research centers engaged in crop improvement programmes (Table 9). Besides, 7181 seed samples of exotic wheat, barley and triticale were also supplied to 58 indenters.

Table 9: Distribution of germplasm of different crops

Crop group/ Crop	No. of samples (Indentors)
Cereals	**755 (5)**
Wheat	735 (4)
Maize	20 (1)
Pulses	**535 (19)**
Cowpea	60 (2)
Pea	118 (7)
Urdbean	102 (1)
Lentil	215 (5)
Fababean	40 (4)
Oilseeds	**103 (5)**
Rapeseed-mustard	96 (4)
Sesame	7 (1)
Vegetables	**283 (23)**
Brinjal	77 (3)
Tomato	21 (2)
Sponge gourd	35 (3)
Ridge gourd	30 (3)
Bottle gourd	64 (5)
Ash gourd	20 (2)
Bitter gourd	6 (1)
Pumpkin	20 (2)
Muskmelon	5 (1)
Watermelon	5(1)
Medicinal & aromatic plants	**152 (17)**
Ocimum	41 (3)
Mucuna	50 (2)
Andrographis	15 (3)
Asparagus	25 (1)
Aloe	25 (1)
Psoralea	11 (1)
Ashwagandha	4 (1)
Hyocymus	1 (1)
Palmarosa	2 (2)
Vetivar	2 (2)
Grand Total	**1,828 (69)**

2.7 Germplasm Holdings in Medium Term Storage (MTS)

A total of 19,556 accessions of various field crops comprising cereals (4,040), millets and forages (250), pulses (4,755), oilseeds (4,596), vegetables (4,648), underutilized crops (1,050) and medicinal and aromatic plants (217) were maintained in medium term storage during the period under report (Table 10).

Table 10: Active Germplasm Holding in MTS as on 31.12.2006

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	**4755**
Pea	750
Cowpea	1500
Lentil	410
Mungbean	645
Urdbean	450
Chickpea	1,000
Oilseeds	**4596**
Rapeseed-mustard	3,450
Sunflower	168
Sesame	550
Linseed	75
Safflower	300
Crambe	22
Tarameera	20
Lepidium	7
Vegetables	**4648**
Brinjal	2000
Tomato	925
Bottlegourd	300
Spongegourd	250
Ridgegourd	275
Bittergourd	100
Pumpkin	6
Raddish	172
Fenugreek	350
Spinach	50
Coriander	90
Ashgourd	40
Onion	90
Under utilized crops	**1,050**
Faba bean	300
Rice bean	103
Amaranth	47
Sesbania	400
Crotalaria	200
Medicinal and aromatic plants	**217**
Ocimum	50
Mucuna	55
Opium poppy	53
Psorolea	11
Andrographis	23
Periwinkle	15
Ashwagandha	4
Hyocymus	6
TOTAL	19,556

2.8 Collaborative Germplasm Evaluation

Germplasm evaluation for agronomic performance was 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 11.

Table 11. Promising accessions identified under collaborative evaluation

Crop/ Location	Trait	Accessions
Pea (Almora)	High yield (>20 q/ha) Pod length (7.3 cm)	IC209123, EC398598, IC268275 EC384275
Pea (Raipur)	Pods/plant (>18) Seeds/pod (>6.5)	IC209105, IC424892, EC384275 IC208385, IC424892, IC267567
Pea (Varanasi)	Pods/plant (>25) Pod length (>6.5) Seeds/pod (>5)	EC341725 IC208390, IC388604 IC208380, IC208390
Lentil (Dholi, Ludhiana and Pantnagar)	Resistant to rust	IC299647
Cowpea (CAZRI, Jodhpur)	Days to maturity (<88 days) Pods/plant (>62) Pod length (10.2 cm) Seeds/pod (>9.5) Seed yield/ ha (2.7 q)	EC311432, IC3311433 IC421828, IC421832 IC421846 IC311403, IC421820 IC374032, IC4121822, IC324032
Mothbean (RAU, Bikaner)	Days to maturity(<59 days) Pods/plant (>55) Pod length (4.4 cm) Seeds/pod (>7.2) Seed yield/ ha (38 q)	IC415152 IC329040, IC402288, IC402283 IC285166, IC396821 IC370476, IC514107 IC329040, IC402288, IC402283
Horsegram (UAS Bangalore)	Primary branches/plant (>6.99) Pod length (5.5 cm) Seeds/pod (8) Seed yield/ha (2.65 q)	IC1452891, IC89027, IC89043 A IC383494, IC22797A, IC89033 IC89021 IC383494
Brinjal (IIHR,Bangalore)	Plant height (>95.0 cm) Primary branches (>7.0) Fruit weight (> 150g) Green and round fruit Purple and oblong fruit	IC345740, IC249297 IC099703, IC249331 IC090130, IC090793 IC090793 IC342832

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

2.9 Multilocation Evaluation of Germplasm

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

2.9.1 Rice: A total of 1,209 germplasm accessions of rice were evaluated at 21 centres for agronomic traits and were also screened for biotic and abiotic stresses. Besides, 160 promising accessions were further evaluated in Delhi and Hydrabad for confirmation. Some of the germplasm accessions were found having multiple disease resistance. Some of accessions include, high no of panicles:(IC114325, IC252142, IC114354, IC114350 >20), long panicles (IC114261-1, IC114345, IC114061, IC114341 >27.5 cm) and early flowering (IC 114341, IC114725, IC114752 <100 days)

2.9.2. Wheat: A total of 1,660 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 Western Plain Zone (DWR Karnal, PAU Ludhiana, GBPUAT Pantnagar), North Eastern Plain Zone (BHU Varanasi, NDUAT Faizabad), Central Zone (JNKV, ARS Powarkhera; SKGAN, WRS Vijapur), Peninsular Zone (IARI Pune and USA, Dharwad). The resistant accessions (no.) identified for

different biotic stresses are presented below.

Stem leaf and stripe rust:	30 accessions
Stem and leaf rust:	62 accessions
Stem and stripe rust:	91 accessions
Leaf and stripe rust:	8 accessions
Leaf blight, black rust and yellow rust:	2 (IC82194 and IC111692)
Leaf blight, brown rust and yellow rust:	2 (IC82194, IC111692)
Leaf blight, black rust and brown rust:	3 (IC82194, IC28960, IC111692)
Karnal bunt, black rust, brown rust and yellow rust:	7 (IC47044, IC63954, IC63955, IC75314, IC111670, IC111771, IC111783)
Karnal bunt, black rust, brown rust:	35 accessions
Karnal bunt, black rust, yellow rust:	34 accessions
Karnal bunt, brown rust, yellow rust:	11 accessions
Leaf blight and Karnal bunt:	7 (IC31979, IC36737, IC36739, IC73647, IC78981, IC82246, IC92190A)

2.9.3. Chickpea: A total of 977 accessions of chickpea were evaluated at nine locations for agronomical traits, against biotic (wilt, root rot, color rot, pod borer) and abiotic (cold and drought) stresses at nineteen locations. The promising accessions for agronomic traits, biotic stresses and quality parameters are as fellow:

Biotic stresses:

Wilt: IC251814, IC251869 (Four locations), IC251681, IC251698, IC251740, IC251815, IC251685, IC251686, IC251708 (three locations) were moderately resistant/ resistant to wilt.

Dry root rot: Over all nineteen accessions mainly IC327031, IC327039, IC327040, IC327041, IC327043, IC327055, IC327065, IC327074, IC327100 and IC327203 were found resistant.

Wilt root rot: Sixty four (64) accessions were found resistant at Hisar.

Ascochyta blight: Fourteen (14) accessions were found resistant at Ludhiana.

Collar rot: Eighty (80) accessions were found resistant at Jabalpur.

Botrytis grey mould: Eighty seven (87) accessions were found resistant at Pantnagar

2.9.4. Pigeonpea: A total of 453 accessions tested for biotic stresses at different locations. The promising accessions for different biotic stresses are as follows:

Agronomic traits:

Maturity (80%): IC245541, IC245534, IC245538, IC245539, IC245540 (<116 days)

Pod/plant: IC73318, C45768, IC73315, IC44871, IC73791 (>125)

Seed/pod: IC73775, ICP6358, IC73976, ICP6674, IC73315 (>3.8)

Seed yield/ plant: IC74166, IC74000, IC73331, IC74089, IC73312 (>24.0 g)

100 seed weight: IC73995, IC74114, IC73796, IC73876, ICP6656 (>9.50 g)

Protein content (%): IC73781, 73334, 2455343, 73321, 73905 (>20.95 %)

Biotic stress

Wilt: Fifty(50) accessions at Dholi , 21 at Badnapur and 11 at Rahuri were found resistant. Only IC73995 was found resistant at two locations.

2.10 ARIS Activities related to PGR Management

2.10.1 Implementation of National Information Sharing Mechanism: The Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture was formally adopted by representatives of 150 countries including India, during the International Technical Conference on Plant Genetic Resources held in Leipzig in 1996. The Conference also adopted the Leipzig Declaration, which focuses on the importance of plant genetic resources for world food security, and commits countries to the implementation of the Plan.

The government of India is among one of the seven Asian countries (Bangladesh, India, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam) signed agreement with the Food and Agriculture of the United Nations (FAO) to participate in the regional cooperative project "Implementation of the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA) in Asia and the Pacific Region", GCP/RAS/186/JPN

Project. The project aims to promote the implementation of the GPA and to contribute to establishing a continuing monitoring framework of the GPA implementation at national and regional levels and a mechanism for gathering and sharing information, as well as for priority setting for the GPA implementation. The project office is based at FAO Regional Office for Asia and the Pacific in Bangkok. It is funded by the Government of Japan.

A network of 114 public and private institutions which conserve and/or use plant genetic resources in India has been developed under this mechanism. The National Bureau of Plant Genetic Resources (NBPGR) has co-ordinated this mechanism as a National Focal Point in India. Its objective is to share information related to Indian plant genetic resources and, in particular, to the implementation of the Global Plan of Action (GPA) on Plant Genetic Resources for Food and Agriculture (PGRFA) in India.

Based on the information gathered through this mechanism in India, national programs can assess the current status of PGRFA in the country, which will assist them in identification of needs and setting priority for the work through a web site available at http:// www.nbpgr.ernet.in). This website was launched by Dr M Mahadevappa, Former Chairman, Agricultural Scientists Recruitment Board (ASRB) during the meeting of the National Advisory Committee of the GPA project held on March 29, 2006 under the chairmanship of Dr G Kalloo, the then Deputy Director General (CS & H), ICAR. It could also be used for coordinating and planning the PGR activities in the country. An immediate output from establishing the NISM-GPA will include a strategic report on the state of plant genetic resources for food and agriculture in the country, which is being prepared by the national focal point, in collaboration with the stakeholders. The report will be submitted to the GCP/RAS/186/JPN project, the Government of Japan and FAO Commission on Genetic Resources for Food and Agriculture to share the information, as well as the Indian contribution to the preparation of the Second Report on the State for he World's Plant Genetic Resources for Food and Agriculture.

Dr M. Mahadevappa, distinguished member of the National Advisory Committee and Former Chairman, Agricultural Scientists Recruitment Board launching the NISM Website (http://www.nbpgr.ernet.in)

2.10.2 Development of online software for the documentation of extant and notified varieties as per DUS guidelines: Having ratified the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs), the Government of India decided to give effect to the clause 27.3b of World Trade Agreement in Agriculture and enacted the legislation "Protection of Plant Varieties and Farmers' Right Act 2001" (53 of 2001). The Rules of the Act were notified on September, 12, 2003 and an Authority known as "Plant Varieties and Farmers' Right Authority" was established by the notification in the Official Gazette (No. 1183 dated November 11, 2005). Under the Act the government of India has decided to implement plant variety protection regimes which seek to provide protection to plant breeders and to farmers. Thus, the Indian plant varieties protection regime introduces both plant breeders' (PBRs) and farmers rights.

The purpose of the PPV&FRA is to "provide and promote an effective system for plant variety protection for India with the aim of encouraging the development of new varieties of plants for the benefit of Society.

Any new variety before registration must conform to the criteria of Distinctness, Uniformity and Stability (DUS) in suitable tests before it is eligible for protection. The Department of Agriculture and Co-operation, Ministry of Agriculture has entrusted NBPGR with the "Development and Digitalization of Extant –Notified Plant Varieties" activity. Under this activity, a software "IINDUS" (Indian Information System as per DUS Guidelines) for the documentation of the Extant notified varieties in accordance with the guidelines developed for various crops has been developed by using vb.net and Oracle relation database. The system is available on the web address http://www.nbpgr.ernet.in/nbpgr/ index.aspx.

The software IINDUS has been tested by all the DUS Centres located in various ICAR Institutes and Universities. The complete data of extanct and notified

varieties which has been grown by DUS centres (about 40) in India as per the guidelines fixed for various crops by the PPV&FRA is being documented through this software. The IINDUS shall help the PPV&FRA in identifying the reference varieties to be grown with any new variety/ies (as a candidate) which shall be submitted for registration.

NBPGR has also provided trainings to all the DUS centres about the statistical analysis of the DUS trials data for finding the distinct and uniform varieties by using DUSNT software and a publication "Statistical Techniques Useful for DUS Testing".edited by R.C.Agrawal, Dinesh Kumar and B.S.Dhillon has been brought out by NBPGR to help the DUS Centres.

Research Projects (Project Code: Title, PI, Co-PI and Associates)

PGR/GEV- BUR-DEL-0I-00: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of various crops, (SK Mishra).

PGR/GEV- BUR-DEL-0I.01: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of wheat, barley and triticale (Ambrish Kumar Sharma and PS Mehta).

PGR/GEV- BUR-DEL-0I.02: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of maize (Ambrish Kumar Sharma, and PS Mehta).

PGR/GEV- BUR-DEL -0I.03: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of cowpea & pea (S Sardana, NK Gautam and Babu Ram).

PGR/GEV- BUR-DEL -0I.04: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of oil seeds with special reference to *Brassica* and sunflower (Ranbir Singh and Vandana Joshi).

PGR/GEV- BUR-DEL -0I.05: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of tomato, sponge gourd, ridge gourd, bottle gourd and ornamentals (SK Yadav, KK Gangopadhyay, Gunjeet Kumar (on study leave) BL Meena).

PGR/GEV- BUR-DEL -0I.06: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of brinjal, radish, palak, methi, coriander and fruit crops (KK Gangopadhyay, SK Yadav, Gunjeet Kumar (on study leave) BL Meena).

PGR/GEV- BUR-DEL-01.07: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of medicinal & aromatic plants (Ashok Kumar, SK Pareek, Archana Raina, Jitender Mohan and Poonam Suneja)

PGR/GEV- BUR-DEL -0I.08: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of forages (Vandana Joshi).

PGR/GEV- BUR-DEL -0I.09: Biochemical evaluation of germplasm resources of various field crops (S.Mandal, Sangita Yadav (on study leave) and Poonam Suneja).

PGR/GEV- BUR-DEL -0I.10: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under utilized crops (BS Phogat, Hanuman Lal and RS Rathi).

PGR/GEV- BUR-DEL -0I.11: Studies on statistical techniques for efficient management of PGR (Hanuman Lal and RK Mahajan).

PGR/GEV- BUR-DEL -0I.12: Genetic Resources Information Programme (RK Mahajan RC Agrawal and Hanuman Lal).

PGR/GEV- BUR-DEL -0I.13: Genetic enhancement of crop species with particular reference to sesame and mungbean (I S Bisht).

PGR/GEV- BUR-DEL -0I.14: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of chickpea and pigeonpea (RP Dua and OP Dahiya).

PGR/GEV- BUR-DEL -0I.15: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of onion and garlic (Ashok Kumar and Harender Singh).

PGR/GEV- BUR-DEL -0I.16: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of oil seeds with special reference to safflower and linseed (Vandana Joshi and Ranbir Singh).

PGR/GEV- BUR-DEL -0I.17-: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of lentil & urdbean (NK Gautam, S Sardana and Babu Ram).

PGR/GEV- BUR-DEL -0I.18: Phytochemical evaluation of medicinal and aromatic plants (Archana Raina, SK Pareek, Ashok Kumar, Jitender Mohan and Poonam Suneja).

PGR/GEV- BUR –DEL – 01.19: Development of core set in Brinjal (*Solanum melongena* L.) (KK Gangoopadhyay, SK Yadav, RK Mahajan and IS Bisht).

3. DIVISION OF GERMPLASM CONSERVATION

Summary: A total of 28,888 germplasm accessions of various crops were received for long-term conservation in the National Genebank. These were processed following the genebank standards adding another 26,571 accessions to the base collection raising the total germplasm holding to 3,39,194. A total of 1,744 accessions out of the 2,621 accessions received at the Germplasm Handling Unit were stored in the long-term storage module, and 877 in the medium-term storage (MTS) as voucher samples. Another 2,523 accessions of exotic material were stored in the MTS as voucher specimen. Monitoring of stored germplasm (2,050 accessions) and updating of passport data (864 accessions) continued for effective upkeep. Studies on seed storage of three species of *Cassia* viz. *C. angustifolia, C. tora,* and *C. holoserica* and *Dalbergia sisso* were carried out. Longevity of castor, sesamum, groundnut, pigeonpea and cotton stored for nine years at ambient temperatures was found to be better in seeds dried to less than 3 per cent moisture content. Methods for breaking seed dormancy were developed in wild *Allium* spp., *Acacia leucophloea, A.nilotica, A. tortilis, Eleusine indica, Prunus mira, Perilla frutescence, Haldina cordifolia and Swertia chirata.*

The Division continued its efforts to enrich the national repository with long term storage of seeds of various agricultural and horticultural crops in the National Genebank (-18^{0}C) with emphasis on wild relatives of crops, agroforestry and medicinal plant species. Voucher samples of introduced and collected accessions were conserved in the medium-term storage at 7^{0}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 have been the other focus. 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

A total of 28,888 germplasm accessions of various agricultural crops were received for long-term conservation at the National Genebank. A total of 26,571 accessions qualified for conservation as per the genebank standards and were stored as base collections at –18^{0}C. These include cereals (7,165), pseudocereals (651), millets and forages (2,631), legumes (4,525), oilseeds (5,197) fibres (404), vegetables (2,340), medicinal and aromatic plants and narcotics (1641), spices (498), agro-forestry (1,428) fruits (91). These include released varieties (263) and genetic stocks (607) of various crops. 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 3,39,194 representing 1,187 species. In addition, a total of 2,523 exotic accessions of different crops were kept as voucher specimens in the medium-term storage module.

The Germplasm Handling Unit (GHU) received a total of 238 seed accessions after regeneration of the seeds collected during NATP. As per the recommendation of IRC of the 34,774 accessions stored earlier in the medium-term storage module a total of 15,025 accessions of cultivated material and 4,874 of wild material were shifted in the long-term storage modules. From the new material 877 accessions were stored in medium-term storage module for safety and as reference specimen and 1,744 accessions with sufficient quantity of seed were sent for long-term conservation.

3.2 Germplasm Registration

A total of 135 proposals were received for germplasm registration and 47 proposals were approved for registration in the 15th 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 was updated for a total of 864 accessions comprising vegetables (390 accessions), pulses (110), fibres (138), pseudocereals (148), medicinal plants (66), and spices (12). Data pertaining to the accessions conserved in the LTS were further validated.

3.4 Monitoring of Conserved Germplasm

Germplasm stored in the long-term storage module for 10 years or more (2,050 accs.) were monitored for seed viability, seed quantity and seed health to identify accessions that may require regeneration as per the genebank standards. This included accessions of cereals (611), millets (30), fibres (582), oilseeds (350), pulses

Table-1 Status of germplasm holdings in the National Genebank at -18 ^{0}C (As on 31st Dec., 06)

Crop Group	No. of Acc. stored (During 1.1.06 to 31.12.06)	Present status Total
Paddy	3857	78714
Wheat	2115	38046
Maize	615	6912
Others	578	10749
Cereals	**7165**	**134421**
Sorghum	1118	18655
Pearl millet	191	7436
Minor millet	591	19025
Others	731	3541
Millets and forages	**2631**	**48657**
Amaranth	290	4549
Buckwheat	235	638
Others	126	305
Pseudo Cereals	**651**	**5492**
Chickpea	39	15972
Pigeonpea	782	10798
Mung bean	134	3499
Others	3570	22575
Grain Legumes	**4525**	**52844**
Groundnut	319	13414
Brassica	1168	8980
Safflower	297	7246
Others	3413	17825
Oilseeds	**5197**	**47515**
Cotton	87	4710
Jute	229	2837
Others	88	1999
Fibre Crops	**404**	**9546**
Brinjal	464	3724
Chilli	7	1997
Others	1869	15480
Vegetables	**2340**	**21201**
Custard apple	1	58
Papaya	-	23
Others	90	184
Fruits	**91**	**265**
Opium poppy	-	349
Ocimum	101	342
Tobacco	12	1460
Others	1528	3182
Medicinal & Aromatic Plants & Narcotics	**1641**	**5333**
Coriander	**27**	**412**
Sowa	-	59
Others	471	1161
Spices & Condiments	**498**	**1632**
Pongam oil tree	265	327
others	1163	1726
Agro-forestry	**1428**	**2053**
Lentil		
Pigeonpea	-	7712
2523		
Duplicate Safety Samples	**-**	**10235**
Total 26571**	**339194***	

*The figure includes 2535 Released varieties and 1312 Genetic stocks

** The figure includes 263 Released varieties and 607 Genetic stocks

(225) and vegetables (252). Viability of all the accessions was maintained conforming to the genebank standards.

3.5 Regeneration of Germplasm

A total of 3,428 germplasm samples of various crops were supplied for seed multiplication/ evaluation/ restoration of lost active collections. These comprise accessions of paddy (2,032), wheat (1296) and cotton (100).

3.6 Supportive Research

Studies on ageing of *Cassia angustifolia, C. tora* and *C. holoserica* seeds showed that germination percentage, vigour index and protein content declined on ageing in all the three species. Methods to break seed dormancy were worked out in medicinal plant species viz. *Haldina cordifolia*(treatment with concentrated sulphuric acid) and *Swertia chirata* (chilling) to improve seed germination. In wild *Allium* spp. cold stratification for 4-6 weeks at 4-8°C enhanced germination up to 80% as compared to 6-10% germination in the controls. In *Acacia leucophloea, A. nilotica* and *A. tortilis,* conc. sulphuric acid treatment improved germination to various extent (70-100%) while in *A. trachycarpa, A. vichoria*, and *A. holosericea* hot water treatment for various durations was effective in breaking dormancy. In *Prunus mira* sand/or scarification and GA_3 (100ppm) application and in *Perilla frutescence* stratification and light treatment were effective in breaking dormancy.

To develop protocols for cost effective conservation, studies on longevity of seeds dried to low moisture contents (<3%) were continued in castor, groundnut, pigeonpea, sesame, niger, safflower, cotton and *Dalbergia* . Monitoring of *Dalbergia* seeds stored at low moisture contents of 1.7 and 2.3% at different temperatures revealed that seeds lost their viability at ambient temperature after 4 years of storage but maintained a reasonably good viability (75%) at 4 and –18°C storage temperatures. In cotton, groundnut, pigeonpea and castor, seeds dried to 2-3 per cent moisture retained higher germination than those stored with higher moistures at ambient temperature after more than 9 years of storage.

The project entitled "Collection, Assembly and Conservation of Genetic Resources of Physic nut (*Jatropha* Linn.) from DBT has been granted for Conservation Division to give a thrust for the collection and *ex-situ* conservation aspects of *Jatropha* from different agroclimatic Zones of India. Efforts are under way for initiating basic physiological studies of *Jatropha* seeds.

Research projects (Project Code: Title, PI, Co-PI and Associates)

PGR/GCN-BUR-DEL-01.01: Management of information and facilities of germplasm conserved in the national network (RC Agrawal; A K Singh, Sanjeev Saxena).

PGR/GCN-BUR-DEL-01-02:Conservation of legume germplasm using conventional seed storage methods(Neeta Singh; Chitra Pandey).

PGR/GCN-BUR-DEL-01-03: Conservation of paddy using conventional seed storage methods (Sanjeev Saxena.; AD Sharma).

PGR/GCN-BUR-DEL-01-04: Conservation of oilseed and fruit crops germplasm using conventional seed storage methods (J Radhamani; Anjali Kak).

PGR/GCN-BUR-DEL-01-05: Conservation of cereals excluding paddy and agro-forestry species, using conventional seed storage methods (K Srinivasan; Manju Uprety).

PGR/GCN-BUR-DEL-01-06: Conservation of spices, medicinal and aromatic plant, and pseudo-cereals germplasm using conventional seed storage methods (Veena Gupta).

PGR/GCN-BUR-DEL-01-07: Conservation of forage and fibre crop species germplasm using conventional seed storage methods (Anjali Kak; Veena Gupta).

PGR/GCN-BUR-DEL-01-08: Conservation of millets germplasm using conventional seed storage methods (AK Singh; J Radhamani).

PGR/GCN-BUR-DEL-01-09: Conservation of vegetable germplasm using conventional seed storage methods (Chitra Pandey; Neeta Singh).

PGR/GCN-BUR-DEL-01-10: Investigating seed dormancy, seed storage behaviour, and physiological and biochemical changes during storage. (Kalyani Srinivasan; Neeta Singh, Sanjeev Saxena, Veena Gupta, J Radhamani, Anjali Kak, Chitra Pandey, Manju Uprety, AD Sharma).

4. DIVISION OF PLANT QUARANTINE

Summary: A total of 27,076 accessions (64,068 samples) comprising 26,925 exotic accessions [63,917samples (germplasm= 16,146 accessions (17,731 samples); nurseries/ trial breeding material (10,779 entries; 46,186 samples)] of various crops and 151 accessions/ samples under export were processed for quarantine clearance. These samples included true seeds, rooted plants, cuttings, rhizomes, suckers, bulbs, nuts and tissue culture plantlets. The detailed quarantine examinations revealed that 648 samples were found infested/ infected contaminated with various pests viz., insects/ mites -296 samples including 91 with hidden infestation; nematodes- 120 and fungi/ bacteria- 232. Of the 648-infested/ infected/ contaminated samples, 647 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip and mechanical cleaning. One samples of *Glycine max* from USA was rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India. In addition, 17,212 accessions of Indian origin repatriated were processed for pest-free conservation. Of these 262 samples found infected and were salvaged. Seven Phytosanitary Certificates were issued for consignments meant for export. In addition, three hundred and eighty samples of transgenic crops viz., *Brassica oleracea* var. *capitata* (cabbage), *Brassica oleracea* var. *botrytis* (cauliflower), *Gossypium* spp. *Oryza sativa* and *Zea mays* were processed for quarantine clearance. The cultures of BCMV, SMV and ULCD are being multiplied under greenhouse conditions. The BCMV was purified and purification of SMV is in progress.

4.1 Quarantine of Imported Germplasm

4.1.1 Quarantine examination: A total of 26,925 exotic accessions (63,917 samples) comprising germplasm 16,146 accessions (17,731 samples); nurseries/ trial breeding material (10,779 entries; 46,186 samples) of various crops including both true seed and vegetative propagules were processed for the detection of associated exotic insect pests, and mites, plant parasitic nematodes, plant pathogens (fungi, bacteria, viruses) and weed seeds by various detection techniques. Of the import samples, 1,110 samples were exposed to X-ray radiography for detection of hidden infestation of bruchids and chalcids. A total of 648 samples were found infested/ infected/ contaminated. Of these, 296 samples were found infested with insects/ mites including 91 with hidden infestation; 120 samples infected with nematodes and 232 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 648 infested/ infected/ contaminated samples, 647 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 30^0C under normal air pressure against insect infestation and hot water treatment (HWT) at 52^0C for 30 minutes for various seed-borne pathogens and nematodes and X-ray screening for hidden infestation, pesticidal dip/ spray for vegetative propagules. Samples infested with insects/ mites (296) were salvaged through fumigation (139), X-ray radiography (91) and pesticidal dips (66); 120 samples infected with nematodes were salvaged by hot water and nematicidal dip treatments; 231 samples infected with fungi/ bacteria were salvaged by fungicidal seed treatment (183) and HWT (35), ethyl alcohol wash (13)**;** and samples infected with viruses were salvaged through grow-out test. One samples of soybean from USA was rejected due to the presence of downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India.

Prophylactic treatments: A total of 25,146 seed samples were subjected to fumigation, 252 samples of vegetative propagules were given dip/ spray treatment and 6,025 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 (194), and tomato (222) were subjected to prophylactic seed treatment with 10% tri-sodium orthophosphate.

4.1.3 Grow-out test in post-entry quarantine nursery (PEQN)/ Greenhouses: International nurseries trial material (5,202 entries) comprising wheat (3,842), barley (1,185) and triticale (175) from CIMMYT Mexico; ICARDA, Syria and registered germplasm (91) of wheat (83) and barley (8) were grown in PEQN.

A total of 555 samples of exotic germplasm comprising *Glycine max* (202), *Lathyrus sativus* (15), *Phaseolus* spp. (20), *Pisum* spp. (13), *Vicia bithynica* (19), *V. ervilia* (15), *Vicia faba* (219), *V. lyaeniscyamus* (1), *V.*

johannis (5), *V. narbonensis* (20), *Vicia sativa* (15), *Vigna mungo* (1), *V. radiata* (1) and *V. unguiculata* (9) 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 151 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, *Alternaria padwickii*. Seven Phytosanitary Certificates were issued.

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

A total of 17,212 accessions of repatriated were processed for pest-free conservation. Of these, 262 samples found infected were salvaged and released for pest free conservation. The pests intercepted were fungi viz., *Alternaria padwickii, Drechslera oryzae, Fusarium moniliforme, Rhizoctonia* sp.

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

A total of 10 accessions of *Allium* spp. including *A. senescens*, *A. griffithianum* and *A. raylei* were indexed against three viruses (the ones against which the commercial antisera kits were 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, 7 accessions revealed the presence of OYDV. The above three *Allium* species were free of all the three viruses in samples tested by DAS-ELISA.

4.5 Supportive Research

4.5.1 Efficacy of microwave radiation treatment: Due to the ill effects of pesticides and phasing out of the methyl bromide, an ozone depletor, preliminary studies using microwave radiations against *Sitophilus oryzae* in rice variety PNR –519 at microwave radiations at 1.35 kW and at 2450 MHz frequencies in the BPL model domestic microwave were conducted. The mortality of *S. oryzae* increased with the increase in the exposure period. The percent mortality was 78, 97.6, 98.4, 100, 100 at the exposure periods of 40,50, 60, 70 and 80-seconds respectively as compared to 0 per cent mortality in the control. However, the germination was slightly affected.

Paddy seeds infested with "white-tip nematode" of rice were treated with microwaves for different durations. Seeds (10-15 g) with 4% moisture content in yellow coloured paper packets required an exposure of 20 seconds to eradicate nematodes from the seeds without affecting germination.

4.5.2 RT-PCR protocols for detecting viruses in leaves and seeds by using degenerate primers being standardized: Tested potyvirus-specific degenerate primers in RT-PCR, which has potential application in identifying new or unknown potyviruses in the absence of specific antisera. The amplification reaction was performed with CN 48 as the forward primer and the degenerate oligo-dT (CN 47, CN 54 and CN 55) mixture as the reverse primers.

It resulted in amplification of approx. 700 bp DNA fragment. BCMNV was detected in leaf tissue successfully using these primers. It is not successful with seed samples, probably due to interference of inhibitors present in seeds and need to be adapted further.

4.5.3 Potential quarantine pests for India in grain legumes: Information on pests of grain legumes (39 crops of 19 genera were compiled on the parameters viz., scientific name of the pest/ synonym(s), Order/ Family, pathway of introduction, host range, geographical distribution, economic losses/ physiological variation and phytosanitary risk. There are about 250 insects / mite, 40 nematodes, 36 fungi, 12 bacteria and 42 viruses of quarantine significance in grain legumes not yet reported from India.

Table 1: Pests Intercepted in the Exotic Germplasm During the Year 2006

Pest	Host	Source/ Country
Insect and mite pests		
Brevipalpus phoenicis	*Ficus carica*[I]	USA
*Bruchus dentipes** [X]	*Vicia narbonensis*	Afghanistan
B. emarginatus [X]	*Pisum sativum*	Russia
B. lentis [X]	*Lens culinaris*	Syria
*B. rufimanus** [X]	*Vicia faba*	Afghanistan
Callosobruchus sp [X].	*Vigna mungo*	Sri Lanka
Lepidosaphes ulmi	*Ficus carica*[I]	USA
Sitotroga cerealella	*Gossypium hirsutum*	Pakistan
Immature stages	*Glycine max*	Taiwan
	G. hirsutum	USA
	Vigna mungo	Sri Lanka
	V. radiata	Sri Lanka
	V. unguiculata	Colombia
	Vitis vinifera	Romania
Mites	*Fragaria*[I]	USA
Scales	*Vitis vinifera*[I]	Hungary
Nematode		
Aphelenchoides besseyi	*Oryza sativa*	Indonesia, Philippines
Fungi/ Bacteria		
Alternaria brassicicola	*Brassica oleracea*	China
	Citrullus lanatus	China
	Crambe abyssinica	UK
A. brassicae	*C. abyssinica*	UK
A. lini	*Linum* spp.	Russia
A. padwickii	*Oryza sativa*	Philippines
A. radicina	*Capsicum annuum*	Taiwan
	Daucus carota	China
Botrytis cinerea	*Brassica juncea*	Germany
	Hordeum vulgare	Sweden
Colletotrichum dematium	*Cicer arietinum*	Syria
	Crambe abyssinica	UK
	Gossypium spp.	USA
	Helianthus annuus	USA
Drechslera maydis	*Zea mays*	Philippines, Thailand
D. oryzae	*Oryza sativa*	Philippines
Drechslera sorghicola	*Zea mays*	Philippines
D. sorokiniana	*Capsicum* spp.	China
	Lycopersicon esculentum	Taiwan
	Poa pratensis	USA
	Triticum aestivum	Nepal, USA
	Triticum spp.	Mexico
Fusarium dimerum	*Oryza sativa*	Philippines
F. moniliforme	*Beta vulgaris*	France, USA
	Capsicum spp.	China, Taiwan
	Capsicum annuum	Taiwan
	Citrullus lanatus	China
	Crambe abyssinica	UK
	Glycine max	Taiwan
	Gossypium spp.	USA
	Helianthus annuus	France
	Hordeum vulgare	Australia, Sweden
	Oryza sativa	Philippines
	Perilla frutescens	USA
	Sorghum bicolor	USA
	Triticum aestivum	USA
	Vigna radiata	Sri Lanka, Taiwan
	Zea mays	Philippines, Thailand, USA
F. solani	*Cicer arietinum*	Syria
	O.sativa	Philippines
	Gossypium spp.	USA

*Peronospora manshurica**	*Glycine max*	USA
Puccinia helianthi	*Helianthus annuus*	Egypt, France, USA
Rhizoctonia solani	*Beta vulgaris*	USA
Verticillium albo-atrum	*Capsicum annuum*	Taiwan
Xanthomonas campestris pv. *campestris*	*Brassica juncea* *B. napus*	Germany, USA Germany
Viruses		
Alfalafa mosaic virus	*Glycine max*	AVRDC (Taiwan)
	Phaseolus vulgaris?	CIAT (Colombia), Russia
	Vigna unguiculata	CIAT (Colombia)
Bean common mosaic virus	*P. vulgaris*	CIAT (Colombia), Russia
	V. unguiculata	AVRDC (Taiwan)
Bean common mosaic necrosis virus	*P. vulgaris*	CIAT (Colombia), Russia
*Cherry leaf roll virus**	*P. vulgaris*	CIAT (Colombia)
	G. max	AVRDC (Taiwan)
Cucumber mosaic virus	*P. vulgaris*	CIAT (Colombia)
Pea seed-borne mosaic virus	*Pisum sativum*	Russia
	Vicia faba?	Spain
Soybean mosaic virus	*G. max*	AVRDC (Taiwan)
	P. vulgaris?	CIAT (Colombia), Russia
Tobacco rattle virus	*P. vulgaris*?	CIAT (Colombia)
Tobacco streak virus	*P. vulgaris*?	CIAT (Colombia)
	G. max?	AVRDC (Taiwan)
	V. unguiculata?	CIAT (Colombia)
Tomato aspermy virus	*P. vulgaris*	CIAT (Colombia)
Tomato black ring virus	*G. max*?	AVRDC (Taiwan)
	P. vulgaris?	CIAT (Colombia), Russia
	V. unguiculata?	CIAT (Colombia)

¦ 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

4.6 Achievements in Externally- funded Projects

4.6.1 National Containment/ Quarantine Facility for Transgenic Planting Material (DBT): A total of 380 samples of imported transgenic planting material comprising *Brassica oleracea var. capitata* (cabbage), *Brassica oleracea var. botrytis* (cauliflower) (299) from Netherlands for Nunhems, Gurgaon; cotton (63) from USA for Mahyco, Vikki's Agrotech and Emergent Genetics, Hyderabad and (4) from China for Nath seeds Ltd., Aurangabad; maize (2) from the Philippines and (7) from South Africa for Monsanto, Mumbai; and rice (3) from China for Nath Seeds, Aurangabad and (6) from USA for IARI, New Delhi; were received for quarantine clearance.

The transgenes present in these crops included *rol-B* gene (cotton) for conferring enhanced tolerance to dehydration stress; *Cry1Ac* & *Cry2Ab* (cotton), *Cry1Ba* & *Cry1Ca* (cabbage/cauliflower), *Cry1A(b)* (maize) and *GFM Cry1A (Cry1Ab-1Ac) Bt* fusion gene (rice) for imparting resistance against insect-pests; *psy* (Phytoene synthase), *crtl* (Phytoene desaturase) gene (rice) capable of synthesizing ß-carotene and *CP4EPSPS* (cotton and maize) for tolerance to glyphosate herbicide.

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 *Pestaliopsis theae,* in cotton from USA; *F. moniliforme* in maize from the Philippines and South Africa; *F. moniliforme* and *Alternaria padwickii* in rice from USA and China.

Rice samples were given prophylactic hot water treatment at 52°C for 30 minutes against various seed-borne pathogens and nematodes. Besides, infected samples of cotton and rice were salvaged by fungicidal seed treatment.

Post-entry quarantine inspection of *Brassica oleracea* var. *capitata* (cabbage), *Brassica oleracea* var. *botrytis* (cauliflower) imported from the Netherlands grown in containment at Nunhems India Pvt. Ltd., Gurgaon and *Gossypium* spp. from USA at Vikki's Agrotech, Hyderabad and Emergent Genetics India Pvt. Ltd.,

Hyderabad respectively was done and the crops were found to be free from exotic pests/ diseases.

A National Orientation Course on "Biosafety Considerations for Evaluation of Transgenic Crops" was held from December 5 –13, 2006 at NBPGR, New Delhi. A total of 12 participants from various organizations including ICAR Institutes, SAUs, Traditional Universities and NGOs attended the training programme. The course was designed to orient the participants on development of transgenics and transgene technology, risk assessment and management and the regulatory mechanism and policy issues related to Biosafety. Besides, there were visits to the Phytotron Facility of IARI and a demonstration of Bt detection kits in the lab at NBPGR. A Panel discussion was also held on the "Mechanism for Stakeholders Education and Communication System, with the panelists from DBT, NBPGR, IARI and MoEF.

4.6.2 Classical Biological Control of *Mikania micrantha* with *Puccinia spegazzinii*: Implementation Phase (ICAR-CABI Collaborative Project): Rust inoculum of Peruvian isolate of *P. spegazzinii* (W 2102) received from CABI was established and multiplied in the National Containment Facility. Fourteen populations of *Mikania micrantha* from Assam and 12 populations from Andamans were screened against Trinidad isolate of *P. spegazzinii* and all were found to be susceptible but *Cineraria lyrata*, *Gypsophila muralis*, *Petunia* sp., *Salvia splendens* and *Verbena officinalis* did not show any symptoms. *M. micrantha* populations from Andaman (6), Assam (7) and Kerala (3) were screened against Peruvian isolate of *P. spegazzinii* and all were found to be susceptible. Four samples of sunflower were screened against Trinidad isolate and 13 against Peruvian isolate of the rust. Chlorotic flecks were observed in 3 samples against Trinidad isolate and in 10 samples against Peruvian isolate. Two consignments of rust inoculum (Trinidad isolate) supplied one each to AAU, Jorhat, Assam and KFRI, Peechi, Kerala for multiplication and limited field release. *M. micrantha* plants from Assam, Kerala and Andaman are being regularly propagated. Regular multiplication of rust inoculums of Trinidad isolate for field release and Peruvian isolate for host-specificity screening.

4.6.3 Network Project on Diagnostics of Emerging Plant Viruses: A total of 286 seed samples comprising of blackgram (94), greengram (89) and soybean (103) were procured from various sources to study seed transmission of mandate viruses i.e., *Bean common mosaic virus* (BCMV), *Soybean mosaic virus* (SMV) and Urdbean leaf crinkle disease (ULCD). A total of 1,081 leaf samples showing symptoms of BCMV and SMV after sap inoculation were tested against BCMV (335) and SMV (746) using Direct antigen coating ELISA and Double Antibody Sandwich-ELISA. A total of 307 samples were found positive, of which, 148 were with BCMV and 159 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, blackgram, greengram and soybean. The cultures of BCMV, SMV and ULCD are being multiplied in respective host plants under greenhouse conditions. Leaves infected with BCMV, SMV and ULCD are lyophilized and also preserved in vials under calcium chloride. BCMV was purified and purification of SMV is in progress. RT-PCR protocols were standardized for detecting BCMV and SMV. The experiments conducted so far clearly ruled out the possibility of involvement of nanoviruses and Whitefly-transmitted Geminiviruses in the etiology of ULCD. ULCD was not found to be spreading through soil. Evidences of seed and sap transmission of ULCD were obtained. Spherical particles were observed in inoculated leaves showing symptoms of ULCD. However, their association with ULCD is to be further confirmed

4.6.4 Treatment Trials to Confirm the Efficacy of Vapour Heat Treatment against Eight Species of Fruit Flies Recorded in India on Mangoes (DAC): Established the fruit fly rearing laboratory. Collected the nucleus cultures of three fruit fly species viz., *Bactocera cucurbitae, B. dorsalis* and *B. zonata* from local vegetable yards/ major mango and guava growing areas of UP (Lucknow, Saharanpur and Meerut). Small scale VHT Trial could not be completed due to reasons beyond control. Conducted 3 preliminary trials on these species using hot water treatment against all the immature stages. Conducted 3 small scale trials on *B. zonata* infesting mango using HWT at 48^{o}C at different time intervals. HWT at 48^{o}C for one hour killed all the stages of all fruit flies with negligible affect on the firmness of the fruit.

4.6.5 Development of Technology for Detecting Presence of GMOs in an Unknown Sample and its Utilization in dealing with Bulk Samples (DAC): The objective of the project is to develop methodology for detecting the presence of transgenicity in a sample not declared as transgenic and to adopt the methodology

developed for detecting transgenicity in a bulk sample by stipulating appropriate statistical procedures. It is expected that the project output will lead to development of quick and reliable diagnostic technique(s) for detecting the presence of transgenicity of an unknown sample**.** This will help in verifying by quarantine personnel if any consignment imported as non-GM is in reality an undeclared transgenic one or not. Besides, the diagnostic kit will also have immense value in monitoring the GM seeds after release.

The work has been initiated to procure the reference material of the marker genes viz., npt-II (Neomycin phosphotransferase), hpt (Hygromycin phosphotransferase), pat (Phosphinothricin-N-acetyl transferase), bar (Bialophos resistance), uidA (B-D-Glucuronidase)-reporter and ipt (Isopentenyl transferase). Procurement of consumables and related equipments is in progress.

Research Projects (Code, Title, PI, Co-PI and Associates)

PGR/PQR- BUR-DEL-01.00 Quarantine Processing of Plant Germplasm Under Exchange and Supportive Research (R. K. Khetarpal).

PGR/PQR- BUR-DEL-01.01 Quarantine processing of Germplasm for Joint inspection (PC Agarwal, Usha Dev, Shashi Bhalla, DB Parakh, Kavita Gupta, Charan Singh, Dinesh Chand, Ashok Maurya, KD Joshi).

PGR/PQR- BUR-DEL-01.02 Post-entry Quarantine Processing of Exotic Germplasm (RK Khetarpal, Arjun Lal, P C Agarwal, B Lal, DB Parakh, V Celia Chalam, Charan Singh, Ashok Maurya).

PGR/PQR- BUR-DEL-01.03 Quarantine Processing of Imported Transgenic Germplasm and Supportive Research (Manju Lata Kapur, Rajan, Shashi Bhalla, Baleshwar Singh, V Celia Chalam, Ashok Maurya).

PGR/PQR- BUR-DEL-01.04 Detection and Identification of Insect and Mite Pests in Quarantine and Supportive Research (Kavita Gupta, B Lal, Manju Lata Kapur, Shashi Bhalla, Charan Singh).

PGR/PQR- BUR-DEL-01.05 Detection and Identification of Nematode Pests in Quarantine and Supportive Research (Arjun Lal, Rajan, KD Joshi).

PGR/PQR- BUR-DEL-01.06 Detection and Identification of Fungi and Bacteria in Quarantine and Supportive Research (Usha Dev, P C Agarwal, Baleshwar Singh, Dinesh Chand).

PGR/PQR-BUR-DEL-01.07 Detection and Identification of Viruses in Quarantine and Supportive Research. (V Celia Chalam, DB Parakh, Ashok Maurya).

PGR/PQR-BUR-DEL-01.08 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, Charan Singh).

PGR/PQR-BUR-DEL-01.09 Quarantine Treatments for Disinfection of Germplasm Under Exchange against Nematodes and Supportive Research (Rajan, Arjun Lal, KD Joshi).

PGR/PQR-BUR-DEL-01.10 Quarantine Treatments for Disinfection of Germplasm Under Exchange against Pathogenic Fungi and Bacteria and Supportive Research (Baleshwar Singh, PC Agarwal, Usha Dev, Dinesh Chand).

PGR/PQR-BUR-DEL-01.11 Seed-health Testing for Conservation of Indigenous Germplasm Free from Pests (B Lal, Arjun Lal, Usha Dev, Manju Lata Kapur, Baleshwar Singh, Charan Singh, Dinesh Chand, Ashok Maurya, KD Joshi).

PGR/PQR-BUR-DEL-01.12 Detection of Viruses in In- vitro Cultures of Germplasm Meant for Conservation (DB Parakh V Celia Chalam, Ashok Maurya).

Externally Funded Projects (Title, funded by, PI and Co-PIs)

- National Containment/ Quarantine Facility for Transgenic Planting Material (DBT)(RK Khetarpal, Gurinder Jit Randhawa, Manju Lata Kapur, Kavita Gupta).
- Classical biological control of Mikania micrantha with Puccinia spegazzinii (DFID funded ICAR-CABI Collaborative Project) (Usha Dev –Co-PI).
- Network Project on Diagnostics of Emerging Plant Viruses (ICAR) (RK Khetarpal, DB Parakh, V Celia Chalam).
- Treatment Trials to Confirm the Efficacy of Vapour Heat Treatment against Eight Species of Fruit flies Recorded in India on Mangoes (DAC) (B Lal, Manju Lata Kapur, Shashi Bhalla, Kavita Gupta) (Completed December 31, 2006).
- Development of Technology for Detecting Presence of GMOs in an Unknown Sample and its Utilization in dealing with Bulk Samples (DAC) (RK Khetarpal, Gurinder Jit Randhawa, V Celia Chalam, Kavita Gupta).

5. GERMPLASM EXCHANGE UNIT

Summary: A total of 26,925 accessions (63,917samples) were imported from 45 countries which included germplasm 16,146 accessions (17,731samples) as well as trial material 10,779 entries (46,186 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were met by arranging material from different Indian sources and 151 samples including CIMMYT transit material were sent to six countries. A total of 9,537 samples of different crops were supplied to various users for utilization in the various crop improvement programmes in the country based on requests received from research workers in the country under Material Transfer Agreement (MTA).

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 :	26,925 (63,917)
(a) Germplasm :	16,146 (17,731)
(b) Trials :	10,779 (46,186)
No. of transgenic material imported :	179
No. of countries involved :	45
No. of Import Permit issued :	668
No. of cases registered :	231

Cereals and Millets: *Eleusine coracana* (2) from Sri Lanka; *Hordeum vulgare* (154) from Australia, USA and Sweden; *Oryza brachyantha* (1) *O.rufipogon* (2), *O.minuta* (1) all from Philippines, *Oryza sativa* (4293) from Bangladesh, China, Philippines and USA; *Sorghum bicolor* (22) from Egypt, USA; *Triticum aestivum* (1262) from Canada, China, Germany, Greece, Mexico, Nepal and USA, *T. dicoccum* (37), *T. durum* (79) both from Mexico, *T. spelta* (54), *T. turgidum* var. *durum* (1) from USA; *Triticum* sp. (7) from Mexico, *Zea mays* (5990)from Argentina, Brazil, China, Finland, France, Italy, Mexico, Philippines, South Africa Thailand, USA, Nigeria and Egypt. **Trials:** *Hordeum vulgare* (1,337 entries; 2156 samples)- IBCB-S, IBLSGP, IBON-LRA-C, IBON-LRA-M, IBON-MRA, IBSP-S, IBSTrGP, INBON, ISEBON, IBYT-LRA-C, IBYT-LRA-M, IBYT-MRA, ISEBON, IBCSGP, IBCSGP, IBSCGP, IBYDV, from ICARDA, Syria and CIMMYT, Mexico; *Oryza sativa* (1,052 entries, 4,688 samples)-33rd IIRON, 7th IRTON, 10thIRFAON, 32nd IURON, 2nd AERON, 31st IRBN, INEVDUST, 7th IRBON, IRFAON, 12th IRHON, 29 th IRLON, 26th IRSSTN, IRTON, IRTN, IURON from IRRI, Philippines; *Triticosecale* (350 entries; 798 samples) from CIMMYT, Mexico; *Triticum aestivum* (6,290 entries; 29,099 samples) –1st EMRRSN, 27th ESWYT, 39th IBWSN, 38th IDYN, 14th SAWYT, 14th FAWWON, 8th WON-IRR, 9th WON-SA; CCNHD, 2nd RRNEMGL, 36th EDUYT, 14th HRWYT, 39th IBWSN, 38th IDSN, 38th IDYN, 14th SAWYT, 10th SRSN, 24th SAWSN, 27th ESWYT; 36th EDUYT, PFORHIGHFEZN, 10th EGPSN, 8th EGPYT, WBYDV GP; 16th HBSN, 14th EMBSN, 29th IBYT, 34th IBON, 38h ITSN, 38th ITYN, 13th FAWWON, 9th WON-IRR, 8th WON-SA from ICARDA, Syria, CIMMYT, Mexico, CIMMYT, Turkey and CIMMYT, Nepal *Zea mays* (364 entires; 1908 samples)- CHTTEW, CHTTEY, CHTTIY, CHTTW, CHTTY, CHTTZLWY, EVT 13 S, EVT14 A, EVT 16 A, EVT 16 B, IPTT31 from CIMMYT, Mexico.

Oilseeds: *Arachis hypogaea* (636) from Indonesia, Japan, Niger and Vietnam, *A. monticola* (2) from Japan, *Arachis pintoi* (1) from Japan, *Arachis* sp.(1) from Kenya, *Brassica juncea* (8), *B. napus* (21), *Brassica sp* (9) all from Germany; *Carthamus arborescens* (1), *C.boisseiri* (1), *C. dentatus* ssp. *dentatus* (1), *C.glaucus* ssp. *anatolicus* (1) all from Germany; *Glycine max* (281) from Sri Lanka, Taiwan, Thailand and USA; *Helianthus annuus* (127) from Australia, Egypt, France, Thailand, and USA; *H. decapetalus* (1) from Slovakia, *H. glaucophyllus* (1) *H. laevigatus* (3) *H. rigidus* (3) *H.smithii* (2) *H. tuberosus* (6) all from Yugoslavia; *Linum grandiflorum* (1) from Russia; *Perilla* sp. (18) from USA; *Sesamum indicum* (8) from Japan, *S. ischinzianum* (1) *S. latifolium* (2) *S. radiatum* (1), *S. triloba* (1) all from Japan, *V. subterranea* (6) from UK.

Grain Legumes: *Cicer arietinum* (871) from Australia, Syria and USA, *C. bijugum* (4), *C. cuneatum* (1), *C. echinospermum* (2), *C. judaicum* (6), *C. pinnatifidum* (5), *C. reticulatum* (1), *C. yamashitae* (1) all from Syria; *Lathyrus odoratus* (20) from UK; *Lens culinaris* (177) from Syria; *Phaseolus vulgaris* (21) from Bulgaria, Canada, Columbia and USA, *Phaseolu*s sp. (50) from Kenya; *Pisum sativum* (13) from Russia and USA; *Vicia faba* (191) from Syria; *Vigna mungo* (2) from Sri Lanka, from UK. *Vigna radiata* (17) from Sri Lanka and Taiwan; *V. unguiculata* (8) from Columbia, Senegal and USA. Trials: *Cicer arietinum* (325 entries; 542 samples) CIABN, CICTN, CIEN-SL1, CIEN-SL2, CIF3N, CIFWN; *Lens culinaris* (865 entries; 6444 samples) LICTN-06, LIDTN-06, LIEN-E-06, LIEN- L-06, LIEN-S-06, LIFWN-06, LIF_3N-E-06, LIF_3N-L-06, LIF_3N-S-06, LIRN-06; i (58 entries; 258 samples) FBIABN, FBICSN, FBILTCN, FBION, $FBIS_1$PN; *Lathyrus sativus* (25 entries; 90 samples) ILAT-LS-06; *Vicia* sp. (45 entries; 135 samples) IVAT-VE, IVAT-VN, IVAT-VS; *Vigna ungulicata* 53entries; 53 samples.

Fibres: *Gossypium hirsutum* (422) from China, Iran, Pakistan and USA.

Vegetables: *Allium angulosum* (1) from Slovakia, *A. cepa* (12) from Taiwan; *Brassica campestris* ssp. *chinensis* (2) from China, *B. oleracea* var. *capitata* (4) from China, *B. oleracea* var. *botrytis* (102) from China, Netherlands and Taiwan; *B. rapa* (1) from China; *Capsicum annuum* (221) from China, Taiwan and USA, *C. baccatum* var. *pendulum* (3) from Taiwan, *C.chinense* (2) from Taiwan, *C.frutescens* (5) from China, *Capsicum* sp. (3) from China, *Cucumis melo* (15) from China and USA, *C. sativus* (7) from China and USA; *Citrullus lanatus* (16) from China and Taiwan; *Daucus carota* (7) from China and France; *Lycopersicon esculentum* (268) Sri Lanka, Taiwan, USA, Uzbekistan and Vietnam, *L. esculentum* var. *cerasiforme* (5) from USA; *L. hirsutum* (8) *L. pimpinellifoluim* (11) both from USA; *Momordica charantia* (4) from China; *Solanum melongena* (5) from China and France. **Trials***: Capsicum annuum* (15 entries; 15 samples) ICPN, ISPN.

Fruits: *Carica papaya* (3) from Cuba and Taiwan; *Ficus carica* (22) from USA; *Fragaria anannassa* ssp. *ananassa* (8) from USA, *Prunus armenica* (1) from Poland; *Vitis vinifera* (8) from Hungary, Italy and Romania.

Forages: *Avena magna* (2) from Russia, *A. sativa* (16) from Russia and UK, *A. sterilis* (2) from Russia; *Cnidoscolus chayanansa.* (1) from USA; *Medicago sativa* (5) from Italy, Newzealand; *Poa pratensis* (27) from USA; *Trifolium pratense* (1) from USA, *T. repens* (14) from New Zealand ; *Eucalyptus grandis* (20), *Eucalyptus* sp (20), *E. urophylla* (20) from Brazil.

Tubers: *Solanmum tuberosum* (68) from Netherlands, Peru and USA, *S. chacoense* (2) from USA.

Sugar yielding: *Beta vulgaris* (9) from Iran, France and USA; *Ipomoea batatas* (22) from Peru.

Spices and condiments: *Apium gaveolens* (1) from China; *Trigonella anguina* (5), *T. balansae* (57) *T. brachycarpa* (1), *T. caelesyriaca* (10), *T. caerulea* (3), *T.calliceras* (1), *T. coerulescens.* (4), *T. cretica* (3), *T. cylindracea* (2), *T. filipes* (8), *T. foenum graecum* (5) *T. gladiota* (2), *T. grandiflora* (1) *T. hierosolymitan* (1), *T. kotschyi* (3), *T. maritina* (3), *T. mesopatanica* (5), *T. plicata* (1), *T. schlumbergeri* (4), *T. spicata* (7), *T. stellata* (1), *T. suvaissima* (3) all from South Australia.

Medicinal and Aromatic Plants: *Atropa belladona* (1) from Slovakia, *Hypericum perforatum* (24) from USA and Slovakia, *H. pymmidatum* (1), *H. olympicum* (1), *H. orientale* (1) all from Slovakia, *Cylagie ovuli* (1), *Geranum palustre* (1), *Glaucium flavum* (1) from Denmark, *Lavandula latifolia* (1) from Slovakia, *Malva neglecta* (1), *Malva parviflora* (1) both from Denmark; *Mentha longifolia* (1) from Slovakia; *Origanum vulgare* (2) from Denmark and Slovakia, *Papaver fugax*, (1), *P.hybridum* (1), *P. rhoeas* (1) from Denmark; *Plantago maritima* ssp. *serpentina* (1) from Slovakia; *Pogostemon heyneanus* (1) from Denmark; *Salvia reflexa* (1) from Denmark, *S. splendens* (1) *S. splendens* var. *violacea* (1), *S. sclarea* (1), *S. officina* (1), *S. forninacea* (1) all from Slovakia*, Salvia* sp. (4) from Denmark; *Satureja nepeta* (1), *S. montana* (1) both from Slovakia; *Sida rhombifolia* (1) from Denmark; *Thymus comphoratus* (1) from Slovakia.

Ornamentals: *Amaranthus crispus* (1) from Denmark, *A. tricolor* (1) from Slovakia*; Begonia acida* (1), *Bromus arvensis* (1), *Chrysanthemum coronarium* (1) all from Denmark, *C. parthenium* (1) from Slovakia, *Cosmos bipinnatus* (1), *C. sulphureus* (1), *Gladiolus communis* (1), *Impatiens balsamina* (2), *I. glandulifera* (1), *Iris laevigata* (1) all from Denmark, *Lathyrus*

odoratus (20) from UK, *Limonium sinuatum* (12) fromUK, *Lupinus bartwegii* (5), *Lupinus* sp. (4) both from UK; *Lolium temutentum* (1) from Denmark; *Lotus corniculatus* (1) from USA; *Malva moschata* (1) *M. neglecta* (1), *Mirabilis longiflora* (1), *Passiflora morifolia* (1); *Rosa glauca* (1), *R. pimpinellifolia* (1), *R. villosa* (1); *Salvia argentea* (1), *Sida rhombifolia* (1) all from Denmark; *Tagetes erecta* (1), *T. patula* (2), *T. tenuifolia* (1) all from Slovakia.

Plantation crops: *Theobroma cocoa* (56) from UK.

Narcotics: *Nicotiana tabacum* (18) from Brazil and USA.

In addition, 6,583 accessions were assigned exotic collection numbers, for the unaccessioned seed material already stored in the National Gene Bank including crops namely wheat, maize, barley, triticale, sorghum, lentil, groundnut, jute, hemp, kenaf.

A total of 8,733 Indian accessions were restored in rice, barley and chickpea from IRRI, Philippines; ICARDA Syria; AVRDC Taiwan and USA.

5.2 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 scientists working in ICAR institutes/ agricultural universities in India under various protocols/ workplans/ memoranda of understanding with different countries/ CGIAR institutions.

The plant material intended for export was procured from known Indian sources through correspondence and the same were forwarded to the indentors in foreign countries alongwith phytosanitary certificates issued by the Plant Quarantine Division of the Bureau and import permit, if any after approval from ICAR/ DARE. The volume of export of seed/ planting materials during 2006 is indicated below.

Number of requests registered :	6
Number of countries to which material exported :	7
Number of accessions exported :	151

Cereals: *Oryza sativa* (3) to Philippines; *Zea mays* (4) to Pakistan; *Triticum aestivum* (102) to Kenya; [19 x2 (38 samples)] to Nepal (19) to Mexico

Vegetables: *Capsicum annuum* (3) to Taiwan

Ornamentals: *Cardiocrinum* sp (1) to Japan

Country wise export: Japan (1) *Cardiocrinum* sp; Kenya (102) *Triticum aestivum*; Mexico (19) *Triticum aestivum*; Nepal (38) *Triticum aestivum*; Pakistan (4) *Zea mays*; Philippines (3) *Oryza sativa*; Taiwan (3) *Capsicum annuum*

Table 1: Trait Specific Material Introduced during 2006

Crop	Country	Traits	Distribution
Cereals			
Oryza sativa EC571081-155 EC571211-227	Philippines	Drought tolerant lines	Barwale Foundation, Hyderabad
Oryza sativa EC571228-238	Philippines	Submergence tolerant lines	Barwale Foundation, Hyderabad
Oryza sativa EC571539-48	Philippines	Cytoplasmic Male Sterile (CMS) and maintainer lines	NBPGR, New Delhi
Oryza sativa EC571549-52	Philippines	Early and late maintainer population	NBPGR, New Delhi
Oryza sativa EC571553-58	Philippines	Thermogenic Male Sterile (TGMS) lines	NBPGR, New Delhi
Oryza sativa EC572259-67	USA	Early maturing, resistant to blast disease, Kernel smut, rice water weevil and rice stalk borer	DRR, Hyderabad
Oryza sativa EC572269	Philippines	Iron rich line	IARI, New Delhi DRR, Hyderabd

Oryza sativa EC573166-200	Philippines	Cytoplasmic Male Sterile (CMS) and maintainer lines	Pioneer Overseas Corporation, Hyderabad
Oryza sativa EC580364-373	Philippines	Brown plant hopper (BPH) resistant lines	Pioneer Overseas Corporation, Ghaziabad
Oryza sativa EC580374-375	Philippines	Blast resistant	Pioneer Overseas Corporation, Ghaziabad
Oryza sativa EC580376-390	Philippines	Bacterial blight resistant lines	Pioneer Overseas Corporation, Ghaziabad
Oryza sativa EC580391-396	Philippines	High yielding	Pioneer Overseas Corporation, Ghaziabad
Oryza sativa EC580501-509	Philippines	Deep water lines	Rice Research Station, Chinsurah, WB
Oryza sativa EC581120-23	Philippines	Submergence tolerant lines	CSSRI, Karnal
Oryza sativa EC581124-27	Philippines	QTL lines	CSSRI, Karnal
Oryza sativa EC582443-447, EC582449-53, 86-92	Philippines	*Bacterial blight resistant lines*	*PAU, Ludhiana*
Oryza sativa EC582455-61	Philippines	Stem borer tolerant lines	PAU, Ludhiana
Oryza sativa EC582463-64, 68-69,71	Philippines	Fe toxicity tolerant lines	PAU, Ludhiana
Oryza sativa EC582473-81	Philippines	Introgression lines for high yield	PAU, Ludhiana
Oryza sativa EC582482	Philippines	Acid Sulphate tolerant line	PAU, Ludhiana
Oryza sativa EC582484	Philippines	BPH resistant lines	PAU, Ludhiana
Oryza sativa EC582493-500	Philippines	CMS, maintainer and restorer lines	Annapurna Seeds, West Bengal
Oryza sativa EC583878-410	Philippines	Resistant to bacterial blight and Rice tungro virus	DRR, Hyderabad
Oryza sativa EC583411-453	Philippines	Resistant to *Grassy stunt virus*	DRR, Hyderabad
Oryza sativa EC582211-24	Philippines	Aerobic, moderate drought tolerance	PAU, Ludhiana
Oryza sativa EC588896-935	Philippines	CMS, maintainers and restorers lines	M/s Errika Seeds, Hyderabad
Oryza sativa EC588992-9027	Philippines	CMS, maintainer and restorer lines	M/s Rasi seeds, TN
Oryza sativa EC592058	Sri Lanka	High yielding, early maturing and resistant to bacterial leaf blight, brown plant hopper and blast	DRR Hyderabad
Triticum aestivum EC580485-86	Canada	Sawfly resistant hexaploid spring wheat derived from durum useful for development of solid stemmed wheat cultivars	DWR, Karnal
Triticum aestivum EC580487-489	Germany	Double Haploid lines, true isogenic and homozygous having different cytoplasm (fodder type)	IGFRI, Jhansi
Triticum aestium EC582225-441	USA	High yielding, non shattering type, tolerant to frost and lodging, resistant to yellow brown rust and powdery mildew	DWR, Karnal
Triticum aestivum EC589025	USA	Clear white grained, high yielding variety, resistant to stripe rust and leaf rust with excellent bread and noodle making quality	DWR, Karnal

Triticum aestivum EC589389-91	USA	Isogenic for stripe rust resistance gene Yr 36, leaf rust resistance gene Lr 47 and leaf, stripe and rusts resistance gene complex	DWR, Karnal
Triticum aestivum EC589421	USA	Var. Oropos high yielding, semi dwarf, broad, adaptation, resistant to lodging, low temperature and diverse climatic conditions, resistant to stem, leaf and stripe rusts	DWR, Karnal
Triticum aestivum EC592591	China	Variety Jimnmai-50 high yielding, wide spread adaptation, early maturing, better quality for bread and noodle making, resistant to yellow, brown, black rusts, powdery mildew; tolerant to cold and drought	DWR Karnal
Triticum turgidum var. *durum* EC592592	USA	Genetic stock rusty, useful for studying genetics of stem rust resistance in tetraploid wheat or in crosses designed to select monogenic progeny from a parent containing multiple genes for stem rust resistance	DWR, Karnal
Triticum aestivum EC586941	USA	Var. Choteav, superior yield, resistant to wheat stem sawfly and lodging	DWR, Karnal
Triticum aestivum EC586942	USA	Var. Jerome, early maturing, resistant to lodging and stripe rust	DWR, Karnal
Hordeum vulgare EC586943	USA	Var. Post 90, high yielding, widely adapted, resistant to all known greenbug biotypes, short statured, good straw quality & winter hardness	PC (Wheat), DWR, Karnal
Hordeum vulgare EC586944	USA	Var-Radiant proanthocyanidin free, potential malting barley and carry the gene that controls a high amount of thermostable b-amylase	PC (Wheat), DWR, Karnal
Zea mays EC592161	USA	Resistant to aflatoxin contamination, yellow kernels, white cobs, good husk coverage	DMR, IARI New Delhi
Zea mays EC586945-47	USA	High amylase, high oil content, high protein quality and waxy with specialty starches, populations of vegetable type	DMR, IARI New Delhi
Zea mays EC583148-167	Nigeria	Tropical mid altitude lines with resistance to foliar disease, gray leaf spot, *Maize streak virus,* northern leaf blight and common rust	NBPGR, New Delhi
Sorghum bicolor EC582502-508	USA	Isogenic for brown midrib genes	NRC, Sorghum, Hyderabad IGFRI, Jhansi
Sorghum bicolor EC582509-513	USA	Male sterile lines	NRC, Sorghum, Hyderabad IGFRI, Jhansi
Oilseeds			
Helianthus annuus EC581515-519	USA	Tolerant to soil salinity and for genetic base broadening for agronomic and oil content characters in development of hybrids, parents or improved germplasm	DOR, Hyderabad
Helianthus annuus EC586970	USA	Maintainer, high oleic fatty acid, short statured type	DOR, Hyderabad
Helianthus annuus EC586971	USA	Excellent lodging resistance, short statured line	DOR, Hyderabad
Helianthus annuus EC586972	USA	Resistant to downy mildew	DOR, Hyderabad

Helianthus annuus EC586973	USA	Restorer line having gene for fertility restoration	DOR, Hyderabad
Glycine max EC592181- 212	Taiwan	Vegetable type, early and late maturing, white fly and downy mildew resistant	PEQN, NBPGR
Glycine max EC592211-19	Taiwan	High oil content	PEQN, NBPGR
Glycine max EC586966	USA	Var. Desha, early maturing, resistant to stem canker and Soybean mosaic virus	NRC Soybean, Indore
Glycine max EC586967	USA	Var. Lonoke high yielding, good standability, shattering resistance and resistant to southern stem canker, soybean cyst nematode, reinform nematode, sudden death syndrome and frog eye leaf spot	NRC Soybean, Indore
Grain legumes			
Cicer arietinum EC571855-572003	Syria	Large seeded kabuli type germplasm	PAU, Ludhiana IIPR, Kanpur
Cicer arietinum EC583236	USA	Extra large kabuli variety	ICRISAT, Patancheru
Phaseolus vulgaris EC589388	USA	Var. Quincy resistant to all known strains of BCMV, *Bean common mosaic necrosis virus,* root rot and high yielding	PEQN, NBPGR
Phaseolus vulgaris EC589468	USA	Var. silver cloud, high yielding resistant to lodging, BCMV & CTV and tolerant to bean rust	PEQN, NBPGR
Phaseolus vulgaris EC590327	Canada	Resistant to BCMV, tolerant to white mold, semi determinate growth habit with very short vines or no vines, upright plant and canopy, higher podding nodes on stems	PEQN, NBPGR
Phaseolus vulgaris EC590328	Canada	Non nodulation genetic stocks	PEQN, NBPGR
Phaseolus vulgaris EC592938	USA	Germplasm USDK-CBB-15 resistant to common bacterial blight	PEQN, NBPGR
Pisum sativum EC581505-514	USA	Differential lines	CSKHPKV, Palampur
Vigna unguiculata EC582501	USA	Var. EIN-E1 Ghazal good for grain production under rainfed conditions	PEQN (IIPR, Kanpur)
Vigna unguiculata EC587822	Senegal	Resistant to *Cowpea aphid borne mosaic virus* (CABMV), bacterial blight and early maturing	IIPR, Kanpur
Fibres			
Gossypium hirsutum EC561526	USA	Male Sterile lines	Proagro Seed Company, Andhra Pradesh
Vegetables			
Brassica oleracea var *botrytis* EC572748	Taiwan	Early maturing (40-45 days), globe shaped and heat tolerant	Vibha Agrotech Ltd, Hyderabad
Capsicum annuum EC571257-266	Taiwan	Cytoplasmic Male sterile (CMS) lines and maintainers	AAU, Gujarat IIVR, Varanasi
Capsium annum EC572236-39	Taiwan	*Chilli veinal mosaic virus* and Potyvirus Y resistant lines	J.K.Agri. Genetics, Hyderabad
Capsium annum EC572238, 43-45	Taiwan	Anthracnose resistant lines	J.K.Agri. Genetics, Hyderabad
Capsicum annuum EC582593	USA	Var. Tangerine dream, non pungent, banana type peppers, heat and drought tolerant, excellent keeping quality suitable for ornamental & culinary applications	IIVR, Varanasi

Capsicum baccatum var. *pendulum* EC572240-42	Taiwan	Anthracnose resistant lines	J.K.Agri. Genetics, Hyderabad
Capsicum chinense EC589469	Taiwan	Resistant to anthracnose & bacterial wilt	UAS, Bangalore
Citrullus lanatus EC572745-47	Taiwan	Globe shaped, firm fleshed, small seeded, sugar content 11-12% and disease resistant	Vibha Agrotech Ltd. Hyderabad
Cucumis melo EC589374 (1)	USA	Var. PMR Delicious 51, resistant to powdery mildew	IIVR, Varanasi
Lycopersicon esculentum EC571821-829	Taiwan	Resistant to whitefly transmitted gemini virus, bacterial wilt, *Tomato mosaic virus* and fusarium wilt	Centre for Plant Biotech. and Mol. Biology, Thrissur
Lycopersicon esculentum EC572692-708	USA	Carotene rich and high lycopene content, male sterile lines	IIVR, Varanasi, NBPGR, New Delhi.
Lycopersicon esculentum EC580001	Taiwan	Resistant to bacterial wilt, tomato mosaic virus, gray leafspot, fusarium wilt (race 1)	MAU, Parbhani
Lycopersicon esculentum EC580988-020	Taiwan	Resistant to bacterial wilt, *Tomato mosaic virus*, fusarium wilt and gray leaf spot, late blight, white fly transmitted gemini virus, early blight	Nodai Seeds India Pvt. Ltd., Gurgaon
Lycopersicon esculentum EC581035-1043	Taiwan	Heat tolerant globe shaped	Nodai Seeds India Pvt. Ltd., Gurgaon
Lycopersicon esculentum EC581525	Sri Lanka	Heat tolerant	IIVR, Varanasi
Lycopersicon esculentum EC592058-59	Sri Lanka	Heat tolerant varieties	IIVR, Varanasi
Lycopersicon esculentum EC586975	Taiwan	Resistant to Geminivirus, bacterial wilt, *Tomato mosaic virus,* fusarium wilt, gray leaf spot pathogen & early blight	VNR seed , Raipur
Lycopersicon esculentum EC588212-230	Taiwan	Resistant to late blight, bacterial wilt, *Tomato mosaic virus*, fusarium wilt	Ankur Seeds Pvt, Nagpur
Fruits			
Fragaria ananassa ssp. *ananassa* EC 571812	USA	Variety Arking large fruited, tolerant to leaf spot, leaf scorch, powdery mildew and red stetle	NBPGR, Regional Station, Shimla
Fragaria ananassa ssp. *ananassa* EC 571816	USA	Resistant to botrytis, verticillium wilt, red stele, powdery mildew and spotted spider mite	NBPGR, Regional Station, Shimla
Fragaria ananassa ssp. *ananassa* EC 571814, 817	USA	Large fruited, good flavor, outstanding fruit quality	NBPGR, Regional Station, Shimla
Fragaria ananassa ssp. *ananassa* EC571820	USA	Early ripening, resistant to red stele races A-1, A-3, A-4 and tolerant to fruit rots	NBPGR, Regional Station, Shimla
Forages			
Trifolium pratense EC578957	USA	Var-Freedom, free from pubescence, good for hay making, faster drying & reduced dustiness	IGFRI, Jhansi
Elytrigia repens EC 586940	USA	Variety Eversett, advanced generation synthetic cultivar for high rhizome production ability to spread by rhizomes and used for land stabilization and rectanation	IGFRI, Jhansi

Medicinal and Aromatic plants			
Papaver sp. EC587085-88	Denmark	Resistant to downy mildew	NRC M&AP, Anand
Apium graveolens EC587045	China	Tolerant to high temperatures	IIVR, Varanasi
Glaucium flavum EC587081	Denmark	High glycyrrhizic content	NRC M&AP Anand

Table 2: Transgenic material introduced during 2006

Crop	Country	Trait	Distribution
Oryza sativa EC588381	China	Bt rice having medium maturity and showing enhanced resistance against infestations of rice stem borer and leaf folders expressing Bt fusion gene (*Cry 1 Ab-Cry 1AC*)	Nath Seeds Ltd, Nath House, Aurangabad
Oryza sativa EC571843-48	USA	Containing Psy.(Phytoene synthase) Crtl. (Phytoene desaturase) genes	IARI, New Delhi.
Zea mays EC591888	South Africa	Containing *Agrobacterium sp.* CP4 EPSPS gene under the control of ract 1, an enhanced CaMV35S promoter and joined with nopaline synthase 3 non translated sequence NoS3 providing m RNA polyadenylation signal and terminating transcription. The CP4EPSPS gene imparts resistance to glyphosate herbicide	Monsanto India Ltd, Mumbai
Zea mays EC582585-90	South Africa	Expressing *Cry 1 Ab* gene (Event Mon 810) under the control of CaMV 35 S promoter for imparting insect resistance character against insect pest	Monsanto India Ltd., Mumbai
Zea mays EC580008-09	Philippines	Transgenic expressing *Cry 1 Ab* gene (Event Mon 810) under control of Ca MV35S promoter imparting insect resistance against insect pest of corn	Monsanto India Ltd, MS
Gossypium sp. EC589424-27	China	Transgenic drought tolerant containing Rol B gene of *Agrobacterium rhizogenes*	Nath Seeds Ltd., Aurangabad
Gossypium sp. EC589428-434	USA	Containing *CP4EPSPS* and *Cry 1AC* & *Cry* 2Ab genes (Mon 15985X Mon 88913) tolerant to glyphosate herbicide and lepidopteran pest infection (Roundup Ready Flex)	Emergent Genetics Pvt. Ltd., Hyderabad
Gossypium sp. EC589435-41	USA	Containing *CP4 EPSPS* genes (Mon 88913 event) tolerant to glyphosate herbicide (Roundup Ready Flex).	Emergent Genetics Pvt. Ltd., Hyderabad
Gossypium hirsutum EC582541-582584	USA	Containing *Cry 1 Ac* & *Cry 2 Ab* (Mon 15985 event) genes Boll gard II	Vikki Agrotech Ltd, Hyderabad
Gossypium hirsutum EC570334-335	USA	Expressing *Cry IAb* gene responsible for imparting resistance to the attack of boll worm and other insect pests.	Syngenta India Ltd, Pune
Gossypium hirsutum EC580888	USA	Containing *CP4EPSPS* gene (Mon 88913 event) tolerant to glysphosate herbicide (Roundup Ready Flex)	Maharashtra Hybrid Seeds Company, Mumbai
Brassica oleracea var. *botrytis* EC587098-7196	Netherlands	Containing *Cry 1Ba* and *Cry1* Ca genes	Nunhems, Gurgaon

5.3 Inland supply of Plant Genetic Resources

The seed and planting materials of diverse agri-horticultural and agri-silvicultural crops were supplied to ICAR institutes/ coordinated projects, agricultural universities and Union Territories of India. Based on specific requests received, 9,537samples 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, 817)		
Wheat	243	Bihar
Wheat (Trial Material) & barley	7,282	Different locations
Maize	22	UP
Barley	232	HP, Haryana
Sorghum	14	New Delhi
Barnyard millet	10	MS
Prosomillet	5	Rajasthan
Finger millet	5	Rajasthan
Foxtail millet	4	MS
Oilseeds (210)		
Soybean	3	HP
Sesame	66	T.N., Punjab, AP, WB
Brassica sp	141	Delhi, J&K, HP, Haryana
Grain legumes (710)		
Urdbean	85	Karnataka, AP, TN
Lentil	125	UA, Bihar, J&K, Punjab, MP
Mungbean	130	UA, WB
Cowpea	15	MS
Chickpea	17	UA
Kulthi	22	UA, UP, MP
Pigeon pea	3	Delhi
Pea	58	TN, HP, Punjab, Bihar, J&K, MS
Frenchbean	85	MS, TN, AP
Fababean	35	Punjab, Rajasthan, J&K
Vigna sp	35	Delhi
Moth bean	100	MS
Underutilized crops (125)		
Jatropha	30	HP, AP, Rajasthan
Amaranth	94	WB, MS, Gujarat, Pondicherry
Simaruba glauca	1	Kerala
Vegetables (421)		
Tomato	67	HP, Punjab, UA, J&K
Allium sp.	16	UP
Brinjal	39	HP, UA, Karnataka
Chilli	230	TN, HP, Karnataka, Delhi, UA, J&K
Bottle gourd	27	Bihar
Melon	8	Gujarat
Ridge gourd	5	Punjab
Snake gourd	19	Gujarat, TN
Cucumis harwickii	10	UP
Fibres (3)		
Cotton	3	MS
Fruits (47)		
Banana	39	Delhi, UP, Karnataka, Kerala
Khirnii	3	UP

Karonda	5	UP
Ornamentals (4)		
Gladiolus	4	UP, Delhi
Spices (4)		
Blackpepper	11	Kerala
Narcotics (1)		
Tobbaco	1	AP
M&AP (128)		
Aloe vera	25	Gujarat
Andrographis paniculata	10	WB
Asparagus racemosus	1	UA
Artemisia annua	1	Delhi
Ruta graveolens	1	Delhi
Hyoscyamus niger	1	MP
Vetiver	2	MP, UP
Ashwagandha	4	MP
Kalmegh	5	MP
Ocimum sp.	9	MP, WB
Palmarosa	2	MP, UP
Mucuna	55	Gujarat, WB
Tinospora	1	MP
Psoralea cordifolia	11	Delhi
Forages (60)		
Oat	2	Delhi, UP
Medicago sativa	3	Delhi
Lolium multiflorum	28	UA
Poa annua	3	UA
Dactylis glomerata	2	UA
Trifolum spp.	22	UA

AP= Andra Pradesh, HP=Himachal Pradesh, J&K=Jammu & Kashmir, MP=Madhya Pradesh, MS=Maharashtra, UP=Uttar Pradesh, UA=Uttarakhand, TN=TamilNadu.

Research Projects (Project Code, Title, PI, Co-PI and Associates)

PGR/GEX-BUR-DEL-01.00: Exchange of plant genetic resources with foreign countries, inland supply of the resources and related information to the scientist/users in the country (RV Singh upto 31.07.06, IP Singh w.e.f.1.8.06) .

PGR/GEX-BUR-DEL-01.01: Import, export and inland supply of PGR in field crops and exchange of related information to the Scientists & users in the country. (Vandana Tyagi, IP Singh, Deep Chand, SP Singh and Surender Singh).

PGR/GEX-BUR-DEL-01.02: Import, export and inland supply of PGR in horticultural crops and exchange of related information to the Scientists and users in the country. (Deep Chand, IP Singh, Vandana Tyagi, SP Singh and Surender Singh).

PGR/GEX-BUR-DEL-01.03: Documentation and Dissemination of information on germplasm both imported and collected in the form of Plant Germplasm Reporter and preparation of crop inventories. (IP Singh, Deep Chand, Vandana Tyagi, SP Singh and Surender Singh).

PGR/GEX-BUR-DEL-01.04: Survey and assembly of literature on Plant Genetic Resources and its documentation for procurement of elite/ trait specific germplasm. (IP Singh, Deep Chand, Vandana Tyagi, SP Singh and Surender Singh).

PGR/GEX-BUR-DEL-01.05: National Network Project on Underutilized fruits (Deep Chand, SS Malik upto 23.7.06, SK Malik wef 24.7.06).

6. TISSUE CULTURE AND CRYOPRESERVATION UNIT

Summary: A total of 1,904 accessions belonging to fruit crops, bulb and tuber crops, medicinal, aromatic and rare/ endangered plants, spices, plantation and industrial crops, and others were conserved as *in vitro* cultures under culture room conditions and/ or at low temperature. The average subculture duration ranged from 4-24 months, depending on the species. Research work was carried out on aspects related to *in vitro* slow growth and cryopreservation in aforementioned group of crops. Employing various strategies, subculture duration could be enhanced to varying periods in *Bacopa monnieri, Dahlia* and *Gentiana kurroo*. Following modulation of pre growth conditions, varying degree of survival after cryopreservation was observed in *Allium tuberosum, Centella asiatica, Dioscorea bulbifera* , *Gentiana kurroo* and *Zingiber officinale*. Employing RAPD and/ or ISSR markers, there were no significant differences between *in vitro*-conserved cultures and their respective mother plants, in *Curcuma. longa* cv. Pratibha, *Colocasia esculenta, Plumbago zeylanica* and *Zingiber officinale*. A total of 85 accessions comprising Musa spp. (65), *A. tuberosum* (1), *Fragaria* spp. (1), *Gladiolus* cv. (2), *Morus* spp. (15) and *Zingiber officinale* (1) were supplied as *in vitro* cultures to various indentors. A total of 657 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen were cryoconserved during the year totaling to 7,922 accessions in the cryogenebank. Air desiccation-freezing protocols were developed for embryonic axes of *Simarouba glauca*, *Juglans regia* and *Prunus armeniaca* and for seeds of *Manilkara hexandra, Carissa* sp. and *Salvadora* sp. using desiccation-freezing methods. Embryonic axes of *Citrus paradisi* and trifoliate hybrids were successfully cryopreserved using vitrification and encapsulation-dehydration techniques.

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, 121 new accessions were added in the *in vitro* genebank and these included *Allium* spp.(6), *Colocasia esculenta* (12), *Curcuma* spp. (16), *Dahlia* (3), *Dioscorea* spp. (6), *Fragaria* spp.(14), medicinal and aromatic plants (12), *Morus* spp. (9), *Musa* spp. (8), *Pyrus* spp. (21), *Rubus* spp.(12) and *Vaccinium* spp.(2). A total of 1,904 accessions belonging to different crop groups were maintained *in vitro* and subcultured at periodic intervals (Table 1).

Tropical fruits: A total of 402 accessions of *Musa* (~ 6,000 cultures) and 3 accessions of *Vitis vinifera* were conserved as *in vitro* cultures in the *in vitro* genebank at 25^{0}C. The average subculture duration under these conditions varied from 6-12 months in banana, depending on the genotype. In all, 8 new accessions of banana were added during the year, comprising wild species of *Musa acuminata* and *M. balbisiana* belonging to the north-eastern region of India.

Work on cryopreservation of shoot meristems of banana was intensified using the vitrification method. During the year, four accessions of banana (*Musa* spp.) belonging to AB, ABB and AAB subgroups could be cryopreserved. In all, nine accessions of banana have been successfully cryostored in the LN tank for long-term conservation.

Bulb crops: A total of 177 accessions belonging to 18 species (*Allium* spp., *Cicer microphyllum*, *Dahlia* and *Gladiolus* cv.) were conserved as *in vitro* cultures under culture room conditions and/or at low temperature, depending on the species.

During the year, 9 new accessions were established *in vitro* which include *A. sativum* (4), *Allium* spp.(2) and *Dahlia* (3).

In Dahlia, procured from Bhowali regional station, several combinations of growth regulators were tried to promote multiple shoot formation. However, only single shoot bearing 3 or 4 culturable cuttings could be induced on MS supplemented with NAA and kinetin. Regarding *in vitro* conservation of dahlia, cultures could be maintained up to 6 months on above medium under culture room conditions.

Regarding cryopreservation, in *A. ramosum,* using vitrification technique, stock cultures pre-conditioned on high sucrose medium or at low temperature (4^{0}C) could survive PVS2 dehydration and showed regrowth of non-frozen controls. Using encapsulation-dehydration technique, up to 20% regrowth of *in vitro* shoot bases of *A. tuberosum* was achieved following LN freezing. Employing vitrification technique, in *A. sativum,* shoot

tips isolated from cloves (non-frozen controls) could tolerate PVS3 dehydration but failed to survive LN freezing.

Medicinal, aromatic and rare/ endangered plants: *In vitro* maintenance of existing cultures of 180 accessions belonging to 24 genera and 32 species was achieved through periodic subculture and resterilization either under culture room conditions and/or at low temperature.

A total of 12 accessions belonging to 9 genera were added in the repository and these include *Acorus calamus* (1), *Centella asiatica* (1), *Chlorophytum borivilianum* (2), *Coleus forskohlii* (1), *Kaempferia galanga* (1), *Picrorhiza kurroa* (1), *Plumbago zeylanica* (3), *Rauvolfia serpentina* (1) and *Valeriana wallichii* (1).

Regarding short-to medium-term conservation, in one accession of *Bacopa monnieri,* conservation period could be enhanced to 18 months at 25^0C with mineral oil overlay, wherein normal subculture period is 6 months. Using another strategy, alginate-encapsulated shoot tips could be conserved for 16 weeks in a cryovial without nutrient medium at 25^0C. In *Gentiana kurroo*, on media supplemented with mannitol, cultures could be maintained up to 30 months at 4^oC while those at 25^0C survived up to nine months.

In *B. monnieri, C. asiatica,* and *G. kurroo,* cryopreservation experiments continued to optimize preculture conditions to improve survival after cryopreservation of shoot tips**.** Using vitrification technique, in *C. asiatica*, shoot tips exhibited very low (5%) post-thaw survival following cryopreservation. In *G. kurroo,* preconditioning and modification of recovery growth conditions led to 25% post-thaw regeneration of cryopreserved shoot tips. However, with droplet freezing technique, shoot tip explants of *B. monnieri* and *P. kurroa* failed to survive LN freezing.

Spices, plantation and industrial crops: A total of 366 accessions (~ 7,900 cultures) comprising 184 of *Zingiber* species, 143 of *Curcuma* species*,* 10 species of *Piper,* 5 of *Elettaria cardamom*, 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 16 accessions of *Curcuma* spp. were added to the *in vitro* repository during the current year.

Cryopreservation experiments in ginger (*Zingiber officinale*) were intensified using four accessions. Shoot buds (2-4 mm) isolated from *in vitro* shoot cultures were precultured on MS medium supplemented with 0.2, 0.4 and 0.6 M sucrose, for 1 day each. The sucrose-precultured buds were treated with a loading solution (0.4 M sucrose) for 20 min., followed by PVS2 dehydration (30 min.), freezing in LN and rapid thawing. In all the four accessions, 75-100% shoot regeneration occurred after loading solution. After PVS2 treatment for 30 min., significant differences were observed in shoot regeneration, ranging from 45-80%. Depending upon the genotype, explant survival after cryopreservation was 16-43%. About 1-4 mm shoot tip emergence was observed. However, no further shoot growth was obtained in any of the accessions after LN treatment. Post-thaw growth of endogenous bacteria was observed to be the common factor that had overgrown the emerging shoot tips and restricted the shoot growth, any further.

Temperate and minor fruit crops: A total of 245 accessions belonging to 9 genera were conserved as *in vitro* cultures and sub cultured at periodic intervals. The average subculture period varied from 6-12 months. During the year, 58 new accessions of various temperate and minor fruits were added in the *in vitro* genebank and these include *Fragaria* spp.(14), *Pyrus* spp. (21), *Rubus* spp. (12), *Morus* spp. (9) and *Vaccinium* spp. (2).

The encapsulation-dehydration protocol for *Morus* species (*M. indica*, *M. alba* and *M. sinensis*) was developed using *in vitro*-grown shoot tips. The efficacy of cryopreservation protocol was tested on five more accessions of mulberry giving 30-35% recovery after LN freezing.

Tuber crops: A total of 20 accessions of taro (*Colocasia esculenta*) were procured from NBPGR regional station, Bhowali. During the year, 18 accessions of tuber crops including taro (12) and yams (6) were added in the *in vitro* genebank.

In taro, *in vitro* corm formation was achieved on two more media combinations i.e., MS+ 6% sucrose + 0.5 mgl^{-1} BAP + 4.0 mgl^{-1}NAA + 1.0 mgl^{-1}IAA + 1.0 $mgl^{-1}GA_3$ + 0.25% phytagel) and MS + 10% sucrose + 0.2% phytagel. The plants obtained, following transplantation of *in vitro* corms, were morphologically similar to the parent plants.

Protocol for cryopreservation of *Dioscorea bulbifera* shoot tips, using vitrification technique, was improved. Employing the improved protocol, survival and regeneration of cryopreserved shoot tips could be achieved up to 85 and 40 %, respectively. The regenerated shoots exhibited rooting and transformed into fully grown plantlets.

6.2 Genetic Stability of *In Vitro* Conserved Germplasm

Genetic stability of 12 month-old plantlets of *C. longa* cv. Prathibha conserved on low-cost media (MS+isabgol+commercial market sugar) was assessed using 24 RAPD primers. There was no variation in RAPD profiles of plantlets conserved on low-cost media and, those of the mother plants and plantlets, conserved on control medium (MS+ agar+ laboratory grade sucrose)

Using RAPD (36) and ISSR (16) primers, genetic stability analysis in *Zingiber officinale,* conserved on slow-growth media (MS+mannitol+abscisic acid), revealed that there were no significant differences in the RAPD profiles of *in vitro*-conserved clones and their respective mother plants, maintained in pots with soil.

Also, genetic stability of *in vitro*-conserved germplasm of taro (*Colocasia esculenta*) and chitrak (*Plumbago zeylanica*) was ascertained on the basis of the profiles generated with six and 10 RAPD primers, respectively, as compared with their respective mother clones.

6.3 *In Vitro* Germplasm Supply

A total of 65 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.

In addition, germplasm of *A. tuberosum* (1)*, Fragaria* spp. (1), *Gladiolus* cv. (2) *Morus* spp. (15) and *Zingiber officinale* (1) were supplied as *in vitro* cultures for research purpose.

6.4 Seed, Pollen and Dormant Buds Cryopreservation

A total of 7,922 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen have been conserved in the cryobank so far (Table 2). A total of 950 accessions of diverse germplasm were received from NBPGR regional stations viz., Shimla, Bhowali, Cuttack, Thrissur and also from CSGRC, Hosur. During the year, two exploration trips were undertaken; one to parts of MP and Rajasthan for *Cordia*, mahua and bael; second to Himachal Pradesh and J&K for minor temperate fruits. Two collection trips; one to CISH, Lucknow and another to NBPGR regional station, Shimla were undertaken for pollen collection. A total of 264 accessions were collected.

A total of 657 accessions were cryostored as seeds/ embryonic axes / dormant buds/ pollen during this period at temperatures between –160 to –180°C. Cryostored accessions comprised of temperate fruits and nuts (187), spices (19), agroforestry species (17), fibres (2), M & APs (45), industrial crops (278) which also included released varieties, wild species and wild relatives of crop plants. Pollen grains of 65 accessions of mango and *Prunus* spp were also cryostored. In addition, dormant buds of 127 accessions of mulberry were also processed for cryostorage.

Seed germination requirements were determined for temperate species of *Rubus, Ribes, Hippophae* sp.*, Elaeagnus* sp.*, Crataegus oxycantha, Carum carvi, Podophyllum hexandrum* and *Rosa* species. Desiccation and freezing sensitivity studies were undertaken in *Manilkara hexandra, Carissa carandus, C. spinarum, Phoenix sylvestris*, grape fruit (*Citrus paradisi*), *Poncirus trifoliata,* Cheura (*Diploknema butyraceae*), mahua (*Madhuca indica*) and *Prunus armeniaca* and categorization of their seed storage behaviour was ascertained. Cheura and Mahua were highly recalcitrant while other species were found to be intermediate.

Air desiccation-freezing protocols were developed for embryonic axes of *Simarouba glauca*, *Juglans regia* and *Prunus armeniaca*. Cryostorage protocols were also developed for seeds of *Manilkara hexandra, Carissa* sp., *Salvadora* sp. using desiccation-freezing methods. New cryotechniques viz., vitrification and encapsulation were applied in *Syzygium cuminii, Citrus paradisi* and trifoliate hybrids. Success achieved in all except *Syzygium.* Species of *Piper nigrum,* wild *Allium*, Jatropha and wild apricot successfully cryostored using seeds or embryonic axes. Seeds of *Carissa carandus,*

C. spinarum, Phoenix sylvestris, Cordia sp., *Diospyros melanoxylon,* various *Citrus* species and *Prunus armeniaca* revealed a decline in viability with storage periods except in *Phoenix sylvestris.*

Standardization of cryoprotocol for grafts of *M. alba, M. indica* and *M. laevigata* was done. Using improved recovery conditions, retesting of 50 cryostored dormant buds of mulberry and 6 months' cryostored apple germplasm revealed improvement in mulberry and low *in vitro* growth recovery in apple. Retesting of 50 cryostored accessions of non-orthodox and orthodox seeds revealed retention of original viability in most of the accessions.

Morphological characterization of 42 accessions of wild apricot, 12 accessions of *Manilkara hexandra*, 19 accessions of *Carissa carandus*, 5 accessions of *Aegle marmelos* and 10 accessions of *Cordia* spp. was undertaken and sizable variability was recorded.

Organization of International Training Course

An International training courses on '*In Vitro* and Cryopreservation Techniques for Conservation of Plant Genetic Resources' was organized by National Bureau of Plant Genetic Resources (NBPGR) and Bioversity International, South Asia Office, New Delhi under the Centre of Excellence programme of ICAR. This was the first International training, organized by NBPGR and Bioversity International, South Asia Office, New Delhi, at Tissue Culture and Cryopreservation Unit, NBPGR during December 4-18, 2006. There were 12 participants from the four countries namely South Africa (3), Papua New Guinea (1), Bhutan (3) and India (5). With in India three participants were from State Agriculture University and two from NBPGR HQ. The training course comprised a series of lectures and related practicals covering all aspects of *in vitro* conservation and cryopreservation of germplasm of vegetatively propagated and non-orthodox seed species.

Table 1. Status of *in vitro* conserved germplasm in TCCU (As on December 31, 2006)

Crop group	Genera (no.)	Species (no.)	Cultures (no.)	Accessions (no.)
Tropical fruits	2	19	6,000	**405**
Temperate and minor fruits	9	37	4,300	**245**
Tuber crops	5	12	9,600	**531**
Bulbous and other crops	3	17	2,634	**177**
Medicinal and aromatic plants	25	32	5,400	**180**
Spices and industrial crops	7	34	7,900	**366**
TOTAL	**51**	**151**	**35,834**	**1,904**

Table 2: Status of cryopreserved germplasm in TCCU (As on December 31, 2006)

Categories	Accessions (no.)
Recalcitrant & Intermediate	
Fruits & Nuts	1,921
Spices & Condiments	115
Plantation Crops	19
Agroforestry & Forestry	1,636
Industrial crops	770
Orthodox	
Cereals	239
Millets and Forages	287
Pseudo-cereals	76
Grain Legumes	632
Oilseeds	470
Fibers	64
Vegetables	432
Medicinal & Aromatic Plants	761
Narcotics & Dyes	34

Miscellaneous	15
Sub-total	**7,471**
Dormant buds Pollen grains	**197** **254**
Total	**7,922**
Wild Relatives*	768
Rare & Endangered plants*	76
Varieties*	646
Elite*	4
Registered germplasm*	22
Number of species	710

*- Included in respective crop groups

Total No. of species : **710**

HRD

- Imparted one month's training to a B. Tech (Biotechnology) student trainee from Rai Foundation Colleges, Delhi Campus, on aspects related to *In Vitro* Techniques for Multiplication and Conservation of Bulbous Crops.
- Imparted one month's training to a B. Tech (Biotechnology) third year student trainee from Allahabad Agricultural Institute, Deemed University, Allahabad, U.P., on aspects related to the techniques of tissue culture.
- Imparted three month's training to an M. Sc (Biotechnology) student from Department of Biotechnology, University of Rajasthan, Jaipur on "*In vitro* multiplication of *Curculigo orchioides Gaertn.*".
- Imparted one month's training to a B. Tech. (Biotechnology) student from Allahabad Agricultural Institute, Deemed University, Allahabad, U.P., on Tissue culture techniques for Conservation of Medicinal plants.
- Imparted three month's training to an M. Sc. (Biotech.) IV Semester student from Department of Biotechnology Govt. P. G. College, Guna, M.P., on aspects related to micropropagation and cryopreservation of pear (*Pyrus amygdaliformis* Vill.).
- Imparted three month's training to an M. Sc. (Biotech.) IV Semester student from Department of biotechnology Amity Institute of Biotechnology, Sector 125, Noida, U.P., on aspects related to cryopreservation of shoot tips and vegetative buds of apple.
- Imparted three month's training to an M. Sc. (Biotech.) IV Semester student from M.Sc. (Biotechnology) I.P. P.G. College Bulandshahr, CCS University Meerut, U.P., on aspects related to RAPD analysis of mulberry.
- Imparted three month's training to an M. Sc. (Biotech.) IV Semester student from Department of Biotechnology Amity Institute of Biotechnology, Sector 125, Noida, U.P.,on aspects related to RAPD molecular marker techniques.
- Imparted one month's training to a B. Tech. (Biotechnology) IV semester student from Sardar Vallabh Bhai Patel University, Modipuram, U.P., on aspects related to plant tissue culture and molecular marker techniques.
- Imparted three month's training to a B.Sc. student of Biomedical science(H) from Bhaskaracharya college of applied sciences, Delhi, on cryopreservation of diverse non-orthodox seed species.
- Imparted four month's training to an M. Sc. (Biotechnology) student from Department of Biotechnology, Guru Jambheshwar University, Hisar, Haryana, on aspects related to molecular characterization of *in vitro*-conserved germplasm of taro (*Colocasia esculenta* L. Schott) by RAPD and ISSR markers.
- Imparted four month's training to an M. Sc. (Biotechnology) student from Department of Biotechnology, Allahabad Agricultural Institute - Deemed University, Allahabad, U.P., on aspects related to Molecular characterization of *Plumbago zeylanica* germplasm using RAPD

and ISSR markers.

- Imparted four month's training to an M.Sc. (Biotechnology) student in Department of Biotechnology, Doon Postgraduate College of Agriculture Science and Technology, Dehradun,Uttaranchal, on aspects related to Genetic Diversity Analysis of *In Vitro*-Conserved Germplasm of Ginger (*Zingiber officinales* Rosc.) Using ISSR markers.
- Imparted four month's training to an M. Sc. (Biotechnology) student from Department of Biotechnology, Allahabad Agricultural Institute - Deemed University, Allahabad, U.P., on aspects related to *in vitro*-conservation of germplasm of taro (*Colocasia esculenta* L. Schott).
- Imparted four month's training to an M. Sc. (Biotechnology) student from Department of Biotechnology, Meerut University, Meerut, U.P., on aspects related to Genetic Diversity Analysis of *In Vitro*-Conserved Germplasm of Ginger (*Zingiber officinales* Rosc.) using molecular markers.
- Imparted four week's training to each of the three M. Sc. (Biotechnology) students from Department of Biotechnology, Maharshi Dayanand University, Rohtak, Haryana., on aspects related to genetic stability and *in vitro* conservation.
- Imparted two month's training to an M. Sc. (Biotechnology) student from Department of Biotechnology, Amity University, Noida, U.P., on aspects related to genetic stability and *in vitro* conservation.
- Imparted three month's training to a B.Sc. student of Biomedical Science (H) from Bhaskaracharya College of Applied Sciences, Delhi, on aspects related to cryopreservation of diverse non-orthodox seed species.

Research Projects (Project Code, Title, PI, Co-PI and Associates)

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-01.01: *In vitro* conservation of tuber crops with special reference to sweet potato, yams and taro (BB Mandal, Zakir Hussain)

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

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

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

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

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

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

PGR/TCCU-BUR-DEL-02: *Ex situ* conservation of plant genetic resources of agricultural and horticultural crops using cryopreservation of seeds (Rekha Chaudhury)

PGR/TCCU-BUR-DEL-02.01: Cryopreservation of orthodox and intermediate seed species in various forms using standard protocols (Rekha Chaudhury, SK Malik, Davendra Nerwal)

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

7. PGR POLICY PLANNING UNIT

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

1. 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.
2. 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

7.1.1 Implementation of the FAO Project on "Establishment of National Information Sharing Mechanism (NISM) for Monitoring the Implementation of Global Plan of Action (GPA)".

The activities envisaged under the project were completed after the meeting of the National Advisory Committee held in March 2006, wherein the draft report was approved with suggested modifications. The National Report on the NISM has been finalized and is under printing. The salient achievements of NISM-GPA project were:

- Identification of all major institutions involved in PGR related activities and synthesis of all PGR work in India.
- A serious lack of institutional mandate in the area of *in-situ* management of PGRFA, is felt, which requires to be strengthened.
- Due emphasis may be given to *in-situ* on-farm conservation of old varieties, traditional cultivars and landraces.
- Priorities in major food crops should be collection of traits specific and area specific diversity.
- Mini-core sets for specific traits in germplasm of different crops should be developed for optimum utilization of PGR.
- Information generated under this project can be used to identify priority areas of research and eliminate duplication in efforts of various agencies.

7.1.2 Digitization of Extant/ Notified Varieties (funded by DAC)

Verification of all data entries in the database developed under the project, was completed during the year including:

- Database of all notified / released varieties since 1965
- Database of notified, de-notified and provisionally notified varieties
- Database of reference collections as per DUS test guidelines for the Protection of Plant Varieties and Farmers' Right Authority.

7.1.3 Operationalization of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

Observations and technical inputs were provided to ICAR/ DAC and FAO for the development of compliance measure of the Treaty and the Standard Material Transfer Agreement (SMTA). The SMTA has been approved during the 1st meeting of the Governing Body of the Treaty in June 2006, was in India was duly represented.

7.1.4 Functional Committee on Plant Genetic Resources

The fifth Meeting of the Functional Committee on Plant Genetic Resources was organized on March, 2006 with the agenda to discuss the draft National Report of the FAO funded project on Implementation of GPA. The second issue discussed was the access and benefit sharing options raised by the Ministry of Environment and Forests (MoEF). Views of the Functional Committee have been communicated to MoEF for further inputs to Conference of Parties (CoP) of the Convention of Biological Diversity (CBD).

7.1.5 Guidelines for Exchange of Genetic Resources under collaborative research projects.

Technical inputs were provided to ICAR/ DARE for formulation of guidelines for exchange of plant genetic resources for food and agriculture under collaborative research project. These guidelines have now been notified by the Biological Diversity Authority for exemption to request permission from National Biodiversity Authority, as per the section 5 of the Biological Diversity Act, taking in view the ICAR/ DARE's draft guidelines.

7.1.6 Formulation of ITMU as per guidelines of ICAR

Institute Technology Management Committee (ITMC) has been constituted as per the ICAR guidelines for Intellectual Property Management and Technology Transfer/ Commercialization. These guidelines have come into force since October 2006. The ITMC to be constituted for each ICAR institute would function as the decision making body relating to all issues of IP Management and Technology Transfer/ Commercialization. The NBPGR, ITMC has the following members.

- Director NBPGR- Chairman
- Dr PC Agarwal, Principal Scientist, Plant Quarantine Division- Member
- Dr KV Bhat, Senior Scientist, NRC on DNA Finger Printing- Member
- Dr RK Tyagi, Senior Scientist, Tissue Culture and Cryopreservation Unit- Member
- Dr Sanjeev Saxena, Senior Scientist, Conservation Division- Member
- Dr Pratibha Brahmi, Senior Scientist, PPU will act as Member Secretary

7.2 Provided Technical Input for the following:

International Plant Protection Convention (IPPC) of FAO

1. For revision of the following International Standards of Phytosanitary Measures prepared by IPPC/ FAO under WTO/ SPS Agreements
   - 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
   - Guidelines for consignments in transit
   - Principles for the protection of plant health

Conference of Parties- 8 of CBD

1. For defending India's stand as a part of Indian delegation along with other experts from MoEF and MoT on the following
   - the moratorium on GURT technology
   - modalities for dealing with invasive alien species through SBSTTA meetings

Department of Agriculture and Cooperation (DAC)

1. Compiled and prepared generic pest risk analysis (PRA) for 140 plant species which are not listed in Schedule V, VI or VII for facilitating import of their germplasm and submitted it to DAC for validation
   - Two meetings to discuss the PRA held (October 5, October 29, 2006)
   - Reminders for speedy expedition sent to DAC/ ICAR
2. Inputs given in monthly meetings of EXIM on phytosanitary issues related to trade and trade negotiations with other countries
   - INDO- US and INDO- Japan negotiations for export of mangoes
3. Participated in negotiations for wheat import based on analysis of phytosanitary requirements related documents from Australia, Canada, Ukraine and USA
4. Inputs given on Quarantine objective of minimizing risk of introduction of exotic pest/ disease vis-à-vis the need to relax phytosanitary requirements for easier import of quality germplasm and sowing materials required to increase productivity, yields and farm income during a Workshop to Review the Implementation of Schedules V and XI of the Plant Quarantine Order 2003 on September 5, 2006 by DAC
5. Technical inputs were provided to DAC for revision of the following

- International Standards on Phytosanitary Measures (ISPMs)-
  o Revision of ISPM No. 2: Pest Risk Analysis
- Guidelines for the importation of plant breeding material for scientific research and development purposes.
- Regional Standards for Scale Insects

ICAR

- For framing response to Supreme Court litigation by NGO on wheat import
- A concept note on establishment of National Institute of Plant Virology for transmission to Knowledge Commission, GoI.
- Global Crop Diversity Trust
- Inter-Governmental Commission on Genetic Resources, traditional knowledge and folklore of the WIPO
- African seed and Biotech programme
- Technology development framework and delivery system in agriculture
- List of Commodities to exempted from BDA
- Jai Kisan Draft National Policy for Farmers
- Bhutan Research -MoU/ICAR

Ministry of Environment and Forests

- Development of third National Report of the India on compliance to Convention on Biological Diversity (CBD), on invasive alien species, and risk assessment aspects under the WTO/ CBD
- Follow up meetings of CoP-8 meeting of CBD held at Curitiba, Brazil as a member of Indian delegation along with other experts
  - Comments for inclusion of paras on role of Invasive Alien Species and transgenics in NBSAP

DBT

- National Consultation on issues related to Plant Quarantine Order, May 17, 2006, DBT, New Delhi on Issues for the Revision of Plant Quarantine Order 2003 with Special Reference to Biotechnology
- Input in meetings of Review Committee of Genetic Manipulation, Monitoring and Evaluation Committee and Project Evaluation Committee

Ministry of Home Affairs

Contributed in Inter-ministerial Expert Group on Bioweapons on requirements, strategies and steps in collection, maintenance and characterization of information and samples of biological agents and in preparation of Standard Operating Procedures for 36 diseases/ pests

Research Information System for Developing Countries

Contributed concept paper in handling, packaging, transfer and storage of GMOs during transboundary movement for MoP- 3 meeting of CBD

National Farmers Commission

Contributed on status and need for developing biosecurity set-up in India for National Farmers Commission

Research Projects (Project Code, Title, PI, Co-PI)

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

PGR/PPU-BUR-DEL-01-01: PGR management and related issues (P Brahmi, S Saxena, GJ Randhawa)

PGR/PPU-BUR-DEL-01-02: Policy issues related to plant biosecurity (RK Khetarpal, Rajan, Kavita Gupta)

8. NRC ON DNA FINGERPRINTING

Summary: NRC on DNA Fingerprinting has so far developed protocols for cultivar identifications in 33 crops of national importance using the molecular marker techniques like STMS, AFLP and ISSR. The crops include cereals (rice, wheat, barley), millets (fingermillet, sorghum, pearlmillet), pulses (chickpea, French bean, horsegram, lentil, peas, pigeonpea, mungbean, ricebean, urdbean, soybean), oilseeds (mustard, safflower, sesame, niger), fibres (cotton, jute), vegetables (tomato, chillies) fruits and nuts (banana, mango, cashew, citrus) and medicinal plants (chlorophytum, neem, vetiver). A total of 2,215 varieties in different crops were fingerprinted till December 2006. The analysis of diversity in molecular markers of important crops like rice, mungbean, oilseed brassicas and tomato have provided insight into the genetic base of Indian crop varieties. Such information will form the basis for developing efficient strategies for their breeding and genetic resources management.

Various molecular markers have been used to analyze the phylogenetic relationships in Asiatic Vigna complex and relatives of eggplant, namely, *Solanum melongena* (brinjal) with wild and weedy species existing in South Asia. The studies indicate that *S. melongena* has originated in South Asia from a wild species, *S. incanum* existing in this region. Analyses of Vigna species complex has indicated that the Asiatic pulses have different path of evolution than the African pulses such as cowpea. The study also helped in the identification of probable progenitor species of *radiata-mungo* complex.

The Centre has also developed PCR-based detection systems for identification of transgenes in important crop plants. Transgenic samples of maize, cotton and golden rice have been tested for various transgenes. Primers have been designed for scorable/ selectable markers, regulatory sequences and *cre* sequence of terminator gene. In addition, primers corresponding to different regions as well as different sequences of transgenes such as *CP4EPSPS, Vip3, Aox* and *Cry1A(c)* have been designed.

The centre has contributed significantly towards human resource development in fingerprinting technology. The scientists of the Centre has been teaching seven courses related to population genetics, biotechnology in PGR and bioinformatics to M. Sc. and Ph. D. students of PGR, Genetics and Agricultural Statistics at IARI. Further, guidance has been provided to M. Sc. and Ph. D. students and scientist trainees in the application of molecular markers.

Details of the research accomplishments of the Centre are presented below under different thematic areas:

8.1 DNA Marker Technology for Cultivar Identification

8.1.1 Rice (*Oryza sativa*): Out of three hundred and seventy six DUS tested rice varieties procured from National Gene Bank, DNA profiling of 240 varieties using 30 Sequence Tagged Microsatellite (STMS) markers has been completed. A total of 61 alleles were detected with an average of 2.3 alleles per locus and principal component analysis (PCA) significant values were 10.9, 2.5 and 2.0. Cluster analysis on the basis of dendrogram generated using Jaccard's similarity coefficient grouped all the rice varieties in two major clusters with four sub groups. A 3D diagram based on PCA is shown in Figure 1.

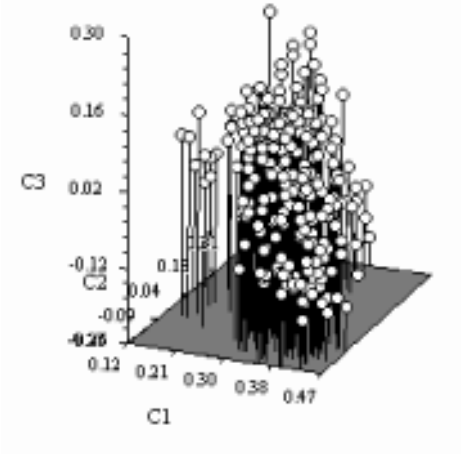


Figure 1. Principal Component Analysis based on STMS study of 240 rice varieties

8.1.2 French bean (*Phaseolus vulgaris*): In French bean, the AFLP profiling of 26 released varieties was completed with 12 primer pairs selected earlier based on marker informativeness. A total of 850 amplicons

were scored, the average similarity among cultivars was 52%. These 26 varieties were also profiled with 28 selected STMS primer pairs selected after screening over 45 primer pairs obtained from published literature. A total of 115 alleles were scored at an average of 4 per locus. A comparison of the marker systems indicated that although STMS were more robust, the AFLPs had greater utility for varietal identification due to their high marker density.

8.1.3 Pigeon pea (*Cajanus cajan*): The DNA profiling of available released varieties of pigeon pea was completed using the 12 selected AFLP primer pairs. The analyses also included selected germplasm lines; hence a comparison of the diversity in released varieties and local cultivars was possible. A total of 96 released varieties and germplasm lines of pigeon pea were analyzed with 12 selected AFLP primer pairs. The comparison indicated presence of low diversity (average similarity of 0.78) among the released varieties while high diversity (average similarity of 0.36) among the germplasm lines (Figure 2). The results indicate the need to analyse the landraces for diversity so that these could be exploited in breeding programmes.

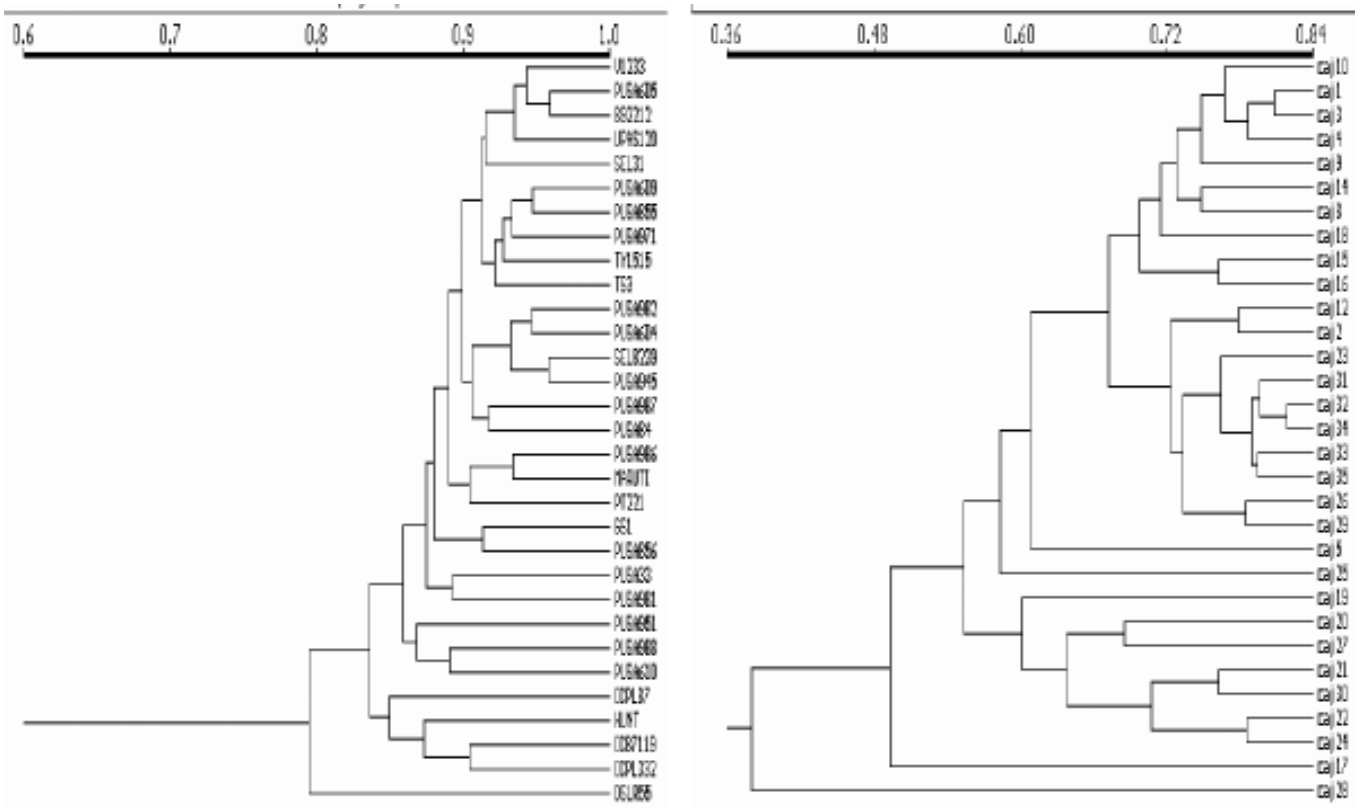


Figure 2. Comparison of genetic diversity in 31 released pigeon pea varieties (tree on the left) and 32 germplasm lines (tree on the right) – based on AFLP data. The average similarity index among released varieties was 0.78 while among germplasm lines was 0.36.

8.1.4 Linseed (*Linum usitatissimum*): Anchored inter-simple sequence repeat (ISSR) markers were used to get information on the prevailing diversity in 21 linseed cultivars. Using 24 primers, 183 markers were generated. A total of 7.6 bands per primer were observed and 2.7 bands per primer were found to be polymorphic. Per cent polymorphism was 34.97 whereas average genetic similarity among the cultivars was 56 per cent. Average polymorphism information content (PIC) for 24 primers was 0.126. All the cultivars could be distinguished from one another using combined profiles of all the primers. Cluster analysis revealed three cultivars, namely KL3, Gaurav and Jawahar 522 to be distinct from the rest.

8.1.5 Lentil (*Lens culinaris*): Nineteen cultivars and 25 landraces representing 14 lentil growing states of India were fingerprinted using sequence related amplified Polymorphism (SRAP) markers. A total of 30 primer combinations were used which amplified bands ranging from 2 (EM1-ME2) to 48 (EM4- ME3) in the size range of 50 to 450 base pairs. All primer-combinations produced polymorphic bands. Average genetic diversity in the material was found to be 41%. All the cultivars and

landraces could be discriminated based on combined profiles for 30 primer-pairs. Landraces and cultivars grouped in separate clusters with few exceptions. Cultivars B177, Precoz, B77 and JL3 and landraces IC-53234 and IC-32367 were found to be distinct from rest of the material which could be used as lentil genetic resource. Besides, STMS analysis in lentil was carried out in the same material. Twenty-five STMS primer pairs were synthesized and PCR conditions and profiling using ten primer pairs was completed.

8.1.6 Cotton (*Gossypium hirsutum*): Thirty STMS primer-pairs were selected to attain optimum amplification in 40 parental lines of cotton hybrids to identify markers useful for seed purity testing after initial screening of around one hundred primers. These 30 primer pairs generated a total of 170 amplification products, of which 160 were found to be polymorphic. This resulted in 94.11% polymorphism. The range of polymorphic markers per primer was 0 to 12 with an average range of 5.33 polymorphic bands per primer. Additionally, fifteen SRAP primer combinations were used in the same material which generated a total of 160 amplification products, among which 97 were found to be polymorphic. This resulted in 60.6 % polymorphism. Markers have been identified which can be used for testing the purity of hybrid seed lots.

8.1.7 Cucumber (*Cucumis sativus*): STMS profiles were developed for thirty six varieties of *Cucumis sativus* and eleven accessions of *Cucumis hardwickii* with twenty five primer pairs. STMS polymorphism for the locus CMTC160a+b is depicted in Figure 3. Further, STMS primer screening and profiling and comparison of genetic diversity in these accessions is in progres.

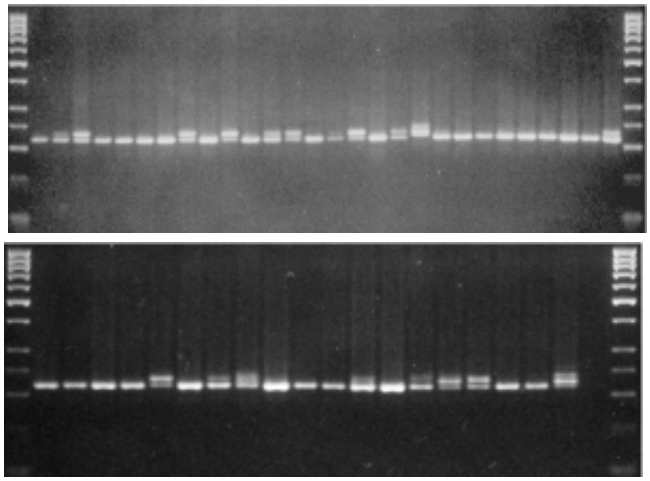


Figure 3: STMS profile of 47 *Cucumis sp*. accessions developed for the locus CMTC160a+b

8.2 Genetic Diversity Analyses

8.2.1 Mungbean (*Vigna radiata*): NBPGR had identified a national core collection in mungbean based on passport and selected minimal descriptors. In order to validate the core and to assess the extent of diversity represented in the core, a molecular analysis was initiated. The study involves estimation of diversity in mungbean core collection (110 accessions) using selected STMS primers. The data generated would be used to estimate spatial distribution of diversity based on origin of the accessions. The information generated would be useful for identifying regions of higher diversity and for making more targeted collections in these areas.

8.2.2 Banana and plantains (*Musa* sp.): The North Eastern states of India have been identified to be the hot spots of diversity for bananas and plantains. Some of the cultivars of banana collected from this region such as 'Calcutta 4' has contributed valuable resistance genes for banana improvement programmes all over the world. Hence, this analysis was undertaken to assess the diversity in banana collections from North Eastern region. STMS markers were identified based on their genomic localizations and extent of polymorphism prevalent at the different loci. A set of 12 highly polymorphic STMS primer pairs were selected to analyze 86 accessions of *Musa*. The results indicated that all *Musa* cultivars analyzed could be distinguished by their combined STMS profiles from 12 polymorphic primer pairs, indicating thereby that the STMS markers identified could be used for DNA fingerprinting of banana and plantain cultivars. The probability of chance identity of profiles of any two of the cultivars taken at random was as low as 5.144 X 10-9. The triploid cultivars of AAB and ABB genomic group were the most diverse in comparison to the diploids, *M. acuminata* and *M. balbisiana*. The STMS markers used in the analyses efficiently clustered the *Musa* cultivars into specific genomic groups. The two progenitor species of cultivated bananas, namely, *M. acuminata* (A genome donor) and *M. balbisiana* (B genome donor) were well differentiated genetically. The A genome donor, *M. acuminata* was observed to be closer to both AAB and ABB triploid cultivars in comparison to the B genome donor *M. balbisiana*. The high value of F_{ST} statistics (0.606) indicated strong differentiation of *M. acuminata, M. balbisiana*, AAB and ABB genomic groups (Table 1). Comparison of Jaccard's similarity coefficients among AAB and ABB group cultivars from Northeast

Table 1. Pairwise F_{ST} between the 4 genomic groups of *Musa* as revealed by the STMS marker polymorphism indicating high differentiation of all groups except the AAB and ABB group.

Genomic group	acuminata	balbisiana	AAB group	ABB group
acuminata	-	-	-	-
balbisiana	0.823	-	-	-
AAB group	0.615	0.642	-	-
ABB group	0.603	0.620	0.153	-

and earlier reported analyses from India indicated prevalence of greater genetic diversity among the North Eastern cultivars. This study highlights the need to make more elaborate collections from the North Eastern regions to capture more diversity for *Musa*.

8.2.3 Mango (*Mangifera indica*): Clonal variation was studied in 73 accessions of 6 cultivars (Amrapali, Mallika, Banganpalli, Dashehri, Mulgoaand Langra) using 10 anchored ISSR primers. This is the most elaborate effort so far in studying molecular basis of intra cultivar variation in mango. Clonal variation was detected in 4 out of 6 cultivars studied with clones of all cultivars clustering within the representative cluster. Clones of 'Banganapalli', 'Langra', 'Mulgoa' had similarity values between 0.77 and 0.84. In 'Mallika' similarity values of variants ranged from 0.97 to 0.99 with a correspondence between the morphological and molecular variations observed within Langra and Banganpalli.

8.3 Phylogenetic Analyses

8.3.1 *Vigna* species: The genus *Vigna* includes several of the cultivated pulses. The group *Ceratotropis* has contributed pulses of importance to the South East Asia, and these include green gram, black gram, rice bean, adzuki bean and mothbean. India has over 15 distinct wild species of *Vigna* that are related to these pulses. An elaborate analysis of the extent of relationships and genetic affinities among the wild relatives is of importance to their utilization in crop improvement programmes. Hence, this analyses was initiated to study the extent of differentiation among the wild *Vigna* species. STMS marker system was chosen for the purpose since these markers are codominant. Eighteen STMS primer pairs were selected to analyze 139 populations representing 50 species of *Vigna*. The statistical analyses in underway which is likely to indicate the extent of differentiation of the species and populations, the proportion of gene flow among these populations and relationships of the wild species to their cultivated derivatives.

DNA sequence analyses of 51 *Vigna* species (135 accessions) for two rDNA and two cpDNA regions was also conducted to precisely define the relationships among the cultivated and the wild species. The results indicated (Figure 4) clear differentiation of the species belonging to *Ceratotropis* group and the African group. Further, the *ITS1* sequences indicated major differences for insertions in *V. radiata* & its relatives, in *V. hainiana* and *V. mungo*. The Asiatic and African *Vigna* were observed to differ for large insertions or deletions. The Asiatic and African *Vigna* have followed different evolutionary paths is evident in Figure 4. The species *V. hainiana* appears to be more closer to *V. radiata* than to *V. mungo* and this species appears to be more primitive in comparison to the close wild relatives for green gram and black gram. The species *V. khandalensis* is closer to *aconitifolia* group than to any other species of Asiatic origin. The African species, *V. unguiculata* and its relatives have an evolutionary mechansim different from members of *Ceratotropis* group.

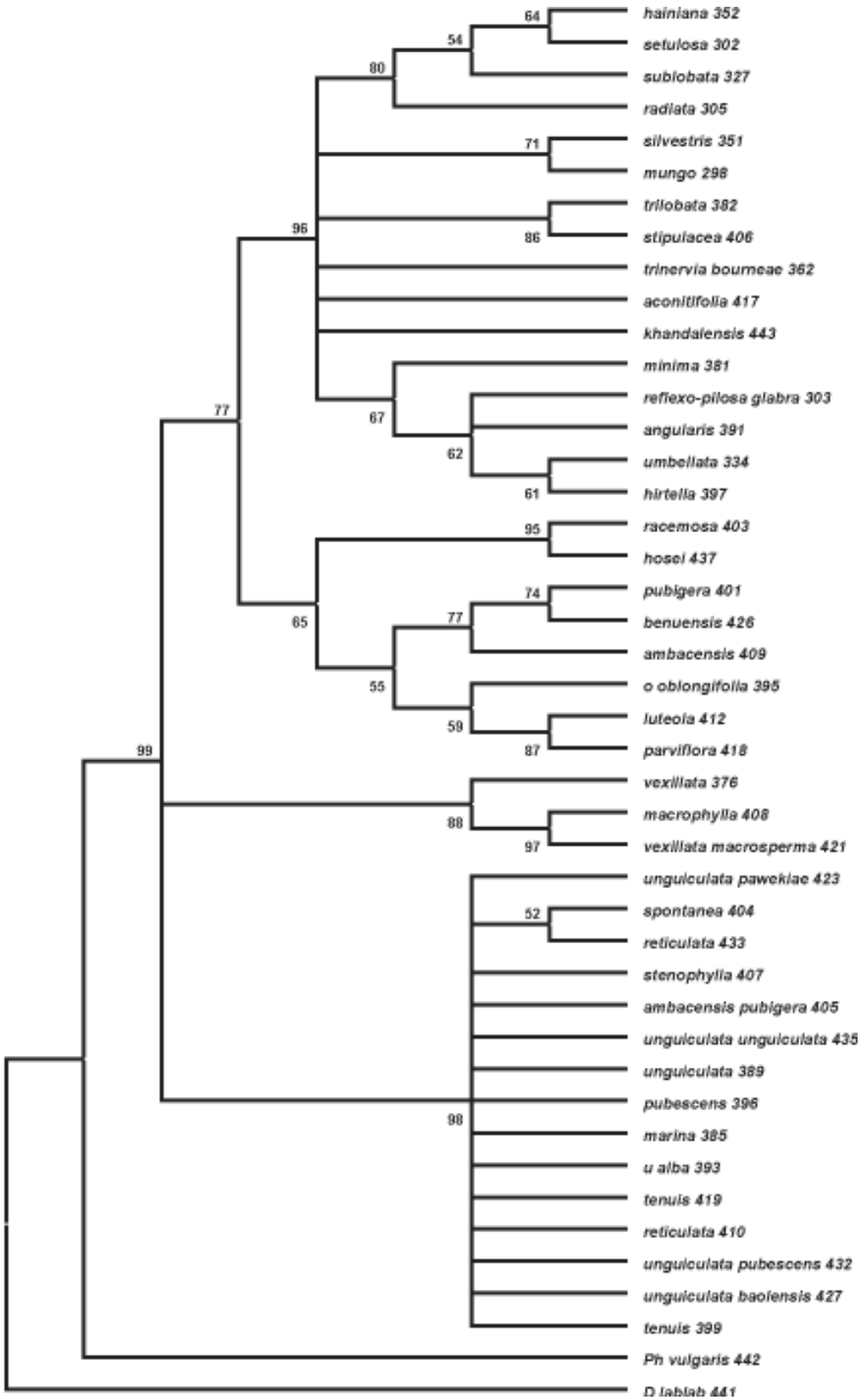


Figure 4. Minimum evolution tree for the *Vigna* species based on *ITS1* sequences. The species belonging to the *Ceratotropis* group are well differentiated from the African *Vigna*. Only the bootstrap values greater than 50% are indicated at the nodes of the trees.

8.4 Identification of New Markers for DNA Profiling

8.4.1 Pigeonpea (*Cajanus cajan*): The public nucleotide sequence databases were screened for identification of sequences containing simple sequence repeats. As a result, 70 primer pairs were designed for analyses of SSRs in pigeonpea. The screening indicated presence of medium to high polymorphism with some of the primer pairs (Figure 5). Overall, very good amplifications were obtained with 65 of the primer pairs. In the germplasm set of 65 accessions, polymorphism within *Cajanus cajan* was observed with only 4 primer pairs. Remaining primer pairs were polymorphic at interspecific level.

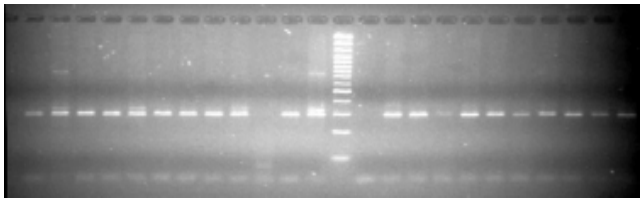


Figure 5. Pigeonpea DNA sequences from GenBank were analyzed for presence of SSRs. 70 primer pairs were designed to amplify SSR regions in pigeonpea.

Efforts were also made to identify STMS primers suitable for DNA profiling of mungbean, urdbean and rice bean. The STMS primer pairs from adzuki bean, cowpea and soybean were screened. Out of the 67 STMS primer pairs screened, 45 primer pairs were identified to be suitable for DNA profiling in mungbean, urdbean and rice bean. The number of alleles scored in these pulses ranged from 2 to 21 per primer pair indicating thereby amenability of transfer of heterologous SSRs to *Vigna* group.

8.4.2 Brinjal (*Solanum melongena*): A microsatellite enriched genomic library of brinjal was constructed for development of new STMS markers. More than 2,300 clones were sequenced for the $(GA)_n$ rich core repeats to identify the positive clones for sequencing and synthesis of primers. Forty per cent of the identified clones contained repeat regions. Following *in silico* analysis of the sequence data, primers were designed from fifty clones for optimization of amplification conditions resulting in the identification of thirty-two new STMS loci in brinjal. Seventy seven alleles were amplified in ninety six accessions of brinjal using these newly developed markers with the number of alleles scored ranging from 2 to 5 per primer pair. Figure 6 shows the DNA profile of brinjal accessions using primer pair EP1.

In addition to the newly developed markers, 96 brinjal accessions were fingerprinted using twenty three previously available primer pairs.

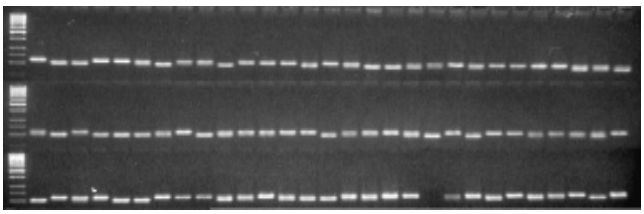


Figure 6. DNA profile of brinjal accessions using the STMS primer pair EP1

8.5 Molecular Testing of Transgenic Planting Material

- One hundred and sixty seven imported samples of transgenic *Brassica*, *Gossypium*, *Oryza* and *Zea mays* were tested for the absence of terminator gene using specific *cre* primers as well as for specific gene inserts including *cry1Ac*, *cry2Ab*, *epsps* and *cry1Ab* genes.
- PCR-based detection of *cry1Ac* gene sequence in Bt cotton event Bollgard-I (Figure 7) and simultaneous detection of *epsps* gene and *CaMV 35S* promoter sequences in transgenic cotton with herbicide tolerance (Figure 7) have been standardized.

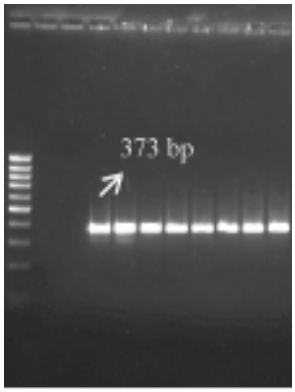


Figure 7. PCR based for detection of *cry1Ac* gene in Bt cotton Bollgard-I

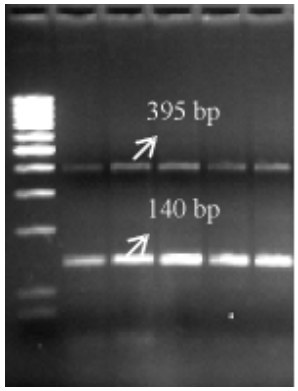


Figure 8. Multiplex PCR of *epsps* gene (395 bp) and *CaMV 35S* promoter (140 bp) in Bt cotton

8.6 Capacity Building for Implementation of Cartagena Protocol on Biosafety

- PCR-based protocols for detection of GM maize (MON 810 event) have been standardized using certified reference materials (CRMs) having different mass fractions (0, 0.1, 0.5, 1, 2 and 5%) of dried seed powder of GMM (Figure 9a and b).

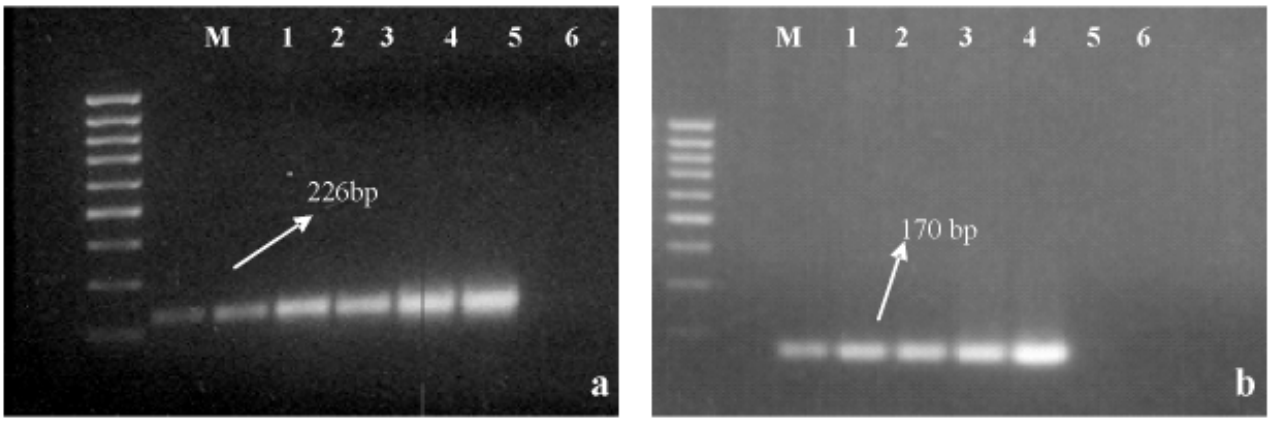


Figure 9. PCR amplification of standard MON 810 maize (Fluka BioChemica) samples; (**a**) using *35S* promoter specific primer and (**b**) using *cry1A(b)* specific primers; (Lane M: 100 bp DNA ladder, Lanes 1-6: 0.1, 0.5, 1, 2 and 5% MON 810 samples)

- PCR based testing of Bt brinjal (Figure 10) and Bt cauliflower has been standardized.

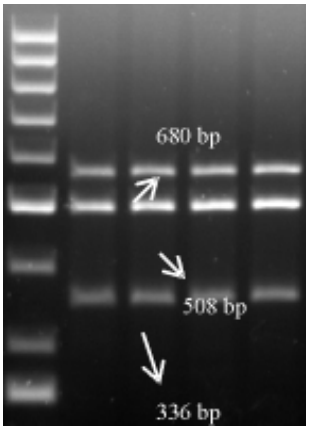


Figure 10. Detection of 336 bp of *cry1Ab* gene, 508 bp of *nptII* gene and 680 bp of endogenous plant chloroplast gene in Bt brinjal.

8.7 Crop DNA Fingerprint Database

Software entitled "Crop DNA Fingerprint Database" has been developed using Visual Basic environment at front end and MS Access at back end. It is interactive software that stores and retrieves information as per user's choice and also performs data analysis. The DNA profiles of the cultivars and elite germplasm are stored in this database. In addition, several forms, reports and modules have also been developed for user interface in current year are depicted below:

Data Menu

Data menu in Menu bar deals with View, Edit, Delete and View Profile Table activities of records stored in database. User can select Crop and Technique from Combo box and Datagrid shows the results.

Form for Inserting Crop Photo

Allows uploading of Crop Photo in database by clicking Insert Crop Photograph from Data Updation menu.

Forms for Data Availability

Indicates the details of total data available in database.

This menu consist of two options.

1. View Data stored in Database
   This option shows the stored data in data grid and total of Crop, Primers and Varieties stored in database.
2. Data Availability in Excel
   This option is used to generate report in MS Excel of Data stored in database.

Forms for Search Menu

There are four types of Searches in Menu Search.

1. Search for Crop
   This option is used to get the details of particular crop. User is prompted to select crop from the list box. Upon selecting crop, details of crop are displayed.
2. Search for Technique
   User is prompted to select technique from the list box. Upon selecting technique, details of technique are displayed.
3. Search for Primer
   There are two types of search for primer searching

1. Search by Crop and Technique:
   In this case user is prompted to select crop and technique from dropdown box. After submitting

the choice the program will show all the primers with respective number of bands.

2. Search by selecting primer:
In this option user would be able to see all the available primers in the database. User has to select the primer and click submit button. Thereafter, program will show the detail of selected primer. The details include-

- Crop and technique to which the selected primer belongs.
- Total number of primers in the crop with their respective number of bands.

Search for Variety

There are three options for variety searching.

1. Search by Crop and Technique:
This option prompts user to select crop and technique from dropdown menu. Upon selecting choice, program shows all the varieties of selected crop profile table in data grid.

2. Search by Selecting Variety:
In this option, user gets list of varieties available in database. User selects and submits his choice. Thereafter, program will show the detail of selected variety. The details include:
   - Crop and technique to which the selected variety belongs.
   - Total number of varieties in the crop.
   - Bands present or, absent, missing bands and total number of bands for each primer with their details of selected variety in the data grid.

3. Search by Crop, Technique, Primer:
This option takes input of crop, technique, primer and variety. After submitting the choice it is showing details of selected variety. In the results it shows, total number of bands, bands present, bands absent, missing bands of selected variety. In addition to this, it is showing a data grid of all the bands with band size and profile values.

Form for barcode representation

Barcode Representation is another representation of profile table where presence of band is reflected by a bar. It develops band map for all primers in a particular profile table. Barcode is shown in MS Excel file, as shown in Figure 11.

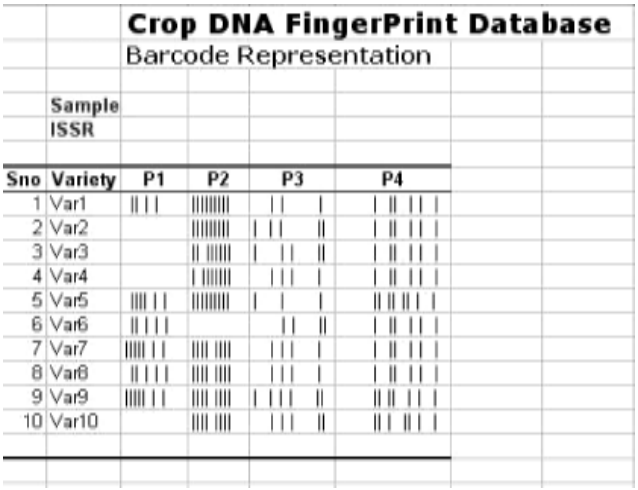


Figure 11. Barcode generation for selected primers and varieties

Form for Statistical Analysis

Facility has been developed in the software to perform statistical analysis on profile table.

Following are eleven types of analysis programs which can be used:

1. Coefficients (Jaccard's, Dice, Simple Matching)
2. Frequency of occurrence of marker
3. Gel Scoring Qualitative Data
4. Average number of bands per cultivars
5. Probability of chance identity
6. Polymorphic information content
7. Polymorphic loci
8. Gene diversity
9. Resolving power
10. Shannon diversity index
11. Marker informativeness (Fraction of Polymorphic Loci, Effective Multiplex Ratio, Diversity Index, Marker Index)

Reports

Different types of reports were developed for different types of analysis. Some of them are discussed here.

1. Report for Coefficients (Jaccard's, Dice, Simple Matching)
There are two types of reports generated for Coefficients analysis.
   1. Standardized report
   2. Matrix Report in MS Excel

2. Report for Probability of Chance Identity Analysis
There are two types of reports to show results. First type of report is 'Detailed Report in Excel'. Second type of report is Standardized Report.

Standardized Report is sorted in ascending order according to the value of Probability of Chance Identity. Primers having higher values of probability are better primer to be considered.

Help

Help option in menu bar is developed to provide assistance to the user while working. It consist of 26 help files. It provides help for starting, data managing, searching and performing statistical analysis.

8.8 Digital Photo Library

Database of digital photo library has been updated with the photographs of recently published annual report 2004-05. Photographs were scanned and relevant information about the picture were entered in the database.

8.9 Web page

Web page for NRC on DNA fingerprinting has been developed and linked with NBPGR website. It consists of information about all the projects, varieties fingerprinted, human resource development, and publications. Detailed information about respective scientists and various crops is also provided. Homepage of NRCDF is shown in Figure 12.

Figure 12. Web page of NRC on DNA Fingerprinting

Research projects (code, title of the project, PI, Co-PI and Associates)

PGR/DFP- BUR-DEL-01.00- Technology Development for DNA Fingerprinting of Cereals and Millet Crops (Lalit Arya, GJ Randhawa, Rakesh Singh and Sunil Archak)

PGR/DFP- BUR-DEL-02.00- Technology Development for DNA Fingerprinting of Pulses, Oilseeds and Fibres. (KV Bhat, GJ Randhawa, MK Rana, Rakesh Singh and AB Gaikwad)

PGR/DFP- BUR-DEL-03.00- Technology Development for DNA Fingerprinting of Horticultural Crops (AB Gaikwad, Sunil Archak (on study leave)

PGR/DFP- BUR-DEL-04.00- Technology Development for DNA Fingerprinting of Medicinal and Aromatic Plants.(G.J. Randhawa and Rakesh Singh)

PGR/DFP- BUR-DEL-05.00- Crop DNA Finger Print Database and Statistical Analysis Package (Madhu Bala)

Externally funded projects

Development of PCR Based Methods for Testing of Transgenic Planting Material. (GJ Randhawa, Rakesh Singh – Funded by DBT).

Capacity Building for Implementation of Cartagena Protocol on Biosafety in India (SK Sharma, GJ Randhawa, Shashi Bhalla, V Celia Chalam, Vandana Tyagi) –Funded by Global Environment Facility GEF World Bank Project.

Analysis Oof Genetic Diversity aand Phylogenetic Relationships in *Solanum Melongena* L. and Related Wild and Weedy Taxa. (KV Bhat, A Gaikwad – Funded by DBT).

Molecular characterization of promising genetic materials of cotton. (MK Rana, KV Bhat - Funded by Cotton Technology Mission, ICAR).

DNA fingerprinting of elite *Jatropha* accessions. (KV Bhat – Funded by CSIR).

Molecular Breeding network project. (SK Sharma and KV Bhat. – Funded by ICAR).

9. REGIONAL STATION, AKOLA

Summary: A total of 260 accessions of germplasm comprising pulses (5), oilseeds (4), vegetables (103), fruits (4), medicinal plants (10), social forestry species (4) and wild relatives of crop plants (130) were collected from Vidarbha and Marathwada regions of Maharashtra. During the period under report, a total of 4,685 accessions comprising millets (636), oilseeds (3,617), under utilized crops (244) and wild relatives of crop plants (188) were grown and maintained at the centre out of which 198 accessions of winged bean and 142 accessions of soybean were evaluated for nine and twelve agro-morphological traits respectively. A total of 669 accessions of germplasm comprising barnyard millet (78), little millet (58), kodomillet (40), foxtail millet (165), niger (280) and soybean (48) were sent for long-term conservation in the National Gene Bank. A total of 2,533 accessions were supplied to various indenters. Crop-wise details of material supplied includes soybean (62), sesame (706), okra (729), horse gram (983), *Abelmoschus moschatus* (7), foxtail millet (9), barnyard millet (10), little millet (3), prosomillet (1), winged bean (20), *Glycine curvata* (1), *G. tabacina* (1) and *G. latifolia* (1).

The Regional Station, Akola was established in November 1977 in Dr PDKV Campus at Akola. It is situated in $20^0$43' North Latitude and $77^0$04' East Longitude. The experimental farm area is 50 acres, which is on lease from Dr. Panjabrao Deshmukh Krishi Vidyapeeth for 99 years. Akola is situated in semi-arid zone at an altitude of 281 meters above mean sea level. The area is characterized with black cotton soil derived mostly from basalt rocks.

The prime objective of the station is to explore, collect, evaluate, maintain and conserve the plant genetic resources of different agri-horticultural crops of the Central Indian region i.e. Maharashtra, Chhatisgarh, Madhya Pradesh and adjoining regions of Gujarat and Karnataka.

This station also provides the desired germplasm to the breeders and scientists of different institutes / universities in India and abroad for their research work focused to improve the agri-horticultural crops. It is one of the cooperating centers for All India Co-ordinated Research

Projects on Under Utilized Plants. It is also the Zonal Headquarter for Zone IX under NATP on Plant Biodiversity.

Tuber variability in *Momordia dioica* accessions collected from the Vidarbha region of Maharashtra during October 2006.

Fruit variability in different accessions of *Cucumis melo* collected from Vidarbha region of Maharashtra.

9.1 Exploration and Collection of Germplasm

Spine gourd (*Momordia dioica*) dehisced fruit showing seeds.

Two exploration and collection missions were undertaken, one to the Vidarbha region and the other to the Vidarbha and Marathwada regions of Maharashtra and assembled a total of 260 accessions of germplasm. The first exploration was targeted for the collection of *Momordica dioica* germplasm and the second was for *Abelmoschus* and *Trichosanthes* spp. germplasm. During the first trip, six districts were covered and collected 122 accessions belonging to 32 species in 25 genera including 51 accessions of spine gourd

Fruit variability in wild *Cucumis callosus* collected from Vidarbha region of Maharashtra.

germplasm. During the second exploration mission, ten districts were surveyed and a total of 138 accessions of germplasm belonging to 23 species in 15 genera comprising 73 accessions in five species of *Abelmoschus* and eight accessions in two species of *Trichosanthes* were collected.

Collection of *Momordica dioica* germplasm: An exploration and collection mission was undertaken to the Vidarbha region of Maharashtra covering six districts viz. Akola, Buldana, Washim, Amravati, Wardha and Yavatmal, from October 6 to 13 2006, for the assemblage of spine gourd *(Momordica dioica)* germplasm. A total of 122 useful and varied germplasm accessions (62 seeds and 60 vegetative) belonging to 32 different species spread over 25 genera was collected during the mission. This comprised 51 accessions (46 tuberous and 5 seeds) of the targeted species viz. *M. dioica*. Wide variability has been observed in the fruit size, weight, days to maturity and the size, shape and weight of tubers of spine gourd. Apart from spine gourd, 13 germplasm accessions of two different species of wild *Trichosanthes* and five accessions in three different species of *Abelmoschus* targeted for the subsequent exploration mission were also assembled. The collected germplasm belonged to different crop groups such as the vegetables comprising 51 accessions of spine gourd, four accessions each of bitter gourd and melon, two accessions each of bottle gourd and smooth gourd, one accession each of okra, taro and chinese spinach; pulses comprising four accessions of cow pea; tree borne oil seeds comprising three accessions of *Jatropha* and one accession of *Pongamia;* fruits comprising one accession each of Indian gooseberry, custard apple, bael and jamun, three accessions of medicinal plants; 37 accessions of wild relatives of crop plants and four accessions of social forestry species. One accession of okra germplasm (N/0658) with long, light green, cylindrical fruits with no prominent ridges and one accession of wild *Luffa cylindrica* germplasm (N/06-37) with ball like fruits were the specific collections. The collected materials were transported to the station, seeds extracted and processed for MTS/ LTS, documented the associated passport information collected and the vegetative materials were planted in pots in the 50% shade net house for regeneration in the forthcoming season namely *kharif 2007*.

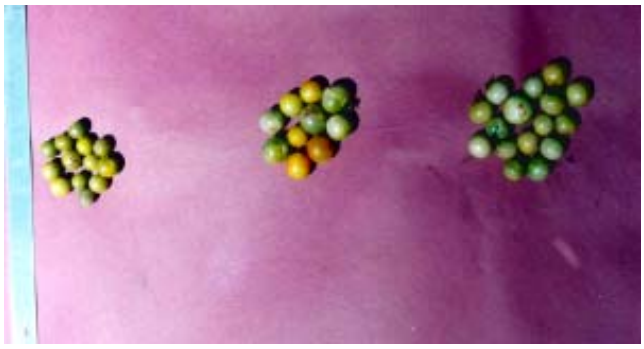
Fruit variability in bottle gourd *Lagenaria siceraria* collected from Marathwada region of Maharashtra.

Collection of *Abelmoschus* spp. & *Trichosanthes* spp. germplasm: As per the National Exploration Programme for the year 2006-07, an exploration and collection mission was undertaken from December 19 to 26 2006 to the Vidarbha and Marathwada regions of Maharashtra for the assemblage of *Abelmoschus* spp. and *Trichosanthes* spp. germplasm. A total of ten districts namely Akola, Washim, Hingoli, Nanded, Parbhani, Latur, Beed, Jalna, Aurangabad and Buldana

White & green fruits of cultivated *Luffa cylindrica* collected from Patur (Akola), Maharashtra.

belonging to these regions were covered extensively for the purpose traveling a circular distance of 1,317 km. A total of 138 accessions of valuable seed germplasm belonging to 23 species spread over 15 genera were assembled during the mission. This comprise 73 accessions in five species of the targeted *Abelmoschus* and eight accessions in two species of *Trichosanthes*, collected randomly with a view to contain the entire variability of the species in the area surveyed. Apart from these, 57 accessions of germplasm, predominantly of vegetables and their wild relatives were also collected, the notable among which are those with variable fruit forms of Bottle gourd, Smooth gourd and Ridge gourd. The collected materials were transported to the station. The seeds were extracted for conservation in the MTS/ LTS along with their associated passport data.

IC 549815 - Smooth gourd (*Luffa cylindrica*) with round ball shaped fruits collected from Taroda (Akola), Maharashtra.



Fruit variability in *Lycopersicon pimpinellifolium* (wild tomato) collected from Vidarbha region of Maharashtra.

Table -1 Explorations undertaken during 2006

Areas explored	Period of collection	Diversity collected	No. of accessions
Vidarbha region of Maharashtra	October 6-13 2006	*Momordica dioica* and wild relatives of crop plants	122
Vidarbha and Marathwada regions of Maharashtra	December 19-26 2006	*Abelmoschus* spp., *Trichosanthes* spp. and wild relatives of crop plants	138
Total			**260**

9.2 Characterization of Germplasm

Characterization and maintenance: During the period under report a total of 6,174 accessions of germplasm were maintained. Out of this 1,550 accessions were raised during Rabi 2005-06 and the remaining 4,624 were raised in Kharif 2006. The crop groupwise accessions maintained during Kharif 2006 include millets (636), oil seeds (3617), under utilized crops (244) and wild relatives of crop plants (188). Out of these 198 accessions of winged bean and 142 accessions of soybean were characterized for nine and twelve agro-morphological traits respectively. Observations on quantitative traits were recorded on five randomly selected plants and post harvest observations were recorded in the laboratory.

Fruits of wild *Solanum incanum* collected from Jalna district of Maharashtra.

Table 2: Crop -wise accessions grown during 2006

Season/crop group	Crop	No. of accs.	Checks
Rabi **(2005-06)'**			
Under utilized (1173)	Amaranth	1173	Suvarna, Akola local
Pulses (174)	*Lathyrus*	174	Narayangaon local
Oil seeds (203)	Linseed	203	J-23-10 & C-429
Kharif **(2006)**			
Millets (636)	Barnyard millet	97	K-21, PS-118
	Little millet	72	PRC-3, CO-2
	Prosomillet	18	PRC-3, CO-2
	Kod millet	54	GPUK-3, IPS-147
	Foxtail millet	199	K-221, PS-118
	Finger millet	196	VL-149, PR-202
Oil seeds (3,538)	Sesame	2886	JLT 7
	Niger	431	CHH-1, CHH-2
	Castor	221	RLC-6, J-23-10
Vegetables (244)	Winged bean	244	AKWB-1
Wild relatives (206)	*Sesamum* spp.	150	
	Abelmoschus spp.	28	
	Setaria spp	25	
	Glycine spp.	3	
TOTAL		**6,174**	

Figures in parenthesis indicate number of accessions characterized

Morpho-agronomic characterization in soybean: A total of 142 accessions were grown in an augmented design in 3 metre row length and the row to row spacing was 60 cm. Out of the total germplasm 112 were exotic and 30 accessions were indigenous. A total of nine quantitative and three qualitative traits such as days to 50% flowering, flower colour, plant height, number of primary branches, pod length, days to maturity, seed colour, hilum colour and number of seeds per pod were recorded. The range of variability observed is given in Table 3.

Fruit variability in *Trichosanthes cucumerina* collected from Vidarbha region of Maharashtra.

Table 3: Range of variability observed in soybean germplasm

Characters	Range	Mean + SEM	CV (%)
Days to 50% flowering	41.7-76	53.0+ 0.47	10.76
Plant height (cm)	18.4-52.1	22.8 + 0.66	34.8
No. of primary branches/plant	2.6-7.2	2.71 + 0.07	34.6
No. of pods/plant	10.4-57.2	19.66 + 0.96	58.2
Days to 80% maturity	100-119	106 + 0.57	6.4
No. of seeds/pod	2.2-3.0	9.2 + 0.01	2.56
100 seed weight	11.5-24.2	11.91 + 0.31	31.75
Pod length	3.2-43	3.2 + 0.03	13.2
Pod width	0.82-1.2	0.73 + 0.01	19.6

Table 4: Promising germplasm lines identified in Soybean

Trait	Accession nos.	Value	Check (SKY/AK-1357) value
100 seed weight (g)	EC538826 EC559565	23.0 24.2	13.66
No. of pods per plant	EC542430	53.5	36.0

Morpho-agronomic characterization in winged bean germplasm: A total of 244 accessions were grown in an augmented design in 3 metre row length with 90 cm between rows. Out of these, a total 198 accessions were characterized. Three qualitative and five quantitative traits were recorded. The range of variation, standard error and coefficient of variation are given in Table 5.

IC-549836 - *Abelmoschus esculentus* (okra) having long whitish green cylindrical, smooth fruits with no prominent ridge, collected from Akolkhed (Akola district), Maharashtra.

Table 5: Range of Variability observed in winged bean germplasm

Characters	Range	Mean + SEM	CV (%)
Pod length	8.0-18.3	13.2 + 0.1	11.1
Wing width	1.4-7.9	1.68 + 0.03	27.97
No.of pods/plant	1.0-48.0	12.29 + 0.42	48.33
No.of seeds/pod	6.0-17	11.97 + 0.11	14.03
100 seed wt.(g)	13.52-35.0	25.47 + 0.25	14.21

Table 6: Promising germplasm lines identified in winged bean

Trait	Accession nos.	Value	Check (AKWB-1) value
100 seed weight (g)	EC178331	34.28	26.3
	EC178303	34.35	
	EC178295	34.62	
	EC178340-1	35.00	
No. of pods per plant	EC178285	48	28
Pod length (cm)	EC114273-C	18.3	13.6
	EC114273-B	17.0	
No. of seeds per pod	EC178331	17.0	11.3

9.3 Germplasm Conservation

A total of 669 accessions of germplasm comprising barnyard millet (78), little millet (58), kodo millet (40), foxtail millet (165), niger (280) and soybean (48) were sent for long-term conservation in the National Gene Bank.

9.4 Seed Supply

A total of 2,533 accessions were supplied to various indenters. Crop-wise details of material supplied are given below. Soybean (62), sesame (706), okra (729), horse gram (983), *Abelmoschus moschatus* (7), foxtail millet (9), barnyard millet (10), little millet (3), proso millet (1), winged bean (20), *Glycine curvata* (1), *G. tabacina* (1) and *G. latifolia* (1).

Interspecific fruit variability in different accessions of *Abelmoschus tuberculatus* & *A. ficulneus* collected from Marathwada region of Maharashtra during December 2006.

Abelmoschus ficulneus (wild) with very small globose fruits collected from Jalna district of Maharashtra.

Research Projects- (Project Code, Title, PI and Co-PI)

PGR/GEV-BUR-AKO-01.00Augmentation, characterization, evaluation, documentation and conservation of PGR in Central Indian Plains (N Dikshit).

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

PGR/GEV-BUR-AKO-01.02: 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)

10. REGIONAL STATION, BHOWALI

Summary: Three explorations were undertaken and 158 accessions including landraces and primitive cultivars comprising cereals (43), pseudo cereals (05), minor millets (14), pulses (18), spices (04), fruits (12), M&AP (28), Wild Economically Useful Plant Species (WEUP's) (16), *Allium* spp. (15) and ornamentals (3) were collected from remote areas of Uttarakhand hills and Himachal Pradesh under National Exploration Programme, Horticultural Technology Mission, Mini Mission I (HTP MM-I) and G-15 for M. & AP. A total of 1349 accessions were received for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material *viz.* M. & AP and WEUPs: Rose- Geranium (7,729), Lavender (554), *Marjorana hortensis* (807), *Ocimum* spp. (181); Rosemary (3,782), *Stevia rebudiana* (3,284); Horticultural Plants: Kiwi (621); Agricultural Crops: Wheat – HB-208, Cowpea- EC229967-B were supplied to different farmers/ indentors. A total of 260 accessions were supplied to user scientists in the country and 765 accessions deposited in National Gene Bank for conservation.

The NBPGR Regional Station at Bhowali was established in 1943, as an Imperial Potato Research Station and known as "Hot Spot" for the development of plant diseases. It was meant for potato seed multiplication work and also for brown rot (*Pseudomonas solanacerum*) testing. In 1956, with the commencement of Wheat Improvement Scheme under PL-480, it was transferred to Indian Agricultural Research Institute (IARI) 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 retransferred to National Bureau of Plant Genetic Resources (NBPGR), New Delhi. Since then, it is with NBPGR as one of its Regional Stations. The station is located 15 km away from the district Headquarters, Nainital.

10.1 Exploration and Collection of Germplasm

A total of 158 germplasm accessions were collected through three explorations (one multicrop and two crop-specific-one in collaboration with NRC on pomegranate, Sholapur, MS and another trip for *Allium* spp. in collaboration with NBPGR, R/S Phagli, Shimla, HP) during the period under report from parts of Uttarakhand and HP under National Exploration Programme, HTM-MM-I and G-15 for M & AP. More emphasis was given for the collection of germplasm of land races/primitive cultivars of various crops from the inaccessible and remote areas of mid-hills and Tarai-Bhaber regions. One collaborative crop- specific exploration was undertaken for the collection of pomegranate from Tarai-Bhaber and hilly districts of Nainital, Almora, Bageshwar and Chamoli, Uttarakhand. The collected germplasm comprised cereals (43), pseudo-cereals (5), minor millets (14), pulses (18), spices (04), fruits (12), M & AP (28), WEUP (16), *Allium* spp. (15) and ornamental (3).

A total of 1349 accessions comprising *Triticum* spp. (100 acc); Wheat (3 acc of Ridley, HB-501 and NP-846); 1082 accessions of exotic winter and facultative wheat (*Triticum aestivum* -52 + 675 + 350); coriander (3); bottle gourd (2); sponge gourd (3); ridge gourd (2); *Allium* sp. (1); *Perilla frutescense* –(48); ricebean, IVT (14); Job's tear (20); pea (69) and *Physalis ixocarpa* (5) were received from NBPGR R/S Hyderabad, AP; IARI R/S Tutikandi, Shimla, HP; NBPGR, R/S Ranchi, Jharkhand; Nodal Officer, UUC, NBPGR, Pusa Campus, New Delhi; NBPGR, R/S Shillong, Meghalaya; NBPGR, R/S Phagli, Shimla, HP; ICARDA through Germplasm Evaluation Division, NBPGR, Pusa Campus, New Delhi.

10.2 Germplasm Evaluation

10.2.1 Germplasm Characterization/Initial Seed Increase/ Multiplication:

The germplasm accessions collected from Kumaon and Garhwal regions of Uttarakhand were sown at Bhowali for characterization, initial seed increase and multiplication during Kharif and Rabi seasons 2005-2006 (Tables 1-5).

IC338701: Bush type, vegetable bean, pods rounded and stingless, pods/plant (22).

Table 1. Germplasm characterization during Kharif 2006

Crop	No. of Acc.	Checks Used
Amaranth	76	Annapurna, Swarna, VL-44, PRA-1 and PRA-9401
Barnyard millet	59	VL-177, VL-29, Local Chamoli, Local Pithoragarh, Local Almora.
Blackgram	30	VG-218, PU-35, PU-19 & Kashipur Local
Cowpea	26	FTC-27, NS/24/82, Almora local, Bhowali local
Cucumber	08	DC-1 & Nepal Local
Finger millet	107	VL-146, VL-149, Local Almora and Local Pithoragarh
French bean (Climber)	139	PLB – 10-1, Ramgarh local and Chaffi local
French bean (Dwarf)	33	VL-1, VL- 63, PLB – 14 – 1, Champawat local, Rudrapur local and Bhowali local
Horsegram	18	Bhimtal Local, Bhowali Local, Almora Local & Koshi Local
Maize	28	Bhimtal Local, Bhowali Local, Him-129 & VL-16
Okra	17	Bhowali local, Pusa A-4, Sel. 1 & Pusa Sawni
Perilla	52	Bhowali local, Shillong local, Almora local, Champawat local & Pithoragarh local
Proso millet	13	Bhimtal Local, Ramgarh Local, Pithoragarh Local & Almora Local
Rice bean	12	RBL-1, RBL-6, PRR-1, BRS-1, Naini & PRR-2
Sesame	28	Baitalghat Local, Bhimtal Local, Pithoragarh Local, Almora Local
Soybean	38	VL-77, VLS-54, VLS-47, VLS-21 & VLS-2

Table 2. Multiplication / seed increase for long term storage (LTS) in National Gene Bank during Kharif 2006

S. No.	Crop	No. of Acc.
1	Cucumber	9
2	Foxtail millet	4
3	Green gram	1
4	Ground nut	6
5	Pigeon pea	4
6	Sesame	14
7	Sunflower	2

IC373376: Pole type, vegetable bean, pods rounded and stingless.

IC417351: Bush type, bean, promising for number of pods/ plant (23).

Lavendula stoechus (IC449512)- A successful introduction established at Bhowali.

Table 3. Promising accessions identified in various crops during Rabi 2005-2006 and Kharif 2006

Crop (acessions)	Main attributes	Superior accessions identified
Amaranth (76) **Checks:** VL-44, PRA-9401, PRA-01, Annapurna, Swarna	Early flowering (<55) Plant height (>228 cm) Early maturity (<106) Inflorescence length (cm) (>69.4) 100 Grain weight (>0.46 g)	IC444159, IC095590, IC329587 IC341509, IC444183, IC444192 IC038057, IC038069, IC444099 IC444190, IC436974, IC341509 IC38598, IC95590, IC328897
Barley (94) **Checks:** VLB-1, VLB-64, VLB-60 & Bhowali local	Days to 75% ear emergence (<132) Ear length (>11.8 cm) Plant height (>106.7 cm) Days to maturity (<180) 100 grain weight (>5.81 g)	IC524208, IC444245, IC444230 EC492264, EC492212 EC492264, EC492267), EC533524) IC430344, IC524208, EC481619, IC444230 EC492166, EC492335, EC492350
Barnyard millet (59) **Checks:** VL-172, VL-29, Chamoli local, Pithoragarh local and Almora local	Days to 50% flowering (<64) Ear head length (>24.8cm) Days to 80% maturity (<93) Plant height (cm) (>189.8) 100 grain weight (g) (>2.25)	IC391440, IC392501, IC392507 IC382642, IC538037, IC444187 IC392517, IC538089, IC538047 IC418380, IC391440, IC383551 IC383598, IC469887, IC469879
Cowpea (26) **Checks:** FTC-27, NS/24/82, Almora local, Bhowali local	Days to 50% flowering (<63) Plant height (>241 cm) Seed yield / plant (>9.35 g) 100 seed weight (>7.75 g)	IC538045 IC341072, IC538060, IC422014 IC341072, IC341064, IC469774, IC422014 IC430018, IC422014, IC341072
Finger millet (107) **Checks:** VI-146, VL-149, Local Almora and Local Pithoragarh	Days to 50% flowering (<77) Ear head length (cm) (>10.53) Plant height (cm) (>133.2) Days to 80% maturity (<113) Seed yield / plant (g) (>16.08) 100 grain weight (g) (>2.57)	IC444225, IC356000, IC393029 IC393050, IC337226, IC382639 IC393059, IC316041 IC538041 IC469795, IC391409, IC444225 IC383401, IC393061, IC393037 IC538041, IC341363, IC316048
French bean (139) Climber/pole type **Checks:** PLB-10-1, Chaffi local, Ramgarh local and Bhowali local	Days to 50% flowering (<60 days) Plant height (>174 cm) Pod length (>12.5 cm) No. of pods/plant (>9) No. of seeds/pod (>5) 100 grain weight (>41.7 g) Seed yield / plant (>13.65 g) Days to 80% maturity (<106)	IC469797, IC278519, IC444220 IC392557, IC430030, IC341339 IC280837, IC278502, IC418393 IC278514, IC278519, IC444096 IC418393, IC280837, IC280838 IC538071, IC361349, IC341339 IC278514, IC373376, IC280837 IC338747, IC340885, IC419817
French bean dwarf / Bush type (33) **Checks:** VL-1, VL-63, PLB – 14 – 1, Champawat local, Rudrapur local and Bhowali local	100 Grain weight (> 38 g) Early maturity (<75)	IC316133, IC419787, IC373375, IC419781, IC421997, IC419793 IC278499, IC419961
Spinach (58) **Checks:** Early green, All green, Pusa Bharti & Bhowali local	Days to 50% flowering (< 98) Leaf length (>17.5) Days to 80 % maturity (<155) Plant height (<21) 100 grain weight (g) (>1.23)	IC262228, IC383472 IC355976, IC356508 IC391560, IC263404 IC341182, IC391568 IC356504, IC469761
Wheat (157 acc.) **Checks:** VL-616, VL-738, VL-832, VL-719 & HB-208	Days to 75% Ear emergence (< 105) Ear length (>12.5) No. of grain/spikes (>60) Days to maturity (<185) 100 Grain weight (>5.17)	IC335933, IC335944, IC335976 IC278944, IC362244, EC519407, IC362251 EC463417, IC212176, IC469748, IC279046 IC524207, IC524213, IC393130 EC463377, EC463382, IC430328

Table 4. Range, mean and coefficient of variation in various crops during Rabi 2005-2006 and Kharif 2006

Crop (accessions)	Character	Range		Mean	PCV%
		Minimum	Maximum		
Amaranth (76)	Days to 50% flowering	50	110	67.8	13.8
	Plant height (cm)	95	320	233	19.8
	Inflorescence length (cm)	30	108	68.9	21.6
	Days to 80% maturity	67	115	104	8.39
	100 grain weight (g)	0.1	0.7	0.43	30.8
Barnyard millet (59)	Days to 50% flowering	62	80	68	7.6
	Ear head length (cm)	17.5	29	21.11	10.74
	Days to 80% maturity	90	103	97.4	4.38
	Plant height (cm)	144	290	186	10.24
	100 grain weight (g)	1.3	3.3	2.4	20.9
Finger millet (107)	Days to 50% flowering	66	87	80.1	6.53
	Ear head length (cm)	4.5	17	8.59	27.03
	Plant height (cm)	90	160	129.1	11.58
	Days to 80% maturity	103	133	117	6.77
	Seed yield / plant (g)	0.8	33.3	9.86	62.26
	100 grain weight (g)	1.2	3.9	2.46	13.3
French bean	Days to 50% flowering	35	80	62	14
Climber/Pole (139)	Plant height (cm)	110	375	236.72	19.37
	Pod length (cm)	8.1	25	12.67	18.59
	No. of pods/plant	4.7	24.7	9.42	35.6
	No. of seeds/pod	3.0	9.3	5.31	23.2
	100 grain weight (g)	13.2	65.36	31.84	29.06
	Seed yield / plant (g)	2.94	43.13	14.68	45.59
	Days to 80% maturity	92	150	119	9.41
Barley (94)	Days to 75% ear emergence	107	157	136	3.10
	Ear length (cm)	4.4	14	8.55	4.61
	Plant height (cm)	63.7	117.7	89	3.53
	No. of grains/spike	17	71	38	6.13
	Days to maturity	160	213	185	2.71
	100 Grain weight (g)	2.75	6.89	4.43	4.18
Spinach (58)	Days to 50% flowering	91	117	98	6.1
	Leaf length (cm)	2.6	20.5	6.63	56.9
	Leaf width (cm)	2.0	9.7	3.47	45.1
	Days to 80% maturity	138	165	149	4.48
	Plant height (cm)	12.3	71.6	31.3	51.08
	100 Grain weight (g)	0.38	1.88	0.82	33.3
Wheat (157)	Days to 75% ear emergence	89	151	118	3.94
	Days to maturity	160	210	180	8.28
	100 Grain weight (g)	2.19	6.05	3.87	4.34
	Ear length (cm)	4.6	20.5	11.5	5.49
	Plant height (cm)	49	136	93	4.64
	No. of grain/ spike	15	89	49	5.64

Table 5. Germplasm Characterization During Rabi 2006-07

Crop	No. of Acc.	Checks used
Wheat	119	VL-616, VL-719, VL-738, VL-829, VL-832, HB-208
Winter & facultative wheat	1077 (52 + 675 + 350)	HS-340, HD-2009, Kathia, Motiya, HB-208
Pea	73	Harbhajan, Lincon, Selection-18, Arkil and VL-8
Spinach	52	Early green, Pusa Bharti, All green
Barley	06	VLB-1, VLB-60 and VLB-64
Garlic	124	Lohit, Bhowali local
Triticum spp. (Wild)	28	—
Aegilops spp.	17	—
Faba bean	07	—
Rapeseed/mustard	20	Rajat, Varun, Pusa Jai Kishan, Italian Rai, Kranti, GLS-1, RH-30, T-9, PT-303, PAC-401
Fenugreek	07	PEB, Bhowali local
Coriander	17	Pant Harit-1, Kashipur local, RCR-41, ACR-250, Bhowali local
Onion	01	Bhowali local

Horticultural Plants

Horticultural germplasm evaluation was continuously done from the Field Gene Bank and all regular cultural operations were undertaken from time to time.

Fruit germplasm evaluation: In Citrus germplasm 142 accessions were characterized and evaluated for 65 qualitative and quantitative traits. The entire germplasm was grown at plant-to-plant distance 3 m (square planting system) in terrace fields. A total of 142 accessions of 19 species i.e. *Poncirus trifoliata* (1), *C. aurantifolia* (31), *C. aurantium* (4), *C. canaliculata* (1), *C. decumana* (4), *C. fartunella* hybrid (1), *C. hybrid* (1), *C. grandis* (5), *C. jambhiri* (31) *C.kinkujiumshin* (1), *C. limettiodes* (3), *C. medica* (13), *C. obovoidea* (1), *C. paradisi* (1), *C. psudolimon* (5), *C. regulosa* (5), *C. reliculata* (18), *C. sinensis* (35), *C. shunkokan* (1) and *Citrus species* (02). All accessions are non-climacteric fruit (ripen gradually over weeks or months and slow to abscise from the tree). Three methods of propagation in five different *Citrus* species i.e. C. *aurantifolia* (IC319045), *C. decumna* (IC319044), *C jambhiri* (IC319059), *C. medica* (IC319067) and *C. sinensis* (IC319066) were studied. The nucellar seedling propagation was found to be a more suitable and the easiest method for the propagation of uniform citrus rootstocks, true to type germplasm in Field Gene Bank in all five selected species. In Malta (*C. sinensis* - IC319066) poor success was observed through cuttings and nucellar seedling but T- budding can be applied to get better results. IC319045 (Uttaranchali Kagazi nimbu)- upright, much branched, plant bears 200 - 300 fruit/tree/year, leaf length 7.2 cm, leaf width 2.62 cm, flower diameter 1.96 cm, with bright lemon yellow round fruit having fruit length 4.14 cm, fruit width 4.18 cm, fruit weight 38 g and TSS 8%. More than 500 plants were supplied to different indentors.

Vegetable germplasm evaluation: Chilli (*C. annuum* 180) were sown in an augmented design with four checks – Pant C-1, Pant C-2, JCA-283 and LCF-206 in five blocks) where row length, row spacing and plant to plant distance was 2.10 m, 45 cm and 30 cm respectively. *C. annuum*-10, *C. frutescens*-8, and *C.annuum* var *annuum*-6 were only multiplied for seed increase. The range of variation and promising accessions for different quantitative traits are presented in table 6 & 7. In chow-chow (*Sehieum edule*) IC340574 Uttaranchali Chow Chow perfoming well among all accessions with fruit length 12-14.47 cm, fruit width 8-9.33 cm, fruit weight 400-600 g and yield 60-80 fruit/ plant. More than 100 plants were distributed among local farmers for popularization.

Ornamental germplasm: All 37 accessions of *Tagetes* were grown for multiplication and initial characterisation. Hajiri 20 accession were transplanted and evaluated in Rendomised Block Design (RBD) with three local checks viz. Hajiri, Lal hajiri and Peeli hajiri. The range of variation and promising accessions for different quantitative traits are presented in table 6 & 7. Uttaranchali Hajri IC318939 dark yellow best collection having 57.13 cm plant height with 3112.33 sq cm canopy, 49.73 flowers/plant, flower diameter 4.09 cm with 15.1 g flower weight. Flower bud emergence start after 115 days transplanting the seedling blooming starts 129 days ended after 208 days.

Table 6. Promising accessions identified in horticultural crops during Kharif 2006.

Crop	Main attributes	Accessions identified for specific/desired traits
Chilli (204) **Checks:** Pant C-1, Pant C-2, JCA-283 and LCF-206	Plant height (>90 cm) No. of fruit/plant (>150) Fruit yield/plant (>556 g)	IC26326, IC266308, IC371673, IC278254, IC278265 IC278336, IC266309, IC266308, IC266311, IC371673, IC266307, IC392325, IC398771, IC469887, IC278317, IC385799, IC317836, IC383072. IC266308, IC278336, IC392325, IC266309, IC398665, IC278317, IC361896, C265050, IC266311.
Tagetes (20) **Checks:** Local Hazari & Peeli hazari	Plant height (>96.67 cm) Days to 50% flower bud emergence (>102.6) Days to 50% blooming (<120) Number of flower/plant (>71) Flower weight (>12 g)	IC319937, IC318945, IC318941, IC318948, IC318949 IC318941, IC318919, IC318944, IC318950, IC318951 IC318941, IC318950, IC318951, IC318943 IC318944, IC318938, IC318933, IC318948, IC318945, IC318932 IC318950, IC318948, IC318939, IC318925, IC318949, IC318945

Table 7. Range, mean and coefficient of variation in horticultural crops during Kharif 2006

Crop	Character	Range		Mean	PCV%
		Minimum	Maximum		
Chilli (204)	Plant height (cm)	21	106.2	65.14	19.66
	No. of fruit/plant	6	295	79.53	53.75
	Fruit yield/plant (g)	18	1085.38	251.16	60.34
Tagetes (20)	Plant height (cm)	32.13	132.20	71.36	35.32
	Days to 50% flower bud emergence	113.22	102.67	120.67	5.04
	Days to 50% blooming	124.85	83	132	9.13
	Number of flower/plant	31	131.20	61.30	40.39
	Flower weight (g)	6.28	15.71	10.89	21.76

Conservation and maintenance of horticultural plants: Fruits (433), vegetables 1212 (Chillies –1201, Chow-chow-11), flowering perennial plants (109), flowering annual plants and other horticultural crops (78) are maintained in glasshouse/ Field Gene Bank/ MTS at the station.

Biochemical analysis: Citrus fruits (4 accessions) were submitted to Department of Horticulture, GBPUA&T, Pantnagar, Uttaranchal for biochemical analysis

Transfer of Technology: Technical know-how given at Farmers field on-

i. Kiwi propagation through cuttings and grafting and

ii. Citrus propagation through nucellar seedlings / cuttings.

PCPGR – HTP I - Bhowali Unit:

a. Greenhouse maintenance (Clonal repository): All regular operations were timely attended for the maintenance of clonal repository / regeneration of the promising fruit material / collected materials in 2500 pots.

b. Field Gene bank maintenance: Exotic horticultural germplasm was established (43 accs.) in Field Gene Bank / Green House and all regular cultural operations were undertaken time to time.

c. Horticultural germplasm evaluation: Horticultural germplasm evaluation is continuously done in the Field Gene Bank. Observation / data are in progress:

Apple: Material from New Zealand - EC528097 (Royal Gala), EC528098 (Regala), EC528099 (Galaxy), EC528100 (Jonagold), EC528101 (Brookfield), EC528102 (Breaburn), EC528103 (Aztec), EC528104 (Aurora), EC528105 (Eve Mariri Red), **Apple root stock (2)**- EC528106 (M-793), EC528107 (M-106) were evaluated.

Pear: Fourteen accessions viz., EC528108 (Tsu Li), EC528109 (Hong Li), EC528110 (Worden seckle), EC528111 (Golden Rosset Bose), EC528112 (Packmens trimph), EC528113 (Beurre Bose), EC528114 (Tylors gold), EC528115 (Concord), EC528116 (Doynne Du Comice), EC362530, EC414132, EC414134 and **Pear root stock (2)**- EC528117 (BAC-29), EC528118 (Quince C) were evaluated.

Walnut: The walnut material from France (EC467892, EC467893, EC467894, EC467895) were established and EC467893 started fruiting. The flowering period was 35-45 days later than local / indigenous collections.

Citrus: The citrus material from USA (EC434444, EC434445, EC434446, EC434447, EC434448 and EC434449) were established and EC434446 started fruiting.

Strawberry: The strawberry material from USA (EC362589, EC362601, EC362602, EC431388, EC439586, EC439587, EC439590 and EC439591) were established and EC362602 performing well among all.

Regeneration / Multiplication/ Nursery management: Grafting of Hayward and Allision scion and cuttings were maintained in field conditions. Plants/ seeds of Kiwi (EC137263), Kagazi (IC319045), Phlox (IC319010, IC319011, IC319012) were regenerated through cuttings, grafting and other vegetative means and through seeds for onward supply to different indentors. Dahlia germplasm was regenerated through

cuttings in green house. Budding operation was carried out at different intervals for 500 plants in kiwi was done.

Wild Economically Useful Plants

Preliminary evaluation of *Allium* spp.: A total of 41 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. clarkei, 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 genera are being maintained.

Maintenance of forage legumes and grasses: A total of 100 accessions of medicage and 39 accessions of *Trifolium* 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 bank/herbal garden of the station. Aromatic plants such as *Aloe, Alpinia, Artimisia, Asparagus, Bunium, Carum, Centella, Chrysanthemum, Cymbopogon, Hedychium, Lavandula, Matricaria, Marjorana, Melissa, Mentha, Ocimum, Origanum, Pelargonium, Plantago, Pyrethrum, Rosa, Rosmarinus, Salvia, Spilenthus, Stevia, Tagetes, Thymus, Valeriana, Withania* and *Zanthoxylum* were multiplied for their supply to the indentors. Steam distillation was done in different seasons for extracting essential oil from aromatic plants including scented rose geranium, lemon grass and others.

Determination of percentage of essential oil: A total of 64 accessions of aromatic plants were extracted for percentage of essential oil in different seasons through steam and Hydro (Clevenger apparatus) distillation unit. The range of oil percentage observed in different species was as follows: *Artimisia nilagirica ssp. septentrionalis* - pati (0.08-0.13); *Cymbopogon flexuosus* – lemon grass (0.25-0.40); *Pelargonium graveolens*- rose geranium (0.06-0.10); *Rosmarinus officinalis*- blue flower (0.09- 0.12); *Acorus calamus*: dried rhizome (1.73-3.0), dried rootlet (0.86-1.75), dried leaves (0.67-0.72); *Achillea millaefolium* (0.16); *Artemisia annua* (0.41); *Artemisia dracunculus* (0.10); *A. maritima* (0.50); *Coleus forskohlii*: dried roots (0.84-1.62); *Curcuma zedoaria* (0.10-0.14); *Cymbopogon flexuosus* (0.20-1.70); *Cymbopogon winteransis* (2.00); *Hedychium coronarium* (0.09); *Hedychium spicatum*: dried rhizome (0.22-2.5), aerial parts (0.14); *Lavandula officinalis* (0.25-3.85); *Lavandula stoechas* (1.18-1.25); *Marjorana hortensis* (0.17-1.56); *Melissa officinalis* (0.25); *Mentha cardiaca* (0.10- 0.20); *Origanum vulgare* (0.25-0.50); *Pelargonium graveolens* (0.04-0.44) and in dried herbage (0.24-0.83); *Perilla frutescence* (0.10-0.72); *Pogostemon cablin* (0.28-1.57); *Rosa damascena* (0.025); *Rosmarinus officinalis*- blue flower, water (0.12- 2.43); *Rosmarinus officinalis*- white flower (0.50-2.80); *Salvia officinalis* (0.59-1.00); *Salvia sclarea* (0.10); *Satureja montana* (0.40); *Saussurea lappa* (0.04 - 0.038); *Tagetes patula* (0.04); *Valeriana jatamansi* (0.47-1.50): rhizome + rootlets-fresh & dried (0.15-0.50); *Zingiber officinalis* (0.25-0.30); *Zanthoxylum armatum* (0.29).

10.3 Germplasm Conservation

A total of 765 accessions of different crops *viz.* cereals: wheat (32), barley (25), paddy (28), maize (19); pseudo cereals: amaranth (47), buckwheat (02): Minor Millets: barnyard (56), finger (99), foxtail (04), proso (05); pulses: adzukibean (02), black gram (08), cowpea (19), frenchbean (52), horse gram (105), lentil (08); mothbean (01), pigeon pea (04), ricebean (31), soybean (30); oil seeds: rapeseed/mustard (19), ground nut (12); vegetables: chenopod (01), faba bean (04), onion (04), sembean (06), spinach (05); spices: chamsur (01), chilli (60), coriander (17), fenugreek (09); M & AP (17); wild relatives: *Aegilops* spp. (2), *Allium* spp. (19), *Avena sativa* (1), *Triticum* spp. (11) were conserved in the NGB.

A total of 54 accessions including M & AP (17), wild

relatives: *Allium* spp. (17) and *Colocasia esculenta* – (20) 5-10 bulbs/corms of each were accession cryostored.

10.4 Germplasm Supply

Material Transfer Agreement: Two hundred sixty accessions of different crops were supplied to various research organisations/indentors under MTA. *Ammomum subulatum* (1); *Hedychium* spp. (3 with two species); *Ruta graveolens* (1), Others (11), *Tinnospora cordifolia* (1); *Allium* spp**.** (15 with nine species), *Cucumis hardwicki* (6), *Hordeum bulbosum* (1); barnyard millet (10), finger millet (5), foxtail millet (4), proso millet (5), horsegram (20), soybean (3), lentil (22); pomegranate (16) and chilli (136).

Besides, A total of 283 accessions of different crops were also supplied with in Bureau and other institute for exhibition purposes for official purposes.

Supply to farmers / indentors: Seed samples and live rooted plant material of *Achillea conferta* – 25; *Achillea millaefolium*- 5; *Adiantum sp.*- 5, *Ajuja sp.*- 5; *Aloe sp.*-5; *Allium spp.* – 8; *Allium angulosum* 10, *Allium ampeloprasum* - 5, *A. fistulosum* 5, *A. tuberosum*- 10+ 820 g; *Ammi majus* – 10 g.; *Ammomum* sp. 10; *Anethum sowa*- 2 ; *Artimisia annua*- 20 + 5 g.; *Artemisia maritima*- 16; *Berberis spp.*- 18; *Bergenia ligulata*- 19; *Calendula arvensis*- 15 g.; *Coleus forskohlii*- 50; *Callicarpa macrophylla*- 25 g; *Curculigo* sp.- 35; *Curcuma zedoaria*- 5, *Cynara scolymus*- 5; *Digitalis* spp.- 10; *Foeniculum vulgare ssp. purpurascense*- 10; Geranium –7729; *Ginkgo biloba*- 10; *Hypericum perforatum* - 5, *Hedychium coronarium* - 10; Lavender - 554; *Levesticum officicnalis* – 10; lemon grass- 125; ***Marjorana hortensis*- 807 + 30 g;** *Matricaria chamomilla*- 30; *Melissa oficinalis*-200; *Mentha longifolia*- 20; *M. piperata*- 100; *M. spicata*- 100; *Ocimum kilmandschianum*- 5 g.; ***Ocimum* spp.-181 + 30 g;** *Origanum vulgare* – 50; *Plantago lanceolata* – 25; *Pogosstemon cablin*-10; *Pyrethrum cinearifolium*- 5; **Rosmary- 3782;** *Rosa damescena cv. Noorjahan* – 75; *Salvia sclarea*- 15; *S. officinalis*- 54; *Sapindus mukorossi*- Sweet soap nut tree- 4, *Scindapsus officinalis*- 10; *Spilenthus achmella* – 25; ***Stevia rebodiana* – 3284**; *Taxus baccata*- 7, *Thalictrum foliolosum* - 5; *Tinospora cordifolia*- 10; *Thymus serphyllum*- 86; *Valeriana jatamansi*- 5; *Vernonia anthelmentica*- 10 g; *Withania somnifera*- 5; **Wild:** bamboo log- 26; rooted / grafted / seedling plants of *Cryptomeria* sp.- 26, Gladiolus spikes-60; grape fruits- 50 kg + 2; Japanese quince - 6; Kagazi- 7; **Kiwi – 621 + 25 Kg;** malta-5; ornamentals-425; passion fruit - 8, peach - 54, pear fruits – 107 kg; plum- 8.0 Kg; santra – 24; *spiraea*-15; strawberry - 2.75 kg. + 260; 60 kg. wheat seed of HB 208 were supplied to different farmers / indentors.

10.5 All India Co-ordinated Trial

Rice bean: All India Co-Ordinated Trial of Initial Varietal Trial –Hills of rice bean consisting of 12 varieties was conducted. LRB-09 (17.2 q/ha), RBL-6 (14.5 q/ha) and RBL-334 (13.8 q/ha) were performed better in grain yield than other entries.

A Chilli Field Day was conducted on September 22, 2006. More than twenty officials from GBPUA&T, Pantnagar, Research Station, Majhera, Garampani, U.K and Regional Agriculture Reasearch Station, ANGRAU, Guntoor, A.P. were present. The chilli breeders identified about 75 accessions out of 204 accessions and MTA form was obtained at the site with collection numbers.

Women farmer from District - Pithoragarh along with Sh. M.S. Kunwar, SMS, Horticulture Development Block, Kanalicheena under HTM/MM-I visited NBPGR, R/S Bhowali on May 04, 2006 and imparted technical know- how on PGR activities in Western Himalaya.

Research Projects (Code: Title, PI, Co-PI and Associates)

PGR/PGC-BHO-01.00: Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation and Documentation of Genetic Resources of the Northern Himalayas and Adjoining Plains (KS Negi).

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

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

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

11. EXPLORATION BASE CENTER, CUTTACK

Summary: A total of 52 accessions comprising both grain type (16 accessions) and leafy vegetable type (36 accessions) of *Amaranthus* germplasm were collected from 41 collection sites of Jagatsingpur, Kendrapara, Cuttack and undivided Dhenkanal districts of Orissa. Wide range of variability was observed in all the accessions with respect to the inflorescence, seed colour (black, purple, white) and size (small, medium, large) palatability of the leafy vegetable and taste of the grains, colour of the stems (green, pale green, purple and red). A total of 1850 accessions comprising cultivated rice (1,238), sesame (498) and turmeric (114) were grown for preliminary characterization and seed multiplication. Two hundred and four accessions of cultivated rice and. of turmeric (94) were characterized and cultivated rice (1,034) and sesame (440) were multiplied. A total of 253 accessions comprising cultivated rice (94), sesame (145), chilli (1), Jatropha (1), wild brinjal (1) and medicinal plants (11) were deposited at NBPGR, New Delhi for MTS(6 accs.), LTS and cryopreservation (10). In addition 16 accessions comprising cultivated rice (10) and medicinal plant (6) were supplied to different research and educational institutes. A total of 1,949 accessions comprising cultivated rice (1,034), medicinal and aromatic plants (300), sesame (295), wild *Oryza* species (152), turmeric (84), other wild relatives of crop plants (34), sylviculturally economic plants (24), banana (17), horticultural crops (6) and betel vine (3) are being maintained in the field gene bank of the centre.

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 characterisation and conservation of rice genetic resources of northern and eastern plain regions of India. The Centre is located in the campus of Central Rice Research Institute, Cuttack (Orissa) between latitude/longitude of $20^0 40^{`}$ N, $85^0 52^{`}$ E and altitude of 23.5 m above mean sea level (msl). It has a farm area of 5.5 acres including the office space

11.1 Plant Exploration and Germplasm Collection

A total number of 52 accessions were collected from Jagtsinghpur, Kendrapara, Cuttack and undivided Dhenkanal districts of Orissa belonging to four species namely, *Amaranthus hypochondriacus* (grain type), *Amaranthus hybridus* (leafy vegetable type) *Amaranthus tricolor* (leafy vegetable type) and *Amaranthus caudatus* (leafy vegetable type). Wide range of variability was observed in all the accessions with respect to the inflorescence, seed colour (black, purple, white) and size (small, medium, large) palatability of the leafy vegetable and taste of the grains, colour of the stems (green, pale green, purple and red). Inter and intra-specific variations were also recorded for some morphological and agronomical traits. Immense variability was recorded for agro-climatic conditions of the crop growing area their habitat, soil types and topography. Two accessions of leafy vegetables are sweet types having good market value. Among all the grain type collections the green plant types had potential for higher yield. It was also noticed during the tour that farmers in almost all the districts are loosing their interest in growing grain type amaranths due to very poor facility of market. Leafy vegetable types were more popular among the farmers as compared to grain types as the latter had poor marketability in that area.

11.2 Preliminary Characterization of Germplasm

Cultivated rice: A total of 204 accessions of rice germplasm were grown in Augmented Design using five checks during *Kharif*-05. The data for various 13 quantitative characters were recorded as per the minimal descriptor. Wide range of variability with respect to plant height, leaf length, leaf width, EBT, panicle length, days to 50% flowering, grain length and width, 100 grain weight and yield per plant was observed among the rice germplasm (Table-1).

Variability in inflorescence of *Amaranths* germplasm collected from Jagatsinghpur, Kendrapara, Cuttack and undivided Dhenkanal district of Orissa

Table 1: Characterization of cultivated rice germplasm

Characters	Range		Mean
	Minimum	Maximum	
Plant ht. (cm)	199.72	66.46	151.54
Leaf length (cm)	80.22	25.4	55.34
Leaf width (cm)	1.36	0.76	1.02
No. of effective tillers/ plant	42.25	4.00	6.50
Panicle length (cm)	32.82	15.5	26.13
Days to 50% flowering	42	115	89.23
Days to maturity	80	148	123.18
Grain length (mm)	8.25	4.05	5.84
Grain width (mm)	3.55	1.65	2.30
L/W ratio	3.87	1.66	2.57
100 grain wt. (g)	3.52	1.01	2.25
Grain yield/plot (g)	2131.62	1.94	954.43
Grain yield/plant (g)	24.94	0.75	10.08

No. of accs.-204, Checks (5) - Panidhan, Jaya, Mahsuri, Tulasi and Jyoti, Design-Augmented, Traits observed - 13, Spacing- 20X15 cm

Promising lines identified: On the basis of grain yield performance IC 470957, 360504, 470919 and 421216 were identified as promising over the best check (Table-3).

Table 2: Promising accessions identified on the basis of yield performance

Accessions	Mean (g)	Superiority over best check (%)
IC 470957	2131.62	36.91
IC 421216	2075.74	33.33
IC 470984	1939.93	24.60
IC 360504	1863.12	19.67
IC 470919	1826.11	17.29
IC 470936	1744.79	12.07
IC 471005	1730.97	11.17
IC 360524	1627.77	4.55

Checks : Tulsi (1556.84), Pani dhan (1213.42), Jaya (1155.30), Mahsuri (539.45)

Seed multiplication of cultivated rice: A total of 1,000 accessions of IRRI rice germplasm was grown for seed multiplication and 34 accessions of cultivated rice collected during NATP programme were characterized at the centre. The range of variation recorded for plant height (53.42 to 209.08 cm), the ear bearing tiller (2.6 – 25.8) and the panicle length (14.94 to 37.58 cm).

Turmeric: A total of 94 accessions of turmeric along with three promising local checks, grown during *Kharif-*

Variability in grain type amaranth

Variability in leafy vegetable type amaranth

05 were characterized for 26 morpho-agronomic characters as per the minimal descriptors. The range of variability is presented in Table-3.

Table 3: Characterization of Turmeric germplasm

Characters	Range		Mean
	Minimum	Maximum	
Plant ht. (cm)	24.9	91.4	52.70
Petiole length (cm)	2.93	19.6	8.05
Sheath length (cm)	1.53	26.56	15.73
Leaf length (cm)	12.8	73.33	30.01
Leaf width (cm)	5.0	18.9	10.42
Sucker number	1.0	6.0	1.47
Basal diameter (cm)	3.5	22.0	11.88
Mother length primary (cm)	2.9	15.56	4.68
Mother medium (cm)	1.7	5.0	2.82
Secondary mother no./plant	1.0	9.0	1.15
Secondary mother length (cm)	2.5	10.9	2.63
Secondary mother thickness (cm)	1.2	3.2	1.18
Primary finger no./plant	1.0	13.0	5.22
Primary finger length (cm)	3.4	12.15	6.45
Primary finger thickness (cm)	0.9	2.13	1.46
Secondary finger no.	1.0	29.0	12.08
Secondary finger length (cm)	1.1	8.5	4.45
Secondary finger thickness (cm)	0.5	2.06	1.21
Mother wt./plant (g)	3.88	64.72	20.18
Tuber length/plant (cm)	2.5	15.5	8.84
Mother dry wt. (%)	61.12	92.40	81.88
Tuber dry wt. (%)	54.14	98.19	80.91
Mother dry wt./plant (g)	2.45	45.03	16.50
Tuber dry wt./plant (g)	5.69	439.44	88.15
Total fresh wt./plant (g)	11.75	557.79	130.94
Total dry wt./plant (g)	8.49	466.62	104.58

No. of accs. -114, Design -Augmented, Spacing -75X30 cm
Date of planting -17.6.05, Trait observed-26, Check-3 (local)

Promising lines identified: On the basis of fresh weight per plant the accessions viz., IC360924, IC360926, IC360927, IC360932, IC446839, IC446848, IC446795, IC446767, IC446774, IC446835, IC446776 and IC446761 were found promising over the best check (Table 4).

Table 4: Promising accessions identified on the basis of fresh weight per plant

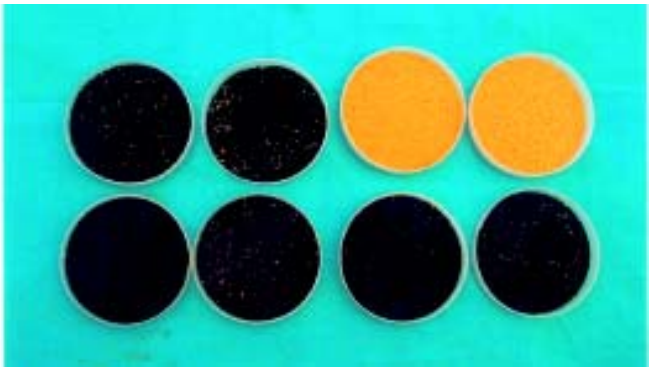
Accessions	Fresh tuber yield (g)	Superiority over best check (%)
IC446807	557.79	416.46
IC360926	351.48	225.41
IC446835	326.60	202.37
IC446803	313.08	189.86
IC360927	309.29	186.35
IC446767	285.33	154.16
IC360924	239.38	121.62
IC446776	186.15	72.34
IC446761	184.07	70.41
IC446774	177.44	64.28

Checks : Check-1 (108.01g), Check-2 (65.41g), Check-3 (60.68g)

Turmeric: A total of 84 accessions of turmeric germplasm collected during NATP and three local promising types (checks) were sown in augmented randomized block design with spacing 30X70 cm for second year characterization. One set of the germplasm has been deposited at Thrissur station for characterization and maintenance.

11.3 Germplasm Conservation

A total of 253 accessions comprising cultivated rice (94),



Variability in Seeds of *Amaranthus* germplasm

sesame (145), chilli (1), Jatropha (1), wild brinjal (1) and medicinal plant (11) were deposited at NBPGR, New Delhi for medium term storage (6), long term storage (237) and cryopreservation (10).

11.4 Germplasm Supply

A total of 16 accessions comprising cultivated rice (10) and medicinal plant (6) were supplied to three different research /educational institutes.

11.5 Germplasm Maintenance

A total of 1,949 accessions comprising cultivated rice (1,034), medicinal and aromatic plants (300), sesame (295), wild *Oryza* species (152), turmeric (84), other wild relatives of crop plants (34), sylviculturally economic plants (24), banana (17), horticultural crops (6) and betel vine (3) are being maintained at NBPGR Base Centre, Cuttack.

Research Projects (Project Code, Title, PI and Co-PI)

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

12. REGIONAL STATION, HYDERABAD

Summary: A total number of 21,736 samples [11,940- imports & 9,796 -exports] were received for quarantine processing during the period under report. A total of 11,180 imported samples processed for quarantine clearance. Of the 2,203 samples found infected/ infested/ contaminated with pests viz. insects (75), nematodes (84), pathogens (2,044), 2,194 were salvaged. Prophylatic treatments given to 5,242 samples. Pests intercepted included *Aphelenchoides besseyi, Callosobruchus chinensis, Drechslera maydis, Fusarium oxysporum, F. solani, Macrophomina phaseolina, Peanut mottle virus* and *Peanut stripe virus*. A total of 1,629 samples processed in PEQN and interceptions were zonate leaf spot, Anthracnose, Downy mildew, *Maize streak virus, Peanut stripe virus*. A total of 9796 samples under export processed for quarantine clearance. Eleven pest intercepted on six crops, 227 samples rejected and 7,689 released. Experiments conducted for elimination of external contamination of smut spores (*Tolyposporium penicillariae*) in pearl millet seed as supportive research. A total of eight explorations were undertaken during the period and 705 germplasm accessions of various crops was collected. A total of 699 accessions of sorghum, blackgram, brinjal, chillies, cherry tomato, and horsegram were grown in the field alongwith checks for characterisation, evaluation/multiplication. A total of 1,014 accessions including horsegram (165), finger millet (150) and small millets (54), brinjal (115), chillies (353), dolichos bean (130), tomato (34) and *Lycopersicon pimpinellifolium* (13) were multiplied and sent to NGB for long-term storage. A total of 953 accessions of diverse germplasm collected during explorations including cereals and millets (144), vegetables (360), pulses (181), oilseeds (25), spices (95), M&AP (12), wild relatives (58) and others (47) were sent to GHU for storage in the MTS and accessioning.

12.1 Quarantine Processing and Clearance of Germplasm

During the year 2006, a total of 21,736 samples of different crops were received and processed for quarantine clearance. Out of these, 11,940 samples (paddy 4,752; maize 4,720; chickpea 1,572; groundnut 647; sunflower 53; safflower 4; Brassicas 9; chilli 62; tomato 69; cauliflower 1, carrot 31, brinjal 11, bambaranut 6 and *Citrullus lanatus* 3) were imported from different countries and the rest 9,796 (sorghum 2,821; pearlmillet 1,536; chickpea 4,140; pigeonpea 434; groundnut 847 and small millets 18) were meant for export to different countries.

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

Pathogen	Crop	Country
Alternaria padwickii, Drechslera oryzae and *Aphelenchoides besseyii*	Paddy	Philippines
Drechslera maydis, Fusarium oxysporum and *F. solani*	Maize	Thailand
Ascochyta rabiei, Botrytis cinerea, Mycosphaerella pinodes and *Phoma medicaginis*	Chickpea	USA
F. oxysporum, Neocosmospora sp and Gram negative bacteria		ICARDA, Syria
Botrytis cinerea	Wild safflower	Germany
Botrytis cinerea, Rhizoctonia bataticola, Sclerotium rolfsii and *Peanut stripe virus*	Groundnut	Japan

During quarantine processing, four samples of maize from Thailand (3) and Philippines (1), infected with *Drechslera maydis;* one accession of wild safflower from Germany infected with *Botrytis cinerea*, and one accession of chickpea from USA infected with *Ascochyta rabiei* were rejected. A set of 23 chickpea accessions of the USA consignment, which was found infected with low infections of *Botrytis cinerea*, *Fusarium oxysporum* and Gram-negative bacteria, was released for growing in the post-entry quarantine greenhouse. The healthy accessions were released after giving the necessary salvaging treatments.

12.1.2 Imports processed and released: During the period under report, 11,186 samples including paddy samples (4,406), maize (4,509), sorghum (483), chickpea (1,549), sunflower (43), safflower (3), bambaranut (6), Brassica (9), chilli (63), tomato (69), brinjal (11), carrot (31) and other vegetables (4) were released to the respective consignees after giving the mandatory treatments.

***Drechslera maydis* on maize from Thailand**

Total number of samples infested/ infected in imports	-	2,203
Samples infected with pathogens	-	2,044
Samples infested with Insects	-	75
Samples infected with nematodes	-	84
Number of samples salvaged	-	2,194
Number of samples detained	-	-
Number of samples Rejected	-	9

12.1.3 Post-entry quarantine observations

The details of crop germplasm grown and inspected in the post-entry quarantine isolation area of ICRISAT were as below:

Crop	Country	No. of samples	Remarks
Maize	Egypt	324	Some highly susceptible lines against *Gloeocercospora* leaf spot and *Colletotrichum graminicola* were noticed
Sorghum	Egypt	10	Healthy
Sorghum	Niger	483	Healthy
Sorghum	France	4	Only 4 out of 14 accessions germinated and were healthy
Chickpea	Syria	75	Poor germination was noticed
Groundnut	Vietnam	1	Healthy
	USA	3	Healthy
	Japan	622	Many accessions that were found infected with *Peanut stripe virus* were removed and incinerated

At private industry farms:

- Three hundred accessions of maize, imported from Philippines and grown in the farm of Bioseed India Pvt. Ltd., Hyderabad were inspected by two quarantine scientists of the station on 27.03.06 during active crop growth stage and were found healthy.
- *Post-Entry Quarantine Inspections*: Pathologist from the station visited the farm of Advanta India Pvt. Ltd on 18.10.06 to inspect maize accessions (111 accs) from Thailand and Australia during active crop growth period. Downy mildew suspected plants were removed and incinerated. Inspection of transgenic cotton accessions (44) from USA, being grown at Vikki's Agro Tech Pvt. Ltd., Hyderabad was completed on 30.10.06 by the Pathologist.

12.2 Export Quarantine

Out of 9,796 export samples consisting of sorghum 2,821; pearlmillet 1,536; chickpea 4,140; pigeonpea 434; groundnut 847 and smallmillets 18, two hundred and forty-two (242) samples were rejected due to the association of various pests and pathogens. Some samples were not permitted for export due to lack of necessary documents like DARE certificate, back history and FAO trust.

In all, 139 phytosanitary certificates were issued during the reporting period. The details are given as under:

Crop	Samples Processed	Samples Rejected	Samples Released
Sorghum	2,821	31	2,790
Pearl millet	1,536	62	1,474
Small millets	18	1	17
Chickpea	4,140	116	4,024
Pigeonpea	434	30	404
Groundnut	847	2	845
Grand Total	**9,796**	**242**	**9,554**

Pathogens detected from export material: The rejections in the export germplasm of ICRISAT mandate crops were mainly due to pathogens such as *Acremonium strictum, Bipolaris setariae, Botrytis cinerea, Claviceps fusiformis, Colletotrichum graminicola, Exserohilum turcicum, Fusarium chlamydosporum, F. oxysporum, Leptosphaerulina crassiasca, Neocosmospora vasinfecta, Phoma medicaginis, Rhizoctonia bataticola, R. solani, Sclerotium rolfsii* and Gram negative bacteria.

Plant quarantine services provided from NBPGR, Hyderabad other to Organizations

ICAR Institutes	SAUs/State Govt organizations	Private institutes/ organizations	International institute
• DOR, Hyderabad • DRR, Hyderabad, • NRCG, Gujarat, • IIHR, Bangalore; • CRRI, Cuttack	• RRS, ANGRAU, Hyderabad; • UAS, Bangalore; • Rice Research Station, Kerala; • TNAU, Coimbatore; -Anbil Dharmalingam Agril. College & Research Institute, Trichy, (TNAU); • RRS, Kerala Agricultural University, Thrissur; -Uttarabengal Krishi Viswavidyalaya, West Bengal; • Agricultural Research Demonstration Farm, Tripura; • Regional Rainfed Lowland Rice Research Station, Assam; • ARS, Assam; -Institute of Agricultural Sciences, Banaras Hindu University, Varanasi; • Rice Development Research Station, West Bengal; • Centre for Plant Biotechnology and Molecular Biology, Thrissur, Kerala; • Department of Plant Breeding, Karaikal, Pondicherry; • TNRI, Aduturai, Tamil Nadu; • Pandit Jawaharlal Nehru College of Agriculture, Karaikal, Pondicherry; • Centre for Plant Molecular Biology, TNAU, Coimbatore	• Advanta India Pvt. Ltd., Bangalore; • Barwale Research Foundation, Hyderabad; -Bioseed Research (I) Pvt. Ltd., Hyderabad; • Hybrid Rice International Pvt.Ltd., Hyderabad; • JK Agrigenetics, Hyderabad; • Monsanto India Ltd., Bangalore; • Nuziveedu Seeds Pvt Ltd., Hyderabad; • Pioneer Overseas Corporation Pvt. Ltd; Hyderabad; • Pro-Agro Seed Co Pvt. Ltd., Hyderabad; • Vibha Agrotech Ltd., Hyderabad; • M/S.Namdhari Seeds Pvt.Ltd., Bangalore; • Metahelix Life Sciences Pvt. Ltd., Bangalore; • Indo-American Hybrid Seeds Pvt.Ltd., Bangalore; • Errika Seeds Pvt.Ltd., Hyderabad; • Emergent Genetics India Pvt.Ltd., Bangalore; -Rasi Seeds Pvt.Ltd., Salem, Tamil Nadu	**ICRISAT-** Patancheru, Hyderabad

12.3 Exploration and Collection of Germplasm

A total of eight explorations were undertaken during the period and 705 germplasm accessions of various crops were collected. Details of explorations and crop diversity collected are as follows:

***Rabi* pulses:** A total of 257 accessions of diverse crop germplasm was collected from Adilabad, Karimnagar and Khammam districts of Andhra Pradesh. A total of 176 accessions of various *Rabi* pulses (black gram – 25, green gram –29, cowpea –26, chickpea - 6, soybean –1, pigeonpea –30, field beans – 60) were collected along with germplasm of cereals and millets (39), oilseeds (15), spices (12) and vegetables (12) and 4 accessions of wild species including one each of mucuna, *Cucumis hardwickii* and *Abelmoschus ficulneus*. Rich diversity was noticed in blackgram, greengram, cowpea and field bean in terms of seed colour and size and lustre. Important landraces among the pulses collected include *chinna minumulu, nattu minumulu, nalla pesaralu, chinna pesaralu and erra senagalu*.

Variation in stem colour in pillipesara (VKA-036) from Penagadi village of Pendurti Mandal of Visakhapatnam, AP

***Vigna trilobata*:** Parts of East Godavari, Visakhapatnam, Vizianagaram and Srikakulam districts of north coastal region of Andhra Pradesh were surveyed for Pillipesara bean. A total of 63 accessions including 38 of pillipesara from cultivated/ wild/ semi-wild habitats were collected. Variability was observad in stem colour (red and green), pod puberulence, seed colour and seed size. In addition, 19 accessions of wild relatives and

medicinal and aromatic plants were collected (*Crotalaria* spp.-4, *Atylosia scarabaeoides* - 2, *Mucuna pruriens*-1, *Solanum* spp.-6, *Ocimum* spp.-2, *Plumbago zeylanica*-1, *Curculigo orchioides*-2, *Cucumis hardwickii*-1). Besides these 6 accessions of other crops (ragi-2, shallot onion –1, ricebean-1, dolichos bean -2) were also collected.

Banana: This survey was undertaken in collaboration with ANGRAU, ARS, Kovvur in parts of East Godavari, Visakhapatnam, Vizianagaram and Srikakulam districts of north coastal region of Andhra Pradesh for the collection of endemic diversity in Banana germplasm. In all, 16 accs. of Banana (cultivated *Musa* spp.), five accs. of *Musa ornata*, one accession of *Ensete glaucum* and 27 accs. belonging to Agri-horticultural crops/ Medicinal/ Dye yielding/ Energy crops/ Wild species were collected. The important landraces collected include *Amruta Paani, Amrutaalu, Bonta Arati, Bontha, Budida Bontha, Erra Arati, Konda Arati, Kura Arati, Kura Bontha, Pasiri Bontha, Tella Chekkarakeli* etc. Significant variability was observed in pseudo-stem height, bunch length, no. of fruits/ bunch, fruit length, fruit width, fruit taste, reaction to diseases and pests and the genome to which the cultivated types belong to. The popular local landraces of table purpose traditionally being cultivated are being replaced with improved/ introduced cavendish types as they are tolerant/ resistant to diseases and being medium tall types can withstand lodging. The area under natural occurrence of *Musa ornata* and *Ensete glaucum* is under tremendous biotic pressure in the East Godavari district.

IC545488 - Kura arati a cooking type of banana with large fruits and huge bunch from Khammam district of Andhra Pradesh

Brinjal: A total of 147 accessions consisting of brinjal (33) along with *Solanum incanum* (12) and *S. surrattense* (2) were collected during the survey from Adilabad, Karimnagar and Khammam districts of Andhra Pradesh. In addition, accessions of cereals (10), sesamum (9), ridge gourd (21), *Cucumis hardwickii* (1), cherry tomato (2), *Canavalia* (2), horsegram (5), ashgourd (3) and bottle gourd (47) were also collected.

Chillies: This survey was undertaken in collaboration with ANGRAU, JVRHRS, Malyal in parts of Warangal district of Telangana region of Andhra Pradesh for the collection of endemic diversity in Chilli germplasm in general and Warangal Paprikas in particular. In all, 90 accessions of Chilli germplasm and nine accessions of other Agri-horticultural, medicinal and wild species were collected in the above survey. The important landraces collected include *Bondu mirapa, Bydige, Byadige kaddi, Doddu kaya, Meka sannalu, Sanna kaya, Single patti, Tomato mirchi, Warangal kaya,* etc. Significant diversity was observed in plant height, degree of plant spread, leaf shape & size, flower size, fruit colour, bearing, fruit length, width, size & shape, pungency, duration and yield. The elite accessions of *Warangal* Paprika include IC545648, IC545649, IC545650, IC545654 and accessions IC545736, IC545737, IC545658, IC545661 for very good colour, moderately pungent and suitable for pickles. The traditional area under *Warangal* Paprika Chilli cultivation is coming down due to fluctuating/ falling market prices, which resulted in patronization of commercial crops like Cotton and Pigeonpea.

Jatropha: Three surveys for the collection of Jatropha germplasm were undertaken under the A.P. State Govt. funded Jatropha project. Parts of Warangal, Nizamabad, Karimnagar, Mahbubnagar, Khammam, Visakhapatnam, Vizianagaram and Srikakulam districts of Andhra Pradesh were surveyed, 96 accessions of jatropha were collected during the survey along with seed for 30 accessions. The stem cuttings have been established in the green house.

12.4 Germplasm Evaluation

***Rabi* 2005-06**

A total of 699 accessions of sorghum, blackgram, brinjal, chillies, cherry tomato, and horsegram were grown in the field alongwith checks for characterisation, evaluation/multiplication.

Sorghum: A total of 204 accessions were characterized and evaluated in ABD along with 2 check varieties (M-35-1 and CSV-16). High diversity was observed for different quantitative traits as follows: plant height (88-322cm), peduncle exsertion and recurving (0-43cm), number of basal tillers (0-9), total number of leaves (5-15), leaf length (28-91cm), leaf width (2-9cm), panicle length (3-32cm) and panicle width (4-24cm). Several

accessions were identified as promising over the best check for various traits. Among the tall types, IC249114 from Warangal and IC249106 from Khammam appear to be promising for panicle length and width. IC413287 from Mahbubnagar appeared promising for panicle length. Among the short types, IC436839 appear to be promising for panicle length.

Horsegram (promising trial): A total of 20 accessions identified promising in previous evaluations were evaluated in RBD trials with two check varieties Palem-1 and Palem-2. IC470226 and IC470213 appear to be high yielding genotypes by having more number pods/ plant. IC470256 appear to be promising for earliness, pods/ plant and seeds/ pod. Anantapur and Mahabunagar districts, which are arid to semi-arid districts, seem to be potential area for horsegram collection while looking for germplasm with traits for earliness, yield and yield contributing characters.

Black gram (Rabi): A total of 159 accessions were grown for characterisation and evaluation in ABD with three checks T-9, PU-19 and LBG-20. High diversity was observed in different quantitative traits as follows: plant height (17-49cm), primary branches (0-13), clusters/plant (2-24), pods/plant (4-54), pods/cluster (2-6), pod length (3-5cm), seeds per pod (3-8), 100 seed wt (3-6 g) and days to flowering (46-58). Several accessions were identified as promising over the best check for various traits. IC282006 from Medak appears promising for clusters/plant, pods/cluster, pods/plant and on par with the check varieties for seeds/pod. IC436753 from Adilabad appears to be promising for pods/cluster and pods/plant. IC436675 from Adilabad is unique with red seeds and appears promising for clusters/plant, pods/ plant. Adilabad, East Godavari and Medak districts may be fine-combed for yield attributing traits.

Black gram: IC436675 from Adilabad with red seeds

Black gram: IC343967 from East Godavari with profuse pods

Brinjal: A total of 46 accessions of brinjal germplasm were evaluated with Bhagyamathi and Shyamala and Pusa Purple Long as local checks in an ABD. A wide range of variation was recorded in different traits.

Cherry tomato: A total of 14 accessions were characterized and evaluated in an RBD with Punjab Chuhara, Marutham as check varieties for nine quantitative descriptors. Fresh fruit weight, fruit yield and fruit weight seems to be more diverse. IC383117 is the highest yielding genotype. IC256085 appears to be promising for multiple traits like primary branches, clusters/ plant, fruits/ plant and yield. IC383190 appears to be promising for fruit traits.

Chillies: A total of 256 accessions were characterized, evaluated and multiplied in an ABD with CA-960, G-4, LCA-334 and Pusa Jwala as check varieties for 45 qualitative and quantitative descriptors. Dry fruit weight, stem diameter and fruit length seem to be more diverse. For days to flowering accessions EC554803 and IC526849 are the earliest with 69 days. EC554803 an exotic accession is found promising for earliness. Accessions IC413713 found promising for fruit length, IC446497 for fruit weight and IC446525 for earliness and fruit weight.

***Kharif* 2006**

A total of 1,182 accessions of blackgram, brinjal, chillies, millets, cowpea, sesame and bambara nut were grown in the field along with checks for characterization, evaluation/multiplication.

Crop	No. of Accs.	Checks	Activity
Black gram	345	T-9, PU-19, LBG-20	Characterisation and evaluation
Finger millet	29	PR-202, VL-149	Evaluation
Italian millet	173	Prasad, Narasimharaya, Lepakshi	Characterization and Evaluation
Italian millet	15	Si.A-326 (Prasad), AK-132-1 (Lepakshi), Si.A-2593 (Krishnadevaraya), Si.A-2622 (Narasimharaya), Si.A-2644 (Sri Lakshmi), Si.A-2829, Si.A-2871	Evaluation
Little millet	12	CO-2, OLM-203	Evaluation
Barnyard millet	11	K-1, VL-29	Evaluation
Sesame	90	Swetha	Multiplication
Bambaranut	5		Multiplication
Beans	119	RND-1, Arka Jay, Arka Vijay	Characterization, Evaluation and Multiplication
Brinjal	55	Bhagyamathi, PPL, Shyamala	Characterization, Evaluation and Multiplication
Chillies	158	CA-960, LCA-334, Pusa Jwala	Characterization, Evaluation and Multiplication
Cowpea	170	GC-153, C-152, CoVu-702	Characterization and Evaluation

Italian millet: Accession IC283716 and IC308935 were the earliest to flower with 34 days on par with the check variety Lepakshi. A wide range of variability was observed for some traits as in plant height (70– 173 cm), number of basal tillers (1-12), peduncle length (11-43cm), earhead length (7.3 – 32 cm), earhead width (0.7 – 4.5cm).

Late maturing (93 days) dual purpose *Setaria italica* - IC 369718 from Vizianagaram (Check Narasimharaya - 52 days)

A purple high yielding (19.2g/ plant) *Setaria italica:* IC426717 - from Srikakulam (check Narasimharaya 12.6g/plant)

Black gram: Eight accessions flowered in 34 days on par with check variety T-9 which flowered in 35 days. Two accessions (IC343877, IC426759) were observed to flower late in 78 days. Range of variability was observed for some traits as plant height (19 – 74cm), pods/ cluster (3-7), clusters/plant (7-27), pod length (4-6) and pods/plant (7-81). IC261178 and IC436720 were found best for pods/plant (74) and pod length (5.6 cm) over T-9.

Chillies: A total of 154 accessions of Chilli germplasm were grown along with CA-960, LCA-334 and Pusa Jwala as the local checks in an augmented block design for detailed characterization, evaluation, and multiplication. EC514810 with 79 days is the earliest to flower when compared to Pusa Jwala with 95 days, which is the best of three checks. For days to maturity, IC545468 was the earliest on par with check variety Pusa Jwala with 146 days.

Brinjal: A total of 55 accessions of brinjal germplasm were evaluated with Bhagyamathi and Shyamala and Pusa Purple Long as local checks in an ABD. A wide range of variation was recorded in different traits viz., plant height (20 – 82 cm), plant spread (45 – 142 cm), primary branches (2-8), petiole length (1 – 4 cm), fruit length (5.5 – 20 cm), fruit width (4.7 –10 cm).

IC383117 with pear shaped fruits from Dantewada, Chhattisgarh, being evaluated at NBPGR, RS, Hyderabad.

Cowpea: IC261240, IC436847 and IC282057 were earliest to flower (54 days) as compared to earliest check variety (60 days). Accessions were identified superior to best check for pod length (6) and seeds/ pod (5). IC436845 was found superior for both pod length (18.7 cm) and seeds/pod over best check C-152.

Dolichos beans: Accession IC526947 was the earliest to flower in 42 days and IC526918 was the earliest to first pod harvest in 130 days. Wide range of variability was recorded for different characters as leaf length (6.3 – 15.3 cm), leaf width (4.4 – 14.3 cm), pedicel length (4.3 – 19.8 cm), number of branches (1-14), internode length (1.2 – 5 cm), pod length (3.7 -12.2 cm), pod width (0.8 – 2.7 cm), 10 pod weight (2.7 – 80.6 g) and number of seeds/ pod (1.5 – 5.2).

***Rabi* 2006-07**

A total of 944 accessions of black gram, green gram, sorghum, horsegram, cowpea, amaranths, brinjal, chillies and tomato were grown in the field along with checks for characterization, evaluation / multiplication. The observations are being recorded for various traits.

Crop	No. of Accs.	Checks	Activity
Black gram	207	T-9, PU-19, LBG-20	Characterization and Evaluation
Green gram	140	ML-267,LGG-460, K-851	Characterization, Evaluation and Multiplication
Sorghum	239	M35-1,CSV-15,CSV-16	Characterization, Evaluation and Multiplication
Horsegram	15	Palem-1,Palem-2	Evaluation
Amaranths	26		Multiplication
Brinjal	112	Bhagyamathi, PPL, Shyamala	Characterization and Evaluation
Chillies	150	CA-960, LCA-334, Pusa Jwala	Evaluation and Multiplication
Cowpea	24	GC-153, C-152, CoVu-702	Evaluation
Tomato	78	Pusa Ruby, Marutham	Multiplication
Wild legumes	40	-	Multiplication

Variety released: Coriander accession (SH-3424/ NIC18189/ LCC-128), collected during 1993 in a collaborative exploration with ANGRAU was released as a variety **SUDHA** by ANGRAU as per the state varietal release committee recommendations. The Coriander Variety **SUDHA** was found to be promising than all the existing varieties under rainfed conditions with a yield potential of 7.5 - 10 q/ ha and 12 - 15 q/ ha under irrigated conditions.

12.5 Germplasm Conservation

Long-term storage in the National genebank: A total of 1,014 accessions including horsegram (165), finger millet (150) and small millets (54), brinjal (115), chillies (353), dolichos bean (130), tomato (34) and *Lycopersicon pimpinellifolium* (13) were multiplied and sent to NGB for long-term storage.

Medium Term Storage, New Delhi: A total of 953 accessions of diverse germplasm collected during explorations including cereals and millets (144), vegetables (360), pulses (181), oilseeds (25), spices (95), M&AP (12), wild relatives (58) and others (47) were sent to GHU for storage in the MTS and accessioning. In addition, 81 voucher samples 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 5,393 samples including 4,893 import vouchers (paddy (917), carrot (31), sunflower (36), maize (33), brinjal (11), tomato (37), chillies (58), chickpea (213), paddy (200), maize (3,351), and bambaranut (6)) along with 403 samples of exploration material (were added to the medium term module (MTM). In addition 49 accessions of chillies (22) and *Canavalia* sp (27) received from different institutes for characterisation and evaluation were also stored. Besides these voucher samples of 48 released varieties of paddy received from DRR, Hyderabad under the DUS programme were also added to the MTM taking the total holdings in MTM to 62,368.

12.6 Germplasm Distribution

A total of 343 accessions of were distributed to different indentors for evaluation and crop improvement research as detailed below. In addition, supplied a set of 92

accessions of *Sesamum* to NBPGR RS Akola for characterization and evaluation.

- 120 accessions of blackgram germplasm were supplied to RARS, LAM, Guntur (70 accs) and ARS, Bidar (50).
- Two accessions of sorghum to IAMR, Ghaziabad, UP.
- Five accessions of *Lycopersicon pimpinellifolium* to Division of Nematology, IARI.
- 159 accessions of chillies germplasm were supplied to KAU, Thrissur, Kerala (51accs.), Dr Y S Parmar University, Solan (10 accs.), IARI, New Delhi (50), UAS, Dharwad (48).
- 16 accs. of *Capsicum* spp (6), *Solanum* spp (5) and *Lycopersicon* spp (5) were sent to CSKHPKV, Palampur.
- 30 accessions including dolichos bean (23 accs) and field bean (7 accs) was supplied to UAS, Dharwad.
- Seven accessions of brinjal to TNAU, Coimbatore.
- Five accessions of horsegram to Crop Improvement Division, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora.

Germplasm shared with NAGS/collaborators: Twenty-two accessions of *Jatropha* germplasm lines (15-20 cuttings each) were supplied to Agroforestry research centre, Rajendranagar, Hyderabad of ANGRAU, a collaborator under the Jatropha project. Thirty accessions were supplied to CRIDA, Hyderabad for evaluation and maintenance. A set of 35 accessions of sorghum was shared each with NRC Sorghum and RARS, ANGRAU, Palem (collaborating institutes in the *Maghi* Sorghum exploration mission).

12.7 Supportive Research

Seed health testing of Jatropha germplasm: Twelve seed accessions of Jatropha, collected from Warangal and Khammam districts of Andhra Pradesh were examined by conducting blotter test. Major pathogens found on the germplasm were *Colletotrichum gloeosporioides, Lasiodiplodia theobromae, Macrophomina phaseolina, Pestalotia* sp., *Fusarium verticilloides, Phomopsis* sp., *Phoma* sp., etc. The infected seed was sown in the pots under controlled conditions to see the affect of the pathogen on seed germination.

Estimation of oil content in 101 accessions of *Jatropha curcas* germplasm, collected in Adilabad (17.9 – 24.8%) and Chhattisgarh (18.3 – 24.8 %) was carried out using NMR Method. Estimation of oil content using Soxhlet method on 25 accessions of *J. curcas* germplasm was carried out. The oil content ranged from 31.4 – 37.8 %.

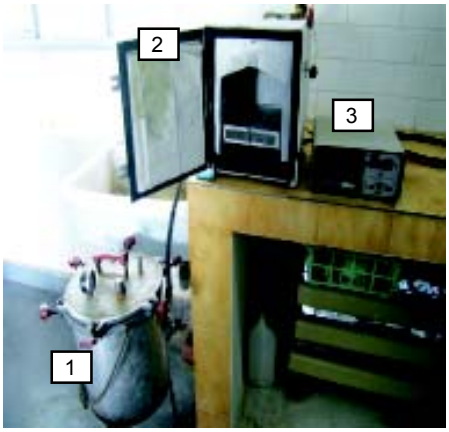
Six out of 123 germplasm lines of chilli being evaluated showed PBNV incidence of <5%. Only 4 out of 33 brinjal lines showed <5% PBNV. Of the 21 chilli lines sap inoculated with PBNV, 3 lines showed less than 20% infection and rest all susceptible. All the twelve chilli cultures, sap inoculated with PBNV, showed susceptibility ranging from 13-100%. Of the 12 BICMV field promising cowpea accessions, on sap inoculation, 6 remained free from BICMV after 14 days of inoculation.

Thrips transmission of *Tobacco streak virus* (TSV): TSV infected *Parthenium* pollen sprinkled on cotton leaves and release of thrips, transmitted TSV. However, the infection was localized and did not become systemic. Seed extraction procedures for conservation of brinjal have been studied. Seeds extracted using the traditional, sun, acid, sodium chloride and sodium carbonate methods and stored in polyethylene bags covered with brown paper bags in the refrigerator since 1996 were tested for germination. The germination percentages 100, 98, 0, 95 and 100 respectively, were recorded for the above treatments after 10 years of storage.

Seed health testing service extended: Seed health testing services were extended to "Hybrid Rice International", Hyderabad for paddy germplasm on payment basis to detect fungi (7 species), bacteria (3 species), nematode (1 species), insects (3 species), mites (2 species) and weeds (27 species) of quarantine significance to Brazil.

Moist heat treatment chamber for salvaging infected germplasm: A new moist heat treatment chamber was fabricated locally to carry out experiments on standardizing salvaging methods for the infected germplasm. Effect of moist heat treatment was studied on molded sorghum grains at different temperatures and periods (50^0C for 10 and 20 minutes; 55^0C for 10 and 20 minutes). Of the treatments tested, 50^0C for 10

minutes was found suitable to reduce the infection. The mold infection could not be eradicated although there was marked reduction in infection percentage.



1. Steam generator 2. Treatment chamber 3.Temperature controller

Effect of moist heat treatment on pigeonpea seed: Pigeonpea seed was given moist heat treatment at 50°C, 55°C and 60°C temperatures for different periods, *viz*., 10, 15, 20, 30 minutes. Germination was not hampered upto 55°C.

Glasshouse screening of field promising cowpea germplasm against *Black eye cowpea mosaic virus* (BICMV): Twelve field promising cowpea accessions against *Black eye cowpea mosaic virus* (BICMV) were tested by sap inoculation. IC519745 remained free from the disease, whereas IC399001, IC436769 showed very mild symptoms. Eleven accessions of cowpea, which showed high susceptibility (>75% infection) under field conditions against BICMV were tested for seed transmission by sowing 50 seeds each harvested from the infected plants. Only three lines showed seed transmission, IC519725 (18%); IC436580 (6%) and IC519730 (2%).

Screening of groundnut germplasm against TSV and PBNV: Two wild *Arachis* spp (ICG 8160 & ICG 8922) were screened against *Tobacco streak virus* (TSV) and *Peanut bud necrosis virus* (PBNV) by sap inoculation. ICG 8160 was resistant to both the viruses whereas ICG 8922 was resistant to PBNV only. *Parthenium* samples (165) representing three locations, received from ANGRAU, Kadiri, showed TSV infection of 9.6, 11.9 and 20.4% in ELISA tests. Assay for PBNV and *Tobacco streak virus* was conducted on groundnut cultivars (12 and 10, respectively). All were found susceptible to TSV, while >80% of the accessions were found susceptible to PBNV.

Leaf samples (10) from *Peanut bud necrosis virus* (PBNV) suspected bambara nut accessions, being grown in the field, were assayed on seedlings of local lesion assay host, cowpea. One sample has shown mild symptoms of PBNV. Precautions were taken to prevent the spread of the disease.

Status of active germplasm holdings at NBPGR RS Hyderabad – as on 31.12.06

Crop / Category	Number of samples in MTS
Brinjal	6,116
Black gram	710
Chillies	3,021
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	32,151
Export voucher samples	3,301
NBPGR collection (Pre-NATP)	1,789
NATP collection & augmented samples from collaborating institutes	10,744
NPTC collection	947
Released & Research Material (Restoration from ICRISAT)	
Sorghum	244
Chickpea	1,168
Pigeonpea	846
Collaborating Institutes	
ANGRAU – Paddy, Vegetables, Sunflower	32
DOR – Sunflower	74
DRR – Paddy	306
CTRI-Rajahmundry (Tobacco)	139
Grand Total	**62,368**

Research Projects (Project Code, Title, PI, Co-PI and Associates)

PGR/PQR- BUR-HYD-01.00- Quarantine Processing Of Plant Germplasm Under Exchange And Supportive Research (KS Varaprasad).

PGR/PQR- BUR-HYD-01.01- Detection, Identification and Control of Pests Associated with Import and Export of Seed/ Plant Material (K Anitha).

PGR/PQR- BUR-HYD-01.02- Developing a Database on Pests And Pathogens of Quarantine Significance (B Sarath Babu).

PGR/PQR- BUR-HYD-01.03- Quarantine Treatments for Germplasm under Exchange and Developing Detection Techniques and Treatment Schedules for Seed Borne Pathogens (SK Chakrabarty).

PGR/PQR- BUR-HYD-01.04- Post-entry Quarantine Processing of Imported Germplasm (RDVJ Prasada Rao).

PGR/PQR- BUR-HYD-02.00- Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, Documentation and Distribution of Genetic Resources of South East Coastal Zone (KS Varaprasad).

PGR/PQR- BUR-HYD-02.01- Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, Documentation and Distribution of Genetic Resources of Agricultural Crops (Cereals, Millets, Pulses, Oilseeds etc.) and their Wild Relatives. (Kamala Venkateshwaran).

PGR/PQR- BUR-HYD-02.02- Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, Documentation and Distribution of Genetic Resources of Horticultural Crops (Vegetables, Fruits, Species, Medicinal and Aromatic Plants etc.) and their Wild Relatives (Someswara Rao Pandravada).

PGR/PQR- BUR-HYD-02.03- Characterization and Evaluation of Wild edible Crops of Leguminosae (N Sivaraj).

Externally funded projects

· A DBT funded Research project on “Improvement of brinjal and chillies for root knot nematode resistance using molecular markers” was sanctioned with a total outlay of Rs. 28.67 lakhs to Acharya NG Ranga Agricultural University with NBPGR Regional Station-Hyderabad as a collaborating institute. The duration of the project is three years with effect from July 7, 2006.

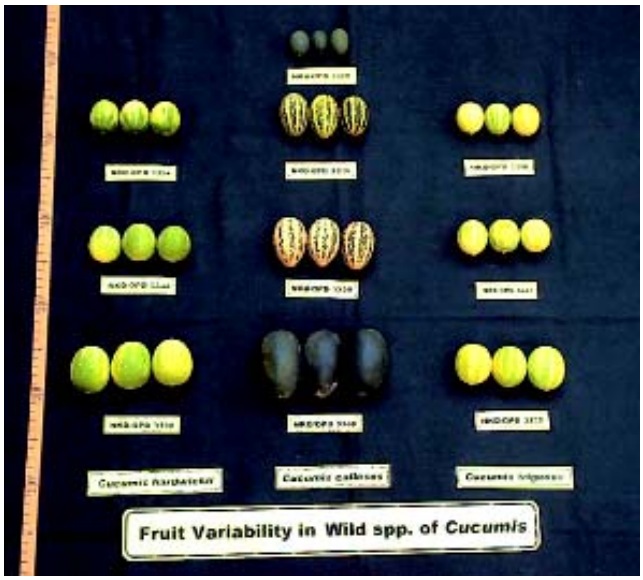
· A new project entitled, “Collection, assembly and conservation of genetic resources of physicnut (*Jatropha* Linn.)” is sanctioned to NBPGR, New Delhi by DBT, Govt. of India with NBPGR Regional Station, Hyderabad as one of the co-operating centres. The duration of the project will be three years with effect from October 3, 2006.

13. REGIONAL STATION, JODHPUR

Summary: One exploration was undertaken in parts of Rajasthan and 41 germplasm collections of wild species of *Cucumis* were made. Observations were recorded on morpho-agronomic traits of 319 accessions raised during *Rabi*, 2005 and 1,303 accessions raised during *Kharif* 2006. Trait specific accessions for determinate habit, foliaceous bracts and male sterility were identified in guar germplasm during *Kharif* 2006. Horticultural plants and plants of economic importance were maintained in field and data were recored in *Aloe barabadensis*, anola, bael, *Capparis decidua*, jamun, mulberry, *Salvadora* spp., *Jatropha curcas* and jojoba germplasm. In all 28,977 germplasm accessions are conserved in the MTS facility, including 1,761 accessions processed and kept in MTS facility during 2006. A total of 936 accessions were sent to NGB for LTS. Eighty-one accessions of horticultural and economically important plants were added to the field gene bank making a total of 758 accessions in the field gene bank at the station. A set of 25 varieties released for Rajasthan state has been received along with 14 other germplasm accessions and conserved at the MTS facility of the station. Seed samples of 445 accessions were supplied to various indentors.

13.1 Exploration and Collection

One exploration and collection trip was undertaken from October 27 to November 4, 2006 for the collection of wild species of *Cucumis* from Aravali hills of Rajasthan in collaboration with Germplasm Exploration and Collection Division, New Delhi as the lead center. A total of 41 collections comprising *Cucumis callosus*, *C. hardwickii*, *C. prophetarum* and *C. trigonus* were collected from Dungarpur, Pali, Sirohi and Udaipur districts of Rajasthan covering Aravalli range. The collections included *Cucumis callosus* (21), *C. hardwickii* (10), *C. prophetarum* (6) and *C. trigonus* (4). Variability was observed in plant habit; shape, colour and texture of leaves; size, shape, colour and weight of the fruits; fruit skin texture and ornamentation; fruit length and width; thickness of mesocarp and pulp; pulp colour; size, shape and colour of seeds and 100 seed weight. Two collections (NKD/ OPD-3345) and (NKD/ OPD-3346) of *C. callosus* made from tribal village Ghata Bhardariya of Dungarpur district had dark blackish green fruits which become orange at maturity.



Variability in fruit shape, size and colour among the wild species of *Cucumis*.

Germplasm enrichment

Seeds of *Withania coagulens* (1), a rare wild relative of Ashwagandha, was collected from Arid Forest Research Institute, Jodhpur.

13.2 Germplasm Characterization and Evaluation

Rabi 2005 - 2006

A total of 319 accessions were raised during rabi 2005 – 2006, which included wheat (223 for characterization, 21 for evaluation), grain amaranth (39), chickpea-IVT (rainfed trial) (26) and fenugreek (10) for evaluation, characterization and multiplication. Data on variability in various parameters was recorded on the germplasm accessions as per the descriptor.

Variability in grain

Table 1. Promising accessions of wheat

1a. Wheat - Exotic Accessions (223 acc.)

Character	Accession No.	Best Check
Flag leaf length (> 20 cm)	EC514382 (21.9), EC514389 (23.0), EC519498 (24.8), EC519496 (42.5)	Raj-3765 (14.8)
50% Spike emergence (< 57 days)	EC514390 (57), EC498437 (57), EC483029 (57), EC498434 (57), EC498436 (57), EC527045 (56)	Raj-3765 (59.8)
Yield/ plant (> 12.0 g)	36th IBWSN-336 (15.07), EC493712, (12.30), EC463441 (12.10)	Hindi-62 (8.32)
1000 grain weight (> 52.0 g)	EC483027 (52.26), EC514390 (52.24), 36thIBWSN- 8 (52.15)	C-306 (44.31)

1b. Wheat - RBD (21 acc.)

Character	Accession No.	Best Check
Flag leaf length (> 17.6 cm)	IC104537 (17.8)	Raj-3765 (15.2)
Effective tillers/ plant (> 10)	IC104579 (11.17), IC105189 (10.87)	Hindi-62 (7.47)
Yield/ plant (> 25.0 g)	IC104579 (26.82)	Hindi-62 (8.32)

Kharif 2006

In all, 1303 accessions of field crops namely pearlmillet (95), cowpea (140), guar (231), mothbean (121), mungbean (148), horse gram (1), castor (135), sesame (431) and tumba (1) were raised for characterization/ evaluation/ multiplication during kharif 2006 (Table 2). The data on various descriptor traits was recorded.

Table 2. Promising accessions identified in various crops during kharif 2006

Crop	Character	Promising accessions	Superior check
Pearlmillet	Leaves/ plant (> 13.0)	IC449452 (13.0), IC541018 (14.4), IC537973 (14.4), IC537959 (15.2), IC449485 (17.6)	Raj-171 (10.7)
	Spike length (> 32.0 cm)	IC537997 (32.2), IC537982 (32.3), IC541900 (32.8), IC538000 (33.9), IC449451 (34.1), IC449448 (34.5), IC537994 (34.7), IC449450 (36.4), IC449466 (36.9), IC537996 (37.5), IC537998 (38.5), IC537992 (38.6)	JBV-2 (25.8 cm)
	Seed yield/ plant (> 36.0 g)	IC537965 (36.6), IC537993 (38.0), IC449450 (38.4), IC541900 (39.4), IC537967 (61.3)	Pusa-383 (27.8 g)
	Stover yield/ plant (> 60.0 g)	IC538000 (61.7), IC537992 (78.3), IC541900 (72.0), IC537994 (67.8), IC537990 (61.8), IC541017 (79.5), IC541018 (72.0)	Raj-171 (38.1 g)
Cowpea	Green pod yield/ plant (> 55. 0 g)	IC52094 (56.1), IC333208 (78.0), IC370499 (83.0), EC367686 (86.7)	GC-3 *(38.4 g)*
	100 seed weight (> 14.2 g)	IC324016 (14.5), IC202779 (14.7), C-1173 (15.4), IC333106 (15.7), EC232352 (16.3), EC35768 (16.5), EC667713 (16.5)	V-585 (11.5 g)
	Seed yield/ plant (> 21.0 g)	IC253273 (21.4), IC202926 (21.9), IC415590 (23.2), EC667713 (25.0), EC367686 (31.0)	GC-3 (15.2 g)
Guar			
Grain Type	Seed yield/ plant (> 11.6 g)	IC310630 (12.5)	Suvidha (9.6 g)
Vegetable Type	Clusters/ plant (> 13.0)	IC10356 (13.1), IC11704 (14.2)	IC11388 (10.3)
	Pods/ plant (> 28.0)	IC11704 (31.8)	IC11388 (22.7)
	Green pod yield/ plant	IC10350 (37.7), IC28269 (37.9), IC3773 (40.3), IC10356 (45.1), (> 37.5 g) IC11704 (58.1)	IC11388 (27.3 g)
Mothbean	Days to 50% flowering (< 38 days)	IC415132 (35.7), IC415127 (36.3), IC415139 (36.3), IC415152 (36.3), IC415143 (36.7), IC415164 (37.0), IC432139 (37.0), IC415155 (37.3)	RMO-40 (42.3 days)

	Seed yield/ plant (> 13.50 gg)	IC402284 (13.80), IC415155 (13.54)	Jadiya (11.70 g)
	100 seed weight (> 3.50 g)	IC415155 (4.58)	Jadiya (3.07 g)
Mungbean	Days to 50% flowering (< 36 days)	EC520036 (33.3), EC512793 (35.3), EC520041 (33.3), EC528611 (36.0), EC528607 (36.0), EC528604 (36.0)	Pusa-105 (41.0 days)
	Clusters/ plant (> 10.2)	IC333253 (10.4), IC39281 (10.4), IC39317 (10.6), IC541051 (11.0), EC538116 (11.0), EC540804 (15.0)	Pusa-105 (3.6)
	Pod weight/ plant (> 16.9 g)	IC333253 (17.0), IC39281 (19.35), IC39317 (20.3), EC538111 (20.6), IC39459 (21.7)	Pusa-105 (14.3 g)
	Seed yield/ plant (> 14.0 g)	IC39281 (14.1), IC39317 (14.6), IC39459 (16.2)	Pusa-105 (10.1 g)
	100 seed weight (> 7.0 g)	EC520042 (7.35), EC528087 (7.24), EC528088 (7.01), EC528614 (7.23)	M1319B (5.09 g)

Trait specific accessions: In guar, germplasm accessions for specific traits such as foliaceous bracts, determinate habit and male sterility were identified during kharif 2006.

Foliaceous bracts: Guar accessions with foliaceous bracts were multiplied for characterization in detail.

IC116895 - A guar accession with foliaceous bracts.

Determinate plant habit: Guar accessions with determinate plant habit were identified and single plant selections have been made in the 27 germplasm accessions namely in order to study this trait in details.

IC522431 - A determinate accession of guar identified during kharif 2006

Male sterility: Seventeen male sterile plants were identified in the guar trials grown during Kharif 2006. Male sterility in these plants was confirmed by analysis of pollen fertility with 2% acetocarmine. These male sterile plants showed variation in pollen fertility with one plant showing as high as 84% pollen sterility. The seeds of these plants will be multiplied, and used for characterization in detail.

Horticultural Plants

Establishment of germplasm: A total of 27 germplasm accessions of fruit crops namely Anola (6), Bael (7), Jamun (2), Karonda (5), Lasora (3), Phalsa (3) and tendu (1) have been transplanted and established in the field gene bank.

Monthly data on plant height and canopy are being recorded in the horticultural plant germplasm.

Economically important plants: Sowing was carried out in *Calligonum polygonoides* (1), *Balanites aegyptiaca* (1) and *Jatropha curcas* (60) during this period. Eighty-one accessions of economically important plants namely *Acacia albida* (1), *A. crassiceps* (1), *A. difficilis* (1), *A. farnesiana* (2), *A. pachycarpa* (1), *A. stenophylla* (1), *A. victorae* (1), *Aloe barbadensis* (5), jojoba (15), *Moringa concanensis* (1), *M. oleifera* (1), *Prosopis cineraria* (49), *Withania coagulens* (1) and *Withania somnifera* (1) were transplanted in the field.

Monthly data on plant height, canopy and number of branches were recorded in different accessions of *Jatropha curcas* (14) and *Prosopis cineraria* (49).

13.3 Germplasm Conservation

MTS facility: During this period a total of 1,761 accessions of different crops were added to the MTS

facility at this station. The germplasm additions include *Carissa edulis* (1), castor (1), *Cucumis* spp. (22), guar (632), Karonda (1), *Moringa concanensis* (1), *M. oleifera* (1), mothbean (127), mungbean (564) and pearlmillet (8) were kept in the MTS facility. Seed samples of 35 varieties released for Rajasthan state namely sesame (5), mothbean (1), guar (11), horse gram (1), castor (3), tumba (1), cumin (2) and isabgol (1) were conserved in the MTS. Besides these, pearlmillet (305) from CAZRI, Jodhpur; *Calligonum polygonoides* (1), *Haloxylon recurvum* (1) and *H. salicornium* (61) germplasm from RRS, CAZRI, Bikaner were also kept in the MTS facility. Altogether, a total of 28,977 germplasm accessions have been conserved at the MTS facility of this station.

Field Gene Bank: A total of 81 germplasm accessions has been added to the field gene bank, which includes fruits (28), oil yielding plants (15), economic plants (32) and medicinal and aromatic plants (6). The field gene bank at this station holds 758 accessions belonging to 101 taxa.

Germplasm sent to LTS: During 2006, a total of 936 germplasm of different crops namely guar (375), mothbean (351), mungbean (154) and pearlmillet (35) were sent to NGB, NBPGR, New Delhi for long-term conservation.

Director (Research), RAU, Bikaner and ADR, ARS, RAU, Mandore observing Aloe germplasm

New Initiative – Conservation of varieties released by State Agricultural Universities in Rajasthan and Gujarat

A new initiative to enrich the regional gene bank with the varieties released by state agricultural universities of Rajasthan and Gujarat was initiated during 2006. To begin with, 25 varieties of different crops were received and conserved at the MTS facility at the regional station, Jodhpur.

Crop	Varieties Received	Source
Castor	RHC-1, VP-1, TMV-25	ARS, RAU, Mandore, Jodhpur
Cumin	RZ-19, RZ-209	ARS, RAU, Mandore, Jodhpur
Guar	RGM-112; RGC-197, RGC-936, RGC-471, RGC-986, RGC1002, RGC-1003, RGC-1017, RGC-1031, RGC-1038, M-83	ARS, RAU, Mandore, Jodhpur; ARS, RAU, Jaipur
Horsegram	KS-2	ARS, RAU, Mandore, Jodhpur
Isabgol	RI- 89	ARS, RAU, Mandore, Jodhpur
Mothbean	RMO-40	ARS, RAU, Mandore, Jodhpur
Sesame	RT-46, RT-54, RT-103, RT-125, RT-127	ARS, RAU, Mandore, Jodhpur
Tumba	RMT-59	ARS, RAU, Mandore, Jodhpur

13.4 Germplasm Exchange

Germplasm supplied: During the reporting period, a total of 445 germplasm accessions of different crops and plants were supplied to different indentors (Table 3).

Table 3. Germplasm supplied to various indentors during 2006

S.No.	Name of the crop	No. of accessions supplied	Indenting Institute
1.	*Abrus precatorius*	2	NBPGR, New Delhi
2.	*Acacia nilotica*	1	JNVU, Jodhpur
3.	*Andrographis paniculata*	1	NBPGR, New Delhi
4.	*Aristolochia bracteata*	1	NBPGR RS, Hyderabad
5.	*Asparagus racemosus*	1	NBPGR, New Delhi
6.	*Baliospermum montanum*	1	NBPGR, New Delhi
7.	*Cassia angustifolia*	1	NBPGR, New Delhi
8.	*Capparis decidua*	1	JNVU, Jodhpur

9.	*Carissa edulis*	1	CISH, Lucknow
10.	*Cenchrus setigerus*	1	JNVU, Jodhpur
11.	*Cyamopsis senegalensis*	1	JNVU, Jodhpur
12.	*C. serrata*	1	JNVU, Jodhpur
13.	*C. tetragonoloba*	24	JNVU, Jodhpur
14.	*Cymbopogon martini*	1	NBPGR, New Delhi
15.	Grain amaranth	39	UUC, NBPGR, New Delhi
16.	*Hemidesmus indicus*	1	NBPGR RS, Hyderabad
17.	*Jatropha curcas*	10	Sri Krishnadevaraya University, Anantapur
18.	Karonda	7	CISH, Lucknow
19.	*Lasiurus sindicus*	1	JNVU, Jodhpur
20.	Mothbean	150	UAS, Dharwad
21.	*Mucuna pruriens*	2	NBPGR, New Delhi
22.	Mungbean	130	GBPUAT, Pantnagar (100); BCKV, Nadia (30)
23.	*Panicum turgidum*		1 JNVU, Jodhpur
24.	*Pithecelobium dulce*	1	JNVU, Jodhpur
25.	*Psoralea corylifolia*	1	NBPGR, New Delhi
26.	*Trigonella foenum graecum*	2	NBPGR, New Delhi
27.	*Withania somnifera*	2	NBPGR, New Delhi
	Total	**445**	

Germplasm received: A total of 55 germplasm accessions were received from different sources which are summarized in Table 4.

Table 4. Germplasm Received from different sources during 2006

S. No.	Name of the Crop	No. of accessions	Source
1.	Mungbean	5	Germplasm Exchange Division, NBPGR, New Delhi (3); NBPGR RS, Ranchi (2)
2.	Pearlmillet	8	NBPGR RS, Ranchi
3.	Released varieties [castor (3); cumin (2); guar (1); horse gram (1); isabgol (1); mothbean (1); sesame (5); tumba (1)]	15	ARS, RAU, Mandore
4.	Released varieties [Guar (10); Muskmelon (5)]	15	ARS, RAU, Durgapura
5.	*Bryophyllum pinnatum*	1	Mohan Lal Sukhadia University, Udaipur
	Total	44	

13.5 Documentation

Compilation of characterization/ evaluation data: Evaluation data of rabi crops (wheat and grain amaranth: 39 acc.) were compiled and sent to Dr. R. K. Mahajan, NBPGR, New Delhi. Data on legume crops collected during 1999 - 2005 were compiled. Compiled the data of Chickpea IVT (rainfed) trial and sent to the Project Coordinator (chickpea), AICRP on Chickpea, Indian Institute of Pulses Research, Kanpur.

Research Projects (Code, Title, PI and Co-PIs)

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

PGR/ GEV-BUR-JOD-01.01- Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of cereals, pearlmillet, minor millets ad horticultural crops (Gopala Krishnan S, NK Dwivedi).

PGR/ GEV-BUR-JOD-01.02- Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of legumes and oilseeds (NK Dwivedi, Neelam Bhatnagar, Gopala Krishnan S).

PGR/ GEV-BUR-JOD-01.03- 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: During the period under report, three explorations were undertaken and 99 samples of different agri-horticultural crops including the wild relatives and wild economic types were collected. A total of 650 germplasm of kulthi were evaluated for both qualitative and quantitative traits. Medicinal plants (120) were maintained in herbal garden for seed multiplication. In addition, 86 accessions of *Jatropha curcas* collected from different states of India are being maintained at National *Jatropha* Garden at the farm at Ranchi.

National Bureau of Plant Genetic Resources, Base Centre, Ranchi is located at latitude 23°N and longitude 85°E and 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 endowed with rich agro-ecological diversity superimposed with tribal and ethnic diversity. The region is well known for its immensely rich primitive crop plant diversity including wild relatives of many crop plants. The agriculture is most traditional. The spread of improved technology by the Government Department/ State Agriculture Universities imposed the danger to landraces and wild relatives in the region. The primary responsibility of this station is to explore and collect crop diversity in Bihar and Jharkhand.

14.1 Plant Exploration and Germplasm Collection

Three explorations were undertaken and 99 samples of different agri-horticultural crops including the wild relatives and wild economic types were collected**.** The details of explorations, duration, collections (Table 1).

Table 1. Plant exploration and collection of germplasm during 2006

S.N	Regions (duration)	Crop(s)/ Species Collected	Collections (accessions)
1.	East & West Champaran, Muzaffarpur, Samastipur, Darbhanga, Begusari, Khagaria, Bihar sharif and Nawada districts of Bihar (15.02.06 to 23.02.06)	Cutting of *Jatropha curcas* (10), *Abelmoschus tetraphylla (1)* & *Solanum indicum (1)*	12
2.	Mahasamunda, Durg, Raipur, Bilashpur, Ambicapur, Jashpur districts of Chhattisgarh (21.02.06 to 3.03.06)	Cutting of *Jatropha curcas*	27
3.	East & West Champaran districts of Bihar and Eastern part of Uttar Pradesh in collaboration with RAU, Pusa Samastipur, Bihar (26.03.06 to 5.04.06)	*Brassica* sp. (11), *Cajanus cajan* (11), *Hordium vulgare* (3), *Lathyrus sativus* (3), *Lens esculenta* (10), *Linum usitatissimum* (8), *Pisum arvense* (2), *Pisum sativum* (1), *Ricinus communis* (1), *Vicia faba* (11), *Vigna radiata* (1)	62

The last two explorations were undertaken under Jatropha project.

Germplasm sent to NAGS

- **Dr. Ranveer Singh, NBPGR, New Delhi:** *Brassica sp.* (11) & *Linum usitatissimum* (8)
- **Head, Evaluation Division:** *Hordium vulgare* (3)*, Pisum arvense* (2) & *Pisum sativum* (1)
- **UUC,Network Project, NBPGR, New Delhi :** *Vicia faba* (11)
- **DOR Hydrabad:** *Ricinus communis* (1)
- **IIPR, Kanpur:** *Cajanus cajan* (11)*, Lathyrus sativus* (3) *& Lens esculenta* (10)
- **Dr. Rajendra Prasad, RAU, Pusa:** *Cajanus cajan* (11)

14.2 Evaluation

Kulthi germplasm: 650 germplasm of kulthi were sown on 8.9.2006 in augmented design with two checks (Birsa

Kulthi-1 and Madhu). Each accession had two rows of three metres length. The spacing was 30X10 cm. 30:30:20 NPK was used. The checks were replicated after every 50 accessions. Observations on both qualitative and quantitative traits were recorded. The data recording is in progress. However, range of some traits are cited here.

Traits	Minimum	Maximum
Days to 50% flowering	34 (IC120790,120840, 139357)	51 (IC33755, 34119, 43497)
Plant height at maturity(cm)	10 (IC23477)	32 (ICPLKU-144)
Number of primary branches	3 (IC15728-A, 53639, 120840)	14 (IC22764)
Number of pods per plant	15 (ICPLKU-59)	145 (IC47118)
Pod length (cm)	3 (ICPLKU-62-B, 94644-A, 105468)	8 (IC23507-A)
Number of seeds per pod	3 (IC26125, 26142, 33152)	8 (ICPLKU-62-C, PLKU-160, 16979)
Days to 80% maturity	93 days (ICPLKU-38, PLKU-53, PLKU-53-B)	132 days (IC56130, 56131, 56132)

Fruit crops: Jackfruit (154), barhal (14), bael (53), tamarind (51), aonla (17), accessions of jamun (46), custard apple (17), mango (15) and *Lawsonia inermis (*25) accessions are being maintained.

Wild relatives, economically important crops, medicinal and aromatic plants: The following species of medicinal plants (120) were sown in herbal garden for seed multiplication and maintenance.

Botanical name	Accessions (No.)	Botanical name	Accessions (No.)
Abroma augusta	3	*Gloriosa superba* (Kalihari)	1
Abrus precatorius	7	*Glycosmis pentaphylla*	2
Abutilon indicum	1	*Gmalina arborea*	4
Acacia nilotica	1	*Grewia hirsute*	1
Acacia concinna	2	*Gymnema sylvestre*	2
Achyabthes aspara	1	*Helicteres isora*	1
Acorus calamus	4	*Hemidesmus indicus*	4
Adhatoda vasica	2	*Holarrhena antidysenterica*	1
Adiantum capillus-veneris	1	*Hygrophila salicifolia*	1
Albizzia proccera	1	*Indigofera tinctoria*	1
Aloe sp.	5	*Jatropha curcas*	9
Alpinia galangal	4	*Jatropha gossyfolium*	1
Alstonia scholaris	1	*Kaempferia galanga/ Hedichium spicatum*	3
Androgaphis paniculata	8	*Lagerstroemia speciosa*	2
Aristolochia oncocephalous	1	*Leea macrophylla*	1
Artemisia scoparia	1	*Leucas aspara*	1
Artimisia annua	3	*Litsaea polyantha*	1
Asparagus racemosus	10	*Lycopodium clavatum (*Syn. *L. flexuosun)*	1
Atylosia scarabaeoides	2	*Madhuca indica*	1
Azadirachta indica	4	*Martynia diandra*	1
Bacopa monnieri	2	*Melia azadirach*	1
Barlaria prionotis (Kata karanch)	1	*Mimosa pudica*	1
Barleria prionitis	3	*Mimrabilis jalapa*	3
Bauhinia purpurea	2	*Moringa oleifera*	3
Bauhinia sp.	2	*Mucuna prurita*	2
Bombax ceiba	2	*Murraya koeniggi* (Kari pata)	1
Bryonopsis laciniosa	1	*Neolitis sp.*	1
Bryophyllum sp.	2	*Nigella sativa* (Kala jira)	2
Buchanania lanzan	6	*Nyctanthes arbortristis*	1
Bulbophyllum sp.	2	*Ocimum basilicum*	1
Butea monosperma	3	*Ocimum sanctum*	2
Caesalpinia crista	3	*Ocimum sp.*	8
Calotrophis procera	1	*Oroxylum indicum*	4
Canavillia ensiformis	1	*Pachyrrhiza angulatus* (Misrikand)	2

Canna indica	3	*Paederia maxima*	1
Cassia alata	1	*Pentapetes phoenicea*	1
Cassia angustifolia	1	*Phyllanthus amarus*	1
Cassia fistula	2	*Phyllanthus niruri*	2
Cassia occidentalis	1	*Piper longum*	3
Cassia sophera	2	*Plumbago zeylanica*	4
Cassia tora	1	*Pongamia pinnata*	3
Catharanthus roseus	4	*Portulaca oleracea*	1
Celastrus paniculatus	2	*Premna herbacea*	2
Centella asiatica	2	*Psoralea corylifolia*	1
Chlorophytum sp.	9	*Pterocarpus marsupium*	2
Cinnamomum tamala	1	*Pterospermum acerifolium*	1
Cinnamomum zeylanica	2	*Pueraria tuberose*	1
Cissus quadrangularis	2	*Putranjivi roxburghii*	1
Clerodendron indicum	1	*Randia dumatorium*	1
Clerodendron indicus	1	*Rauvolfia serpentine*	5
Clerodendron infortunatum	1	*Rauvolfia tetraphylla*	3
Clerodendron serratum	1	*Santalum album*	1
Clitoria ternetia	3	*Sapindus mukorosi*	1
Coix lachyrema jobi	1	*Schleichera oleosa*	1
Colchicum luteum	2	*Scorpia dulcss* (Hazardana)	1
Coleus amboinicus	2	*Semecarpus anacardium*	2
Commiphora wightii	1	*Shorea robusta*	4
Costus speciosus	5	*Sida acutifolia*	1
Curculigo orchiodes	7	*Smilax procera & ovalifolia*	4
Curcuma amada	2	*Solanum khasianum/ Solanum viorum*	1
Curcuma aromatica	1	*Solanum torvum*	1
Curcuma caesia	2	*Solanum xanthocarpum* (Katrangni)	1
Curcuma sp.	9	*Sphaeranthus indicus*	1
Cymbopogan martinii (Palma rosa)	1	*Spilanthes paniculata*	2
Cymbopogan winterianus (Citronella java)	1	*Spondias mangifera*	1
Cymbopogon flexuosus (Lemon grass)	1	*Sterculia* sp.	1
Cyperus rotundus (Nagar motha)	1	*Tectona grandis*	9
Dalbergia sissoo	1	*Terminalia arjuna*	6
Datura alba	1	*Terminalia bellerica*	5
Desmodium gangeticum	2	*Terminalia catappa*	2
Dioscorea pentaphylla	1	*Terminalia chebula*	3
Dioscorea sp.	5	*Terminalia tomentosa*	1
Diospyros tomentosa	1	*Thespesia lampus*	2
Eclipta alba	1	*Tinospora cordifolia*	11
Elephantopus scaber	1	*Tribulus terrestris* (Gokhuru)	1
Embelia ribes	1	*Typhonium trilobatum*	4
Entada scandens	1	*Urginia indica*	4
Erythrina indica	1	*Vanda tasselata*	3
Euphorbia hirta	1	*Vitex negundo*	1
Ficus benghalensis	1	*Withania somnifera*	4
Ficus religiosa	1	*Zingiber* sp.	5

***Jatropha* germplasm:** Under externally funded project 86 accessions of *Jatropha curcas* collected from different states of India are being maintained at National *Jatropha* Garden at NBPGR Farm, Ranchi. In addition, 92 accessions of *Jatropha* obtained during October, 2006 from different collaborators of Jatropha Project (CSIR) are being maintained in green house for establishment and will be transferred in the field.

Germplasm distribution:

- *Jatropha* germplasm (33 accessions) supplied to different collaborators of Jatropha project viz.

(CRIDA, Hyderabad, CSMCRI Bhavnagar, FRI Dehradun, NBRI Lucknow, NBPGR, Delhi & AFRI Jodhpur)

- Kulthi (12 accessions) were sent to Crop Improvement Division, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora.
- Vegetatively propagated material (30) were sent to NBPGR Regional Station, Thrissur.
- *Colchicum luteum* (1 accession) was given to Dr. Z. Haider, Associate Dean, BAU, Kanke, Ranchi
- kulthi (983) received from NBPGR, Regional Station, Akola.
- Sem (16 samples), Kulthi (12 accessions) and *Dolichus* (5 accessions) were sent for LTS.

Research Projects (Project Code, Title, PI and Co-PI)

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

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

PGR/PGC-BUR-RAN-01.02 Augmentation characterization, evaluation maintenance, regeneration, conservation and documentation of genetic resources of horticultural crops&perennial medicine (VK Gupta, JB Tomar).

Externally Funded Project

Genetic Improvement of *Jatropha curcas* for adaptability and oil yield (NMITLI).

15. REGIONAL STATION, SHILLONG

Summary: A total of 207 accessions of rice germplasm was facilitated for the collection from Barak Valley, Assam. The NERIST, Itanagar collected and provided two important endangered and rare species for their safe conservation. These are *Arundinaria malling* Gamble and *Gymnocladus assamicus* Kanjilal. During the year, a total of 2084 accessions covering 12 crops were sown of 1941 accessions were characterized. Promising accessions were identified based on the yield characteristics of the genotype for each sown crop. Three hundred and sixty accessions of various crop germplasms were provided to 11 indenting institutes while 23 accessions of rice bean were received from the BCKVV, Kalyani. A total of 350 accessions of paddy, maize, ricebean, medicinal plants, endangered and rare species have been conserved in LTS/Cryobank, as per their suitability.

15.1 Exploration and Collection of Germplasm

During the year, no exploration was conducted. However, the rice germplasm collection made from Barak Valley, Assam was facilitated. A total of 207 accessions of rice germplasm were collected from this area, against which, IC No. was allotted for 150 accessions. Two noteworthy collections were made by the following institutes and passed on to us to assign the necessary IC No. as well as for their safe conservation.

Institute	Species	Status	Collection site	No. of accessions
NERIST, Nirjuli, Itanagar, Arunachal Pradesh	*Arundinaria malling* Gamble	Endangered	Tawang, Arunachal Pradesh	1
NERIST, Nirjuli, Itanagar, Arunachal Pradesh	*Gymnocladus assamicus*	Critically endangered Kanjilal	Dirang, Arunachal Pradesh	1
Assam University, Silchar	*Oryza sativa*	Rare (Resistant type)	Dargakona, Cachar, Barak Valley, Assam	1

15.2 Germplasm Characterization and Maintenance

A total of 2,084 accessions belonging to different agri-horticultural crops were characterized. Usually, after screening of each germplasm (seed propagated), continuously over a period of three years, it is sent to the National Gene Bank for conservation. In addition to

Thalictrum sp. from Nagaland

Panax sp.

this, mandate crop germplasm received from outside the region was also characterized under the prevailing agro-climatic condition of Umiam, Meghalaya. Based on yield and stress tolerant parameters, the promising genotypes of the respective sown crop accessions were identified.

The following crops and their respective accessions were characterized during the year 2006-07.

Crop	Germplasm accessions		Yield (q/ha.) (Single location)	Superior genotype
	Sown	Harvested		
Upland Paddy	235	222	43.75	IC-540185
Lowland Paddy	232	226	58.00	IC-545249
Maize	212	202	118.75	DRLT-2293
Rice bean	301	263	36.25 35.00	LRB-71-3 LRB-22-2
Perilla	31	31	18.75	IC-524622
Buckwheat	97	94	15.00	IC-421600
Job's Tear	54	54	17.50	IC-089384
Ginger	216	195	446.6	IC-002940
Turmeric	165	165	453.00	UB-132
Colocasia	322	310	413.00	IC-087140
Chilli	122	100	104.00	IC-330193
Dioscorea	97	79		
Total	**2084**	**1941**		

15.3 Germplasm Exchange

A total of 360 accessions of germplasm were distributed to various indentors.

Institute	Crop	No. of accessions
1. Officer-in-Charge, DMR Research Centre Kushmahout, Begusarai-851105. Bihar	Maize	50
2. Dr. R. Saravanan, College of Horticulture & Forestry, CAU, Pasighat, Arunachal Pradesh	Turmeric Ginger	14 13
3. Head, Evaluation Division, NBPGR, Pusa, New Delhi	*Solanum* spp.	04
4. Dr. V.K. Mahajan, VPKAS, Almora-263601, Uttaranchal	Maize	25
5. Dr. I.S. Bisht, NBPGR, Pusa, New Delhi	*Perilla*	11+15
6. Dr. Veena Gupta, Conservation Division, NBPGR, Pusa, New Delhi	*Perilla*	12
7. Dr. D.S. Yadav, IIVR, Varanasi-221005, U.P	*Cucumis hystrix* and *C. hardwickii*	02
8. Dr. Jyotsna Devi, Deptt. of Horticulture, AAU, Jorhat-785013, Assam.	Chilli	21
9. Prof. D.K. De, BCKVV, Kalyani, Nadia (W.B.)	Maize Job's Tear Rice bean	28 30 100
10. Horticulture Division, ICAR (NEH), Umiam, Meghalaya	*Colocasia*	25
11. Prof. of Botany, College of Agriculture, Pune (M.S.)	Rice bean	10
Total		**360**

Tree of *Elaeocarpus ganitrus*

Kaempfaria rotundus

Paedaria foetida under maintenance

15.4 Germplasm Received

A total of 23 accessions of rice bean were received from Forage Breeder, BCKVV, Kalyani, West Bengal

15.5 Germplasm Conservation

	Crop	No. of accessions	Mode of conservation
i)	Rice bean	249	LTS
ii)	Medicinal Plants	18	LTS
iii)	Paddy	31	LTS
iv)	*Arundinaria malling* Gamble	01	Cryopreservation
v)	Maize	28	LTS
vi)	Upland Paddy	22	LTS
vii)	*Gymnocladus assamicus* Kanjilal	01	LTS/Cryobank
	Total	**350**	

Research Projects (Project Code, Title, PI and Co-PIs)

PGR/BUR-SHL-01.00: Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, Documentation and Distribution of Plant Genetic Resources in North Eastern India (DK Hore).

PGR/PGC–BUR–SHL-01.01): Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, and Documentation of Genetic Resources of agricultural and horticultural crops, plants of economic importance, their wild relatives and underutilized crops under the AICRP (DK Hore).

PGR/PGC–BUR–SHL-01.02): Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, and Documentation of Genetic Resources of indigenous and exotic lines of Chillies, Ginger, Turmeric, Yams, Taros, *Citrus*, Banana and Passion fruits (R Srivastava – till July 6, 2006).

Externally funded project (DBT)

PROJECT-II: National Gene Bank for Medicinal and Aromatic Plants (G-15) Sanction Order No. BT/MAP/01/GB–N/98 dated 10-01-2003. (DK Hore).

16. REGIONAL STATION, SHIMLA

Summary: Four explorations focused for the collection of wild relatives of crops plants and some trait specific germplasm of cultivated crops were undertaken in various parts of Himachal Pradesh and 187 accessions comprising cereals (21), pseudocereals (1), oil seeds (2), pulses (9), vegetables (4), fruits and nuts (35), minor fruits (10), medicinal plants (23), spices (4), ornamentals (4), and wild relatives (74) were collected. Important genera collected in wild relatives represent *Allium*, *Prunus*, *Pyrus*, *Trichosanthes*, *Cucumis, Vigna, Solanum, Atylosia, Rhyncosia, Amaranthus*. A total of 2514 accessions of various agri-horticultural crops comprising grain crops (2289), vegetables (125) and temperate fruit crops (100) were characterized and evaluated while 601 accessions grown for seed increase. Germplasm accessions viz. IC469165, IC394026, IC469155, IC394027, IC381057, IC381054, IC311066 of pea and EC537998, EC537975, EC537996, EC50218, EC537990 of French bean were found resistant to powdery mildew and anthracnose, respectively. 752 accessions were sent for long-term conservation in the NGB, 7866 maintained in the MTS and 1,167 maintained in field gene bank and 428 accessions of various crops were supplied to different institute for research purpose. Herbarium specimens of 103 plants were submitted to NHCP.

National Bureau of Plant Genetic Resources, Regional Station, Shimla is carrying out the activities on plant genetic resources management in North-West Himalayan region, comprising the states of Himachal Pradesh adjoining Uttarakhand, Jammu & Kashmir and Punjab. Augmentation of crops germplasm, characterization, evaluation, maintenance, documentation, conservation and its distribution to the user scientists/ researchers are the prime activities of the station. Germplasm of various temperate fruits, pseudocereals, small millets, medicinal and aromatic plants, ornamentals, wild relatives of crop plants and other economically useful plants are being maintained at experimental farm of the station as active collection in the MTS and in the field gene bank in case of perennial/ vegetatively propagated plants.

16.1 Germplasm Augmentation

Four explorations were conducted and 187 germplasm accessions were collected from Himachal Pradesh, adjoining Punjab and Uttaranchal (Table 1).

Table 1. Plant exploration and collection of germplasm

Exploration	Areas explored	Germplasm collected
Temperate fruits & their wild relatives	Shimla(Matiana, Kumarsain, Thanedhar, Sarahan), Kinnaur (Badi, Sungra, Nichar, Sangla, Kalpa, Recong-peo, Nigulsari)	42
Wild *Allium* spp.	Shimla (Churdhar peak), Kinnaur, (Sangla, Raksham, Chitkul, Nako), Lahaul-Spiti (Hurling, Tabo)	26
Temperate fruits & their wild relatives	Shimla (Chansel peak, Larot, Dhamwari, Diudi, Gnashidhar)	18
Multi-crop with emphasis on wild relatives	Shivalik hills of HP and Punjab (Solan, Una, Chamba, Bilaspur, Kangra, Hamirpur, Mandi, Gurdaspur)	101

The explorations were mainly focused for the collection of wild relatives of crops plants along with some traits specific germplasm in cultivated crops. Good genetic variability was recorded in temperate fruits and their wild relatives. For instances, in *Pyrus pashia* eight different types were collected. Similarly, variability within genera (*Vigna*, *Amaranthus*, *Atylosia*, *Rhyncosia*, *Solanum*) and also in species (*Cucumis*, *Trichosanthes*) was recorded. The germplasm collected represent various crops groups given in table 2. Variability was indexed for fruit shape, size, colour, pedicel length, no. of fruits/ cluster, in *Juglans regia* for shell thickness, productivity, no.of fruits/ cluster, nut shape, size and

Abelmoschus pungens

Characterisation of wild *Allium*

maturity period; in apple for skin colour, fruit shape and size; and in *Prunus persica* for skin colour and maturity period. The plants were indexed for 5-9 fruits/cluster in walnut in Sungra village; yellow skin colour peach in Sarahan village; small to big fruit size of *Pyrus pashia* in Kalpa and Badagaon; Thumba and Haddi nashpati, late maturing alucha and fruit shape size and skin colour in apple.

Table 2. Crop group-wise germplasm collected

Crop group	Accessions	Crop group	Accessions
Cereal & pseudocereals	**23**	Minor fruits	**10**
Pulses & oil seeds	**11**	Ornamentals	**04**
Vegetables & spices	**07**	Medicinal plants	**23**
Fruit & nuts	**35**	Wild relatives	**74**

Among wild relatives important species collected were *Allium humile* (1), *A. consanguineum* (4), *A. graffithianum* (2), *Prunus mira* (2), *P. cornuta* (2), *Pyrus pashia* (8), *Melothira* sp.(3) *Trichosanthes cucumeriana* (8), *Trichosanthes lobata* (1), *Cucumis callosus* (4), *C. hardwickii* (2), *Cucurbita benincasa* (1), *Vigna glabresense* (1), *V. mungo* var. *sublobata* (1), *V. vexillata* (5), *Vigna* sp.(4), *Solanum surettense* (1), *S. indicum* (1), *Coccinea indica* (1), *Atylosia scarabeoides* (2), *Atylosia platicarpa* (2), *Rhyncosia himalensis* (1), *Amaranth tricolour* (1), *A. hybridus* (3), *A. dubius* (3), *A. spinosus* (1), *A. viridis* (1), *Abelmoschus pungens* (2), *Corchorus acutangularis* (3), *Cleome viscoa* (2), *Rosa macrophylla* (1), *Rosa sericea* (1),

Charcaterisation of *Setaria italica*

Coccinea indica

Cucumis callosus

16.2 Germplasm Characterization and Evaluation

16.2.1 Agricultural crops: The mandate crops are Adzuki bean, amaranth, apple, apricot, buckwheat, chenopod, French bean, kiwi, pea (hill type), peach, pear, pecan nut, plum, pomegranate (wild) and walnut.

'DURGR' Amaranth variety released by the station

A total of 2,263 germplasm accessions were grown during the year for characterization and preliminary evaluation. The crops wise details is as given in Table 3. Besides, 500 accessions of French bean, 93 of buckwheat and eight of chenopod were also grown for seed increase.

Table 3. Crop wise detail of the germplasm characterized

Crop	Accession	Checks
French bean	1242	Vaspaa, Laxmi pole, Jwala, Triloki, Kailash, PLB-10-1, Kentucky Wonder
Adzuki bean	25	HPU-51, EC108080
Cowpea	123	Cowpea No.1, Cowpea No.2
Horsegram	125	HG No.1, HG No.2
Pea	134	DMR-11,HFP-4,Super Lincon , Rachna, NC60953
Amaranth	94	Annapurna, PRA-2, PRA-3, Durga
Buckwheat	116	Shimla B1, Himpriya, VL7, Sangla B1
Chenopod	33	EC507741, IC 22503
Finger millet	266	VL146, VL315
Foxtail millet	63	Local checks (3)
Barnyard millet	54	Local checks (2)
Proso millet	14	Local checks (2)

The germplasm is characterized in ABD and also in RBD along with standard checks. The data were recorded as per the descriptors on five plants. The data were analyzed for mean and range and coefficient of variance and given in Table 4 along with promising accession identified for important traits.

Table 4: Promising accessions identified for important traits

Crop	Character	Range	Mean ± SE	Promising accessions (value)
French bean	No. of pods/ plant	4.0-45.0	23.25+3.28	EC500458, IC328658, IC326959
	Pod length (cm)	6.3-20.1	12.80+1.98	EC500386, EC500687, EC500839, EC537967, EC537975, IC381082
	No. of seeds/ pod	3-9	7.01+1.02	EC500779, EC500308, IC199227
	Days to maturity	80-145	119.00+4.84	EC500474, EC500674, EC500229, EC500262, EC500282
	100 Seed wt. (g)	9.62-64.91	36.15+3.95	EC531031, EC500196, EC500905, EC531033, EC537967, EC531032
Adzuki bean	No. of pods/ plant	18-35	28.11+1.22	IC341952, EC120460,
	No. of primary branches	4.0-6.5	5.10+1.55	IC469173, EC340244, EC341961,
	Days to maturity	104-119	109.90+4.01	HPU-51, EC341961, EC000372
	100 seed wt. (g)	8.2-16.4	12.4+2.22	EC281186, , EC000248, EC340254
Cowpea	100 seed weight (g)	16.82 -20.58	18.45+2.14	IC107472, IC280012, IC326958, IC313300
	Days to flowering	62-70	65.25+4.98	IC313301. IC313300, IC106836, IC326998
	Days to maturity	115-123	119.00+6.23	IC313301, IC321136, IC421900, IC421917
	Pod length (cm)	20.5-24.8	22.4+3.41	IC280013, IC280014, IC327000, IC313301
Amaranth	Leaf length (cm)	10.4 -27.4	21.42+3.45	IC467894, IC540860, IC467908, IC467886
	Inflorescence length (cm)	35.5-98.1	65.21+2.22	IC540902, IC467911, IC467894, IC467892
	Days to maturity	138-174	138.20+3.24	IC519562, IC519541, IC467912, IC467897
	1000 seed wt. (g)	0.5-0.8	0.57+0.07	IC540872, EC519539, IC540902, IC540879
Buckwheat	Leaf length (cm)	5.6–25.4	18.24+2.30	IC547346, IC547396, IC547384, IC107293
	Cyme length (cm)	3.4–12.0	6.88+1.32	IC360826, IC547549, IC547346, IC547396
	No. of cymes/plant	15.6-28.2	19.11+3.49	IC540858, IC360829
	Days to maturity	77.0–159	131.04+4.99	IC107986
	100 seed wt. (g)	11.9–34.2	22.25+3.55	EC216635, IC467920, IC540852, IC547310
Chenopod	Inflorescence length (cm)	16.2-42.5	29.02+5.49	IC341696, NIC22517, IC109731, IC341707
	Leaf length (cm)	4.9 – 19.2	10.90+1.99	IC341707, IC363733, IC415493, IC540811
	Leaf width (cm)	1.19-3.2	2.08+0.9	EC359445, IC415493, IC341707
	Days to maturity	98.00 – 154	141.00+7.04	IC382223, IC447575, IC540823, IC540831
	100 seed wt. (g)	0.4 – 1.6	1.01+0.08	EC507733, IC540842, IC540823

EC500910 of French bean found resistant to anthracnose

HIMGIRI' Buckwheat variety released by the station

Solanum indicum

16.2.2 Screening of pea and French bean for biotic stress: Since Shimla is a hot spot for powdery mildew and anthracnose, germplasm of pea (134 accessions) and French bean (145 accessions) were screened against these diseases. Germplasm accession showing resistance under field conditions are given in Table 5.

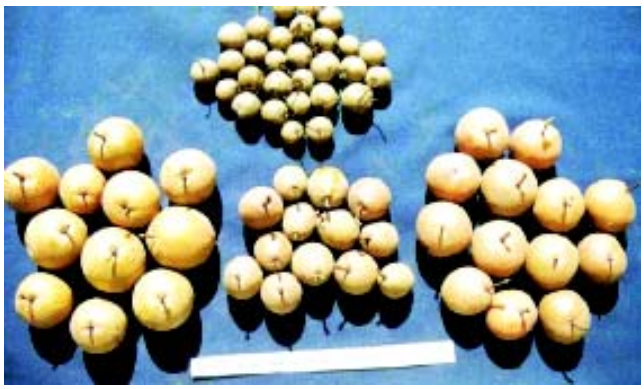
Trichosanthes cucumerina

Table 5. Germplasm accessions showed resistance to diseases

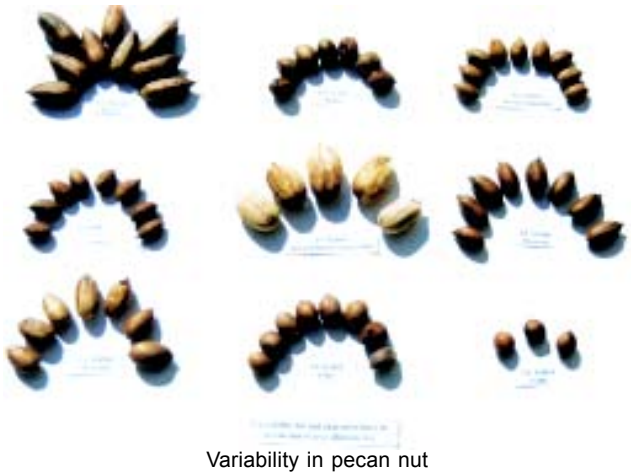
Pea (Powdery mildew)	IC469165, IC394026, IC469155, IC394027, IC381057, IC381054, IC311066, IC311063, IC469155, IC242034, IC342037, IC394030
French bean (Anthracnose)	EC537998, EC537975, EC537996, EC537990, EC502157, EC500957, EC500910

16.2.3 Horticultural crops

Characterization and evaluation: In fruit crops the data were recorded on those accessions which have come into bearing either first time or are in bearing for the last three years. The number of accessions characterized in horticultural crops is given in Table 6.



Variability collected in *Pyrus pashia*



Variability in pecan nut

Table 6. Characterization of fruit crops germplasm

Crop	Accs	Checks	Crop	Accs	Checks
Apple	13	Michael Tydeman's Early Worcester, Princess Noble	Pomegranate	6	Local checks (1)
Peach	09	Shan-e-Panjab, Flordason, Flordabelle	Walnut	35	Ogden
Pear	08	Flemish Beauty	Chillies	42	DKC-8, Local checks (2)
Plum	11	Fortune, Methley	Meetha karela	33	EC-36910
Apricot	09	Nugget, St. Ambroise	Tomato	25	Solan bazer, Arka vikas
Almond	09	Non-paeril	Wild *Allium*	25	Nil

The data were analyzed for range, coefficient of variability (CV) and promising accessions identified. In apple maximum CV was found for fruit weight (70.8%) followed by fruit length (35.3%) and TSS (33.8%). Fruit weight ranged from 0.9 to 320 g, fruit length 9.3 to 79.4mm and TSS 10.5to 27.8%. Promising accession for high productivity were EC27819 (Winter Banana), EC 552613 (Neema Delicious), and EC200813 (Oregon Spur). In peach, high coefficient of variation was found for fruit weight (38.0%) followed by stone width (37.9%). Fruit weight ranged from 37 to 102.5 g and stone width 10 to 22.9mm. Promising accessions were EC552645 (Early Red Fair) and IC349924 (Ambri) for high productivity. In pear, high coefficient of variation was recorded for fruit weight (70.5%) followed by fruit length (48.4%), fruit width (43.9%) and peduncle length

(42.8%). EC38739 (Shinsui), EC 552674 (King's Pear), IC19392 and IC20218 showed high productivity. In plum, the phenotypic CV was high for fruit weight (73.2%) followed by stone length (46.3%), fruit length (37.1%) and fruit width (36.6%). High productivity was recorded in IC349970 and IC349972. in apricot, high phenotypic CV was found for fruit weight (88.3%) followed by kernel width (39.1%), kernel weight (36.6%) and kernel length (34.5%). None of the accessions could surpass fruit yield than checks. In walnut, high phenotypic CV was recorded for kernel weight (37.6%) followed by shell weight (37.3%) and nut weight (35.7%). Out of 35 accessions studied, only six were found soft-shelled, while 13 belong to intermediate category. Promising accessions for high productivity were IC19371, EC36746 (Ogden), IC538531 and EC38836 (Fatley). In almond, high shell weight ranged from 0.46 to 2.93g and kernel weight 0.68 to 1.50g. EC2024664 (1xL), IC349908 (Thin shelled) and EC82378 showed early nut maturity.

In meetha Karela, promising accessions were IC411611, IC411667and IC20298 which were also having spine-free fruits. In tomato, high phenotypic CV (60.3%) was found for fruit weight, ranging from 6.38 to 52.50g. IC328607, IC361804, IC447604 were identified as promising for fruit yield. In chillies, no. of fruit/ plant ranged from 18.0 to 138.0g and fruit 1.11 to 7.94g. promising accessions were IC313446, IC328622, and IC278891. Wild *Allium* germplasm comprising of *Allium schenoprasum, A. fistulosum, A. carolinianum, A. tuberosum, A auriculatum, A. griffithianum* and *A. consangunium* were characterized. High phenotypic CV was recorded for leaf width (117.0%) followed by no. of flowers/ head (95.0%), effective/ plant (66.3%), 100- seed weight (48.3%), flower stalk length (32.3%) and leaf length (31.4%) high phenotypic

Inter and intra-specific crossing studies: An attempt was to understand crossing behavior in several genera of temperate fruits so that future genetic enhancement and breeding work can be taken up. Forty crosses including reciprocals were attempted involving genera viz., *Cydonia, Chaenomelos, Actinidia, Malus, Pyrus, Docynia, Fragaria, Juglans,* and *Prunus*. Fruit set was successfully achieved in 15 crosses as given in Table 7.

Table 7. Successful cross combinations

Cross combinations	Cross combinations
Pyrus pashia x *P.pyrifolia*	
Juglans regia 'Xenia-1 x *J.mandshuria*	*Docynia hookiriana* x *Malus glaucensis*
Chaenomelos superba x *C.speciosa*	*Pyrus pyrifolia* x *P. pashia*
Actinidia arguta x *A.deliciosa*	*Pyrus pashia* x *P. jacquemontiana*
Prunus amygdalus 'I X L x *P. persica* ' Mayfare'	*Pyrus communis* 'Severyanka' x *Pyrus* Hybrid 'Kieffer'
Pyrus jacquemontiana x *P. pyrifolia* 'King Pear'	*Malus pumila* 'Mayan' x *M.glaucensis*
Prunus domestica 'Prune' x *Prunus salicina* 'Japan Plum'	*Prunus persica* 'Japan Peach' x *P. armeniaca* 'Nugget'
Docynia hookeriana x *Malus pumila* 'Mayan'	*Prunus salicina* 'Japan plum' x *P. domestica* 'Prune'

16.3 Germplasm Conservation

Germplasm supplied to NGB: A total of 752 germplasm accessions of different crops such as French bean (392), buckwheat (172), chenopod (66), amaranth (56), horse gram (8), cowpea (3), peach (17), medicinal plants (24) and wild relatives (14) were deposited for Long Term Storage in the NGB.

Germplasm status in MTS at Shimla: A total of 7,866 germplasm accessions of seed crops are being maintained in the MTS (Table 8) and 1167 accessions of vegetatively propagated crops in the field gene bank (Table 9).

Table 8. Germplasm accession being maintained in the MTS

Crop name	MTS (Shimla)	Crop name	MTS (Shimla)
Amaranth	2,958	Barnyard millet	54
Buckwheat	743	Proso millet	14
Chenopod	98	Horse gram	38
French bean	2,926	Pea	222
Rice bean	231	Lentil	54
Adzuki bean	158	Cuphea	16
Finger millet	266	Meetha karela	25
Foxtail millet	63	**Total**	**7,866**

Table 9. Germplasm accession being maintained in the field gene bank

Crop	Accs.	Crop	Accs.	Crop	Accs.
Apple	258	Almond	20	Persimmon	9
Pear	77	Hazelnut	22	*Rubus* spp.	22
Peach	49	Kiwi fruit	9	*Rosa* spp.	27
Plum	38	Pomegranate	115	Minor fruits	46
Apricot	49	Strawberry	42	Medicinal & aromatic plants	70
Walnut	171	Grapes	11	Other economic plants	72
Pecan nut	49	Cherry	11	**Total**	**1,167**

16.4 Germplasm Supply

A total of 428 accessions of grain crops were supplied to the researchers of various institutes and farmers

Crop	Accs.	Crop	Accs.	Crop	Accs.
Amaranth	150	Adzuki bean	18	Cherry	6
Buckwheat	75	Horse gram	21	Pomegranate	29
Chenopod	15	Apple	18	*Prunus mira*	01
French bean	76	Apricot	14	Kiwi	5

Other activities:

Herbaria prepared: One hundred and three herbarium specimens were prepared and submitted to National Herbarium of Cultivated Plants at Headquarters, New Delhi.

Varieties released: Two varieties viz. 'HIMGIRI' of buckwheat for high yield and early maturing (90 days) and 'DURGA' of grain amaranth for high yield, dwarf and early maturity (140 days) released for general cultivation.

Research Projects (Code, Title, Project PI and Co-PIs)

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

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

Externally Funded Projects

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

Germplasm conservation (*ex situ* and *in situ*) of Minor Millets and Pseudo-cereals in participatory mode in Himachal Pradesh by Govt. of Himachal Pradesh (JC Rana).

Mass multiplication and promotion of cultivation of Geranium (*Pelargonium graveolens*) and English Lavander (*Lavadula angustifolia*) in Himachal Pradesh by Horticulture Technology Mission for HP (JC Rana).

Assessing Available Biomass for Meeting Demand and Supply of Energy – A Case Study in Three Watersheds of Himachal Pradesh by DST (JC Rana).

17. REGIONAL STATION, SRINAGAR

NBPGR, Regional Station, Srinagar was established in 1989 with major responsibility of germplasm exploration and collection in the region. This station was temporarily closed in 1990 and once again re-opened in July 1999. Since then along with its major responsibility of plant germplasm exploration, evaluation of different agri-horticultural crops is being carried out, despite the unfavorable socio-political environment. NBPGR, Regional Station is located in the south of Srinagar city and its farm is located at K.D. Farm, old air field Rangreth, that is about 14 Km away from Srinagar City.

17.1 Germplasm Characterization and Evaluation

A total of 226 accession comprising wheat (108), barley (68) and mustard (50) were characterized and evaluated for standard descriptors during *rabi* season 2005-2006. A total of 405 accessions of wheat, barley and mustard have been sown during *rabi* season 2006-2007 for characterization and evaluation.

Research Project (Code, Title, PI and Co-PIs)

PGR/PGC-BUR-SRI-01.00**:** Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources from Jammu & Kashmir region (Om Vir Singh, D Gautam).

19. GENERAL INFORMATION

19.1 Institute Management Committee

Chairman: Dr. SK Sharma, Director, NBPGR, New Delhi.

Members:

- Assistant Director General (Seeds), 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.

19.2 Research Advisory Committee

Chairman: Dr SS Baghel, Vice Chancellor, Assam Agricultural University

Member Secretary: Dr RK Khetarpal

The **Research Advisory Committee (RAC) Meeting** was held on 10-11 May under the Chairmanship of Dr SS Baghel. The major recommendations included

- Intensive gap analysis using modern techniques like GIS and preparation of distribution and genetic diversity maps for future explorations. Electronic/ digitized National Herbarium of cultivated plants.
- In view of the quantum of work, the characterization data should be recorded by NBPGR scientists and for evaluation data, a network approach in collaboration with AICRPs should be developed for effective management of PGR.
- There is a need to take care of validation of promising accessions for breeder driven traits and against biotic stresses needs to be evaluated at hot spots.

19.3 Institute Research Council

Chairman: Dr SK Sharma, Director, NBPGR

Member Secretary: Dr RK Tyagi, Senior Scientist

The first meeting of IRC was held from August 28-31, 2006 under the Chairmanship of Dr SK Sharma, Director and attended by 95 members of IRC including scientists and technical officers associated with projects from the NBPGR Headquarters and regional stations. The member-secretary, IRC presented the action taken reports based on the recommendations of previous IRC (formerly known as SRC) and the house approved the proceedings. Progress reports of 11 programmes (67 projects) from headquarters and 12 programmes (30 projects) from regional stations were presented and discussed.

Three new projects were approved in principle with some modifications in project title.

i) "Genetic enhancement of pulses crops species with particular reference to pigeonpea and mungbean"; PI: Dr SK Mishra

ii) "Technology Development for DNA Fingerprinting of Important Forage Crops"; PI: Dr MK Rana and Co-PI: Dr Manjusha Verma

iii) "Analysis of Genetic Diversity and DNA Fingerprinting of Cucurbitacceous Crop"; PI: Dr Manjusha Verma and Co-PI: Dr Mukesh Rana

The Second IRC meeting was held from December 19-23, 2006, at divisional level under the Chairmanship of Dr SK Sharma, Director, NBPGR, New Delhi. The

progress of each Division / regional stations was presented by the respective heads. All the scientists and technical officers associated in the project were present during the presentation and discussion of the progress report of their respective divisions. Thus, progress of a total of 11 programmes (67 projects) from Headquarters and 12 programmes (30 projects) were presented and discussed.

19.4 Institute Joint Staff Council

Chairman: Dr SK Sharma

Secretary (Official side): Dr (Mrs.) Veena Gupta, Senior Scientist

Secretary (Staff side): Shri Lalu Rai, SS Gr.II

Members (Official side): Dr SK Malik, Senior Scientist, Ms. Sunita Sharma, Sr. Admn. Officer, Mrs. Sanjeevan Prakash, F& AO

Members (Staff side): Sh Rakesh Singh, T-4, Sh Girish Chandola, Assistant, Sh Yogesh Kumar, Senior Clerk, Sh. Mahesh Ram, SS-Gr-I

IJSC meeting was held on 19 July 2006.

19.5 Personnel

I. Scientific Staff

	Dr SK Sharma	Director (June15, 2006)	Genetics & Plant Breeding
	Dr AK Singh	Director (Feb 1- June-14, 2006)	Genetics & Plant Breeding
	Dr JL Karihaloo	Director (January 1-31, 2006)	Genetics & Cytogenetics
Division of Germplasm Evaluation			
1	Dr SK Mishra	Head	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 RP Dua	Principal Scientist	Plant Breeding
8	Dr IS Bisht	Senior Scientist	Plant Pathology
9	Dr Ashok Kumar	Senior Scientist	Plant Breeding
10	Dr RC Agarwal	Senior Scientist	Agricultural Statistics
11	Dr Vandana Joshi	Senior Scientist	Economic Botany
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 (on study leave)	Scientist	Biochemistry
17	Dr (Ms) Archana Raina	Senior Scientist	Plant Biochemistry
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 (Ms) E Roshini Nair	Principal Scientist	Economic Botany
3	Dr (Ms) Anjula Pandey	Senior Scientist	Economic Botany
4	Dr Rakesh Srivastava	Senior Scientist	Horticulture
5	Dr KC Bhatt	Senior Scientist	Economic Botany
Division of Germplasm Conservation			
1	Dr AK Singh	Head	Genetics & Plant Breading
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 PC Agarwal	Principal Scientist	Plant Pathology
4.	Dr Beche Lal	Principal Scientist	Agricultural Entomology
5.	Dr (Ms) Usha Dev	Principal Scientist	Plant Pathology
6.	Dr (Ms) Manju Lata Kapur	Principal Scientist	Agricultural Entomology
7.	Dr Rajan	Senior Scientist	Nematology
8.	Dr DB Parakh	Senior Scientist	Plant Pathology
9.	Dr Baleshwar Singh	Senior Scientist	Plant Pathology
10.	Dr (Ms) Shashi Bhalla	Senior Scientist	Agricultural Entomology
11.	Dr (Ms) Celia Chelam V	Senior Scientist	Plant Pathology
12.	Dr (Ms) Kavita Gupta	Scientist (Senior Scale)	Agricultural Entomology

Germplasm Exchange Unit

1.	Dr Ranvir Singh (upto 31-07-2006)	Principal Scientist & Head	Economic Botany
2.	Dr IP Singh	Principal Scientist	Genetics
3.	Mr Deep Chand	Scientist (Selection Scale)	Economic Botany
4.	Dr Vandana Tyagi	Scientist (Senior Scale)	Economic Botany
5.	Ms Nidhi Verma (on study leave)	Scientist (Senior Scale)	Economic Botany
6.	Dr Anil Kumar Singh (upto 13-07-2006)	Scientist	Economic Botany

Policy Planning

1	Dr (Ms) Pratibha Brahmi	Senior Scientist	Economic Botany

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	Senior Scientist	Economic Botany
8.	Dr SK Malik	Senior Scientist	Economic Botany
9.	Dr Zakir Hussain	Scientist	Genetics

Under Utilized & Under Exploited Plants Project

	Dr BS Phogat	Senior Scientist	Agronomy
	Dr Hanuman Lal Raigar	Scientist	Agricultural Statistics

National Research Center on DNA Fingerprinting

	Dr SS Malik	Principal Scientist	Economic Botany

	Dr KV Bhat	Senior Scientist	Plant Breeding
	Dr (Ms) Gurinder Jit Randhawa	Senior Scientist	Plant Physiology
	Dr Mukesh Kumar Rana	Scientist (Senior Scale)	Plant Breeding
	Mr Sunil Archak (on study leave)	Scientist(Senior Scale)	Biotechnology
	Ms Lalit Arya	Scientist (Senior Scale)	Biochemistry
	Dr Ambika Baldev	Scientist (Senior Scale)	Biotechnology
	Dr Rakesh Singh	Scientist (Senior Scale)	Biotechnology
Regional Station, Shillong			
1.	Dr DK Hore	Principal Scientist & In-charge	Economic Botany
2	Dr WL Barwad (upto 11-01-2007)	Senior Scientist	Agricultural 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
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
Regional Station, Ranchi			
1.	Dr 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
2	Mr Abdul Nizar	Scientist (SS)	Economic Botany
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
Base Center, Cuttack			
1.	Dr DP Patel (upto 30-06-2006)	Principal Scientist & In-Charge	Economic Botany
2.	Mr Diptiranjan 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	Agricultural 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 Sunil Neelam	Scientist	Economic Botany
Regional Station, Srinagar (J & K)			
1.	Dr Om Vir Singh	Principal Scientist & In-charge	Plant Breeding

II. Administrative Staff

#	Name	Designation
1.	Sh. Suresh Kumar	Sr. Administrative Officer
2.	Ms. Sunita Sharma	Sr. Administrative Officer (w.e.f. 14.09.2006)
3.	Mrs. Sanjeevan Prakash	Finance & Accounts Officer
4.	Sh. Mahender Kumar Ahuja	Jr. Accounts Officer
5.	Sh. ML Bagga	Assistant Administrative Officer
6.	Sh. Umesh Chandra Sati	Security Officer
7.	Ms. Archna Raghav	Assistant Director (OL)
8.	Sh. DD Sharma	Assistant Administrative Officer

III. Technical Staff (T-5 and above)

#	Name	Category	#	Name	Category
1	Mr. BP Dahiya	T-7	27	Mr. Ashok Kumar Maurya	T-6
2	Dr Om Prakash Dahiya	T-6	28	Mr. Surender Singh Ranga	T-6
3	Mr. Jitender Mohan	T-6	29	Mr. JK Ingle	T-6
4	Mr. Harinder Singh	T-6	30	Mr. Babu Ram	T-5
5	Dr PS Mehta	T-6	31	Mr. Narendra Singh Panwar	T-5
6	Miss Poonam Suneja	T-6	32	Ms. Rita Gupta	T-5
7	Dr Anil Kumar Singh	T-6	33	Mr. Ram Singh	T-5
8	Dr (Ms) Manju Upreti	T-6	34	Miss Anshu	T-5
9	Ms. Rita Rani	T-6	35	Mr. Devendra Kumar Nerwal	T-5
10	Mr. Ram Prasad Yadav	T-6	36	Mr. Rakesh Singh	T-5
11	Mr. Satya Pal Singh	T-6	37	Mr. VK Pant	T-5
12	Mr. Charan Singh	T-6	38	Mr. GL Arya	T-5
13	Mr. K.D. Joshi	T-6	39	Mr. AS Rana	T-5
14	Mr. Rajiv Mathur	T-6	40	Mr. Bhikka Ram Saini	T-5
15	Dr Rajveer Singh	T-6	41	Mr. Kheta Ram	T-5
16	Dr Ranbir Singh Rathi	T-6	42	Mr. Ashok Kumar Gupta	T-5
17	Mr. Rajiv Gambhir	T-6	43	Mr. RR Arya	T-5
18	Mr. Bharat Lal Meena	T-6	44	Mr. Kishan Nath	T-5
19	Miss Sheela Kumari	T-6	45	Mr. Sat Narayan Rrai	T-5
20	Mr. Babu Abraham	T-6	46	Mr. S Mani	T-5
21	Mr. BC Bachhawandia	T-6	47	Mr. RS Yadav	T-5
22	Mr. Brij Pal Singh	T-6	48	Mr. YS Rathi	T-5
23	Mr. R. Ashokan Nair	T-6	49	Mr. Anang Pal	T-5
24	Mr. Mahabir Singh Rathore	T-6	50	Ms. Sangeeta Tanwar	T-5
25	Mr. Axma Dutt Sharma	T-6	51	Mr Abhay Sharma	T-5
26	Dr. Dinesh Chand	T-6	52	Mr Bhopal Singh Panwar	T-5

19.6 Staff Reservations

Category	Total number of	Total number of Employees OBC Employees	Total number of Scheduled Caste SC) Employees	Total number of Scheduled Tribe (ST) Employees
Scientist	128	10	1	12
Technical	117	14	3	-
Administrative	60	14	4	1
Supporting	126	44	5	13

19.7 Staff Transferred/ Retired/ New Appointments

Transfers

- Dr. JL Karihaloo, Principal Scientist transferred to APCoAB w.e.f 31.01.2006
- Dr. R Senthil Kumar, Scientist, NBPGR, Regional Station Thrissur transfer to Chardamom Research Centre, Appangala, Madikeri (Karanataka) w.e.f 26.8.2006.
- Dr. Anil Kumal Singh, Scientist transferred to ICAR Complex, Patna w.e.f 13.07.2006.
- Dr. RK Srivastava, Senior Scientist (Hort) transferred from NBPGR Regional Station Shillong to NBPGR, New Delhi w.e.f 6.6.2006.
- Dr. WL Barwad, Senior Scientist transferred from NBPGR Regional Station Shillong to NRC on Pomegranate, Solapur w.e.f. 12.1.2007.

Retirements

- Sh. Sher Chand, SSG-III,NBPGR, Regional Station Bhowali retired on 31.03.2006.
- Sh. Sat Narayan Rai, T-4 (Driver) NBPGR Farm Issapur retired on 31.05.2006.
- Dr. DP Patel, Principal Scientist, NBPGR, Regional Station, Cuttack retired on 30.06.2006.
- Sh. DD Sharma, AAO, NBPGR, New Delhi-12 retired on 30.06.2006
- Dr. Ranvir Singh, Principal Scientist, GEX Division, NBPGR, New Delhi-12 retired on 31.07.2006
- Sh. Bhawani Ram, SSG-III, NBPGR, Regional Station, Bhowali, retired on 31.05.2006
- Sh. BB Kurumbanshi, SSG-IV, retired from NBPGR, Regional Station, Akola w.e.f 31.10.2006.
- Sh. Ghanshyam, SSG-IV, retired from NBPGR, Regional Station, Jodhpur w.e.f 31.12.2006.

New Appointment

- Dr. SK Sharma joined as a Director, NBPGR, New Delhi w.e.f. 15.6.2006.
- Dr. Manjusha Verma, Scientist, joined NRC on DNAFP w.e.f. 21.01.2006.
- Dr. RC Upadhayay, Principal Scientist, joined Exploration Division, w.e.f. 22.12.2006.
- Ms. Sunita Sharma, joined as Senior Administrative Officer, NBPGR, w.e.f.14.9.2006.
- Sh. Dasharath Singh Rajprohit, joined as a SSG-1, at NBPGR, Regional Station, Jodhpur on 3.4.2006.

19.8 Promotions

	Name and designation Administrative staff promotion	Promoted as	Date of promotion
1	Sh.Mohar Singh	Assistant	w.e.f. 27-12-2006
	Technical staff promotion		
1	Ms. Indira Rani	T-7-8	w.e.f. 3-2-2005
2	Sh. Jitendra Mohan	T-7-8	w.e.f. 3-2-2005
3	Sh.Charan Singh	T-7-8	w.e.f. 3-2-2005
4	Mrs.Manju Uprety	T-7-8	w.e.f. 3-2-2005
5	Sh.Sheela Kumari	T-7-8	w.e.f. 3-2-2005

Technical staff S.No. 1 to 4 promoted vide office letter No. 39-25/89/PII/6404dated 23-3-2006 and S.No. 5 promoted vide office order No. 10284-82/PII/3926 dated 19/6/2006.

19.9 Awards/ Honours

Neelam Bhatnagar, NK Dwivedi and Gopala Krishnan S., awarded **second best poster award** for the paper "Castor – an industrial crop for sustainable agriculture in Indian arid region" presented in the National Symposium on "Livelihood security and diversified farming systems in arid region" held at Central Arid Zone Research Institute, Jodhpur from January 14 - 16, 2006.

Shashi Bhalla, Kavita Gupta, Manju Lata Kapur, Charan Singh, B Lal and RK Khetarpal awarded **Best Paper Award** for Risk of Introducing Bruchid Pests with the Import of *Pisum* spp. In: XII National Seed Seminar on Prosperity through quality seed by Indian Society of Seed Technology at ANGRAU, Hyderabad from February 24- 26, 2006.

K. S. Varaprasad appointed as **Expert Member in Andhra Pradesh State Biodiversity Board** vide Gazette Notification of GOMS No.68 EFS & Dept dt. 11.05.06.

VC Chalam received **"Team Championship CWS 2006"** award during Training Programme on " Recent Advances in Structural and Functional Genomics" held at Central Institute for Medicinal and Aromatic Plants, Lucknow, Uttar Pradesh from December 15-24, 2006.

Ambika Baldev Gaikwad was awarded the **BOYSCAST fellowship 2004 -2005** sponsored by the department of Science and Technology, Govt. of India and worked on 'Development and use of microarray platforms for efficient and cost-effective genotyping and mapping of Quantitative Trait Loci (QTL) in rice' under Dr. David Galbraith at the University of Arizona, Tucson,USA.

19.10 Deputation/ Visits Abroad

Name	To attend	Place and dates
RK Khetarpal	Conference of Parties (CoP)- 8 of Convention on Biological Diversity (CBD)	Curitiba, Brazil, March 25-29.2006
RC Agarwal	Under a Personnel Serviced Agreement with Food and Agriculture Organization of the United Nations to assist the National Focal Point of Oman	Oman (Muskat) from 16 Sept to 23 Sept 2006
RC Agarwal	Under a Personnel Serviced Agreement with Food and Agriculture Organization of the United Nations to assist the National Focal Point of Laos	Lao PDR (Vientiane) from 22 May to 2 June 2006

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, 480 books related to various aspects of PGR management and Hindi literatures were added to Headquarters and Regional Station libraries through purchase and exchange basis. Library procured 51 journals including 14 foreign and 37 Indian through subscription/ gift and exchange 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 readers at Headquarters. Library possesses AGRIS, AGRICOLA, CABSAC, CAB-CD and PLATN GENE database. Bureau's publications were provided to over 200 different organizations in India and abroad and in return 150 publications were received 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 Field Days Organized

NBPGR, New Delhi: To promote germplasm utilization, six Germplasm Field Days were organized for different

crops. These were on Oil-seed Crops (March 10 , 2006), Rabi Pulses (March 22, 2006), Wheat, Barley and Triticale (March 24, 2006), Kharif Pulses (October 7, 2006), Maize (October 17, 2006) and Medicinal and Aromatic Plants and Vegetables (November 25, 2006). A large number of participants from different parts of country belonging to ICAR institutes, State Agricultural Universities (SAUs), Govt Departments , NGOs and private organization have participated in the Germplasm Field Days. The live variability was observed for agro-morphological traits. The scientists/ research workers selected the material of their choice.

NBPGR, R/ S Bhowali: A Chilli Field Day was conducted at on September 22, 2006. More than twenty officials from GBPUA&T, Pantnagar, Research Station, Majhera, Garampani, U.K and Regional Agriculture Reasearch Station, ANGRAU, Guntoor, A.P. were present. The chilli breeders identified about 75 accessions out of 204 accessions and MTA form was obtained at the site with collection numbers.

NBPGR, R/S Thrissur: A field day on okra was conducted on 23/08/2006. A total of 657 accessions of cultivated okra, in fruiting stage were exposed to the users. Five scientists participated in this event.

Photograph of the participants and the organizers of the training programme Biosafety concerns and detection of LMOs January 6 to January 20, 2006

19.13 Workshops/ Group Meetings/ Trainings Organized by NBPGR during 2006

#	Title of the Programme	Duration	Venue
1.	Biosafety Concerns and Detection of LMOs	January 16 to January 20, 2006	NBPGR, New Delhi
2.	Brainstorming Session" Promotion of Traditional Mountain Crops Cultivation in HP	September 20, 2006	NBPGR, R/S Shimla
3.	Cartagena Protocol on Biosafety: Decisions to Diagnostics	November 23 to 30, 2006	NBPGR, New Delhi
4.	International Training on *In Vitro* and Cryopreservation Techniques for Conservation of Plant Genetic Resources	December 4-18, 2006	NBPGR, New Delhi
5.	Biosafety Considerations in Evaluation of Transgenic Crops	December 5-13, 2006	NBPGR, New Delhi
6.	One day training programme on Kiwi cultivation	December 21, 2006	NBPGR, R/S Bhowali

19.14 Participation of Staff in Workshops/ Trainings/ Seminars/ Symposia, etc.

Name of Employee	Title of the Seminar/ Symposium/ Conference	Place and Period
KS Varaprasad, SR Pandravada, V Kamala, N Sivaraj, N Sunil, Babu Abraham	93rd session of the Indian Science Congress	Acharya NG Ranga Agricultural University, Hyderabad during January 3-7, 2006
Z Abraham	Workshop on Biodiversity Awareness	National Biodiversity Authority, Chennai at CTCRI from January 10- 11, 2006
KS Negi	Silver Jubilee Symposium on Ethnobotany in the New Millennium 2006	NBRI (CSIR), Lucknow, January 11- 14, 2006
NK Dwivedi Neelam Bhatnagar Gopala Krishnan S	National Symposium on "Livelihood security and diversified farming systems in arid region"	CAZRI, Jodhpur January 14-16, 2006

NK Dwivedi	Panel discussion on "Strategies of Technology Dissemination and Adoption for farm based programmes in arid region"	CAZRI, Jodhpur January 16, 2006
RK Khetarpal	Model Training Course on Production of Karnal Bunt-free Wheat for Export	DWR Karnal, January 17-24, 2006
Z Abraham	State Level Seminar on Recent trends in Biotechnology	Sri Paramakalyani College, Alwarkurichi, Tirunelveli district, Tamil Nadu on 28 January 2006
RK Khetarpal, RDVJ Prasada Rao, VC Chalam	XVI Annual Convention and International Symposium on Management of Vector-borne Viruses	International Crop Research Institute for the Semi-Arid Tropics, Patancheru, India, February 7-10, 2006,
B. Sarath Babu	National Workshop on "Scientific Journal publishing in India"	Bangalore during February 9- 12, 2006
RK Khetarpal, VC Chalam, DB Parakh	Interactive Workshop on Plant Molecular Virology	Indian National Science Academy, New Delhi, India, February 11-12, 2006
KS Varaprasad	National Conference of Biodiversity	National Biodiversity Authority at Chennai during February 12 -15, 2006
Manju Lata Kapur	Training Course on Fumigation Technology with Reference to Stored Grains and Seeds	Division of Entomology, IARI, New Delhi, February 15-18, 2006
RK Tyagi	Workshop on 'National consortium on low-cost plant tissue culture and food processing'	Informatics India, New Delhi, February 16-17, 2006
SK Mishra, Ashok Kumar, Poonam Suneja	National Conference on "Medicinal and Aromatic Plants: Global Perspective"	J.V. College, Baraut 17-18 February, 2006
Neelam Sharma	Workshop on Biotechnological Approaches in Conservation of Medicinal Plants	Tata Energy Research Institute, at India Habitat Centre, New Delhi, February 20-22, 2006
RK Khetarpal	APFISN Workshop on Early Warning Systems for Forest Invasive Species	Kerala Forest Research Institute, Peechi, Kerala, February 21- 24, 2006
RK Khetarpal, Shashi Bhalla Kalyani Srinivasan, Veena Gupta, Chitra Devi L, V. Kamala, K. Anitha, N. Sunil and Babu Abraham	XIIth National Seed Seminar on 'Prosperity through quality seed	Acharya NG Ranga Agricultural University, Hyderabad, February 24- 26, 2006
N Sivaraj	National Seminar on Advances in Plant Sciences	Bharathidasan University, Tiruchirapalli, during February 24-25, 2006
KC Muneem, KS Negi	Villagers Development Meeting and Exhibition	Tata Energy Research Institute (TERI), February 27, 2006
JB Tomar	National Seminar on Increasing Production, Productivity and Quality of Spices, Medicinal and Aromatic Plants In Eastern region	Birsa Agril., University, Kanke, Ranchi, February 28 to March 2, 2006
RK Khetarpal	National Consultation on Trade in GM Products: Issues Concerning Cartagena Protocol	Research and Information System for Developing Countries, New Delhi, March 1, 2006,
JB Tomar	49th Annual Maize Workshop	Birsa Agriculture University, Kanke from March 5-6, 2006
JB Tomar	National conference On Recent Advances in Environment	March 7, 2006

	Biotechnology for forest & Bio-diversity management	
Ashok Kumar	National seminar on "Biodiversity, Conservation, Cultivation, Processing and Marketing of Medicinal and Aromatic Plants"	MPUAT, Udaipur March 8-10, 2006
RK Khetarpal, Baleshwar Singh, Shashi Bhalla, VC Chalam	Consultation on establishment of National Agricultural Biosecurity System	National Commission on Farmers, Ministry of Agriculture, Indian Agricultural Research Institute, New Delhi, March 18, 2006
SK Mishra S. Sardana, S Mandal, Ashok Kumar, Anjula Pandey, Kavita Gupta Anuradha Agrawal, RK Tyagi	National Convention on "Knowledge driven Agriculture Development: Management of Change"	IARI, New Delhi March 24-26, 2006
KC Muneem	NASI- Platinum Jubilee Celebrations Satellite Symposium; Himalayan Biodiversity – issue and options for priority research	GBPIHED, Kosi- Katarmal, Almora, March 27, 2006
SK Mishra	Annual Maize Workshop	Ranchi April 4-6, 2006
Vandana Joshi	National Seminar on "Millets as fodder and Feed Energy"	JAU, Junagarh, Gujarat April 10, 2006
Vandana Joshi	Annual Group Meeting on Pearl and Millet	JAU, Junagarh, Gujarat April 11-13, 2006
Z. Abraham	Workshop-cum-seminar on Sesame and Niger under the AICRP on Sesame and Niger	Onatukara Regional Agricultural Research Station, KAU, Kayamkulam, Kerala from April 18-20, 2006
DK Hore	National Seminar on 'Biodiversity Conservation: the post Rio scenario in India' – Delivered a lead talk on 'Agrobiodiversity and their Conservation' and chaired the same session (sponsored by the MOEF and DST, New Delhi).	Assam University, Silchar, Cachar. April 20, 2006
SK Yadav	XXIV AICRP Annual Group Meeting of Vegetable Crops	UAS Dharwad, April 22-26, 2006
KS Varaprasad, N. Sunil	Technical workshop on "Rainfed area network on biofuels "	CRIDA, Hyderabad, April 24, 2006
Vandana Joshi	Annual Group Meeting on Forage Crops	PAU, Ludhiana May 2-4, 2006
Gopala Krishnan S	International Training Course on "Pearlmillet Improvement and Seed Production"	ICRISAT, Hyderabad May 2-15, 2006
NK Gautam	Kharif Annual Group Meet on Pigeonpea and MULLARP	TNAU, Coimbatore May 5-7, 2006
K Anitha, Babu Abraham, Radha Rani	One-day Hindi Workshop on "Stress management"	NAARM, Rajendranagar, Hyderabad on May 16, 2006
RK Khetarpal, Manju Lata Kapur, S Bhalla, Rajan, B Singh,VC Chalam, Kavita Gupta	National Consultation on Issues Related to Plant Quarantine Order	Department of Biotechnology, Government of India, New Delhi, May 17, 2006
RK Khetarpal	National Seminar on Gene Constructs	Indian Institute of Horticultural Research, Bangalore, May 17-18, 2006
DK Hore	National Seminar on 'Value additions to bioresources of NE India, post harvest technology and cold chain'	Guwahati University, Guwahati. May 20, 2006
Sandhya Gupta	International Conference on 'Agriculture for Food, Nutritional Security, and Rural Growth	India Habitat Centre, Lodhi Road, New Delhi, May 25-27, 2006
Z Abraham	National Group Meeting (XVIII Workshop) of Research Workers of AICRIP on Spices	IISR, Kozhikode, May 25-27, 2006
D K Hore	'Occurrence, adaptability and Utilisation of wild relatives of cultivated	Northeastern Hill University,

	plants in Northeast India' (6th meeting of PAC on Plant Sciences of DST, New Delhi).	Shillong – May 27, 2006
KS Varaprasad	Agrobiodiversity Workshop	Indian Institute of Management, Ahmedabad May 27-29, 2006
Kamala Venkateswaran	One-day workshop on 'Integrated marker assisted selection system (iMAS)'	ICRISAT on May 29, 2006.
SK Mishra	Annual Workshop on Arid Legume	CAZRI, Jodhpur June, 1-2 2006
NK Dwivedi	XXII Annual Workshop on Arid Legumes	CAZRI, Jodhpur June 2 - 3, 2006.
RK Khetarpal	Short-term Orientation Course on Biosafety and Biotech Regulations	The Energy and Resources Institute-SAS and MoEF, New Delhi, India. June 5-9, 2006
Chitra Devi L., Veena Gupta	National symposium on Underutilized horticultural crops	IIHR, Bangalore on June 8-9, 2006
DK Hore	'Strategy development meeting for Biodiversity Conservation and Management' project of Kamakhya Temple Trust.	Kamakhya, Guwahati, June 11, 2006
DK Hore	2nd Scientific Advisory Committee meeting for Biodiesel production programme.	NEDFI, Khetri, Kamrup, Assam. June 12, 2006
RK Khetarpal	Workshop on World Trade Organization (WTO) and Intellectual Property Rights (IPR)	Mashobara, Shimla, June 16- 17, 2006
Z Abraham	First Annual Workshop of ICAR Network Project on Tree Borne Oilseeds	NBPGR, New Delhi on June 19, 2006
AK Singh	Senior Certificate Course in Agricultural Statistics and Computing	IASRI, New Delhi July 3 – Dec. 23, 2006
DK Hore	NAIP Consultative Group Meeting (conducted by ICAR, New Delhi).	ICAR (NEH), Umiam, Meghalaya. July 7, 2006
VC Chalam	Managing Intellectual Property in Agricultural Research Organizations	National Academy of Agricultural Research, Hyderabad, July 13-19, 2006
KS Varaprasad	Third meeting of the National Advisory Committee for establishing "National Repository for Human Genetics Resources and Data"	Bangalore on July 22-23, 2006
DK Hore	Advisory body meeting for Scientific Research on medicinal plants.	NEDFI, Khetri, Kamrup, Assam, July 29, 2006.
Kamala Venkateswaran, N Sivaraj, N Sunil, Babu Abraham and Suresh Reddy	National Seminar on "Changing Agricultural Scenario – Status of the Indian Farmer	Osmania University, Hyderabad, July 31, 2006
RK Khetarpal	APCoAB Workshop on Biosafety Regulations for Transgenic Crops and the Need for Harmonizing them in the Asia-Pacific Region	ICRISAT, Hyderabad, 31 July to August 2, 2006
Ranbir Singh	Annual Research Worker's Group Meeting on Rapeseed-mustard	CCS, HAU, Hisar August 2-4, 2006
DK Hore	Consultation Workshop on National Capacity Self Assessment (NCSA) for biodiversity thematic area of Northeast region (sponsored by – ATREE, MOEF, UNDP).	NEHU, Shillong. August 26, 2006
Kavita Gupta	National Workshop on International Regime for the Movement of Living Modified Organisms: Implications for developing Countries	Amity institute of Global Legal Education and Research, Amity House, Defence Colony, New Delhi, August 26, 2006
SK Mishra	Search of new genes	NASC, New Delhi September 1-2, 2006
RK Khetarpal	Workshop to Review the Implementation of Schedules V and XI of	DAC, New Delhi, September 5,

	the Plant Quarantine Order 2003	2006
SK Yadav	Summar School on "Sample Survey Techniques in Agricultural Research"	IASRI, Pusa, New Delhi September 5-25, 2006
RK Khetarpal, Rajan, Kavita Gupta	Summer School on Nematode Biodiversity, Identification and Role of Agriculturally Useful Nematodes in Soil Health Dynamics of Nematode Community Structure in Major Cropping Systems and Relevance in Integrated Nematode Management	Division of Nematology, IARI, New Delhi, September 7-27, 2006
RP Dua, S Sardana	Annual Group Meet on Chickpea and MULLaRP Crops	Rahuri, 12-14 September, 2006
RK Khetarpal, Kavita Gupta	National Workshop on Fish Introduction in India: Status, Challenges and Potentials	NBFGR, Lucknow, September 16-17, 2006
DK Hore	'Hindi Rajbhasa' Workshop and chaired the Technical Session-II (sponsored by MOEF, New Delhi).	Hotel Pinewood, Shillong, September 18, 2006
RK Khetarpal	Train the Trainees Workshop for Senior Customs Officials on Biosafety on Agricultural Biotechnology and Trade Issues.	Ministry of Environment and Forests and National Academy of Customs, Excise and Narcotics (NACEN), New Delhi, September 18-19, 2006
Vandana Joshi	Forage Workshop (Rabi)	Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu 22-24 September 2006
NK Dwivedi	Stake-holder satellite sensitization workshop (NAIP)	CAZRI, Jodhpur September 27, 2006.
NK Dwivedi Gopala Krishnan S	National Workshop on "Forestry for food security in dry zone"	AFRI, Jodhpur October 5 - 6, 2006
RK Khetarpal, Shashi Bhalla, Rajan, Gurinder Jit Randhawa, Kavita Gupta, JC Rana	2nd international Rice Congress 2006	NASC Complex, Pusa Campus, New Delhi, October 9-13, 2006
Pratibha Brahmi	Advanced Training programme on Management of Intellectual Property Rights in Biotechnology	WIPO and BCIL at New Delhi October 9-11, 2006
DK Hore	National Seminar on 'Potential and prospect of Organic Farming in Northeast'.	ICAR (NEH), Umiam, Meghalaya, October 30, 2006
JB Tomar	Two day Seminar/ Workshop on Issues related Farmers Rights on the Protection of Plant Varieties for Eastern States	Birsa Agriculture University, Kanke, Ranchi from October 30 – 31, 2006
DK Hore	'National Symposium on 'Issues and Challenges for conservation of plants and ecosystems'	NEHU, Shillong November 3, 2006
KS Negi	Workshop on Cultivation of Herbal Plants organized by Civil Soyam Forest Division, Almora and HRDI, Gopeshwar, Chamoli	VPKAS, Almora on November 04, 2006
DK Hore	66th Annual Conference of Indian Society of Agricultural Economics.	ICAR (NEH), Umiam, Meghalaya. November 8, 2006
Sandhya Gupta	Global Forum of Agriculture	NASC complex, New Delhi, November 8-11, 2006
Madhu Bala	Fifth International Conference of the Asian Federation for Information Technology in Agriculture	Bangalore. November 9-11, 06
DK Hore	National Seminar on 'Environment and sustainable development'	Raigunj College, West Dinajpur, West Bengal. November 10, 2006
RC Agarwal	Second Annual Meeting of the Project "Preparation of Plant Variety	NBPGR, New Delhi on November

	Protection and DUS Testing through ICAR-SAU System"	10 2006
RK Khetarpal	Indo-US Workshop on Invasive Plants in Indian Protected Areas	Indo-US Science and Technology Forum at Corbett Hideaway, Corbett National Park, Haryana., November 13- 16, 2006
JC Rana and VD Verma	Workshop on Status, Prospects and Potential of Agro-Forestry in the Northern Mountains	Himalayan Forest research Institute, Shimla from November 14-16, 2006
DK Hore	DBT Brain Storming session on Biodiversity Conservation.	NEHU, Shillong, November 15, 2006
RK Khetarpal, Manju Lata Kapur, GJ Randhawa, Rajan Baleshwar Singh, Shashi Bhalla, V Celia Chalam, Kavita Gupta	International Conference on the Implications of the Cartagena Protocol on Biosafety	Biotech Consortium India Limited and ITDC at Ashoka Hotel, New Delhi November 20-22, 2006
K Pradheep	National Symposium on Production, Utilization, and Export of Under-Utilized fruits with Commercial Potentialities	BCCKV, Mohanpur, WB from November 22-24, 2006
Madhu Bala	Training programme on "Design & Development of Web Based Application Using .NET Technology"	Indian Agricultural Statistical Research Institute, Library avenue, Pusa, New Delhi from November 22– December 12, 2006.
RK Khetarpal	Discussion meeting on Setting up a National Agenda for Biosecurity	Ministry of Agriculture, at NIAS, Bangalore, November 23-24, 2006
JC Rana	Regional Meeting of the working group on Monitoring Glacial Environment and Climate change	State Council for Science and Technology, Shimla from November 23-24, 2006
Shashi Bhalla, VC Chalam	Training Programme on Biosafety Measures for Monitoring of Deliberate and unintended release of transgenic crops	G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal, India. November 23-29, 2006
DB Parakh	Training Programme on Soil Health and Plant Disease management	Centre of Advance Studies in Plant Pathology, Department of Plant Pathology, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttar Pradesh, India, December 2-22, 2006
Pratibha Brahmi	International Training Course on In Vitro and Cryopreservation Techniques for Conservation of Plant Genetic Resources	NBPGR (ICAR)-Bioversity International at NBPGR New Delhi December 4-18, 2006
Vandana Joshi	National Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops	NBPGR, New Delhi December 5-13, 2006
N Sivaraj	Seminar on "US-India knowledge initiative on agriculture-whither Indian farmer?"	Centre for World Solidarity, Hyderabad from December 8- 9 2006
Kavita Gupta	International Symposium on Biology, Ecology and Management of World's Worst Plant Invasive Species organized by Centre for Environmental Management of Degraded Ecosystems	University of Delhi, December 10-14, 2006.
Veena Gupta, Anjali Kak	International Conference on Indigenous Vegetables and Legumes	ICRISAT, Hyderabad. December 12-15, 2006
DK Hore	Trainers training on 'ABS from genetic resources and associated traditional knowledge in Biological diversity' (sponsored by – NERCORMP and ICIMOD).	Conference Hall, NEC Secretariat, Shillong. December 13, 2006

DK Hore	Interactive Workshop on 'Benefit sharing and prior informed consent (organized by CUTS, Calcutta).	NEHU, Shillong. December 14, 2006
VC Chalam	Training programme on Recent Advances in Structural and Functional Genomics	Central Institute for Medicinal and Aromatic Plants, Lucknow, Uttar Pradesh. December 15-24, 2006.
Sandhya Gupta	2nd Global Biotech Congress 2006	December 18-21, 2006 at Nagpur
DK Hore	Regional Committee meeting of ICAR (Zone-III).	ICAR (NEH), Umiam, Meghalaya. December 20-21, 2006
Madhu Bala	International Conference on Statistics and Informatics in Agricultural Research	Indian Agricultural Statistics Research Institute, New Delhi December 27 -30 , 2006

19.15 Publications

I Research papers

Abdul Nizar M, Joseph K John and R Karuppaiyan (2004) Evaluation of okra germplasm for fruit yield, quality and field resistance to Yellow vein mosaic virus. *Indian J. Plant Genet. Resour*. **17 (3)**: 241-243.

Abraham Z, SK Malik, GE Rao, SL Narayanan and S Biju (2006) Collection and characterization of Malabar tamarind (*Garcinia cambogia* (Gaertn. Desr.). *Genet. Resour. and Crop Evol.* **53:** 401-406.

Joshi Vandana, IS Bisht and KG Mukerji (2006) Seed borne pathogens: An overview. *Annals of Forestry* **14(1):** 97-120.

Joshi Vandana, Ranbir Singh, S Mandal and SK Mishra (2005) Genetic variability, correlation and path coefficient analysis for fruit yield and its component traits in crambe (*Crambe abyssinica* Hochst ex RE Fries) *Indian J. Plant Genet. Resour*. **18(3)**: 180-182.

Agarwal PC, Baleshwar Singh, Usha Dev, Indra Rani, Dinesh Chand and RK Khetarpal (2006) Interception of *Peronospora manshurica* hitherto not reported from India in soybean germplasm imported during 1976-2005. *Curr. Sci.* **91**: 347-350.

Agarwal PC, Baleshwar Singh, Usha Dev, Indra Rani, Dinesh Chand, KD Joshi and RK Khetarpal (2006) Pathogenic fungi intercepted in introduced germplasm during 2004. *Indian J. Agric. Sci.* **76**: 267-269.

Agarwal PC, Baleshwar Singh, Usha Dev, Indra Rani, Dinesh Chand, KD Joshi, AK Maurya and RK Khetarpal (2006) Interception of seed-borne fungi in introduced planting material. *Indian Journal of Plant Protection* **34:** 81-84.

Agarwal PC, Usha Dev, Baleshwar Singh, Indra Rani and RK Khetarpal (2006) Seed-borne fungi detected in consignments of soybean seeds (*Glycine max*) imported into India. *Bulletin OEPP/EPPO Bulletin* **36**: 53-58.

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Arya L, GS Sandhia, SK Singh, MK Rana and SS Malik (2006) Analysis of Indian sorghum [*Sorghum bicolor* (L.) Moench] cultivars and lines using RAPD markers. *J. Plant Biochemistry & Biotechnology* **15**: 97-101.

Asha KI and Maya C Nair (2004) Inter-relationships in morphotypes of greater yam (*Dioscorea alata* L.) *Indian J. Plant Genet. Resour*. **17 (2):** 148-153.

Barua U, DK Hore, RS Rathi and G Das (2006) Occurrence of orchids in parts of Upper Assam districts and Lohit, Dibang Valley districts of Arunachal Pradesh. *Environ. and Ecol.* **24(4):** 736-742.

Barua U, SK Singh, AK Pal and DK Hore (2006) Collection of crop germplasm from Nagaland state of India. *Environ. and Ecol.* **24(4)**: 704-709.

Bhalla Shashi, Kavita Gupta, Manju Lata Kapur, Beche Lal and R K Khetarpal (2006) Quarantine risk of introducing bruchids (Coleoptera: Bruchidae) in import of lentil. *OEPP/EPPO Bulletin* **36**: 25-29

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.

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VII. Compact Discs

Khetarpal RK, GJ Randhawa, Manju Lata Kapur and Kavita Gupta (2006) *Safe Movement of Transgenics*, National Bureau of Plant Genetic Resources, New Delhi.

VIII. Radio Talks

SK Verma on " Parvatiya Khetro Me Kiwi Phal Ki Bagwani" and " Nimbu Prajati Ke Phalo Ki Bagwani" at All India Radio (AIR), Almora , Uttarakhand on March 27, 2006.

VK Gupta on "Aushadiya Paudho Ki Bagawani Jharkhand Me–Kaise Kare" on All India Radio on December 14, 2006.

IX. TV Programmes

KC Muneem, RR Arya and Sher Singh on "Significant Contribution Made by NBPGR, R/S Bhowali for the Farmers of Uttaranchal" on JAIN TV Channel on January 27 and 28, 2006.

VK Gupta on "Safed musali its Cultivation" on Doordarshan, Jharkhand on December 12, 2006.

19.16 Patent and copyrights filed

1. Randhawa GJ and Firke PK (2006) PCR based detection kit for *cry1Ac* in Bt cotton File No. 2069/DEL/2006.
2. "Crop DNA Fingerprint Database" Software has been registered at The Registrar of Copyrights, Copyright Office, New Delhi-1.

19.17 Participation in Exhibition

- Participated in an exhibition "Pride of India-Science Expo" organized on the occasion of 93rd Indian Science Congress held at ANGARU, Hyderabad during January 3-7, 2006.
- Participated in 48th Annual Flower Show at Delhi University on February 24, 2006.

Dr. M. S. Swaminathan visited NBPGR stall at "Pride of India-Science Expo" during 93rd Indian Science Congress at ANGARU, Hyderabad 2006.

19.18 Budget Estimate and Expenditure incurred (Rupees in lakhs) for 2006-2007

A: Non- Plan

Head	Allocation	Revised Allocation	Expenditure
Estt. Charges	860.00	950.00	949.99
OTA	0.20	0.20	0.20
Wages	29.80	29.80	29.82
TA	7.00	9.00	7.80
Other Charges including Equipment	238.00	271.00	271.00
Works (ARMO Office)	35.00	65.00	64.94
Works (Residential)	5.00	10.00	10.00
Minor Works	0.00	10.00	10.00
Total	**1175.00**	**1345.00**	**1343.75**

B. Plan including NRC on DNA

Head	Allocation	Revised Allocation	Expenditure
TA	21.79	8.11	8.11
HRD	20.00	1.99	1.99
Other Charges including Equipment	674.06	509.62	509.62
Works	369.15	78.39	73.26
Total	**1085.00**	**598.11**	**592.98**

C. NEH Region

Head	Allocation	Revised Allocation	Expenditure
TA	2.00	1.40	1.39
Other Charges including Equipment	8.00	9.60	9.59
Works	5.00	0.00	0.00
Total	**15.00**	**11.00**	**10.98**

D. AICRP

Head	Allocation	Revised Allocation	Expenditure
TA	0.00	0.00	0.00
HRD	0.00	0.00	0.00
Other Charges including Equipment	90.00	90.00	89.63
Works	0.00	0.00	0.00
Total	**90.00**	**90.00**	**89.63**

Annexure I: Meteorological data (temperature in degrees Celsius and rainfall in mm) of NBPGR Stations

Station	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Akola	Max temp	29.9	35.0	33.8	40.1	40.9	36.8	30.4	28.9	30.7	32.6	30.9	29.9
	Min temp	10.8	15.3	18.7	24.2	27.2	26.0	23.1	23.1	22.9	20.0	16.7	13.5
	Rainfall	0.0	0.0	111.8	0.0	94.2	71.5	261.7	332.5	261.3	56.5	3.0	0.0
Bhowali	Max temp	17.34	20.5	19.4	24.19	24.96	27.16	24.92	24.00	23.96	20.68	16.8	14.00
	Min temp	0.34	3.54	5.32	8.33	15.07	15.96	18.28	17.37	15.52	07.95	8.23	0.66
	Rainfall	-	-	129.00	24.00	160.00	116.00	226.00	292.00	101.2	07.00	-	27.00
Cuttack	Max temp	20.3	33.7	33.9	35.1	34.7	39.0	31.9	30.1	31.7	32.1	29.5	28.7
	Min temp	14.9	18.3	22.0	25.7	25.9	26.1	26.3	25.5	25.9	24.5	20.3	16.4
	Rainfall	-	-	021.7	004.4	113.6	115.4	340.4	970.0	299.8	025.4	005.2	000.0
Hyderabad	Max temp	29.5	32.9	33.6	37.3	38.1	33.8	32.2	29.8	30.6	30.9	28.7	28.6
	Min temp	12.3	14.0	20.2	23.1	25.4	24.8	24.2	23.3	23.0	20.6	18.6	13.3
	Rainfall	-	-	22.00	20.15	19.6	6.35	14.05	19.2	11.80	8.75	13.65	-
Jodhpur	Max temp	26.2	33.8	33.2	39.2	42.1	40.7	37.1	32.6	35.2	36.3	32.0	26.4
	Min temp	10.3	15.7	18.3	24.1	28.8	28.5	28.1	25.0	24.8	22.2	16.2	13.0
	Rainfall	-	-	0.8	6.0	0.0	21.0	27.7	185.5	29.2	-	-	0.2
Shillong	Max temp	21.2	24.4	27.2	27.6	27.6	27.5	29.4	29.7	27.8	27.4	23.5	21.1
	Min temp	7.0	12.0	13.8	16.4	17.8	19.7	21.0	20.3	19.0	15.6	12.8	8.4
	Rainfall	-	1.8	4.0	104.9	317.3	343.7	171.1	197.1	390.7	234.0	50.7	14.3
Shimla	Max temp	12.5	17.0	21.3	20.5	23.9	27.6	24.0	24.8	21.4	20.1	20.2	16.8
	Min temp	4.1	3.2	7.5	13.8	16.4	15.2	16.5	15.9	15.2	10.0	7.6	2.4
	Rainfall	49.7	6.5	10.5	35.8	110.3	415.0	869.6	540.5	115.9	45.6	22.8	31.4
Thrissur	Max temp	32.5	34.3	34.8	33.4	31.8	29.9	28.7	29.9	29.4	31.0	30.7	31.5
	Min temp	22.6	22.3	23.8	24.7	24.3	23.6	23.0	23.3	23.3	23.2	22.9	22.1
	Rainfall	0.0	0.0	95.2	86.2	67.5	608.6	727.5	346.5	416.1	178.4	11.6	3.2

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