



NBPGR



वार्षिक प्रतिवेदन
ANNUAL REPORT
2007-2008



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



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



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

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ACRONYMS

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

PREFACE

It gives me immense pleasure to place before you the Annual Report (2007-2008) 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 the Germplasm Advisory Committees (GACs) on the 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, etc., was introduced from abroad and made available to indentors/ researchers after 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, multi-location 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.

A total of 14,683 accessions of orthodox seeds were added to the base collection raising the total germplasm holding to 3,53,877 accessions in the National Genebank. A total of 1,957 accessions of fruit crops, bulb and tuber crops, medicinal, aromatic and rare/ endangered plants, spices, plantation and industrial crops were conserved as in vitro cultures. Significant progress was made in the development of protocols for cultivar identification in crops of national importance using molecular techniques like STMS, AFLP and ISSR. More than 2500 varieties in different crops were fingerprinted and included in the database on DNA fingerprinting. Three M.Sc and two Ph.D students were awarded degrees in PGR during the year.

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

I thankfully acknowledge the contributions made by all the scientists, Technical, administrative and supporting staff NBPGR in this compilation.

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

22 May 2008
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 मार्गदर्शन किया। पादप आनुवंशिक संसाधनों के प्रबंधन से सम्बन्धित सभी गतिविधियों/कार्यों पर वर्ष 2007-08 के दौरान अर्जित उपलब्धियों का संक्षिप्त विवरण इस अध्याय में दिया गया है जो इस प्रकार है।

पादप अन्वेषण तथा जननद्रव्य संग्रहण

देश के विभिन्न प्रान्तों/क्षेत्रों से कुल 47 अन्वेषण किए गए जिनमें विविध प्रकार की प्रजातियों के 2369 नमूने/प्राप्तियां (जिसमें फसलीय तथा जंगली प्रजातियां सम्मिलित हैं) संग्रहित की गईं। इनमें से मुख्यालय नई दिल्ली द्वारा नौ अन्वेषणों के तहत कुल 468 प्राप्तियां संग्रह की गईं। बाकि के 38 अन्वेषण ब्यूरो के क्षेत्रीय केन्द्रों द्वारा किए गए। सभी संग्रहित प्राप्तियों को राष्ट्रीय पहचान नम्बर (आई.सी.) दिये गये और पासपोर्ट सूचना के साथ उचित मात्रा में एकत्र बीज को राष्ट्रीय जीन बैंक में दीर्घवधि भण्डारण हेतु संग्रहित किया गया। 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 गया। राजस्थान के विभिन्न क्षेत्रों से तीन अन्वेषणों के दौरान 67 प्राप्तियां एकत्र की गईं। जो जंगली प्रजातियां मुख्य तौर पर एकत्रित की गईं वे इस प्रकार हैं अड़क ग्वार (37 संग्रह), अड़क मोठ (8), जंगली कुसुम (6), विगना ट्राईलोबेटा (6), कोरडिया केनाटा (3), कोरडिया मिक्षा (3) तथा कोरडिया रोथाई (4)।

फसल विशेष अन्वेषण: फसल विशेष अन्वेषणों के अन्तर्गत रतन जोत (जेट्रोफा करकास) की 180 प्राप्तियां जो देश के विभिन्न प्रान्तों से एकत्रित की गईं थीं, उन्हें ग्रीन हाउस में उगाकर मूल्यांकन किया गया। इनमें उत्तरप्रदेश से 14 प्राप्तियां, हिमाचल से 4 प्राप्तियां, पंजाब से 3, प. बंगाल से 10, हरियाणा से 8, राजस्थान से 10, उत्तरांचल से 13, महाराष्ट्र से 3, गोवा से 2, कर्नाटक से 2, गुजरात से 14, झारखण्ड से 13, बिहार से 10, छत्तीसगढ़ से 10, तमिलनाडू से 10, केरल से 10, असम से 5, अरुणाचल से एक, मणिपुर से एक, नागालैण्ड से दो, त्रिपुरा से दो, मेघालय से एक, उड़ीसा से सात, मध्य प्रदेश से नौ तथा आन्ध्र प्रदेश से दस प्राप्तियां शामिल थीं।

आन्ध्र प्रदेश के कडपा, चित्तूर तथा कूरनूल जिलों से काकसिनिया इन्डीका की 75 प्राप्तियां, जंगली दलहनी (लेग्यूम) की दस प्राप्तियां, ककुमिस मेलों की 42 प्राप्तियां, खरबूजे की 41 प्राप्तियां, विगना ट्राईलोबेटा की 50, रबी लेग्यूम की 30, पोंगामिया की 115 तथा रतनजोत की 14 प्राप्तियां संग्रहीत की गईं। पोंगामिया की एकत्रित प्राप्तियों में पत्तियों के रंग, शाखाओं, तने की मोटाई, फूल (सफेद/गुलाबी/बैंगनी), फली का आकार, रंग, बीज का प्रतिवेदन सारांश

आकार आदि गुणों में बहुत विविधता पाई गई। रतनजोत में भी इसके कई गुणों खासकर पैदावार में काफी विविधता पाई गई। जेक फ्रूट (कटहल) की एकत्रित 24 प्राप्तियों तथा सीताफल के 16 प्राप्तियों में विविधता पाई गई।

संग्रहित भू-जातियां (लैण्ड रेसेज) : कुल 170 प्राप्तियां जिसमें धान्य फसलें (81), शूडो-धान्य (9), मोटे अनाज (2), दलहन फसलें (7), मसाले (16), फलदार पौधे (22), वन्य एवं उपयोगी पौधे (2), फूलदार पौधे (1) शामिल थे। उन्हें उत्तराखण्ड की दुर्गम पहाड़ियों/ढलानों से एकत्र किया। आन्ध्रप्रदेश से एकत्रित भू-जातियों में पपीता, बतासापाण्डु, जामीन, शरबत अनार, तेलक्या, आलमगीर आदि शामिल हैं।

जननद्रव्य विनिमय

आयातित जननद्रव्य: अनुसंधान हेतु आयात किए गए बीज/पादप प्रजनकों का प्रवेश केवल नई दिल्ली हवाई अड्डे द्वारा ही कानूनन मंजूर है। इस प्रावधान के अन्तर्गत निदेशक, पादप ब्यूरो द्वारा जारी आयात परमिटों से कुल 47517 प्राप्तियां (1,01,631 नमूने) तथा 29487 परीक्षण (ट्रायल) प्राप्तियां (82439 नमूने) विभिन्न फसलों के शामिल थे आयात किए गए।

इसके अतिरिक्त विभिन्न फसलों के 11,596 नमूने अनुसंधानकर्ताओं को उनकी मांग के अनुसार मटेरियल ट्रांसफर एग्रीमेंट (एम.टी.ए.) के प्रावधान के अन्तर्गत वितरित किए गए।

विभिन्न फसलों में विशिष्ट गुणों वाले जननद्रव्यों का आयात किया गया जो इस प्रकार है (ईसी-एकजोटिक कलेक्सन):-

धान: इसी 595767-लवणता रोधी प्राप्तियां मिश्र से आयात की गईं; सी.एम.एस., रिस्टोरर तथा मेनटेनर पंक्तियां (ईसी 608591 से 608650) एवं सिंचाई उपयुक्त (इसी 605403) फिलिपाइन से; इन-ब्रेड पंक्तियां (ईसी 609524 से 609543) तथा टी जी एम एस (ईसी 609544 से 609547) किनिया से; नये तरह के पौधे (ईसी 609339 से 609354), जीवाणु झुलसा रोग रोधी (ईसी 609355 से 609359), सूखा प्रतिरोधी कतारें (ईसी 609360 से 609366), जलमग्न प्रतिरोधी (ईसी 609367 से 609374), सिंचित क्षेत्र हेतु (ईसी 609375 से 609380), एवं लवणता रोधी कतारें (ईसी 609381 से 609394) सभी फिलिपाइन से; इन्डिका धान-जेनेटिक स्टोक म्यूटेंट (ईसी 609612)-अमेरिका से आयात किए गए।

गेहूँ: शुष्क क्षेत्रों के लिए उपयुक्त, अधिक उपज, रतुआ (स्ट्राइप) प्रतिरोधी, सेपटोरिया ग्ल्यूम ब्लोच प्रतिरोधी (ईसी 596302), अधिक उपज, अधिक तापक्रम रोधी, रतुआ (स्ट्राइप) प्रतिरोधी (ईसी 596664), चपाती एवं नूडल्स के लिए उपयुक्त (ईसी 596665), सख्त लाल विन्टर गेहूँ, जानवरों के चर जाने पर पनपने

की क्षमता, कम पी. एच (अम्लीय) मिट्टी के लिए उपयुक्त, रतुआ रोग प्रतिरोधी (ईसी 596713 से 596714) अमेरिका से; रूसी एफिड प्रतिरोधी आसोजेनिक कतारें (ईसी 596303 से 596308) दक्षिण अफ्रीका से; अधिक पैदावार, अधिक प्रोटीन (ईसी 605444), विन्टर गेहूँ (ईसी 609395 से 6093412), स्प्रिंग गेहूँ (ईसी 609413 से 609314) - साईबेरिया से; ट्रिटिकम टरजीडम - इक्म (ईसी 609335 से 609338) - ग्लोडीन जीन युक्त - अमेरिका से आयात किए गए।

जौ: छः कतार वाली स्प्रिंग जौ, अधिक उपज वाली, जल्दी पकने वाली, नेट - ब्लाच एवं कंडूआ रोग रोधी (ईसी 596667), अधिक बीटा-ग्लूकान मात्रा, कम माल्ट, फीड बारले (ईसी 596668) तथा कम फाइटेट, छः कतार वाली स्प्रिंग जौ फासफोरस को पाचन करने में मनुष्य तथा जानवरों के लिए उपयुक्त, रतुआ प्रतिरोधी (ईसी 607790) अमेरिका से आयात की गई।

सरसों (ब्रासिका प्रजातियां): ब्रासिका नेपस की मध्य पकने वाली, अधिक तेल एवं प्रोटीन मात्रा युक्त, ब्लेकलेग रोग प्रतिरोधी (ईसी 597255 से 597274), बड़े बीज दाने, जल्दी पकने वाली (ईसी 597253), सूखा प्रतिरोधी (ईसी 597254, 609294 से 6092328) आस्ट्रेलिया से; *ब्रासिका नेपस आलीफेरा* - खाने युक्त तेल जिसमें कम ग्लूकोसीनोलेट्स एवं कम यूरिक अम्ल मात्रा (ईसी 596635) अमेरिका से; *ब्रासिका जनसिया* - कम ग्लूकोसिनोलेट्स, अधिक पैदावार एवं अधिक तेल मात्रा (ईसी 537309 से 597325) आस्ट्रेलिया से आयात की गई।

सोयाबीन: उन्नत किस्म एन.सी. 114 (ईसी 606918) अधिक प्रोटीन युक्त, सोयाबीन मोजेक विषाणु तथा जीवाणु रोग प्रतिरोधी, एवं अधिक तेल मात्रा (193 ग्राम प्रति कि.ग्राम) अमेरिका से आयात की गई।

सूरजमुखी: सी.एम.एस कतारें तथा फर्टीलिटी रिस्टोरर कतारें (ईसी 595322 से 593333) अमेरिका से और अधिक उपज अधिक तेल मात्रा वाली (ईसी 595334 से 595348) आस्ट्रेलिया से आयात की गई।

चना: सर्दी रोधी कतारें (ईसी 595376 से 595383), अधिक उपज तथा एशकोचाईटा रोग प्रतिरोधी (ईसी 599949) - सिरिया से; रीकम्बिनेन्ट इनब्रेड कतारें, गुलाबी फूल, नहीं गिरने वाली फलियां, सीधे खड़े रहने वाले पौधे तथा झुलसा रोग प्रतिरोधी तथा रतुआ रोधी (ईसी 595969) स्पेन से; आधुनिक इजराइल द्वारा विकसित अधिक उपज वाली किस्म काबूली चना, देर से फूल देने वाली, झुलसा प्रतिरोधी (ईसी 600092 से 600093) - इजराइल से आयात की गई।

मसूर : सर्दी में उपयुक्त, छोटे बीज वाली, लाल रंग तथा बिना चितकबरे छिलके (ईसी 608175) अमेरिका से आयात की गई।

राजमा: जीवाणु द्वारा होने वाली विल्ट प्रतिरोधी (ईसी 599950) कनाडा से; छोटे बीज वाली, अधिक तापमान के अनुकूल,

जीवाणु झुलसा रोग तथा मिट्टी से फैलने वाली फफूंद रोग रोधी (ईसी 593020) अमेरिका से आयात की गई।

मटर: झुलसा रोग (एसकोचायटा) प्रतिरोधी (ईसी 595959 से 595963) अमेरिका से आयात की गई।

मूंग: छाछिया रोग प्रतिरोधी कतार (ईसी 605445) आस्ट्रेलिया से आयात की गई।

मिर्च: मिर्च की इनब्रेड कतारें (ईसी 596866 से 596918), ऐंथ्रेकनोज प्रतिरोधी (ईसी 596919 से 536323), अधिक उपज वाली (ईसी 596924 से 596930), सीबीएमबी प्रतिरोधी कतारें (ईसी 506931 से 596936), सी.एम.एस. (ए और बी कतारें - इसी 596937 से 596948), रिस्टोरर कतारें (ईसी 596949 से 596960) तथा गर्मी रोधी कतारें (ईसी 596949 से 596750) ताईवान से आयात की गई।

टमाटर: झुलसा रोग, सूखा रोग, फ्यूजेरियम रेस-1 तथा कई विषाणु रोग प्रतिरोधी (ईसी 600031, 606704, 610636, 610627), गर्मी रोधी (ईसी 610636) सभी ताईवान से तथा अधिक दिनों तक खराब न होने वाले, तथा लम्बे आकार के फल (ईसी 604747) फ्रांस से आयात की गई।

चुकन्दर: बीट नेक्रोटिक येलो बेन विषाणु, जड़ सड़न पैदा करने वाली एफिड प्रतिरोधी (ईसी 596298) तथा मोनोजर्म चुकन्दर राईजोक्टोनिया जड़ सड़न रोग एवं सरकोस्पोरा पत्ती धब्बा प्रतिरोधी (ईसी 596399 से 596301) अमेरिका से आयात की गई।

तम्बाखू: शैल्फ इनकम्पीटेबल (ईसी 608736, 608740, 608745, 608748, 608751, 608773, 608777, 608786, 608796, 608796, 608798) सभी अमेरिका से आयात की गई।

जननद्रव्यों का निर्यात: विदेशों में अनुसंधान हेतु जननद्रव्यों के निर्यात हेतु सभी आवेदन पत्रों को बायोलाजिकल डेव्लपमेंट एक्ट, 2002 (बी.डी.ए. 2002) के नियमानुसार, राष्ट्रीय हितों के मद्दे नजर आंकलन किया गया। कृषि अनुसंधान एवं शिक्षा विभाग तथा अध्यक्ष, राष्ट्रीय बायोडिस्कवरी आथोरिटी की अनुमति मिलने पर कुल 77 नमूने निर्यात किए गए। हैदराबाद केन्द्र द्वारा कुल 9457 नमूने (इकरीसेट फसलों के) स्वस्थता प्रमाण पत्र के साथ विदेशों को निर्यात किए गए।

पादप संगरोध

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

मुख्यालय, नई दिल्ली में कुल 42,563, प्राप्तियां (93740 नमूने) आयातित जननद्रव्यों की प्राप्त हुई तथा 77 प्राप्तियां निर्यात के लिए

जिन्हें विभिन्न कीटों/रोगों के लिए निरीक्षण किया गया। इन प्राप्तियों में विभिन्न फसलों के बीज, जड़ सहित पौधे, कलम, कंद, तथा टिश्यूकल्चर पौधे शामिल थे। पौध संगरोधालयों में विस्तृत जांच निरीक्षण करने पर 1395 नमूने रोग/कीट से ग्रसित पाये गये। इनमें से 296 नमूने कीटों द्वारा, 553 नमूने सूत्रकृमियों द्वारा, तथा 499 नमूने फफूंद/जीवाणुओं द्वारा तथा 47 नमूने विषाणु द्वारा ग्रसित पाये गये। कुल ग्रसित/संक्रमित (1395) नमूनों में से 1377 नमूनों को विभिन्न विधियों जैसे धूमन, एक्सरे रेडियोग्राफी, उष्ण जल उपचार, फफूंद नाशक एवं कीटनाशक रसायनों द्वारा उपचारित कर स्वस्थ बीज/पौध सामग्री को मांगकर्ताओं को भेजा गया। कुल 18 नमूने ग्रसित पाये जाने पर जलाकर नष्ट कर दिए गए क्योंकि ये ऐसे रोग से ग्रस्त थे जो हमारे देश में नहीं पाया जाता। निर्यात हेतु 77 प्राप्तियों को परीक्षण पश्चात स्वस्थ पाया गया जिन्हें स्वस्थता प्रमाण पत्र जारी कर निर्यात कर दिया गया। इसके अतिरिक्त ट्रांसजेनिक फसलों के 380 नमूने प्राप्त हुए जिन्हें स्वस्थ पाये जाने पर मांगकर्ताओं को भेजा गया। ट्रांसजेनिक फसलों में फूलगोभी, पत्तागोभी, कपास, चावल तथा मक्का के बीज आयात किए गए।

क्षेत्रीय केन्द्र, हैदराबाद को कुल 4954 प्राप्तियां (7691 नमूने) मुख्यालय की मार्फत आयात कर संगरोध जांच हेतु भेजी गयी। इनमें मुख्यतः इकरीसेट फसलों के जननद्रव्य शामिल थे। इनमें से 7613 नमूने परीक्षण पश्चात स्वस्थ पाये गये और आवश्यक उपचार के बाद मांगकर्ताओं को भेजा गया। इनमें धान (3073 नमूने), मक्का (1959 नमूने), ज्वार (884 नमूने) बाजरा (423), अरहर (226), सूरजमुखी (142), मिर्च (458), टमाटर (170), गाजर (25), तम्बाखू (105), कपास (110), मूंगफली (13) तथा अन्य (25) शामिल हैं। इकरीसेट फसलों के कुल 9,457 नमूने स्वस्थता प्रमाण पत्र के साथ विभिन्न देशों को निर्यात किए गए।

जननद्रव्य लक्षण वर्णन, मूल्यांकन तथा अनुरक्षण

पादप ब्यूरो के मुख्यालय नई दिल्ली, ईसापुर फार्म, ब्यूरो के क्षेत्रीय केन्द्रों तथा भारतीय कृषि अनुसंधान परिषद की विभिन्न संस्थानों के साथ तैयार साझा कार्यक्रम के अन्तर्गत विभिन्न फसलों के जननद्रव्यों को लक्षणवर्णन, मूल्यांकन एवं अनुरक्षण हेतु उगाया गया जो निम्नवत है :

मुख्यालय एवं ईसापुर फार्म, नई दिल्ली: विभिन्न फसलों की 8161 प्राप्तियां (धान्य-2002) मोटे अनाज एवं चारे की फसलें-300, दलहनी फसलें-2535, तिलहनी फसलें-1248, सब्जियां-1504, कम उपयुक्त फसलें-476, औषधीय एवं संगंधीय पौधे-96) मुख्यतः लक्षणवर्णन तथा मूल्यांकन हेतु उगाई गई। इसके अतिरिक्त 2435 प्राप्तियां (धान्य-1287, तिलहन-479, सब्जियां-550, औषधीय एवं संगंधीय पौधे-119) अनुरक्षण तथा पुनरूत्पादन हेतु उगाई गई। कुल 5202 प्राप्तियां अन्तर्राष्ट्रीय नर्सरी (गेहूँ, जौ, ट्रिटिकेल) के लिए उगाई गई। कुल 130 प्राप्तियां फलदार

पौधों की अनुरक्षित की गई।

सरसों (628), सूरजमुखी (387), अलसी (76), पेरिला (16), सोयाबीन (16), को तेल मात्रा एवं गुणवत्ता के लिए बायोकेमिकल मूल्यांकन किया गया। इसी प्रकार अरहर (464), चवला (159), राजमा (118), में प्रोटीन मात्रा नापी गई। हल्दी के 306 नमूनों को गुणवत्ता के लिए मूल्यांकन किया गया। औषधीय एवं संगंधीय पौधों के 293 नमूनों को उनमें पाये जाने वाले एकटीव कम्पाउण्डस के लिए मूल्यांकन किया गया। गेहूँ, धान, चना, तथा अरहर की आशाजनक प्राप्तियों को कई स्थानों पर उगाकर मूल्यांकन किया गया। विशिष्ट गुणों के मूल्यांकन के लिए कृषि विश्वविद्यालयों/फसल संस्थानों के साथ साझा मूल्यांकन किया गया।

क्षेत्रीय केन्द्र, आकोला में रबी मौसम में 2544 प्राप्तियों (चौलाई 635, चना 1006, मटर 118, अलसी 192, कुसुम 538) तथा खरीफ मौसम में 4134 प्राप्तियों (मोटे अनाज 599, तिलहन 1972, सब्जियां 1435, तथा अल्प प्रयुक्त फसलें 121) को पुनरूत्पादन हेतु उगाया गया। खरीफ मौसम में फसलों की जंगली प्रजातियों की 148 प्राप्तियां (भिण्डी 120, सिटेरिया 25, सोयाबीन 3) को उगाकर मूल्यांकन किया गया। इसी प्रकार तिलहन की 86 प्राप्तियों को लक्षणवर्णन हेतु उगाया गया। क्षेत्रीय केन्द्र भुवाली में 547 प्राप्तियां, हैदराबाद केन्द्र में 1058 प्राप्तियां, (ज्वार 239, उड़द 175, मूंग 140, चना 15, चंवला 194, मिर्ची 133, बैंगन 61, टमाटर 73, केनेवेलिया 28) की रबी मौसम में तथा 1370 प्राप्तियां खरीफ मौसम में; क्षेत्रीय केन्द्र जोधपुर पर 5576 प्राप्तियां खरीफ तथा रबी में उगाई गई और ग्वारपाठा, आंवला, बेल, कैर, जामुन, शहतूत, रतनजोत, होहोवा को फील्ड जीन बैंक में अनुरक्षण किया; क्षेत्रीय केन्द्र शिलांग पर 2073 प्राप्तियां विभिन्न फसलों की उगाई गई; क्षेत्रीय केन्द्र शिमला पर 3775 प्राप्तियां फसलों एवं फलों की उगाई गई एवं आशाजनक प्राप्तियों की मटर (आईसी 341362, 342029, 39674, 469165, 394026 - फलियों की अधिक संख्या, आईसी-469155, 394027, 381445, 381054 - छाछिया रोग प्रतिरोधी), आडू की जल्दी पकने वाली (ईसी 552644) पहचान की गई; श्रीनगर केन्द्र पर 356 प्राप्तियों (गेहूँ 194, जौ 98 तथा सरसों 64) को रबी में तथा 605 प्राप्तियों (गेहूँ 330, जौ 98 तथा सरसों 111) को रबी 2008 में उगाया गया, त्रिशूर केन्द्र पर चावल 110, हार्सग्राम 122, करकूमा 146, आम 22, चौलाई 33, कोकम 5, भिण्डी 100, करेला 21, चीनी आलू 10 को उगाया गया। इन सभी क्षेत्रीय केन्द्रों 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 'फसल दिवसों' का आयोजन भी किया गया जिनमें फसल विशेषज्ञों, अनुसंधानकर्ताओं ने भाग लेकर, वांछित गुणों के आधार पर प्राप्तियों का चयन कर मांग हेतु आवेदन किया।

तालिका 1: राष्ट्रीय जीन बैंक में दीर्घावधि हेतु संरक्षित जननद्रव्यों की यथास्थिति (31-12-2007 तक)

फसल वर्ग	कुल प्रजातियां	1 जनवरी से 31 दिसम्बर 2007 तक संरक्षित प्राप्तियां	कुल प्राप्तियों की वर्तमान स्थिति
धान	18	4,052	82,766
गेहूँ	56	5,661	38,612
मक्का	01	349	7,261
अन्य धान्य	13	405	11,154
कुल धान्य	88	5,372	1,39,793
ज्वार	01	179	18,834
बाजरा	02	116	7,552
मोटे अनाज	07	691	19,716
अन्य	135	391	3,932
मोटे अनाज तथा चारे की फसलें	145	1,377	50,034
रामदाना	16	383	4,932
कूटु	04	42	680
अन्य	06	25	330
कूट धान्य	26	450	5,942
चना	10	455	16,427
अरहर	12	188	10,988
मूंग	04	60	3,559
अन्य	41	1,443	24,016
दलहन	67	2,146	54,990
मूंगफली	12	35	13,449
सरसों	14	339	9,322
कुसुम	04	39	7,285
अन्य	16	1,668	19,540
तिलहन	46	2,081	49,596
कपास	05	122	4,832
जूट	13	27	2,837
अन्य	22	111	2,864
रेशदार फसलें	40	260	2,110
बैंगन	24	144	3,806
मिर्च	04	6	2,002
अन्य	116	1,475	16,956
सब्जियां	144	1,625	22,826
सरीफा	01	1	59
पपीता	01	-	23
अन्य	18	116	300
फलदार फसलें	21	117	382
पोस्ता	03	-	350
तुलसी	09	34	376
तम्बाकू	43	1	1,461
अन्य	498	355	3,536
औषधीय, संगंधीय एवं नशीले पौधे	549	390	5,723
धनिया	01	73	485
सोवा	02	-	59
अन्य	10	510	1,671
मसाले	13	583	2,215
पोंगम तेल वृक्ष	01	68	395
अन्य	178	214	1,940
कृषि वानिकी	179	282	2,335
मसूर	-	-	7,712
अरहर	-	-	2,523
द्वितीयक नमूने	-	-	10,235
योग	1,318	14,683**	3,53,877*

* इनमें 3,022 निर्मुक्त किस्में तथा 1,454 आनुवंशिक धरोहर शामिल हैं।

** इस संख्या में 467 निर्मुक्त किस्में तथा 142 आनुवंशिक धरोहर शामिल हैं।

जननद्रव्य संरक्षण

बीज जननद्रव्य संरक्षण : राष्ट्रीय जीन बैंक में दीर्घकालीन संरक्षण हेतु विभिन्न फसलों/पौधों की कुल 14807 प्राप्तियां प्राप्त हुईं। इन सभी प्राप्तियों को जीनबैंक द्वारा निर्धारित मापदण्डों के अनुसार संशोधित किया गया तथा इनमें से 14683 प्राप्तियों को आधार संग्रहों में शामिल किया गया जिसके फलस्वरूप जीनबैंक में आधार संग्रहों की कुल संख्या बढ़कर 3,53,877 हो गई है (तालिका -1)। इसी दौरान जननद्रव्य संचालन यूनिट ने 3116 प्राप्तियां प्राप्त की जिनको मध्यावधि भण्डार में संदर्भ सामग्री के रूप में रखा गया। कुल 2012 संरक्षित प्राप्तियों को मानिटर किया गया एवं 16999 प्राप्तियों की पासपोर्ट सूचना को पूर्ण किया गया। कुल 4606 प्राप्तियों को मूल्यांकन/अनुसंधान अथवा पुनरुत्पादन हेतु जीनबैंक से निकालकर सम्बन्धित संस्था/केन्द्र को वितरित किया गया। अनुसंधान से पता लगा कि रतनजोत के बीज सुखाये जा सकते हैं (आर्थोडोस)। यह भी पाया गया कि अरण्ड, मूंगफली, तिल, नाईगर तथा कपास के बीजों को 5 प्रतिशत से कम नमी पर सूखाकर भण्डारण करने से दीर्घायु होती है।

पादप उत्तक कल्चर संरक्षण: वानस्पतिक संवर्धन वाली पादप प्रजातियों जिनमें बीज नहीं बनता जैसे बागवानी, प्रकन्दीय, औषधीय एवं संकटापन्न पौधे एवं नई औद्योगिक फसलों की कुल 1957 प्राप्तियों को उत्तक संवर्धन विधि द्वारा कमरे के तापमान अथवा निम्न (तापमान 4 डीग्री से.) पर संरक्षित किया गया। प्राप्तियों के अनुसार संवर्धन का अंतराल 4 से 24 माह रहा। कल्चर में पौधे की बढ़ने की रफ्तार को कम करके संवर्धन अंतराल को बढ़ाया जा सकता है। विभिन्न पौधों की 144 प्राप्तियां (अदरक 82, केला 60, सर्पगंधा 2) उत्तक कल्चर रूप में मांगकर्ताओं को भेजी गईं।

हिमपरिरक्षण : विभिन्न पौधों की कुल 439 प्राप्तियां (जिनमें आर्थोडोक्ष बीज, रिक्लसीट्रेट बीज, पराग कण, सुषुप्त कोपलें शामिल थी) तरल नाइट्रोजन में-160 से-180 डिग्री से. पर रखकर परिरक्षण किया गया। इस प्रकार हिम परिरक्षण में संरक्षित प्राप्तियों की संख्या 8459 हो गई। बीज, एम्ब्रियो (भ्रूण) तथा भ्रूण-अंश (सालबाडोरा, मधुका लांगिफोलिया, महुआ) को सफलतापूर्वक हिमपरिरक्षण किया गया। आम के हिम-परिरक्षण परागकणों को आम में पालीनेसन कराकर फल बनाने में सक्षम पाया गया।

डी एन ए फिंगर प्रिंटिंग

अब तक 33 फसलों की पहचान हेतु प्राटोकाल विकसित किए जा चुके हैं। इन प्राटोकाल को विकसित करने में एस.टी.एम., ए. एफ. एल. पी. तथा आई.एस.एस.आर. आणविक चिन्हक विधियों का उपयोग किया गया। ये फसलें इस प्रकार हैं- धान, गेहूँ, जौ, फिंगरमिलेट, बाजरा, ज्वार, राजमा, चना, हार्सग्राम, मसूर, मटर, अरहर, मूंग, राइसबीन, उड़द, सोयाबीन, सरसों, कुसुम, तिल, नाईगर, कपास, जूट, टमाटर, मिर्च, केला, आम, काजू, नीबू, सफेद मूसली, नीम तथा खसखस। विभिन्न फसलों की 2500 से भी अधिक किस्मों को फिंगरप्रिंट किया जा चुका है। चावल, मूंग,

सरसों तथा टमाटर में आणविक चिन्हकों में व्याप्त विविधता का मूल्यांकन किया गया। एमटीएमएस, आईआईएसआर तथा आरएपीडी चिन्हकों से मूंग (145 प्राप्तियां), धान (45 भू-जातियां), कपास (45 पेटुक कतारें), जई (35 भूजातियां), परीला (72 भूजातियां) तथा गेहूँ (112 किस्में) डीएनए प्राफाइलिंग से वंशिकी विविधता का विश्लेषण किया गया।

अन्य प्रमुख गतिविधियां

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

- ब्यूरो के वैज्ञानिकों, अनुसंधान सहायकों, तकनीकी तथा प्रशासनिक कर्मचारियों ने देश तथा विदेशों में आयोजित कार्यशालाओं, सम्मेलनों एवं प्रशिक्षण कार्यक्रमों में भाग लेकर ज्ञान का आदान-प्रदान किया।
- विशिष्ट वैज्ञानिकों, प्रगतिशील किसानों, नीति नियन्ताओं तथा विद्यार्थियों ने राष्ट्रीय जीनबैंक, डीएनए फिंगरप्रिंटिंग प्रयोगशालाएं, संगरोध प्रयोगशालाएं, शीशघर एवं सी-4 स्तर की राष्ट्रीय नियंत्रित सुविधा तथा पादप उत्तक संवर्धन प्रयोगशालाओं को देखा और जानकारी प्राप्त की।
- ब्यूरो द्वारा निम्न कार्यशालाएं, प्रशिक्षण कार्यक्रम, सम्मेलन आयोजित किए
 - 12 सितम्बर 2007 को 'जीएम चीप टेक्नोलॉजी-डवलपमेंट तथा एप्लीकेशन' विषय पर चर्चा।
 - 14 नवम्बर 2007 को 'हिमाचल प्रदेश में खेत पर मोटे अनाजों के संरक्षण हेतु उपयुक्त जगहों की पहचान' विषय पर कार्यशाला आयोजित की गई।
 - 16 तथा 17 नवम्बर 2007 को 'डीएनए फ्रिगरप्रिंटिंग तथा पौध विविधता संरक्षण' विषय पर प्रशिक्षण आयोजित किया गया।
 - 15 से 19 नवम्बर 2007 तक 'इन विट्रो एवं हिमपरिरक्षण विधियों द्वारा पादप आनुवंशिक संसाधनों का संरक्षण' पर अंतरराष्ट्रीय प्रशिक्षण आयोजित किया गया।
 - 27 नवम्बर से 4 दिसम्बर 2007 तक 'बायोसेफ्टी कंसीडरेशन इन इवेल्च्यूसन आफ ट्रांसजेनिक क्रोपस' विषय पर प्रशिक्षण कार्यक्रम आयोजित किया।
 - प्रायोगिक प्रक्षेत्र, ईसापुर, नई दिल्ली एवं अन्य क्षेत्रीय केन्द्रों पर फसल दिवसों का आयोजन किया गया जिनमें फसल विशेषज्ञों ने भाग लिया।
 - विभिन्न फसलों के लिए गठित 'जननद्रव्य सलाहकार समितियों' की बैठकें आयोजित की गईं तथा दिए गए सुझावों को कार्यान्वित किया गया।
 - पेटेंट कराने के लिए दो आवेदन किए गए - एक मक्का में ट्रांसजीन पता लगाने की विधि पर तथा दूसरा सोयाबीन में ट्रांसजीन का पता लगाने की विधि पर।
 - जननद्रव्य रजिस्ट्रेशन समिति ने बैठकों में निर्णय लेकर 20 फसलों के 50 आवेदनों को अनुमोदित किया।

EXECUTIVE SUMMARY

NBPGR continued its role of leadership for the management of plant genetic resources in the country. Several significant achievements were made during the year 2007-08 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 47 explorations were undertaken across the country and 2,369 accessions of various agri-horticultural crops, wild relatives of crops and other economic plants were collected. Of these, 468 accessions were collected by NBPGR Headquarters, New Delhi through nine explorations from parts of Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Punjab 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. Three exploration and collection trips were undertaken and 67 germplasm collections were made from different parts of Rajasthan. The germplasm collections included wild relatives of crop plants namely adak guar (37), adak moth (8), *Carthamus oxyacantha* (6), *Vigna trilobata* (6) and minor fruit crops namely *Cordia crenata* (3), *C. myxa* (3) and *C. rothii* (4).

Crop specific explorations: One hundred and eighty (180) accessions of *Jatropha* germplasm collected from across the country were maintained in National *Jatropha* Garden and green house. They represented collections from Uttar Pradesh (14), Himachal Pradesh (4), Punjab (3), West Bengal (10), Haryana (8), Rajasthan (10), Uttranchal (13), Maharashtra (3), Goa (2), Karnataka (2), Gujrat (14), Jharkhand (13), Bihar (10), Chhattisgarh (10), Tamilnadu (10), Kerala (10), Assam (5), Arunachal Pradesh (1), Manipur (1), Nagaland (2), Tripura (2),

Meghalaya (1), Orissa (7), Madhya Pradesh (9) and Andhra Pradesh (10).

The survey was undertaken in the districts of Kadapa, Chittoor, Kurnool districts of Rayalaseema region of Andhra Pradesh and a total of 414 germplasm accessions of various crops were collected including *Coccinia indica* (75), wild edible legumes (10), *Cucumis melo* (42), musk melon (41), *Vigna trilobata* (50), *rabi* legumes (30), *Pongamia* (115) and *Jatropha* (14). A total of 115 accessions of *Pongamia* and 14 accessions of *jatropha* were collected. In *Pongamia*, significant diversity was observed in leaf colour (light green/ dark green), branching habit (erect/ semi-erect/ drooping), stem girth, flowering (white/ pink/ purple), pod shape, size, colour, beak characters, seed size, shape and colour. In *Jatropha*, diversity was observed for bearing, bunches/ tree and capsules/ bunch. In case of snap and musk melon germplasm diversity was observed for fruit shape, size and presence/ distribution of net markings on fruits. A total of 40 accessions comprising jackfruit (24 accessions) and custard apple (16 accessions) were collected from 31 collection sites. The species diversity included *Artocarpus heterophyllus* (23 accessions), *A. lacucha* (one acc.) and *Annona squamosa* (16 accessions).

Landraces collected: A total of 170 accessions including landraces and primitive cultivars comprising cereals (81), pseudo cereals (09), minor millets (02), pulses (07), spices (16), fruits (22), wild economically useful plants (02) and ornamentals (01) were collected from remote areas of Uttarakhand hills under National Exploration Programme. Landraces collected also included *papaya*, *batasapandu*, *zamin*, *sharbat*, *sharbat anar*, *tellakaya*, *allangir* etc. of *Cucumis melo* (melons) from districts of Kadapa, Chittoor, Kurnool districts of Rayalaseema region of Andhra Pradesh.

EXCHANGE OF GERmplasm

Introduction of germplasm: During the period under report 47,517 accessions (1,01,631 samples) were imported from 56 countries, which included germplasm 18,030 accessions (19,192 samples) as well as trial material 29,487 entries (82,439 samples) of different agricultural and horticultural crops. Requirements of germplasm from abroad were met by arranging material

from different Indian sources and 77 samples were exported to six countries with phytosanitary certificate issued by Plant Quarantine Division, NBPGR, New Delhi while 9457 samples of ICRISAT mandated crops were exported to different countries with phytosanitary certificate issued by NBPGR regional station, Hyderabad. A total of 11,596 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:

***Hordeum vulgare*:** Six rowed spring barley, high yielding, early maturing, resistant to net blotch or smut (EC596667), high B-glucan content, low malt extract, feed barley type (EC596668) and low phytate, six rowed spring feed barley which provides phosphorus (p) digestibility and mineral nutrition for humans and non ruminant animals, resistant to rust (EC607790) from USA.

***Oryza sativa*:** Salinity tolerant types (EC595767) from Egypt; CMS, restorer and maintainer lines (EC608591-650) and irrigated type (EC605403) from Philippines; inbred lines (EC609524-43) and TGMS line (EC609544-47) from Kenya; new plant types (EC609339-54); BLB resistance (EC609355-59); drought tolerant lines-Lowland (EC609360-66); submergence tolerant (EC609367-74); irrigated (EC609375-80) and salinity tolerant lines (EC609381-94) from Philippines; Indica rice genetic stock mutants (EC609612) from USA.

***Triticum aestivum*:** Suitable for dryland areas, high yield potential, resistant to stripe rust and *Septoria* glume blotch (EC596302), superior type, high grain yield potential, resistant to stripe rust (EC596664), high yield potential, high temperature tolerant, adult-plant resistance to local races of stripe rust, partial resistance to Hessian fly, superior dual purpose for noodle and bread products (EC596665); hard red winter wheat, unique ability to endure and recover from extended and intensive grazing in a dual purpose management system, tolerant to low pH soils with high aluminum starvation, resistant to wheat leaf rust (EC596713-14) from USA; Russian wheat Aphid (RWA) *Diuraphis noxia* resistant near isogenic lines (NILs) (EC596303-08) from S. Africa; broad adaptation, high yielding ability, high protein concentration, and good end use quality in central and northern Greece (EC605444); winter wheat (EC609395-412) and spring wheat (609413-14) from Serbia; *Triticum turgidum* var. *durum* (EC609335-38) durum germplasm

carrying Glu-d1d with glutenin or gliadin genes from USA.

***Brassica napus*:** Mid maturity, very high oil and protein, resistant to blackleg (EC597255-74), Large seeds, early to mid maturity (EC597253), drought tolerance (EC597254) and screening for drought tolerance (EC609294-328) from Australia, *Brassica napus* subsp. *oleifera*- edible quality oil, low glucosinolates and low erucic acid (EC596635) from USA; *Brassica juncea*- low glucosinolates, good yield, moderate to high oil (EC597309-25) from Australia.

***Glycine max*:** Var. NC 114 with high seed protein content and resistant to *Soybean mosaic virus* and bacterial pustule (*Xanthomonas campestris* pv *glycines*) (EC606917), high seed protein- 402 g/kg and high oil content 193 g/kg (EC606918) from USA.

***Helianthus annuus*:** CMS line and fertility restoration lines (EC595322-33) from USA and high yield and high oil content (EC595334-48) from Australia.

***Cicer arietinum*:** Cold tolerant germplasm lines (EC595376-83) and high yielding, resistance to Ascochyta blight (EC599949) from Syria; Recombinant inbred line with pink flowers, non shattering pod, semi erect growth habit, and combined resistance against Ascochyta blight (caused by *Ascochyta rabiej*) and rust (EC595969) from Spain; modern high yielding Israeli Kabuli cultivar, late flowering, with good resistance to Ascochyta blight. Currently, leading variety in Israel (EC600092-93) and a breeding line combining early flowering with moderate Ascochyta resistance, selected from cross Sanford X ICC 7344 (EC600097) from Israel.

***Lens culinaris*:** Winter hardy lentil intended for fall planting directly into cereal stubble, small seeds with red cotyledon and absence of seed coat mottling (EC608175) from USA.

***Phaseolus vulgaris*:** Resistant to both yellow and orange strains of bacterial wilt (EC599950) from Canada and small seeded tropically adapted, resistance to common bacterial blight caused by *Xanthomonas campestris* pv. *phaseoli* and *Rhizoctonia solani*, and unique source of resistance to soil fungi, adapted to temperate climates (EC593020) from USA.

***Pisum sativum*:** Ascochyta blight resistance lines (EC595959-63) from USA.

***Vigna radiata*:** Powdery mildew resistant green gram line (EC605445) from Australia.

***Capsicum annuum*:** Pepper inbred lines (EC596866-

918); Anthracnose resistant lines (EC596919-23), high yielding lines (EC596924-30), CVMV resistant lines (EC596931-36), CMS (A and B lines) (EC596937-48), restorer lines (EC596949-60) and heat tolerant lines (EC596749-50) from Taiwan.

Lycopersicon esculentum: Resistant to TY, BW, F-1, TMV (EC600051) and resistant to BW, F-1, F-2, TMV (EC606704), bacterial wilt and late blight resistance (EC605432-43), TY, BW, F-1, TMV (EC606703), BW, F-1, F-2, TMV (EC606704), BW, TMV, F-1 (EC610636), heat tolerant (EC610636) and TY, BW, F-1, TMV, ST (EC610627) from Taiwan and for long shelf life, indeterminate type, elongated fruit (EC604747) from France.

Linum usitatissimum: Spring type (EC607789) from UK.

Beta vulgaris: A heterogeneous disease resistant sugar beet population resistant to *Beet necrotic yellow vein virus*, root rotting strains and root aphid (EC596298) and Monogerm sugar beet resistant to *Rhizoctonia* root rot and moderately resistant to *Cercospora* leaf spot (EC596299-301) from USA.

Medicago sativa: Broad genetic base population with resistance to blue alfalfa aphid (*Acyrtosiphon kondoi*) (EC596669-71) and with unique combination of a broad genetic base (EC596672-73) from USA.

Nicotiana spp.: Self-incompatible sib pollinate plants to produce seed (EC608736), seed can be produced in green house, but mature plants can be induced to flower with growth chamber conditions of 30 °C day/16 °C night with 8 hour photoperiod (EC608740), self-incompatible. Sib pollinate plant to produce seed (EC608745), prefers cool nights for pollen production, flowers should have purple color for good pollen production (EC608748), self incompatible sib pollinate plants to produce seed (EC608751), seed may take 20-30 days to germinate. Self incompatible- Sib pollinate to produce seed (EC608773), prefers cool nights for flowering (EC608777), seed may take 20-30 days to germinate. Prefers cool nights for flowering, self incompatible. Sib pollinate to produce seed (EC608786), seed production is improved by sib pollination. Prefers cool nights for flowering (EC608796) and self-incompatible and with seed production improved by sib pollination (EC608798) from USA.

Export of germplasm: The plant material intended for export was procured from known Indian sources through correspondence and the same was forwarded to the

indentors in foreign countries along with phytosanitary certificates issued by the Plant Quarantine Division of the Bureau and import permit, if any after approval from ICAR/DARE and clearance from National Biodiversity Authority of India. A total of 9,534 samples (77 from New Delhi and 9,457 from Hyderabad of ICRISAT mandate crops) were exported to several countries.

QUARANTINE OF GERmplasm

At New Delhi, a total of 42,563 accessions (93,740 samples) comprising germplasm as well as trial material of various crops and 77 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 1395 samples were found infested/ infected/ contaminated with various pests viz., insects/ mites -296 samples including 91 with hidden infestation; nematodes- 553; fungi/ bacteria- 499 and viruses (47). Of the 1395-infested/ infected/ contaminated samples, 1377 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip, mechanical cleaning and growing-on test. Eighteen samples were rejected including 14 samples of *Glycine max* from USA 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. Six 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.

At Hyderabad, a total of 4954 accessions (7691 samples) of ICRISAT mandate crops and germplasm meant for south India were routed through Headquarters, New Delhi to Regional Station, Hyderabad for quarantine inspection and clearance. A total of 7,613 samples comprising paddy (3,073), maize (1,959), sorghum (884), pearl millet (423), chickpea (226), sunflower (142), chilli (458), tomato (170), carrot (25), tobacco (105) cotton (110), groundnut (13), *Hypericum sp.* (21) and *Leucaena spp.* (4) were released after giving mandatory treatment. Important interceptions in imported samples included *Alternaria padwickii*, *Drechslera oryzae*, and *Sclerotium oryzae* in paddy from Belgium; *Fusarium oxysporum* in maize from Mexico and Thailand;

Drechslera setariae in pearl millet from Niger; *Alternaria helianthi* and *Botrytis cinerea* in sunflower from Australia and Serbia Monte-Negro respectively; *Alternaria radicina*, *A. dauci*, *Rhizoctonia solani* in carrot from USA; *Alternaria solani*, *Colletotrichum capsici*, *Rhizoctonia solani* in chilli from Taiwan and *Pseudomonas syringae* in tomato from Taiwan. A total of 9457 samples of germplasm of ICRISAT mandate crops were processed and cleared with necessary Phytosanitary Certificate for export.

GERMPLASM CHARACTERIZATION, EVALUATION AND MULTIPLICATION

A total of 8,161 accessions of various agri-horticultural crops comprising cereals (2,002), millets & forages (300), pulses (2,535), oilseeds (1,248), vegetables (1,504), underutilized crops (476), medicinal and aromatic plants (96) were grown for characterization and evaluation. Besides, 2,435 accessions of various crops *viz.*, cereals (1,287), oilseeds (479), vegetables (550), medicinal and aromatic plants (119) were grown for regeneration, multiplication and maintenance. In addition, 5,202 accessions of international nurseries comprising of wheat, barley and *triticale* were also grown in Post-entry Quarantine Nursery (PEQN). In addition, 130 accessions of perennial fruit plants were also maintained in the field genebank. Promising accessions for various agromorphological characters have been identified. The germplasm of the oilseeds namely, rapeseed mustard (628), sunflower (387), linseed (76), perilla (16) and soybean (16) was analyzed for oil content and quality parameters. Similarly, the germplasm of pulses namely chickpea (464), cowpea (159) and French bean (118) was analyzed for protein content. In addition, 306 accessions of turmeric were also analyzed for quality parameters. In phytochemical evaluation, 293 samples of medicinal and aromatic plants were analyzed and evaluated for their active compounds. Multi-location evaluation of 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 also undertaken for specific traits involving AICRP/ ICAR/ SAUs. The details of germplasm characterized and evaluated at the various regional stations are as follows:

Akola: During *rabi* 2006-07, 2,544 accessions comprising amaranth (635), chick pea (1,006), grass pea (118), linseed (192), safflower (538) and *Carthamus* spp. (55) and during *kharif* 2007, 4,134 accessions of germplasm comprising millets (599), oilseeds (1,979),

vegetables (1,435) and under utilized crops (121) were regenerated and multiplied. During *kharif* 2007, regenerated 148 accessions of germplasm of wild relatives of crop plants comprising *Abelmoschus* spp. (120), *Setaria* spp. (25) and *Glycine* spp. (3) and also were evaluated. A total of 86 accessions of sesame germplasm were characterized for seven qualitative and eight quantitative traits.

Bhowali: A total of 547 accessions were received for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material *viz.* M& AP and WEUPS (Wild Economically Useful Plant Species): Rose- geranium (559), Lavender (158), *Marjorana hortensis* (321), *Rosmarinus officinalis* cv. French – 42,704, *Rosmarinus officinalis* cv. Italian - 7,795; Horticultural Plants: Kiwi (2,124 +135 Kg fruit); Agricultural Crops: Wheat – HB-208 (05 kg) were supplied to different farmers/ indentors.

Hyderabad: A total of 1,058 accessions of different crops including sorghum (239), black gram (175), green gram (140), horse gram (15), cowpea (194), chillies (133), brinjal (61), *Lycopersicon* species (73), *Canavalia ensiformis* (28) were grown for characterization/ evaluation and multiplication during *Rabi* 2006-07. In *kharif* 2007, a total of 1370 accessions of black gram (136), finger millet (30), Italian millet (180), little millet (24), barnyard millet (22), cowpea (100), green gram (144), sesame (100), beans (130), brinjal (190) were characterized/ evaluated and multiplied.

Jodhpur: Morpho-agronomic traits of 197 and 5,379 accessions raised during *Summer* and *Kharif* 2007, respectively were recorded. Trait specific accessions for determinate habit in guar and trilobed leaves in mungbean were identified and characterized during *Kharif* 2007. A crop germplasm field day for *kharif* crops was organized on October 6, 2007. Blocks of horticultural plants and plants of economic importance were maintained and data were recored in *Aloe barbadensis*, anola, bael, *Capparis decidua*, jamun, mulberry, *Salvadora* spp., *Jatropha curcas* and jjoba germplasm.

Shillong: A total of 2,073 accessions covering 12 crops were characterized, while 1,872 accessions were harvested. Promising accessions were identified for each crop, based on the yield data. As many as 169 accessions of rice, ginger, spine gourd, *Colocasia* were supplied to the five indentors under MTA. Four mutant genotypes of *Persea bombycina* Kost. were conserved in the field gene bank of the station, while 101 accessions of lowland

rice germplasm were sent for conservation in LTS of the National Gene Bank, New Delhi.

Shimla: A total of 3,775 germplasm accessions of various agri-horticultural crops were characterized and multiplied for conservation. The promising accessions identified in pea for pod number were IC341382, IC342029, IC396094 IC469165, IC394026, for powdery mildew resistance IC469155, IC394027, IC381445, IC381054, IC311066; in peach EC552644 exhibited earliest fruit maturity while EC468324 for high TSS; IC019392 high fruit weight and high pulp juiciness in pear; EC552694 and EC393741 early maturity and high productivity in plum; IC349933 high TSS in apricot. In apple, quality fruits along with high productivity were noticed. 551 germplasm accessions of different crops were deposited for Long/Medium Term Storage in the National Gene Bank while 1,153 accessions of fruit crops, their wild relatives, medicinal plants and ornamentals were conserved and maintained in field genebank. A total of 9,443 accessions are being conserved in MTS and 201 herbarium specimens were submitted to NHCP at HQs, New Delhi.

Srinagar: The 356 accessions of wheat (194), barley (98) and mustard (64) were characterized and evaluated during *rabi* 2006-07 and the 605 accessions of wheat (330), barley (164) and mustard (111) were sown in *rabi* 2007-08.

Thrissur: During *rabi* 2006-07, 110 accessions of rice (*Oryza sativa*), 122 of horsegram (*Macrotyloma uniflorum*), 146 of 12 identified wild/run wild tuberising (finger bearing) *Curcuma* taxa, 3 of cinnamon (*Cinnamomum verum*), 22 of mango (*Mangifera indica*), 11 of typical *S.incanum* and 5 of typical *S.insanum* were characterised/evaluated. In summer 2007, 33 accessions of Chinese spinach (*Amaranthus tricolor*) and 5 of kokam (*Garcinia indica*) were characterised/evaluated. During *kharif* 2007, 100 accessions of okra (*Abelmoschus esculentus*), 21 of small bittergourd (*Momordica charantia* var. *muricata*), 10 of Chinese potato (*Solenostemon rotundifolius*), 34 of 12 identified wild/run wild *Curcuma* taxa and 24 of Malabar tamarind (*Garcinia cambogia*) were characterized/ evaluated. Deposited seeds of 517 multiplied accessions for long-term storage.

GERMPLASM CONSERVATION

a. Conservation in Seed Genebank: A total of 14,807 germplasm accessions of various crops were received for long-term conservation in the National Genebank.

These were processed following the genebank standards adding another 14,683 accessions to the base collection raising the total germplasm holding to 3,53,877. A total of 3,116 accessions received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (2,012 accessions) and updating of passport data (16,999 accessions) remained the priority activities. A total of 4600 accessions were supplied from the genebank for evaluation/regeneration/ research /restoration of active collection. Studies on seed storage of *Pongamia pinnata*, *Murraya paniculata*, *Saraca asoka*, *Swietenia macrophylla*, *Mimusops hexandra* and *Jatropha curcas*, showed that *Swietenia macrophylla* and *Mimusops hexandra* seeds have intermediate behaviour while *Saraca asoka* seeds have recalcitrant behaviour and *Pongamia pinnata*, *Murraya paniculata* and *Jatropha curcas* have orthodox behaviour. Cost effective conservation protocols are being worked out for castor, groundnut, sesame, niger and cotton. In these crops longevity at ambient temperatures was found to be more when seeds were dried to ultra low moisture contents (i.e. < 5 per cent moisture content). Methods for breaking seed dormancy were developed in some wild species, viz. *Amaranthus viridis*, *Malva verticillata*, *Perilla frutescence*, *Rosa webbiana*, *Alysicarpus vaginalis*, *Physalis coagulans*, *Eleusine indica* and *Neolitsea* sp. to facilitate cultivation and monitoring of seed viability during storage. Their storage behaviour was found to be orthodox.

b. In vitro/ Tissue Culture Conservation: During the year, a total of 1,957 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. Employing several slow growth strategies, subculture duration could be enhanced to varying periods in alliums and *Bacopa monnieri*. Cost-effective conservation experiments yielded encouraging results in *B. monnieri*, *Kaempferia galanga* and *Musa* sp. Experiments to test the potential of synseeds in *Zingiber officinale* yielded encouraging results. Cryopreservation experiments led to varying degree of pre-and post-freezing success in *Allium sativum*, *Gentiana kurroo*, *Morus* sp., *Picrorhiza kurroa* and *Rubus* sp. Genetic stability studies employing various morphological or molecular marker (RAPD) in *Colocasia esculenta* revealed that there were no

significant differences between *in vitro*-regenerants and their respective mother plants. A total of 144 accessions comprising *Zingiber officinale* (82), *Musa* sp. (60) and *Rauvolfia serpentina* (2) were supplied as *in vitro* cultures to various indentors.

c. Cryopreservation: A total of 439 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen were cryopreserved during the year totaling to 8,459 accessions in the cryogenebank. Successful cryopreservation was achieved in seeds, embryos and embryonic axes of *Salvadora* sp., *Madhuca longifolia*, *M. indica* and *Prunus armenica*. Fruit-setting after field pollination, using cryostored mango pollen, indicated successful cryopreservation protocol development.

DNA FINGERPRINTING

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 (finger millet, sorghum, pearl millet), 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). More than 2500 varieties in different crops were fingerprinted till December 2007. 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.

Genetic diversity analyses and DNA profiling was conducted in mungbean (145 accessions of core collection), rice landraces from southern India (45), cotton (41 parental lines), oats (35 landraces), Perilla, an oilseed crop of northeastern region (72 landraces) and wheat (112 released varieties) using STMS, ISSR and RAPD markers. The analyses helped in the estimation of available genetic diversity in the collections and also in generating DNA fingerprints of these indigenous cultivars.

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 strengthening various activities and infrastructure / facilities to achieve the targets.

- The scientists, research associates, technical and administrative staff from the headquarters and its regional stations/ centres participated in a number of seminars, symposia, conferences, workshops, trainings and summer institutes to exchange ideas and upgrade their skills. Five scientists were sent abroad to participate in foreign meetings. 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.
- NBPGR organised the following events
 - Brainstorming Session on “GM Chip Technology: Development and Applications” from 12 September 2007 at NBPGR, New Delhi
 - A one day workshop on “Finding out suitable sites for on-farm conservation of small millets and pseudocereals in Himachal Pradesh” on 14 November 2007 at NBPGR Regional Station, Shimla
 - A two-day training programme on “DNA fingerprinting and plant biodiversity conservation” from 16- 17 November 2007 at NBPGR, New Delhi
 - International training on ‘*In Vitro* and Cryopreservation Techniques for Conservation of Plant Genetic Resources’ from 15- 29 November 2007 at NBPGR, New Delhi
 - National Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops from 27 November – 4 December 2007 at NBPGR, New Delhi
- **Field days organized:** At Issapur Experimental Farm and IARI, New Delhi, four Germplasm Field Days for various crops (Rabi pulses, wheat, barley and triticale, maize and pearl millet, *khariif* pulses,

medicinal & aromatic plants and vegetables) were organized to promote germplasm utilization by the plant breeders/user scientists. A total of 6895 accessions of different crops were supplied to 121 indentors belonging to different institutes for their use in crops improvement programmes. The meetings of Germplasm Advisory Committees constituted for different crops/ crop groups were also organized. Field days were also conducted at Regional Stations, Hyderabad, Jodhpur and Thrissur for the benefit of breeders.

- **Patent Applications filed:** Two applications filed for processes enabling simultaneous detection of two transgenes- one using a multiplex polymerase chain reaction utilizing a combination of novel primers and polymerase chain reaction (PCR) programme in transgenic maize and the second multiplex polymerase chain reaction utilizing a

combination of novel primers and PCR programme in transgenic soybean.

- **Publications:** NBPGR Annual Report and quarterly Newsletter were published and distributed to all concerned with PGR management. Besides, research papers (104) on various subjects were published in national and international journals; book chapters (33) in various edited books; proceedings/ annual review/ books (8); plant germplasm reporter (1); crop catalogues (3); information bulletins/ brochures (4); advisory leaflets on plant quarantine pests (5); and popular articles in Hindi/ English (17) were published by the scientists of the NBPGR (details are given in chapter 19).
- **Germplasm Registered:** Fifty proposals belonging to 20 crops were approved for registration in the Plant Germplasm Registration Committee meeting.

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 Network 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

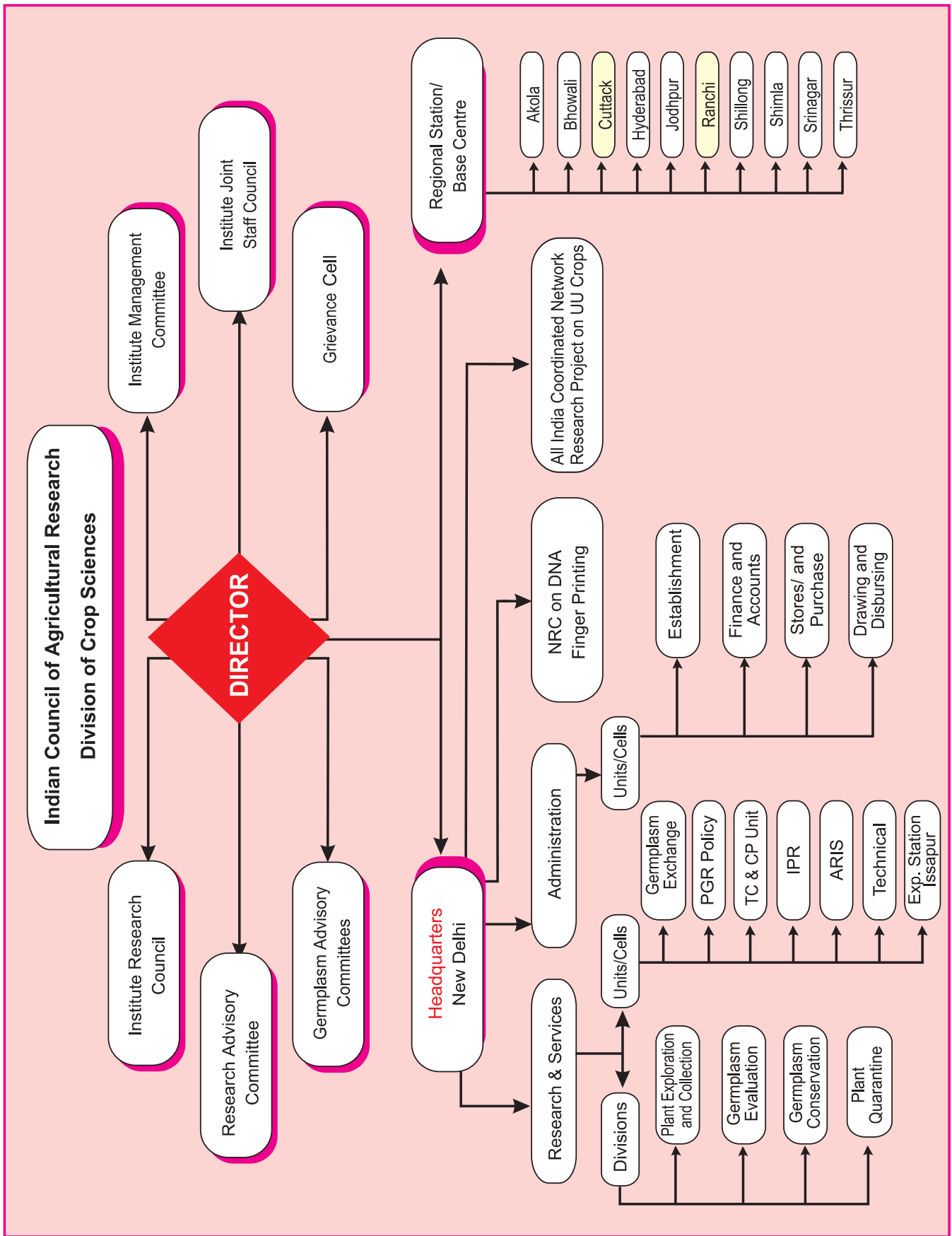
The Indian National Genebank was established by the council at NBPGR to conserve national heritage of germplasm collections in the form of seeds, vegetative

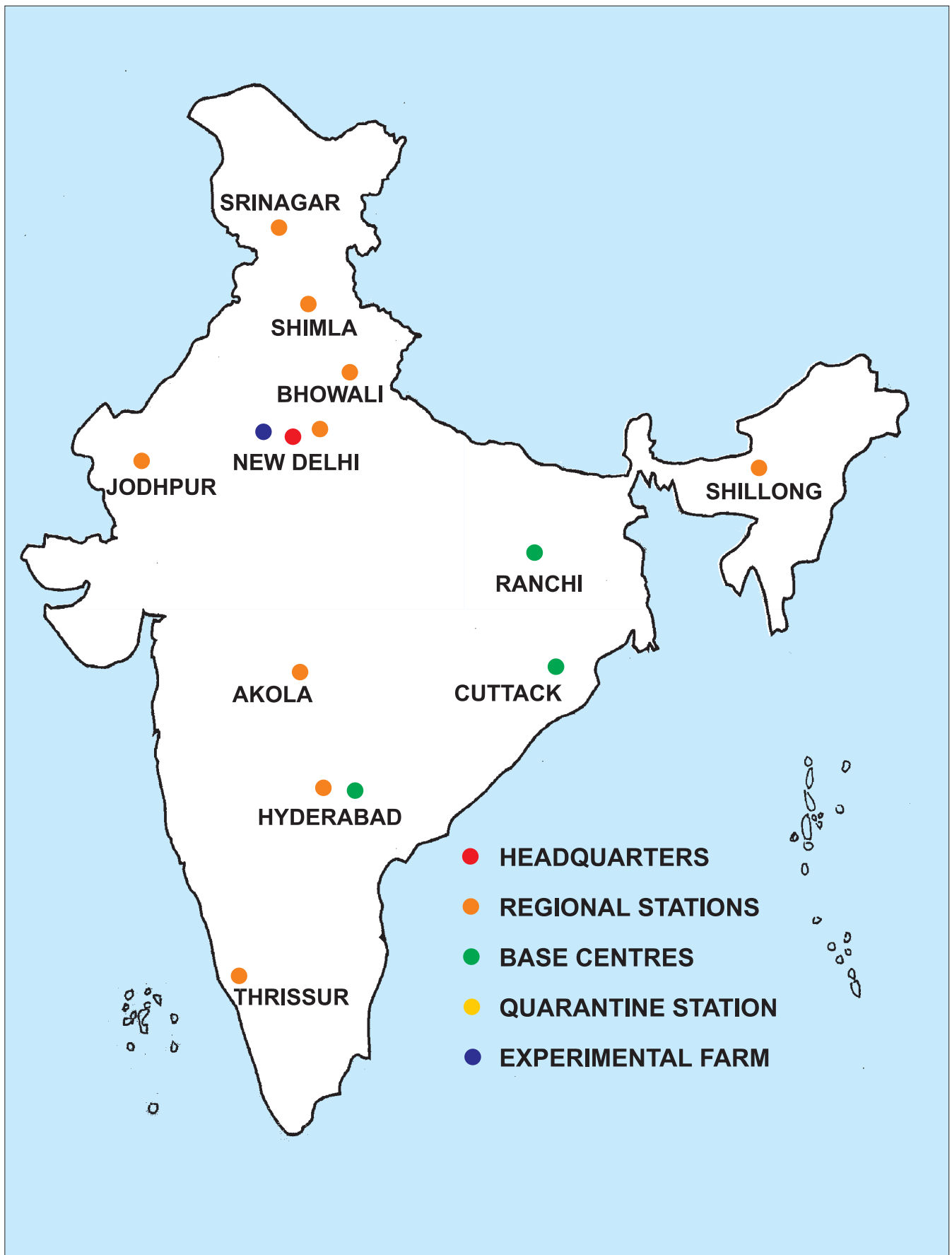
MANDATE

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.





propagules, tissue/cell cultures, embryos, gametes etc. Based on experiences gained from working with a built-in cold storage vault obtained from UK in 1983, four modules (two units of 100 m³ and two of 176 m³ capacity) were installed for long-term storage of seeds of orthodox species kept in laminated aluminium foils at -20°C after drying them to 5-7% moisture content. Stand-by diesel generator backs up the electricity supply. Vegetatively propagated clonal materials and recalcitrant seeds species are being maintained under field conditions backed up by tissue culture repositories. The Bureau has a strong programme on *in vitro* conservation and cryopreservation.

The 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 57 National Active Germplasm Sites responsible for different crops where germplasm collections are evaluated and multiplied under field conditions, backed by medium-term storage facilities. The Research Advisory Committee and Germplasm Advisory Committees for different crops advise the Bureau regarding improving the capability, efficiency and effectiveness of its services.

International Collaboration

NBPGR implements workplans developed under MoU between ICAR and IPGRI (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

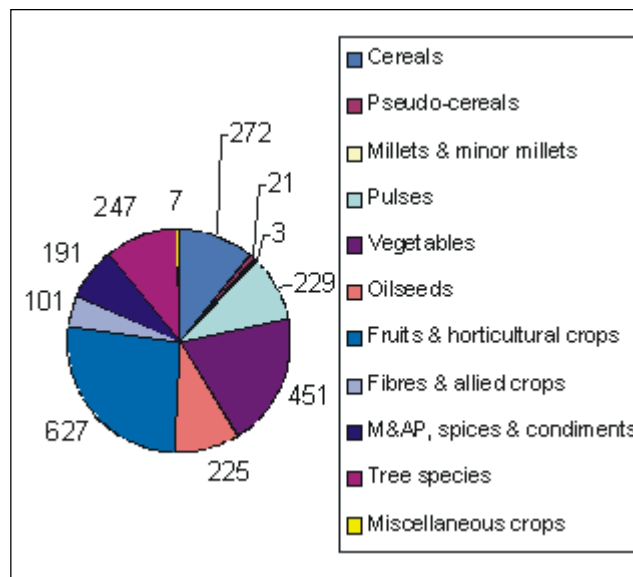
Summary: A total of 47 explorations were undertaken across the country and 2,369 accessions of various agri-horticultural crops, their wild relatives and other economic plants were collected. Of these, 468 accessions were collected by NBPGR Headquarters, New Delhi through nine explorations from parts of Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Punjab 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

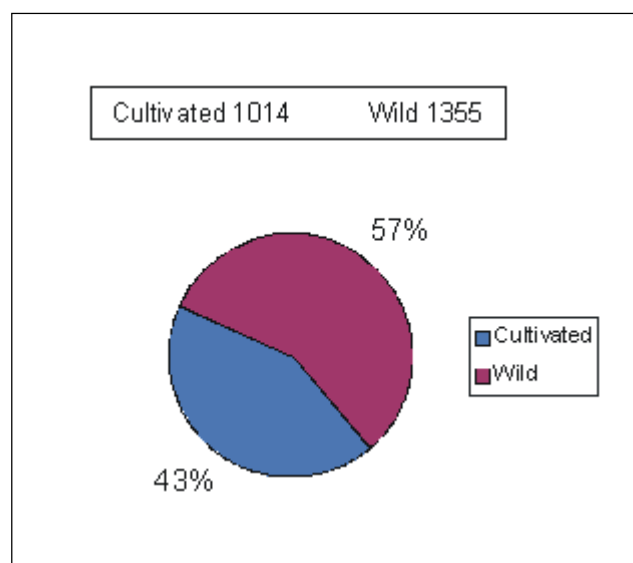
A total of 47 explorations were undertaken and 2,369 accessions of different agri-horticultural crops comprising 1,014 accessions of cultivated and 1,355 of wild species including wild relatives of crop plants were collected from parts of Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand and Uttar Pradesh.

Table 1: Explorations undertaken and germplasm collected during 2007

Region	Explorations undertaken	Accessions collected
Akola (Central Indian region)	2	258
Bhowali (Central Himalayan region)	3	170
Cuttack (Humid/ moist tropical east coastal region)	2	40
Hyderabad (South east coastal region)	8	436
Jodhpur (Arid region)	3	83
New Delhi (North west plains)	9	468
Ranchi (Sub-tropical humid region)	1	26
Shimla (North west Himalayas and high altitude region)	3	220
Shillong (North east hill region)	5	313
Thrissur (South west coastal region)	14	584



Germplasm collected in different crop groups



Germplasm (%) collected in cultivated and wild species

Table 2: Details of crop diversity collected during 2007

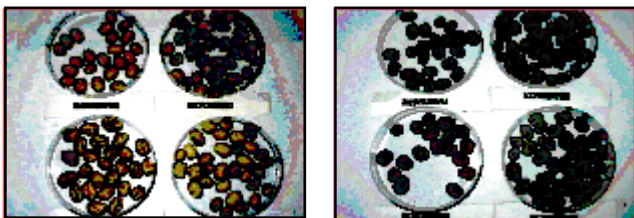
Crop group (s)	Crop(s)	Accessions
Cereals	Barley (18), maize (62), paddy (167) and wheat (25)	272
Pseudocereals	Amaranth (17) and buckwheat (4)	21
Millet and minor millets	Finger millet (2) and foxtail millet (1)	3
Pulses	Black gram (22), chickpea (2), cowpea (10), cluster bean (37), French bean (33), green gram (3), horse gram (3), jack bean (3), lentil (7), moth bean (8), pigeon pea (3), rice bean (25), wild <i>Vigna</i> (61) and others (12)	229
Vegetables	Bitter gourd (23), brinjal (5), chilli (7), coriander (10), cucumber (4), <i>Cucumis hardwickii</i> (6), <i>C. prophetarum</i> (1), <i>C. callosus</i> (1), <i>Dioscorea bulbifera</i> (1), elephant foot yam (2), greater yam (1), ivy gourd (75), jack fruit (3), jack bean (10), kachri (44), lablab bean (10), <i>Luffa echinata</i> (2), <i>Lycopersicon pimpinellifolium</i> (1), fenugreek (6), <i>Momordica dioica</i> (138), musk melon (21), okra (23), onion (5), pea (2), pumpkin (2), ridged gourd (1), runner bean (4), snake gourd (2), snap melon (20), <i>Solanum incanum</i> (10), <i>S. indicum</i> (2), <i>S. surattense</i> (2), and sponge gourd (7)	451
Oilseeds	<i>Brassica</i> spp. (15), <i>Jatropha curcas</i> (93), <i>Perilla frutescens</i> (7), safflower (6), sesame (96), soybean (4) and others (4)	225
Fruits/ horticultural crops	Apple (8), apricot (61), banana (13), bael (3), cherry (25), chironji (47), <i>Citrus grandis</i> (15), <i>C. pseudolimon</i> (6), <i>C. indica</i> (14), <i>C. medica</i> (3), <i>C. limmetta</i> (2), <i>C. aurantium</i> (7), <i>C. aurantifolia</i> (5), <i>C. jambhiri</i> (2), <i>C. sinensis</i> (1), <i>C. reticulata</i> (1), <i>C. limon</i> (5), custard apple (16), jack fruit (38), jamun (28), <i>Manilkara hexandra</i> (25), <i>Cordia myxa</i> (19), <i>Madhuca longifolia</i> (55), malabar tamarind (7), mango (4), peach (8), pear (3), pomegranate (21), rambutan (20), <i>Rosa longicuspis</i> (1), <i>R. roxburghii</i> (1), <i>Rosa</i> var. <i>omeiensis</i> (1) <i>R. sericea</i> (2), <i>R. webbiana</i> (8), <i>Rosa eglanteria</i> (1), <i>Rubus acuminata</i> (1), <i>R. alpestris</i> (1), <i>R. andersonii</i> (1), <i>R. assamensis</i> (1), <i>R. calycinus</i> (2), <i>R. hexagynus</i> (2), <i>R. lasiocarpus</i> (1), <i>R. lasiocarpus</i> var. <i>pauciflorus</i> (1), <i>R. macilentus</i> (1), <i>R. moluccanus</i> (3), <i>R. niveus</i> (1), <i>R. opulifolius</i> (1), <i>R. rosaefolius</i> (2), <i>R. rosaefolius</i> var. <i>rubrifolius</i> (1), <i>R. thomsonii</i> (1), <i>R. niveus</i> (1), <i>R. ellipticus</i> (1), strawberry (1), tamarind (7), walnut (28), wood apple (1) and other fruits (92)	627
Fibers and allied crops	<i>Agave</i> spp. (4), <i>Corchorus</i> spp. (12), Jews mallow (13), kenaf (4), <i>Sesbania</i> (6), sisal (1), sunnhemp (27) and others (34)	101
Medicinal and aromatic plants, spices and condiments	<i>Abrus precatorius</i> (2), <i>Acorus calamus</i> (4), <i>Adhatoda zeylanica</i> (1), <i>Agave americana</i> (1), <i>Ailanthus malabarica</i> (1), <i>Aloe barbadensis</i> (3), <i>Alpinia galanga</i> (4), <i>A. purpurata</i> (1), <i>A. variegata</i> (1), <i>Andrographis paniculata</i> (2), <i>Apama siliquosa</i> (1), <i>Aristolochia indica</i> (1), arrowroot (2), <i>Asparagus racemosus</i> (6), <i>Barleria alba</i> (2), <i>B. cristata</i> (10), <i>B. longiflora</i> (1), <i>B. grandiflora</i> (1), <i>Barringtonia acutangula</i> (1), <i>Berberis asiatica</i> (1), <i>B. lycium</i> (1), <i>Bixa orellana</i> (1), <i>Cassia auriculata</i> (1), <i>Chlorophytum borivilianum</i> (2), <i>C. tuberosum</i> (1), <i>Clerodendron paniculatum</i> (1), <i>C. viscosum</i> (1), <i>Clitoria ternatea</i> (1), <i>Commiphora wightii</i> (1), <i>Costus speciosus</i> (5), <i>Crossandra infundibuliformis</i> (1), <i>Curcuma manga</i> (2), <i>Dactylorhiza hatagirea</i> (1), <i>Dioscorea deltoidea</i> (1), <i>Dioscorea bulbifera</i> (1), <i>Garcinia indica</i> (18), <i>G. xanthochymus</i> (3), <i>G. cowa</i> (2), <i>G. mangostana</i> (7), <i>G. hombroniana</i> (1), garlic (1), ginger (2), <i>Gymnema sylvestre</i> (1), <i>Hedychium coronarium</i> (4), <i>Hedychium spicatum</i> (1), <i>Heliconia p sittacorum</i> (2), <i>Melastoma malabathricum</i> (1), <i>Moullava spicata</i> (1), <i>Mucuna pruriens</i> (33), neem (5), <i>Ocimum kilimandscharicum</i> (1), <i>Phyllanthus emblica</i> (1), <i>Plumbago zeylanica</i> (1), <i>Podophyllum hexandrum</i> (1), <i>Polygonatum multiflorum</i> (1), <i>Rauvolfia serpentina</i> (4), <i>Rheum emodi</i> (1), <i>Rubia cordifolia</i> (1), <i>Saraca indica</i> (1), <i>Saussurea costus</i> (2), <i>Sida rhombifolia</i> (1), <i>Strychnos nux-vomica</i> (4), <i>Swertia chirayita</i> (4), <i>Tephrosia purpurea</i> (2), <i>Thunbergia grandiflora</i> (1), <i>Urgenia indica</i> (7), <i>Valeriana jatamansi</i> (2), <i>Vetiveria zizanioides</i> (1), <i>Withania somnifera</i> (1)	191
Tree species	<i>Acacia jacquemontii</i> (2), <i>Cassia alata</i> (2), <i>Cassia siamea</i> (6), <i>Moringa oleifera</i> (16), <i>Pongamia pinnata</i> (199), <i>Salvadora persica</i> (3) and others (19)	247
Miscellaneous crops	<i>Thunbergia coccinea</i> (1), <i>Erythrina indica</i> (4), <i>Saccharum officinarum</i> (1)	6
Total		2369

1.2 Explorations undertaken by the Headquarters

Nine explorations were undertaken in parts of Chhattisgarh, Gujarat, Goa, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Punjab and Uttar Pradesh and a total of 468 accessions of different agri-horticultural crops were assembled. The details of areas explored and germplasm collected during explorations are given below:

1.2.1 Exploration for *Jatropha curcas* in Maharashtra, Karnataka and Goa: Under the New Millennium Indian Technology Leadership Initiative (NMITLI) Project on Genetic Improvement of *Jatropha curcas* for Adaptability and Oil Yield, cuttings from 11 previously identified accessions of *J. curcas* were collected from three states namely Maharashtra (Wasim, Hingoli, Osmanabad, Pune, Aurangabad, Jalna), Karnataka (Belgaum) and Goa (Tiswali, Perenem).

1.2.2 Collection of medicinal and aromatic plants from Chhattisgarh: An exploration was undertaken for the collection of medicinal and aromatic plants in different districts of Chhattisgarh (Durg, Kanker, Bastar, Dantewada) in collaboration with NBPGR Regional Station, Ranchi. Forty-two accessions comprising *Mucuna pruriens* (17), *Asparagus racemosus* (5), *Urgenia indica* (6), *Rauvolfia serpentina* (3), *Andrographis paniculata* (2), *Curcuma angustifolia* (2), *Abelmoschus moschatus* (1), *Abrus precatorius* (1), *Bixa orellana* (1), *Chlorophytum tuberosum* (1), *Costus speciosus* (1), *Gymnema sylvestre* (1) and *Vetiveria zizanioides* (1) were collected.



Seed variability in *Mucuna pruriens* collected from Chhattisgarh

1.2.3 Exploration for minor fruits in parts of Gujarat and adjoining Madhya Pradesh:

An exploration was undertaken for collection of



Manilkara hexandra (Khirni) -a minor fruit from MP

diversity in various minor fruits in parts of Gujarat and adjoining Madhya Pradesh. A total of 54 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 Vadodara, Bharuch, Dahod, Godhra districts of Gujarat and Dhar and Neemach districts of Madhya Pradesh.

1.2.4 Exploration for minor fruits in parts of Madhya Pradesh: Thirty-nine accessions comprising *Buchanania lanzan* (37), *Tamarindus indica* (1) and



Buchanania lanzan (Chironji)-a minor fruit from MP

Diospyros melanoxylon (1) were collected from different districts (Bhopal, Vidhisa, Raisen, Sehore, Seoni, Chhindwara, Hosangabad and Narsingpur) of Madhya Pradesh.

1.2.5 Exploration for minor fruits in parts of Himachal Pradesh: Collection of minor fruits was done (75) in parts of Himachal Pradesh. These included *Berberis asiatica* (1), *Citrus jambhiri* (1), *Cordia myxa* (5) and *C. crenata* (1), *Ficus palmata* (1), *Prunus armeniaca* (60), *P. persica* (3), *Pyrus pashia* (1), *Rubus niveus* (1), *R. ellipticus* (1) collected from Kullu, Mandi, Kangra and Chamba districts of Himachal Pradesh.

1.2.6 Exploration for minor fruits in parts of Meghalaya: Exploration was undertaken for fruits crops in parts of Meghalaya and 62 accessions comprising *Citrus grandis* (15), *C. pseudolimon* (6), *C. indica* (14), *C. medica* (3), *C. limetta* (2), *C. aurantium* (7), *C. aurantifolia* (4), *C. jambhiri* (1), *C. sinensis* (1), *C. reticulata* (1), *C. limon* (1), *Tamarindus indica* (1) and others (5) were collected in East, West and South Garo hills of Meghalaya.

1.2.7 Exploration for vegetable crops in parts of

Haryana and Punjab; Collection of diversity in vegetable crops (73 accessions) comprising *Abelmoschus esculentus* (14), *A. tetraphyllus* var. *pungens* (1), *Momordica charantia* var. *muricata* (13), *Cucumis callosus* (42) and *C. sativus* (3) was collected from Nawashahar, Hoshiarpur, Pathankot, Taran Tarn, Muktsar and Fazilka districts of Punjab and Sonipat, Sirsa, Hisar, Bhiwani, Mahendergarh and Rewari districts of Haryana.

1.2.8 Exploration for vegetable crops in parts of

Goa and Karnataka: Diversity in horticultural crops (38 accessions) comprising *Barleria cristata* (10), *Heliconia psittacorum* (2), *Alpinia variegata* (3), *Thunbergia grandiflora* (1), *Moullava spicata* (1), *Costus speciosus* (1), *Barleria longiflora* (1), *Crossandra infundibuliformis* (1), *Barleria grandiflora* (1), *Blumea* sp. (1), *Melastoma malabathricum* (1), *Barleria alba* (1), *Clerodendron paniculatum* (1), *C. viscosum* (1), *Barrigtonia acutangula* (1), *Apama siliquasa* (1), *Saraca indica* (1), *Alpinia galanga* (1), *A. purpurata* (1), *Plumbago zeylanica* (1), *Ailanthus malabarica* (1), *Sida rhombifolia* (1), *Mucuna pruriens* (2) and *Cucumis hardwickii* (2) were collected from North Goa and Kannada, Shimoga, Chikmagalur and south Kannada.



Amherstia nobilis- an ornamental tree from Ghats



Lobelia nicotiniifolia from Bhimoga, Western Karnataka used locally as tobacco

1.2.9 Exploration for fibre crops in parts of Uttar

Pradesh and Madhya Pradesh: Exploration was undertaken for collection of fruits crops in parts of UP and MP and 74 accessions comprising *Crotalaria juncea* (24), *Corchorus olitorius* (13), *C. aestuens* (9), *Hibiscus cannabinus* (4), *Agave americana* (1), *A. miradurensis* (1), *A. sisalana* (1), *Corchorus tridens* (1), *C. pseudo-olitorius* (1), *C. trilocularis* (1), *Abelmoschus tetraphyllus* (2), *A. pungens* (2), *Luffa echinata* (2), *Cucumis callosus* (1), *Aloe barbadensis* (2), *Chlorophytum borivilianum* (1), *Asparagus racemosus* (1), *Urgenia indica* (1), *Lawsonia inermis*

(1), *Diplocyclos palmatus* (1), *Ocimum kilimandscharicum* (1), *Tricholepsis glaberrima* (1), *Jatropha curcas* (1) and *J. gossypifolia* (1) were collected from Mathura, Agra, Jhansi, Mahoba, Hamirpur districts of UP and Datia, Tikamgarh, Sagar, Chhatarpur districts of MP.



Sunnhemp collection from Bundelkhand region

1.3 National Herbarium of Cultivated Plants (NHCP)

A total of 636 herbarium specimens, 218 seed samples and 31 economic products were processed and added to the existing collection of 19,479 herbarium specimens, 2,699 seed samples and 527 economic products during the period under report. These included a total of 106 taxa, which were not earlier represented in the NHCP. Specimens were added from Delhi (136), Kerala (50), Karnataka (20), Tamil Nadu (3), Madhya Pradesh (11), Uttar Pradesh (3), Gujarat (6) and Himachal Pradesh (3). Herbarium specimens were received from regional stations at Bhowali (21) which included exotic species of *Vicia* and *Glycine*, Hyderabad (88) including variability in *Solanum melongena*, *Setaria italica* and wild species of *Arachis* and *Lycopersicon*; Shimla (201) including *Allium consanguineum*, *A. humile*, *A. jacquemontii*, *A. chinense*, *Prunus nepalensis*, *P. cornuta*, *Rubus niveus*, *R. ellipticus*, *Naringi crenulata*, *Cajanus mollis*, *C. scarabaeoides*, *Sorbaria tomentosa*, *Artemisia biennis*, *A. macrocephala* and *Crataegus songaricus*; these also were processed and added to the NHCP. Variability in collections of *Linum usitatissimum* from Delhi and vouchers of *Eragrostis* sp. were represented from Andhra Pradesh, Kerala, Karnataka, Goa, Maharashtra and Uttar Pradesh.

Seed samples added included variability in castor from Manipur (118), Delhi (11), Uttarakhand (17), Madhya Pradesh and Uttar Pradesh (26) and several species from Kerala, Tamil Nadu, Andaman and Nicobar, Arunachal Pradesh and Jammu and Kashmir. Economic products added included fruits of *Gymnocladus*

assamicus, *Momordica subangulata*, *Diospyros lotus* and *Tamarindus indica* from Arunachal Pradesh, *Musa balbisiana*, *Balanites aegyptiaca* and *Diospyros cordifolia* from Delhi and *Cyclanthera pedata* from Uttarakhand.

Information/ identification services (47) were provided and authentication certificates (10) issued to students and researchers from different institutions and universities including Delhi Institute of Pharmaceutical Sciences And Research (DIPSAR), Indian Agricultural

Research Institute (IARI) and All India Institute of Medical Sciences (AIIMS), Delhi; Department of Pharmaceutical Technology, Meerut Institute of Engineering and Technology (MIET) at Meerut. Training on herbarium methods and procedures was organized for students of Garhwal University, Uttarakhand, College of Agriculture, Kolhapur, Maharashtra, Daulat Ram College, Delhi University and National Institute of Science Communication and Information Research (NISCAIR), New Delhi.

Table 3: Some important taxa added to NHCP

Botanical Name	Family	Common Name	State
<i>Diospyros cordifolia</i> Roxb.	Ebenaceae	Mountain persimon	Delhi
<i>D. lotus</i> L.	Ebenaceae	Dateplum persimmon	HP
<i>Gentiana kurroo</i> Royle	Gentianaceae	*Kutki	HP
<i>Hibiscus mutabilis</i> L.	Malvaceae	Chinese rose	Delhi
<i>Ipomoea alba</i> L.	Convolvulaceae	*Dudhiakalmi	HP
<i>Melilotus officinalis</i> Lam.	Fabaceae	Yellow sweetclover	HP
<i>Milletia auriculata</i> Baker	Fabaceae	* Gauj, gonj	HP
<i>Nerium indicum</i> Mill.	Apocynaceae	Indian oleander	Delhi
<i>Nymphaea nouchali</i> Burm.f.	Nymphaeaceae	Indian red waterlily	Delhi
<i>Osbeckia cupularis</i> D. Don	Melastomataceae	*Cherkualathi	Karnataka
<i>Ougeinea oojeinensis</i> (Roxb.) Hochr.	Fabaceae	Sandan	HP
<i>Papaver orientale</i> L.	Papaveraceae	Oriental poppy	HP
<i>Quercus glauca</i> Thunb.	Fagaceae	Blue Japanese	HP
<i>Salvadora oleoides</i> Decne	Salvadoraceae	*Pilu	Rajasthan
<i>Sauropus androgynus</i> Merrill	Euphorbiaceae	Star gooseberry	Kerala
<i>Suaeda fruticosa</i> (L.) Forsk.	Chenopodiaceae	Seablite	Delhi
<i>Tragopogon pratensis</i> L.	Asteraceae	Buck-Beard/Yellow salsify	HP
<i>Tricholepis glaberrima</i> DC.	Asteraceae	*Brahmadandi	UP
<i>Viburnum grandiflorum</i> Wall. ex DC.	Caprifoliaceae	*Telam	HP
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	* Ban-ber	HP

*Local names

1.4 Augmentation, conservation and documentation of diversity in wild/ weedy relatives of crop plants occurring in Western Himalayas

A total of 268 accessions (24 families, 57 genera, 97 species) of different wild relatives were assembled/augmented from Western Himalaya. Significant diversity was represented from parts of Lahaul and Spiti, Shimla,

Kinnaur (Himachal Pradesh), Baramulla, Leh, Kargil (Jammu and Kashmir) and Nainital, Almora, Pithoragarh, Champawat, Lohaghat, Chamoli, Rudrayaprayag, Haridwar (Uttarakhand). Important taxa augmented belonged to *Allium*, *Abelmoschus*, *Alysicarpus*, *Amaranthus*, *Cajanus*, *Crotalaria*, *Cucumis*, *Eleusine*, *Fagopyrum*, *Nicotiana*, *Perilla*, *Prunus*, *Rosa* and *Solanum*; *Eleusine indica*, wild species with high crossability with cultivated finger millet, *Perilla*

frutescens (semi-domesticated and weedy forms of *Fagopyrum cymosum*, (wild relative of buckwheat were added among the significant species. Foothill region for *Perilla*, *Cucumis* and *Abelmoschus*, for *Allium*, *Linum*,

Cicer and mid hills for *Eleusine* and *Fagopyrum* high hills were identified for future collection and further systematic work.



Eleusine indica- weedy type from North-west Himalayan region



Chenopodium foliosum -wild type from North-west Himalayan region

Research Programme (Programme Code: Title, PI and Co-PIs)

PGR/PGC-BUR-01.00: Exploration for collection of germplasm of agri-horticultural crops, maintenance of herbarium and biosystematics and ethno-botanical studies (E.R. Nayar)

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

PGR/PGC-BUR-01.01: Exploration for collection of genetic resources of agricultural crops and their wild relatives. (K.C. Bhatt, R. Srivastava, Anjula Pandey, Rajbir Singh and N.S. Panwar)

PGR/PGC-BUR-01.02: Exploration for collection of genetic resources of horticultural crops and their wild relatives (R. Srivastava, S.K. Malik, E.R. Nayar, Gunjeet Kumar and A.K. Singh).

PGR/PGC-BUR-01.03: Exploration for collection of medicinal and aromatic plants diversity from different phyto-geographical regions (K.C. Bhatt, R. Srivastava, N.S. Panwar and Rakesh Singh).

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, K.C. Bhatt, K.S. Negi, J.C. Rana and J. Radhamani).

Externally funded projects

New Millennium Indian Technology Leadership Initiative (NMITL) project on Genetic improvement of *Jatropha curcas* for adaptability and oil yield (S.K. Sharma, K.C. Bhatt, J.B. Tomar and K.V. Bhat).

2. DIVISION OF GERmplasm EVALUATION

Summary: A total of 8,161 accessions of various agri-horticultural crops comprising cereals (2,002), millets & forages (300), pulses (2,535), oilseeds (1,248), vegetables (1,504), underutilized crops (476), medicinal and aromatic plants (96) were grown for characterization and evaluation. Besides, 2,435 accessions of various crops viz., cereals (1,287), oilseeds (479), vegetables (550), medicinal and aromatic plants (119) were grown for regeneration, multiplication and maintenance. In addition, 5,202 accessions of international nurseries comprising of wheat, Barley and triticale were also grown in Post Entry Quarantine Nursery (PEQN). In addition, 130 accessions of perennial fruit plants were also maintained in field genebank. Promising accessions for various agro-morphological characters have been identified. The germplasm of oilseeds namely, rapeseed mustard (628), sunflower (387), linseed (76), perilla (16) and soybean (16) was analysed for oil content and quality parameters. Similarly the germplasm of pulses namely chickpea (464), cowpea (159) and French bean (118) was analyzed for protein content. In addition 306 accessions of turmeric were also analysed for quality parameters. In phytochemical evaluation, 293 samples of medicinal and aromatic plants were analyzed and evaluated for their active compounds. Multi-location evaluation of 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 also undertaken for specific traits involving AICRP/ ICAR/ SAUs. Four Germplasm Field Days for various crops (Rabi pulses, wheat, barley and triticale, maize and pearl millet, Kharif pulses, medicinal & aromatic plants and vegetables) were organized to promote germplasm utilization by the plant breeders/user scientists. A total of 6,895 accessions of different crops were supplied to 121 indentors belonging to different institutes for their use in crops improvement programmes. The meetings of Germplasm Advisory Committee constituted for different crops/crop groups were also organized.

2.1 Germplasm Evaluation

2.1.1 Characterization and preliminary evaluation for agro-morphological traits:

A total of 8,161 accessions of various agri-horticultural crops comprising cereals (2,002): wheat (1,093), barley (593), maize (406); millets & forages (300): pearl millet (230) and oat (70); pulses (2,535): cowpea (502), urdbean (564), pea (583) and lentil (886); oilseeds (1,248): rapeseed-mustard (875), safflower (247), sunflower (45), linseed (84); vegetables (1,504): brinjal (250), tomato (268), bottle gourd (110), ridge gourd (42), sponge gourd (38), onion (118), garlic (678); underutilized crops (476): fababean (148), rice bean (214), amaranth (114) and medicinal and aromatic plants (96): aloe (30), mucuna (14), kalmegh (22) and basil (30) were grown for characterization and evaluation. Besides, a total of 2,435 accessions of various crops, viz., cereals (1,287), oilseeds (479), medicinal and aromatic plants (119) and vegetables (550) were grown

for regeneration and maintenance and 5,202 accessions of wheat (3,842), barley (1,185) and triticale (175) belonging to international nurseries were also grown in Post Entry Quarantine Nursery (PEQN). In addition, 130 accessions of fruit crops 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) and 353 accessions of medicinal and aromatic plants comprising vetiver (131), palmarosa (55), giloe (25), aloe (80), asparagus (22) and other M&AP (40) were also maintained in the field gene bank.

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 1).

Table 1: Promising germplasm accessions in different crops for different traits

Crop	Promising traits	Accession no.
Cereals		
Maize	Early maturing types (<80) days	IC339677, IC339681, IC339685, IC339687, IC3359697
	Late maturing types (>100) days	IC3699826, IC538749, IC345996, IC548610
	Dwarf types (<80 cm)	IC547811, IC547816, IC344596, EC5996647, EC596653, EC596654, EC596659, EC596660, EC596661
Pulse and legumes		
Pea	Days to 50% flowering (<70)	EC564809, EC564811
	First blossom node (\leq 8.4)	EC538006
	Primary branches (\geq 6)	EC564804, IC544574

	Plant height (<45cm)	EC538006, EC564805
	Pods/cluster (≥ 2)	EC564803
	Pod length (>14 cm)	EC564815, EC538003
	Pods/plant (>70)	IC 520830, IC 520831
	Seeds/pod (≥ 5.6)	EC564803, EC538007
	Days to 80% maturity (≤ 128)	EC564806, IC544575
	100-seed weight (>20 g)	EC538010, EC538009
	Yield/plant (191.46g)	IC447782
Lentil	Early flowering (≤ 77 days)	IC560110, IC560111, IC560117, IC560138
	High no. of pods (≥ 122)	IC559699, IC559702, IC559704, IC559716, IC 559718
	High yielding (≥ 18 g)	IC559716, IC559718, IC559780, IC559790, IC201698
	Tall with high biomass	IC559877, IC559895, IC 959938, IC559613, IC559668
Oilseeds		
Indian mustard	Early maturity (<125 days)	IC491320, IC491508, IC491637
	Dwarf habit (<80.0 cm)	IC491373, IC255439
	Long siliqua (>4.2 cm)	IC491536, IC491278, IC491472, IC491483, IC491474, IC491204, IC491013,
	Bold seeded (>4.5g/1000 seed wt)	IC491429, IC491293, IC491360, IC491015, IC491113
	Vegetable type (soft, non hairy, broad leaves, very late flowering)	IC255462, IC255498, EC573027
Sunflower	Bold seeded (>8.0g/100 seed wt.)	EC512749, EC512698, EC494393, EC512770, EC512740, EC512692
	Broad head diameter (>16.0cm)	EC512687, EC512690, EC512743
	High seed yielding (>50g seed wt./head)	EC512688, EC512795, EC559588, EC512690, EC512687
Vegetable crops		
Tomato	No. of primary branches (>10)	EC521045, EC521086
	Days to 50 % flowering (<99 days)	EC521068, EC521078
	No. of fruits/ cluster (>6)	EC52265, EC114375
	No. of fruits/plant (>135)	EC25265, EC339066
	Fruit weight (>30 g)	EC32933, EC9046
Brinjal	Plant spread (>86 cm)	IC398153, IC90965
	Fruit weight (>225 g)	IC249300
	Big, green round fruit(>450 g)	IC350885
	Big, green oblong fruit (>550 g)	IC350886
Bottlegourd	Node no. at which first female flower appears (<11)	IC284928, IC244758, IC331088
	No. of fruits/plant (>14)	IC418458, IC276528, IC395821
Spongegourd	Node no. at which first female flower appears (<11)	IC284844, IC398578, IC284767
	Fruits length (>36 cm)	IC411904, IC264897, IC411891
Ridgegourd	Node no. at which first female flower appears	IC427676, IC424548, IC418476
	Fruits length (>20 cm)	IC427163, IC427131
Onion	Bulb weight (>90 g)	IC375128, IC373087
	Bulb diameter (> 5.5 cm)	IC373101, IC315128
	Bulb length (>7 cm)	IC373104, IC373113
Garlic	No. of cloves/ plant (>20)	IC48634, IC32286
	Clover length (> 2.5 cm)	IC49382, IC375110
	Clover width (>10 cm)	IC49381, IC375081

	Bulb weight (>15 g)	IC49382, IC48157
Underutilized Crops		
Amaranth	Plant height (>150cm)	IC386984
	Days to 50% flowering (<60)	IC21941, IC333241
	Days to maturity (<150)	IC396955, IC396956, IC38127
	Leaf length (>15 cm)	IC386984, IC324011
	Panicle length (>60 cm)	IC423448, IC423460
	Seed yield (>7.0 q/ha)	EC519544, IC325877, IC333241, IC396973
	100 ml seed weight (>9.0 g)	IC469676, IC423117
	Dry matter yield (>15.0 q/ha)	IC386984
Fababean	Plant height (>90 cm)	EC34710, EC243808, EC108908
	Branches / plant (> 9)	EC10845, EC243709, EC117741
	Days to 50% flowering (<55)	EC329724
	Flowers / cluster (4.0)	IC332138
	Pods / cluster (3.0)	IC332138, IC417884
	Pods / plant (>110)	EC354951, EC10845, EC329707
	Pod length (>78.5 cm)	EC556903, EC556902, IC417842, IC322949
	Seeds / pod (4.0)	EC117361, EC117748, EC299713, EC32790, EC329713, EC329725, EC399712, EC556903, IC332101, IC417842, IC417884
	100 seed weight (>50 g)	EC556902, IC417842, IC322949
	Days to maturity (<100)	EC25192, EC117705, EC329662
	Seed yield (> 50 q/ha)	EC329672, EC329668
Dry matter yield (> 300 q/ha)	IC361496, IC38498, IC361499	
Medicinal and Aromatic Plants		
Aloe	Leaf length (> 55 cm)	IC112514, IC1125142, IC111271, IC111269
	Leaf width (8.5 cm)	IC112514, IC112512, IC111269
	Leaf thickness (>2.0 cm)	IC112512, IC112526, IC111271
	Plant weight (> 3 kg)	IC112511, IC112534, IC112512, IC112513, IC111267
Basil	Plant height (>45 cm)	EC388895, IC26771, EC338785
	Herbage yield (FWB)	EC388869, IC333232, IC326271
	Inflorescence length (>35 cm)	EC388895, EC338785, IC369247
Kalmegh	Plant height (>45 cm)	IC471919, IC399612
	Herbage yield (FWB)	IC342635, IC471919, IC210365
	Herbage yield (DWB)	IC399612

2.1.2 Germplasm enhancement in sesame: Crossed progenies (F_3) of superior enhanced germplasm and the trait specific exotic accession with non-shattering habit and white seed colour were grown for evaluation and further progeny advancement.

2.1.3 Core Set Development in Brinjal: A total of 1,608 accessions including indigenous (1,428) and exotic (180) were evaluated for 34 descriptors. Pooled SDI for each group was calculated and 10% sample size was fixed to develop separate core sets for indigenous and exotic accessions. The indigenous accessions were grouped zone-wise and accessions were selected using principal component score strategy (PCSS) covering 95 % diversity and a core set of 181 accessions (151

indigenous, 30 exotic) was developed.

2.2 Biochemical evaluation of field crops

2.2.1 Oil content in oilseeds: In oilseeds 628 germplasm collections of rapeseed and mustard comprising Indian mustard (*B. juncea*), yellow sarson (*B. rapa* var. yellow sarson), toria (*B. rapa* ssp. toria), rapeseed (*B. rapa*), kali sarson (*B. napus*), taramira (*Eruca sativa*), *S. alba*, *B. tournefortii*, *Lepidium* spp. were analyzed for total oil content. Besides, samples of sunflower, linseed, perilla and black soyabean were also analysed for total oil content. Range of variation and mean values of oil percentage are given in table 2.

Table 2: Range and mean value of oil content in oilseeds

Oilseed crop (accessions)	Range (%)	Mean (%)	Promising accessions (% oil content)
Indian mustard (395)	23.13-40.63	35.89	IC343120, IC538778 (>40%),
Yellow sarson (104)	32.46-45.63	40.96	IC385669, IC334283, IC334292 (>45 %)
Toria (70)	36.81-44.74	41.06	IC424412 (>44 %)
Kali sarson (30)	23.48-40.18	32.01	EC564729 (>40 %)
Rapeseed (22)	33.40-40.93	36.20	IC420752 (40 %)
Taramira (12)	23.13-33.63	30.57	EC400096 (>33%)
<i>S.alba</i> (1)	31.56 -	-	
<i>B.tournefortii</i> (1)	27.46 -	-	
<i>Lepidium</i> spp. (3)	19.97-26.38	22.27	IC447921 (>26 %).
Sunflower (387)	20.49-49.13	39.57	EC512684, EC512726, EC512765, EC512682 (>47 %)
Linseed (76)	38.20-45.80	42.11	IC345460, IC512460, IC345457 (>45 %)
Perilla (50)	30.10-51.66	45.44	IC419706, IC419477 (>50 %)
Soybean (16)	16.20-21.45	18.65	-
Mahua (27)	44.43-58.85	53.95	- -

2.2.2 Fatty acid profile in oilseeds: A total of 50 accessions of *perilla*, 16 of black seeded soybean and 27 of Mahua (*Madhuca longifolia*) were analysed for quality parameters and fatty acid profile (Table 3). In perilla accessions IC374543 (9.33%), IC419475 (9.21%) for palmitic acid, IC369352 (8.34%) for stearic acid and IC374494 (66.06%), IC521284 (63.70%), IC374609 (63.69%) for linolenic acid were found promising.

Table 3: Fatty acid profile in some crops

Plant	Fatty acid	Range (%)	Mean (%)
Perilla	Palmitic acid	6.42-9.33	7.32
	Stearic acid	0.71-8.34	2.50
	Oleic acid	7.57-13.89	10.54
	Linoleic acid	13.38-28.02	19.71
	Linolenic acid	53.78-66.06	59.89
Black seeded soybean	Palmitic acid (%)	8.17-10.78	9.64
	Stearic acid (%)	2.24-5.23	3.96
	Oleic acid (%)	16.23-25.95	19.61
	Linoleic acid (%)	51.89-60.52	56.52
	Linolenic acid (%)	7.66-14.70	10.33
Mahua	Palmitic acid	16.09 - 25.86	19.57
	Stearic acid	19.11 - 32.16	23.66
	Oleic acid	32.91 - 46.72	40.82
	Linoleic acid	9.36 - 15.24	12.06

2.2.3 Protein content in field crops: A total of 741 accessions of pulse crops comprising chickpea (464), cowpea (159) and French bean; 50 accessions of perilla and 16 of black seeded soybean were studied for total protein content. The range of variation, mean value and promising accessions are given in Table 4.

Table 4: Protein content (%) in some field crops

Crop	Mean (%)	Range (%)	Promising accessions
Chickpea	21.34	17.21-27.02	ICC-10948 (>27%)
Cowpea	23.17	20.4 - 27.18	EC226899B-2, IC391507 (>26 %)
French bean	21.51	15.60-25.62	EC43564, EC762067 (>25 %)
Perilla	18.59	15.27-22.83	IC003908 (>22 %)
Black seeded soybean	40.80	38.69-43.15	-

2.2.4 Estimation of total curcuminoid in turmeric: A total of 306 accessions of turmeric were processed for the estimation of individual curcuminoids *i.e.* bisdemethoxycurcumin, demethoxycurcumin, curcumin and total curcuminoids. The mean values (%) for

bisdemethoxycurcumin, demethoxycurcumin, curcumin and total curcuminoids were found to be 0.317, 0.469, 2.315 and 3.101 respectively. Some of the promising lines (>6% total curcuminoids) are IC265562, IC273572, IC310576, IC312710, IC315689, IC088600, IC088643, IC310575, IC310575 A, IC313542, IC137107, IC360168 and IC360171.

2.2.5 Calibration equations for non-destructive analysis of turmeric (Ground rhizomes) samples for individual curcuminoids: Based on absorption of NIR region of wave length (1100-2500nm) by turmeric rhizomes, three equations were developed with HPLC (High Performance Liquid Chromatography) analysis data of 95 accessions of turmeric. Modified

Partial Least Square Regression procedures were followed. First derivative equations with gap of 4 and smooth and second smooth of 4 and 1 respectively were used.

2.3 Phytochemical Evaluation of Medicinal and Aromatic Plants

A total of 293 samples of various aromatic (167) and medicinal plants (126) were analysed for their active compounds. Details of crops and range of active components alongwith promising accessions are presented in Table 5. Essential oil of twenty samples of various aromatic plants were analysed for their physico-chemical properties (Table 6).

Table 5: Active component in different medicinal and aromatic plants

Plant (Botanical name)	No. of samples analysed	Plant part	Active compound	Range %	Promising accessions
Basil (<i>Ocimum basilicum</i>)	150	Herbage	Essential Oil	0.06-0.25 (FWB)	IC381552 (0.24%) IC466168 (0.22%) IC112548 (0.21%)
Palmarosa (<i>Cymbopogon martinii</i>)	14	Herbage	Essential oil	0.30-0.87 (FWB)	IW4485 (0.87%) IW4490 (0.70%)
Lemon grass (<i>Cymbopogon flexuosus</i>)	3	Herbage	Essential oil	0.47-0.54 (FWB)	-
Ghrit kumari (<i>Aloe barbadensis</i>)	42	Leaf	Aloe gel	0.94-2.07	-
Satavar (<i>Asparagus racemosus</i>)	18	Root	Total saponins	0.94-3.84	-
Kalmegh (<i>Andrographis paniculata</i>)	66	Herbage	Andrographolide	1.26- 2.51	IC342139 (2.51%) IC 111291 (2.20%)

Table 6: Physico-chemical properties of some essential oils

Plant Name	Refractive Index	Specific Gravity	Acid Value	Optical Rotation
Lemon grass (<i>Cymbopogon flexuosus</i>)	1.4800	0.8763	7. 3	(-) 7. 32°
Eucalyptus (<i>Eucalyptus globulus</i>)	1.4625	0.8822	13.5	(-) 9. 83°
Black pepper (<i>Piper nigrum</i>)	1.4730	0.8996	6.1	(+) 3. 91°
Perilla (<i>Perilla frutescence</i>)	1.4705	0.8545	13.3	-
Mentha (<i>Mentha arvensis</i>)	1.4715	0.8734	11.2	(+) 2. 81°
Greater galangal (<i>Alpinia galanga</i>)	1.4690	0.8817	3.9	-
Lesser galangal (<i>Alpinia calcarata</i>)	1.4710	0.8789	7.8	-

2.5 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.

2.5.1 Rice: In rice 1,500 accessions were multiplied at DRR, Hyderabad during *Kharif* 2007. In addition 170 promising accessions were evaluated at three locations (Hyderabad, Raipur and Delhi).

2.5.2 Wheat: In wheat, 1,660 accessions were tested at different locations against biotic stresses under artificial inoculated conditions. The promising accessions identified

are IC63954, IC63955, IC111659, IC111667 for stem, leaf and stripe rust; IC41589, IC36751, IC36747, IC36723 for Leaf and stripe rusts; IC47044, IC63954, IC63955, IC75314 for leaf blight, black rust, brown rust and yellow rust; IC36747, IC41589, IC47044, IC63954 for Karnal Bunt, brown and yellow rust and IC31979, IC36737, IC36739, IC73647 for leaf blight and Karnal Bunt.

2.5.3 Chickpea: In chickpea, 957 accessions of chickpea were evaluated for agronomic traits at eight locations and for biotic and abiotic stresses at 16 locations. Based on the average performance over the locations, promising accessions for different traits were identified (Table 7).

Table 7: Promising accessions identified in chickpea

Trait	Promising accessions
Days to 50% flowering (<60)	ICC53387, ICC5787, ICC5784, ICC8352, ICC5706, ICC5810, ICC8340, ICC10431, ICC8347 and ICC5743
No. of primary branches (>3.0)	ICC497, IC327373, ICC12477, ICC10992, ICC509, ICC506, ICC11063, ICC10426, IC377460 and ICC11005
No. of pods per plant (>44)	ICC8418, ICC519, ICC11180, ICC11015, ICC5068, ICC509, IC327319 and ICC6028
No. of seed/ pod (>1.2)	ICC12686, ICC8582, ICC971, ICC970, ICC6094, ICC972, ICC10026, ICC10031, ICC10399 and ICC485
Days to 80% maturity (<122)	ICC8360, ICC12588, ICC8434, ICC5787, ICC11183, ICC10067, ICC10409, IC327388, ICC10385 and ICC5773
Grain yield per plant (>10 g)	ICC8418, EC548088, ICC12646, ICC8697, ICC6093, ICC5753, EC548084, ICC11165 and ICC5689
100 seed weight (>23 g)	ICC5697, ICC7496, ICC10819, ICC5689, ICC5337, EC548088, ICC6029, ICC11155 and ICC12365
Seed yield (>9.5 q/ha)	ICC5681, ICC487, ICC5753, ICC6041, IC327471, ICC5085, ICC849, ICC9998, ICC5858 and ICC516
Highly resistant to wilt	IC8383, IC8328 and ICC6109
Collar rot resistant	ICC5707, ICC5710, ICC5793, ICC6085, ICC8328, IC8349, ICC10001, ICC10025, ICC10029 and ICC10933

2.5.4. Pigeonpea: In pigeonpea 453 accessions were evaluated at 6 locations for agronomical traits and at 5 locations for biotic and abiotic stresses. The promising accessions were selected on the basis of average

performance over the locations. List of top ten promising accessions for each agronomical trait and biotic stress is given in table 8.

Table 8: Promising accessions identified in pigeonpea

Trait	Promising accessions
Days to 50% flowering (<78)	ICPL 09008-1, AL-1357-2, PAU3-1, Pant A 110-1, AL1362-1, ICPL-88039-1, ICPL-00004, ICPL-90052-2, H 91-12, ICPL-92041-1, ED-13, ICPL 85010, 19-148, EN-01
Days to 80% maturity (<136)	IPA 94-4, ICPL-92041-1, ED-13, PAU3-1, ICPL 91035, H33-76, EN-06, Pant A 110-1, EN-01, 19-148, 20-148, IDTOT-2-2, ICPL 09008-1, AL-1357-2, AL1362-1, K-3992, B-17 IMP, EXN-16
Plant height (>162 cm)	PLA-232, IC139580, PLA-254-1, PLA-432, D-043, PLA-239, PLA-448, PLA-374-1, PLA-308, PLA-365-2, PLA-378, IC139711, PLA-447, PLA-531, PLA-560
No. of pods per plant (>66)	PLA-560, PLA-365-3, IC139739, PLA-257, PLA-432, IC139590, IC139593, DCB-1143, ICP-8141, IC139711, IC139577, PLA-536, IC139704, IC249773,
PLA-431	
No. of seed per pod (>4)	IC139748, PLA-549, PLA-560, IC139758, PLA-225, IC056054, PLA-192-1, PLA-209, PLA-432, PLA-477, PLA-482, PLA-496, PLA-498, PLA-512, PLA-545
Pod bearing length of plants (>64 cm)	PLA-249, IC208400, IC139729, IC056060, IC201051, PLA-285, PLA-274, PLA-232, PLA-375-2, IC139574, IC028199, PLA-496, IC015707, PLA-510, PLA-287-1

Primary branches per plant (> 6)	PLA-480-2, IC139590, PLA-487, PLA-477, PLA-512, DCB-1177, FRAZALPUR -7, EXN-16, PLA-312, EXN-18, IC139704, IC139719, PLA-537, PLA-573, PUSA -33
Seed yield / plant (>7 g)	IC139593, PLA-274, IC139577, IC117587, IC016195, IC139580, IC139590, IC201058, DCB-1143, PLA-374-1, PLA-265, IC016194-1, PLA-310, IC139691, KP-5336
Seed yield (>5.3 q/ha)	IC201058, PLA-560, PLA-274, DCB-1143, PLA-536, IC139594, IC139790, IC025 059 , IC003415, IC033755, IC056068, IC016195, PLA-350, IC047233, IC056063
100 seed weight (>7.00g)	D-379, PLA-331, IC201060, IC139579, IC033022, PLA-430, IC208400, IC201059, BDS-715, KP-5389, IC139580, PLA-365-2, IC139574, IC056068, K-3740
Wilt resistant (at Dholi)	IC22500
SMD (up to 25 % infection)	IC248939, NIC23579, ICP8141, H-88-22-1, PLA-431, EXN-5, KP-5389, EN-16, IC-2486, 10-148, DNM-13, TRA-19/20, IC201059, H-91-17, IC139599, IC139758, PLA-410, IC201060

2.5.5 Brinjal : Under collaborative multilocation evaluation of germplasm, the accessions IC90141, IC90146, IC90982, IC99736 and IC249349 were found to be resistant to bacterial wilt at KAU, Vellanikkara during 2005-06 and 2006-07. At IIHR, Bangalore the accessions IC249297, IC90890 for plant spread; IC249300 for number of primary branches; IC249300, IC249306 for fruit weight and IC249306, IC89847, IC249297, IC90146 for fruit yield per plant, were found promising.

2.6 Documentation of Information of PGR

- Accession numbers allotted to 9000 accessions along with passport data storage in the SQL Server and the data of all the released and notified varieties was updated.
- Annual Reports on Characterization and Evaluation of Agri-horticultural crops for kharif 2006, rabi 2005-06 and horticultural crops 2005-06 were brought out.

2.7 Germplasm Advisory Committee Meetings

The Germplasm Advisory Committee meeting were organized for different crop/ crop groups at NBPGR Headquarters, N. Delhi (table 9).

Table 9: Germplasm Advisory Committee Meetings Held

Crop/Crop group	Date
Medicinal & aromatic plants	28.02.07
Commercial crops	10.03.07
Underutilized crops	19.03.07
Forage, grapes & range legumes	19.04.07
Vegetable & horticultural crops	24.04.07
Pulses	11.05.07
Rice, wheat & barley	16.05.07
Oilseeds	04.06.07

2.8 Distribution of Germplasm for Utilization

Utilization of germplasm of various crops by breeders and other scientists in the country for crop improvement programmes is an important aspect in sustainability of crop production. During the period, a total of 1,410 seed samples of various crop groups namely, cereals (109), pulses (498), oilseeds (290), vegetables (296), forages (65), underutilized crops (10), medicinal and aromatic plants (142) were supplied to 79 research workers of ICAR Institute, State Agricultural Universities and other research centers engaged in crop improvement programmes (Table 10). Besides, 5,485 seed samples of exotic wheat, barley and triticale were also supplied to 42 indentors.

Table10: Distribution of germplasm of different crops

Crop group/ crop	No. of samples (indentors)
Cereals	5,594(47)
Maize	74 (3)
Wheat	35 (2)
Wheat (International Nurseries)	4,644 (31)
Barley (International Nurseries)	841 (11)
Pulses	498(24)
Cowpea	108 (5)
Pea	148 (6)
Urd	83 (5)
Lentil	19 (5)
Mung	40 (2)
Chickpea	100 (1)
Oilseeds	290(12)
Rapeseed mustard	269 (10)
Safflower	20 (1)
Lepidium	1 (1)
Vegetables	296 (16)
Brinjal	81 (4)
Tomato	72 (4)
Bottlegourd	21 (2)
Fenugreek	45 (2)
Radish	18 (1)
Okra	59 (3)
Forages	65 (3)
Oat	65 (3)
Underutilized Crops	10 (2)
Medicinal and aromatic plants	142 (17)
Grand total	6,895 (121)

2.9 Germplasm Holdings in Medium Term Storage (MTS)

A total of 2,0376 accessions of various filed crops comprising cereals (4,300), millets and forages (250), pulse (4,900), oilseeds (4,730), vegetables (4,906), underutilized crops (1,073) and medicinal and aromatic plants (217) were maintained in medium term storage during the period under report (Table 11).

Table 11: Active Germplasm Holding in MTS as on 31.12.2007

Crop Group	Accession (no.)
Cereals	4,300
Wheat	1,250
Barley	1,350
Maize	1,700
Pulses and legumes	4,900
Cowpea	1,525
Pea	750
Lentil	430
Urd	450
Chickpea	1,100
Mung	645
Millets & Minor millets	250
Pearl millets	200
Sorghum	50
Oilseed crops	4,730
Rapeseed mustard	3,550
Sunflower	168

Sesame	550
Safflower	350
Linseed	75
Crambye	22
Taramera	4
Lepidium	11
Vegetables	4,906
Brinjal	2,050
Tomato	1,050
Bottle gourd	350
Ridged gourd	300
Sponge gourd	300
Ash gourd	50
Pumpkin	6
Radish	200
Fenugreek	360
Spinach	50
Coriander	100
Onion seed	90
Underutilized crops	1,073
Fababean	300
Ricebean	103
Amaranthus	70
Sesbania	400
Crotolaria	200
Medicinal & Aromatic Plants	217
Ocimum	50
Mucuna	55
Poppy	53
Andrographis	23
Psoralia	15
Ashwagandha	4
Hyacocymus	6
Catharanthes	11
Total	20,376

Research Projects (Code, Title, Project Leaders and Associates)

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

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

PGR/GEV- BUR-DEL -0I.03: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of cowpea & pea (S. Sardana, N.K. 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 (S.K. Yadav, K.K. Gangopadhyay, B.L. Meena, Gunjeet Kumar (on study leave))

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

PGR/GEV- BUR-DEL-01.07: Characterization, Evaluation, Maintenance, Regeneration and Documentation of Germplasm Resources of Medicinal & Aromatic Plants (Ashok Kumar, S.K. Pareek, Archana Raina, Jitender Mohan and Poonam Suneja)

PGR/GEV- BUR-DEL -01.08: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of forages (Vandana Joshi).

PGR/GEV- BUR-DEL -01.09: Biochemical evaluation of germplasm resources of various field crops (S. Mandal, Sangita Yadav (on study leave) and Poonam Suneja)

PGR/GEV- BUR-DEL -01.10: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of under utilized crops (B.S. Phogat, Hanuman Lal and R.S. Rathi).

PGR/GEV- BUR-DEL -01.11: Studies on statistical techniques for efficient management of PGR (Hanuman Lal and R.K. Mahajan).

PGR/GEV- BUR-DEL -01.12: Genetic Resources Information Programme (R.K. Mahajan R.C. Agrawal and Hanuman Lal)

PGR/GEV- BUR-DEL -01.13: Genetic enhancement of crop species with particular reference to sesame and mungbean (I.S. Bisht).

PGR/GEV- BUR-DEL -01.14: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of chickpea and pigeonpea (R.P. Dua and O.P. Dahiya)

PGR/GEV- BUR-DEL -01.15: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of onion and garlic (Ashok Kumar and Harender Singh)

PGR/GEV- BUR-DEL -01.16: 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 -01.17: Characterization, evaluation, maintenance, regeneration and documentation of germplasm resources of lentil & urdbean (N.K. Gautam, S. Sardana and Babu Ram).

PGR/GEV- BUR-DEL -01.18: Phytochemical evaluation of medicinal and aromatic plants (Archana Raina, S.K. Pareek, Ashok Kumar, Jitender Mohan and Poonam Suneja)

PGR/GEV- BUR -DEL - 01.19: Development of core set in Brinjal (*Solanum melongena* L.) (K.K. Gangoopadhyay, S.K.Yadav, R.K. Mahajan and I.S. Bisht).

3. DIVISION OF GERMPLASM CONSERVATION

Summary: A total of 14,807 germplasm accessions of various crops were received for long-term conservation in the National Genebank. These were processed following the genebank standards adding another 14,683 accessions to the base collection raising the total germplasm holding to 3,53,877. A total of 3116 accessions received at the Germplasm Handling Unit were stored in the medium-term storage module as reference material. Monitoring of stored germplasm (2,012 accessions) and updating of passport data (16,999 accessions) remained the priority activities. A total of 4,600 accessions were supplied from the genebank for evaluation/regeneration/ research /restoration of active collection. Studies on seed storage of *Pongamia pinnata*, *Murraya paniculata*, *Saraca asoka*, *Swietenia macrophylla*, *Mimusops hexandra* and *Jatropha curcas*, showed that *Swietenia macrophyll* and *Mimusops hexandra* seeds have intermediate behaviour while *Saraca asoka* seeds have recalcitrant behaviour and *Pongamia pinnata*, *Murraya paniculata* and *Jatropha curcas* have orthodox behaviour. Cost effective conservation protocols are being worked out for castor, groundnut, sesame, niger and cotton. In these crops longevity at ambient temperatures was found to be more when seeds were dried to ultra low moisture contents (i.e. < 5 per cent moisture content). Methods for breaking seed dormancy were developed in some wild species viz. *Amaranthus viridis*, *Malva verticillata*, *Perilla frutescence*, *Rosa webbiana*, *Alysicarpus vaginalis*, *Physalis coagulans*, *Eleusine indica* and *Neolitsea* sp. to facilitate cultivation and monitoring of seed viability during storage. Their storage behaviour was found to be orthodox.

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

3.1 Germplasm Augmentation

The Germplasm Handling Unit (GHU) received a total of 3,116 seed accessions. Of which 352 accessions were stored in medium-term storage module as reference material and to ensure multiplication in the area of collection and 945 accessions with sufficient quantity of seed were sent for long-term conservation.

A total of 14,807 germplasm accessions of various agricultural crops were received for long-term

conservation at the National Genebank. A total of 14,683 accessions qualified for conservation as per the genebank standards and were stored as base collections at minus 18°C. These include cereals (5,372), pseudocereals (450), millets and forages (1,377), legumes (2,146), oilseeds (2,081), fibres (260), vegetables (1,625), medicinal and aromatic plants and narcotics (390), spices and condiments (583), agro-forestry (282). These include released varieties (467) and genetic stocks (142) for respective crop/crop groups.

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 3,53,877 representing 1,318 species. In addition, a total of 3,153 exotic accessions of different crops were kept as voucher specimen in the medium-term storage module for reference.

3.2 Germplasm Registration

A total of 110 proposals were received for germplasm registration and 50 proposals belonging to 20 crops were approved for registration in the Plant Germplasm Registration Committee meeting. The details of registered germplasm are given in table-2. A database on plant germplasm registration was developed and 534 records of registered germplasm with information on different fields were recorded.

Table 1: Status of germplasm holdings in the National Genebank (at -18 0C) (as on 31 December 2007)

Crop Group	1st Jan 2007 to 31st Dec., 2007	No. of Total species	Present status Total
Paddy	4,052	18	82,766
Wheat	5,661	56	38,612
Maize	349	1	7,261
Others	405	13	11,154
Cereals	5,372	88	1,39,793
Sorghum	179	1	18,834
Pearl millet	116	2	7,552
Minor millet	691	7	19,716
Others	391	135	3,932
Millets and forages	1,377	145	50,034
Amaranth	383	16	4,932
Buckwheat	42	4	680
Others	25	6	330
Pseudo Cereals	450	26	5,942
Chickpea	455	10	16,427
Pigeonpea	188	12	10,988
Mung bean	60	4	3,559
Others	1,443	41	24,016
Grain Legumes	2,146	67	54,990
Groundnut	35	12	13,449
Brassica	339	14	9,322
Safflower	39	4	7,285
Others	1,668	16	19,540
Oilseeds	2,081	46	49,596
Cotton	122	5	4,832
Jute	27	13	2,864
Others	111	22	2,110
Fibre Crops	260	40	9,806
Brinjal	144	24	3,868
Chilli	6	4	2,002
Others	1,475	116	16,956
Vegetables	1,625	144	22,826
Custard apple	1	1	59
Papaya	-	1	23
Others	116	19	300
Fruits	117	21	382
Opium poppy	-	3	350
Ocimum	34	9	376
Tobacco	1	43	1,461
Others	355	494	3,536
Medicinal & Aromatic Plants & Narcotics	390	549	5,723
Coriander	73	1	485
Sowa	-	2	59
Others	510	10	1,671
Spices & Condiments	583	13	2,215
Pongam oil tree	68	1	395
others	214	178	1,940
Agro-forestry	282	179	2,335
Lentil	-	-	7,712
Pigeonpea	-	-	2,523
Duplicate Safety Samples	-	-	10,235
Total	14,683**	1,318	3,53,877*

*The figure includes 3,002 released varieties and 1,454 genetic stocks

No. of crop species conserved - 1,318

**The figure includes 467 released varieties and 142 genetic stocks

No. of crop species conserved -131

Table 2: Germplasm registered during 2007

Crop	No.	Trait for which registered
Wheat	13	Amber grain and pyramided rust resistance genes, Sr 24 and Sr 25 genes, excellent chapatti quality, powdery mildew resistance gene(s) for brown rust races, resistance to brown and black rusts and predominant pathotypes of yellow rust, tolerance to salinity and water logging.
Paddy	14	Male sterility in mid late duration, long slender grain, good panicle and stigma exertion, better grain and cooking, higher elongation ratio and free from grain chalkiness, resistant to rice tungro virus disease, resistance to blast disease.
Maize	1	Source of resistance to Maydis leaf blight.
Sorghum	1	Better drought tolerant mechanisms.
Pigeon Pea	1	Thermo-insensitive CMS in UPAS 120 background with cytoplasm of <i>Cajanus scarabaeoides</i> .
Urd bean	1	Brown pod and yellow seed
Sesame	2	Mutant with greater initial seeding vigour and tallness, polypetalous corolla
Sunflower	1	Mutant without ray florets
Groundnut	1	Large pod and seed
Rape seed	2	High oleic acid and Low erucic acid, brown seed
Cotton	4	Pink flower colour, pink filament mutant resistance to spotted, pink and <i>Heliothis</i> bollworms
Jute	1	Premature flowering resistance, chocolate seed and finer quality fiber
Sugarcane	1	Resistance to sugar cane woolly aphid.
Chilli	1	Resistance to leaf curl virus disease
Potato	1	Resistance to leaf hopper burn and <i>Potato stem necrosis virus</i>
Kalmegh	1	Compact plant type with higher andrographolide contents.
Rose geranium	1	Quality aroma
Jasmine	1	Variiegated leaves
Snap melon	1	Downy mildew resistance
Pea	1	Bold seed size with 100 seed weight (50.14g)
Total	50	

3.3 Documentation and Database Management

Efforts were continued to update passport data on germplasm conserved in National Genebank. Passport data were updated for a total of 16,999 accessions comprising paddy (16,663), fibres and forages (235) and pulses (101).

3.4 Monitoring of Germplasm for Viability

Germplasm (2,012 accs.) stored in the long-term storage module for 10 years or more were monitored for seed viability, seed quantity and seed health to identify accessions that may require regeneration as per the genebank standards. This included accessions of cereals

(888) millets (48), fibres (334), oilseeds (235), pulses (400), and vegetables (107). This indicated maintenance of seed viability and seed quality of all the accessions conforming to the genebank standards.

3.5 Regeneration of Germplasm

A total of 4,600 germplasm samples of various crops were supplied for seed multiplication/research/evaluation and restoration of lost active collections. These include accessions of paddy (2,656), maize (33), millets (32) and horsegram (333).

3.6 Supportive Research

To develop protocols for cost effective conservation,

studies on storability of seeds dried to ultra- low moisture contents were continued in castor, groundnut, cotton, pigeonpea and *Dalbergia* . Monitoring of cotton, groundnut, pigeonpea and castor, seeds dried to 2-3 percent moisture revealed retention of higher germination than those stored at higher moistures at ambient temperature after more than 6 years of storage.

3.6.1 Seed germination and storage behaviour:

Studies on seed storage behaviour of *Pongamia pinnata*, *Murraya paniculata*, *Saraca asoka*, *Swietenia macrophylla*, *Mimusops hexandra* and *Jatropha curcas* were carried out. *Swietenia macrophylla* and *Mimusops hexandra* seeds showed intermediate behaviour while *Saraca asoka* showed recalcitrant behaviour and *Pongamia pinnata*, *Murraya paniculata* and *Jatropha curcas* had orthodox behaviour. Hot water treatment at 60° C for half an hour improved the poor seed germination in *Pongamia pinnata* L. due to hardseededness. In *Jatropha curcas* poor germination due to hardseededness was overcome with scarification followed by soaking in water at $27 \pm 2^\circ$ C. Combination of Diethane M45 with Bavistin (0.2%) was found to be the best for controlling the fungal infection in *Jatropha* seeds. The seed viability varied in different accessions of jatropha. Ideally the seeds should be collected when they are ready for natural dispersal. Since flowering and fruiting in *Jatropha* are asynchronous, harvesting physiologically mature seeds of same age should be done carefully. Seeds harvested after 60 days of anthesis showed the best survival percentage. Germination towel is found to be the best substrata for germination.

Wet seeds desiccated to 5-7% mc, and maintained at low temperatures of 10°C and -18°C, showed a good survival of 80-85% after storage for 3 months. There were no significant differences in viability with desiccation and chilling of both pongamia and *Jatropha* thereby confirming the orthodox nature of these seeds.

Effect of seed invigoration in *Trigonella foenum-graceum* was investigated using different chemical seed priming methods. Although priming treatments enhanced the speed of germination, they invariably reduced the seedling length and vigour. Of all the treatments tried, priming with 60mM PEG and KNO_3 (0.5%) provided maximum germination speed as well as percentage germination.

3.6.2 Standardization of germination protocols in

wild species: Methods for germination and breaking seed dormancy were developed in some wild species viz. *Amaranthus viridis*, *Malva verticillata*, *Perrilla frutescence*, *Rosa webbiana*, *Alysicarpus vaginalis*, *Physalis coagulans*, *Eleucine indica* and *Neolitsea* sp. The details of the dormancy breaking treatments are given in Table –3. All the species were found to be both desiccation and chilling tolerant confirming their orthodox nature.

Table 3: Seed germination and dormancy breaking treatments in wild species of western Himalayas

S.No	Species	Seed treatment
1	<i>Amaranthus viridis</i>	Soaking in water overnight
2	<i>Malva verticillata</i>	Soaking in water overnight
3	<i>Perilla frutescence</i>	Soaking in water overnight
4	<i>Rosa webbiana</i>	Scarification, treatment with GA3 (50 ppm)
5	<i>Alysicarpus vaginalis</i>	Chipping and soaking in running water for 5 days
6	<i>Physalis coagulans</i>	Scarification, treatment with GA3 (50 ppm)
7	<i>Neolitsea</i> sp.	Chipping and soaking in water overnight. Soaking in running water for 5 days
8	<i>Eleucine indica</i>	Soaking in water overnight

3.6.3 Differentiation of released varieties on protein profiles:

Analysis of the protein profiles of *Momordica* cultivars showed that SDS protein profiles can differentiate the three released varieties of *Momordica charantia*. Of a total of 10 bands observed in three varieties, band with Rm value 1.000 was present in Pant Karela-1 only and band with Rm values 0.461, 0.569 and 0.920 in Arka Harit only which can be used for varietal identification.

3.7 Additional Activities

3.7.1 Consultancies

1. At the request of FAO, Seed and Plant Genetic

Resources Services, Dr. AK Singh provided consultancy from 23rd September – 12th October, 2007 for the development of technical proposal with the objective of developing technical proposal for establishment of National Genebank for efficient and effective long-term conservation of plant genetic resources. The Consultancy report accepted and approved by the FAO has been communicated to the Government of Nepal.

2. Protection of Plant Variety and Farmers' Rights Authority constituted a Task Force 2/2006 that included Dr. AK Singh as Senior Consultant for Developing DUS guidelines for another 13 crops. This task has been completed and DUS guidelines have been submitted for the targeted crops, viz. Rapeseed mustard, Groundnut, Soyabean, Sunflower, Safflower, Castor, Sesame, Linseed, Cotton, Jute, Sugarcane, Lucerne, and Barseem.
3. Protection of Plant Variety and Farmers' Rights Authority constituted a Technical Advisory Group, known as Task Force 6/2007 comprising of members including Dr. AK Singh, as Member Secretary.

The consultant group has initiated the activity to develop guidelines and formulations for benefit sharing under the provision of National Gene fund by identifying agro biodiversity hot spots and collection of related information with regard to species endemic to hot spots and that are under threat and need protection.

3.7.2 Technical assistance to NAGS/ NBPGR regional stations

1. Technical input provided by the staff of the National Genebank for the repair and maintenance of refrigeration systems in the medium term storage at the National Research Centre (small millets), Bangalore. On-job training was provided to the concerned staff to cope with the breakdown of the facility.
2. Detailed drawings for National Varietal Repository under the auspices of PPV&FR was prepared
3. Technical support was provided for maintenance of MTS facility at Bureau's regional stations at Bhowali and Jodhpur.

Research projects (Code, Title, PI and CoPIs)

PGR/GCN-BUR-DEL-01-01: Management of information and facilities of germplasm conserved in the national network (R.C. 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.; A.D. 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 pseudocereals 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; J Radhamani)

PGR/GCN-BUR-DEL-01-8: Conservation of millets germplasm using conventional seed storage methods (A. K. Singh; Veena Gupta)

PGR/GCN-BUR-DEL-01-9: 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, A.D. Sharma)

Externally funded projects

- "Biodiversity conservation of Targeted Rare and Endangered Medicinal Plants of Western Ghats" funded by "National Medicinal Plant Board". (Veena Gupta)
- "Collection, Assembly and Conservation of Genetic Resources of Physic nut (*Jatropha* Linn.)" funded by Deptt. of Biotechnology.(J. Radhamani)
- "National Plant Variety Repository" funded by Protection of Plant Varieties and Farmers' Rights Authority. (Anurudh K. Singh)

4. DIVISION OF PLANT QUARANTINE

Summary: A total of 42,563 accessions (93,740 samples) comprising germplasm accessions as well as trial material entries of various crops and 77 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 1395 samples were found infested/ infected contaminated with various pests viz., insects/ mites -296 samples including 91 with hidden infestation; nematodes- 553, fungi/ bacteria- 499 and viruses (47). Of the 1,395-infested/ infected/ contaminated samples, 1,377 were salvaged through fumigation, hot water treatment (HWT), X-ray radiography, pesticidal dip, mechanical cleaning and growing-on test. Eighteen samples were rejected including 14 samples of *Glycine max* from USA 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. Six 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. Polyclonal antiserum to BCMV was produced and DAS-ELISA protocol was standardized. SMV was purified and immunization of rabbits with SMV for production of polyclonal antiserum to SMV is in progress. Polyclonal antiserum to npt II (Neomycin phosphotransferase) has been produced and purification of IgG is in progress.

4.1 Import Quarantine

4.1.1 Quarantine examination: A total of 42,563 exotic accessions (93,740 samples) comprising germplasm accessions; nurseries/ trial breeding material 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, 1,130 samples were exposed to X-ray radiography for detection of hidden infestation of bruchids and chalcids. A total of 1,395 samples were found infested/ infected/ contaminated. Of these, 296 samples were found infested with insects/ mite including 91 with hidden infestation; 553 samples infected with nematodes, 499 found infected with fungi/ bacteria and 47 with viruses. A number of pests of major quarantine importance were intercepted (Table 1).

4.1.2 Salvaging of infested/ infected/ contaminated germplasm: Of the total 1,395 infested/ infected/ contaminated samples, 1,377 were salvaged by various disinfestation techniques/ treatments like mechanical cleaning to remove damaged/ abnormal seeds, soil clods, plant debris etc., fumigation with ethylene dichloride-carbon tetrachloride mixture @ 320 mg/ litre for 48 h at 30°C under normal air pressure against insect infestation and hot water treatment (HWT) at 52°C for 30 minutes for various seed-borne pathogens and nematodes and X-ray screening for hidden infestation, pesticidal dip/ spray for vegetative propagules. Samples infested with insects/ mites (296) were salvaged through fumigation

(139), X-ray radiography (91) and pesticidal dips (66); 553 samples infected with nematodes were salvaged by hot water and nematicidal dip treatments; 481 samples infected with fungi/ bacteria were salvaged by fungicidal seed treatment (308) and HWT (35), ethyl alcohol wash (138); and samples infected with viruses were salvaged through grow-out test. Fourteen samples of soybean (one from USA and 13 from Thailand) infected with downy mildew fungus (*Peronospora manshurica*), a pest not yet reported from India; one sample of maize due to heavy infection with *Drechslera maydis*, one cutting of *Percea americana* and two culture tubes of *Solanum tuberosum* received in contaminating and decaying conditions were rejected.

Prophylactic treatments: A total of 26,133 seed samples were subjected to fumigation, 2,151 samples of vegetative propagules were given dip/ spray treatment and 10,686 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 (236), and tomato (360) 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 (4,216 entries) comprising wheat (3,208), barley (776) and triticale (163) from CIMMYT (Mexico), ICARDA (Syria), Australia and registered germplasm (69) of wheat (66) and barley (3) were grown in PEQN. Covered smut of barley (*Ustilago hordei*) was detected in 19 entries and loose smut of barley (*U.*

segetum var. *nuda*) in 29 entries of barley from CIMMYT. Loose smut of wheat (*U. nuda* f. sp. *tritici*) was also detected in 21 entries of wheat. Infected plants were uprooted and destroyed.

A total of 603 samples of exotic germplasm comprising *Glycine max* (114), *Phaseolus vulgaris* (4), *Pisum* spp. (443), *Vicia faba* (25), *Vigna mungo* (1) and *V. radiata* (16) were grown in Post-entry Quarantine Greenhouses. The plants showing virus-like symptoms were tested by electron microscopy and using specific antiserum against various seed-transmitted viruses using enzyme-linked immunosorbent assay. The harvest from only healthy plants of different accessions was released to the indenters. The interceptions made are presented in Table-1.

4.2 Export Quarantine

A total of 77 accessions/ samples of various crops intended for export to various countries were processed for detection of associated pests. Of these, 21 samples were found infected and all were salvaged. The fungi found associated were *Drechslera sorghicola* on finger millet, *Alternaria padwickii*, *Drechslera oryzae*, *fusarium moniliforme* and *Nigrospora oryzae* on rice. Six Phytosanitary Certificates were issued.

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

A total of 73 accessions of *Allium* spp. including 27 accessions of *in-vitro* cultures of *A. sativum*, 37 field samples of *A. sativum*, two pot cultures of *A. senescens* and *A. griffithianum* and 7 accessions, one each of *A. angulosum*, *A. ascalonicum*, *A. cernum*, *A. fistulosum*, *A. griffithianum*, *A. orcoprasum* and *A. roylei* were indexed against six viruses (the ones against which the commercial antisera kits are available) viz., *Carnation latent virus* (CLV), *Garlic common latent virus* (GCLV), *Leek yellow stripe virus* (LYSV), *Onion yellow dwarf virus* (OYDV), *Shallot latent virus* (SLV) and *Shallot yellow stripe virus* (SYSV) by Double Antibody Sandwich-ELISA technique. The results revealed the presence of CLV (39 accessions), GCLV (58 accessions), LYSV (27 accessions), OYDV (28 accessions) and SLV (8 accessions). *A. angulosum*, *A. fistulosum*, *A. griffithianum*, *A. orcoprasum*, *A. roylei* and *A. senescens* were found to be free from all the six viruses tested by DAS-ELISA.

4.4 Supportive Research

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

4.4.2 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 146 insects/ mites, 40 nematodes, 36 fungi, 12 bacteria and 42 viruses of quarantine significance in grain legumes not yet reported from India.

4.5 Achievements in Externally- funded Projects

4.5.1 National Containment/ Quarantine Facility for Transgenic Planting Material (DBT): With the approval of RCGM, 153 samples of imported transgenic planting material comprising *Lycopersicon esculentum* (1) from USA for Bejo Sheetal Seeds Pvt. Ltd.; *Oryza sativa* (133) viz., 131 from Belgium for Proagro Seed Company Pvt. Ltd., New Delhi and 2 from USA for Mahyco, Mumbai; *Triticum aestivum* (1) from USA for Mahyco, Mumbai and *Zea mays* (18) viz., 10 from Philippines and 7 from USA for Monsanto India Ltd., Mumbai, and 1 from USA for Metahelix Life Sciences Pvt. Ltd., Bangalore; were received during the period for quarantine processing.

The transgenes present in these crops included, AVP1 (Arabidopsis vacuolar H⁺ pyrophosphatase) in *Lycopersicon esculentum* for increased salt and drought tolerance; *Cry1Ab*, *Cry1c* (insect resistance), *bar* (glufosinate ammonium herbicide resistance), PARGhp, PNC1 (component of salvage pathway) in *Oryza sativa*; EPSPS (5-enolpyruvylshikimate-3-phosphate synthase) in *Oryza sativa* and *Triticum aestivum*; and CP4EPSPS and *gat* (glyphosate-N-acetyl transferase) for herbicide tolerance in *Zea mays*.

Seeds of transgenic material were subjected to various

Table 1: Pests Intercepted in the Exotic Germplasm during the Year 2007

Pest	Host	Source/ Country
Insect and mite pests		
<i>Aonidiella orientalis</i>	<i>Vitis vinifera</i>	Brazil
<i>Bruchidius spp.</i>	Barseem	Egypt
<i>Bruchophagus roddii</i>	<i>Trifolium pratense</i>	USA
<i>Chrysomphalus dictyospermi</i>	<i>Persea americana</i>	USA
Immature stages of bruchids	<i>Gossypium hirsutum</i>	Israel
<i>Olygonychus spp.</i>	<i>Saccharum officinarum</i>	USA
<i>Parasaissetia nigra</i>	<i>Persea americana</i>	Vietnam
<i>Polyphagotarsonemus latus</i>		
<i>Rhizopertha dominica</i>	<i>Triticum aestivum, Hordeum vulgare, Triticale</i>	CIMMYT (Mexico)
<i>Sitophilus zeamais</i>	<i>Zea mays</i>	Philippines
<i>Sitotroga cerealella</i>	<i>Triticum aestivum</i>	South Africa
Nematode		
<i>Aphelenchoides besseyi</i>	<i>Oryza sativa</i>	Nepal, Indonesia, Philippines
Fungi/ Bacteria		
<i>Alternaria brassicae</i>	<i>Brassica oleracea</i>	Netherlands
<i>A. brassicicola</i>	<i>B. oleracea</i>	Netherlands
	<i>B. napus, B. juncea</i>	Australia
<i>A. padwickii</i>	<i>O. sativa</i>	Philippines
<i>A. solani</i>	<i>Capsicum annuum</i>	Taiwan
<i>A. tenuissima</i>		
<i>Botrytis cinerea</i>	<i>Triticum aestivum</i>	USA
	<i>Allium spp.</i>	UK
	<i>Zea mays</i>	Mexico
<i>Cephalosporium maydis</i>	<i>Z. mays</i>	Thailand
<i>Cercospora kikuchii</i>	<i>T. aestivum</i>	USA
<i>Colletotrichum dematium</i>	<i>C. annuum</i>	Taiwan
	<i>Glycine max</i>	Australia
<i>Drechslera avenae</i>	<i>Avena sativa</i>	USA
<i>D. longirostrata</i>	<i>Hordeum vulgare</i>	ICARDA (Syria)
<i>D. maydis</i>	<i>Zea mays</i>	Thailand
<i>D. sorghicola</i>	<i>Triticum aestivum</i>	Mexico
<i>D. sorokiniana</i>	<i>Aegilops speltoides</i>	USA
	<i>A. sativa</i>	USA
	<i>Brassica juncea, B. napus</i>	Australia
	<i>T. aestivum</i>	Mexico, South Africa, USA
<i>Drechslera avenae</i>	<i>Avena sativa</i>	USA
<i>D. longirostrata</i>	<i>Hordeum vulgare</i>	ICARDA (Syria)
<i>D. maydis</i>	<i>Zea mays</i>	Thailand
<i>D. sorghicola</i>	<i>Triticum aestivum</i>	Mexico
<i>D. sorokiniana</i>	<i>Aegilops speltoides</i>	USA
	<i>A. sativa</i>	USA
	<i>Brassica juncea, B. napus,</i>	Australia
	<i>T. aestivum</i>	Mexico, USA
<i>Fusarium moniliforme</i>	<i>Beta vulgaris</i>	USA
	<i>Brassica spp.</i>	Australia, Netherlands
	<i>Capsicum annuum</i>	AVRDC (Taiwan),
	<i>Gossypium hirsutum</i>	USA
	<i>Hordeum vulgare</i>	ICARDA (Syria)
	<i>Lycopersicon esculentum</i>	AVRDC (Taiwan),
	<i>O. sativa</i>	Egypt, Philippines
	<i>Pisum sativum</i>	USA
	<i>T. aestivum</i>	Mexico, USA
	<i>Zea mays</i>	Mexico, Nigeria, Philippines, Thailand, USA
<i>F. poae</i>	<i>T. aestivum</i>	South Africa
<i>F. solani</i>	<i>Allium spp.</i>	UK
	<i>C. annuum</i>	AVRDC (Taiwan), Taiwan

	<i>L. esculentum</i>	AVRDC (Taiwan)
	<i>P. sativum</i>	USA
	<i>T. aestivum</i>	USA
<i>Nigrospora oryzae</i>	<i>T. aestivum</i>	Mexico
* <i>Peronospora manshurica</i>	<i>Glycine max</i>	USA, Thailand
<i>Puccinia helianthi</i>	<i>Helianthus annuus</i>	France
<i>Rhizoctonia solani</i>	<i>C. annuum</i>	Taiwan
<i>Xanthomonas campestris</i> pv. <i>campestris</i>	<i>Brassica oleracea</i>	Netherlands
Viruses		
<i>Alfalfa mosaic virus</i>	<i>Glycine max</i>	AVRDC (Taiwan), Brazil, Sri Lanka
<i>Bean common mosaic virus</i>	<i>G. max</i>	AVRDC (Taiwan), Brazil
<i>Broad bean stain virus</i> *	<i>Vicia faba</i>	ICARDA, Syria
<i>Broad bean wilt virus</i>	<i>V. faba</i>	ICARDA, Syria
<i>Cucumber mosaic virus</i>	<i>G. max</i>	AVRDC (Taiwan), Sri Lanka
<i>Grapevine fan leaf virus</i>	<i>G. max</i>	AVRDC (Taiwan)
<i>Pea seed-borne mosaic virus</i>	<i>Pisum sativum</i>	Russia, USA
	<i>V. faba</i> *	ICARDA, Syria
<i>Raspberry ring spot virus</i> *	<i>G. max</i>	AVRDC (Taiwan)
<i>Tobacco ring spot virus</i>	<i>G. max</i>	Brazil
<i>Tobacco streak virus</i>	<i>G. max</i> *	AVRDC (Taiwan), Australia, Brazil
<i>Tomato black ring virus</i>	<i>G. max</i> *	AVRDC (Taiwan), Brazil, Sri Lanka

* Pest not yet reported from India

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

tests in containment for detection of insects, mites, nematodes, bacteria, fungi and viruses. An important fungus *Fusarium moniliformae* was intercepted in *Oryza sativa* from Belgium and USA, and in *Zea mays* and *Lycopersicon esculentum* from USA. Rice samples were given prophylactic hot water treatment at 52°C for 30 minutes against various seed-borne pathogens and nematodes and tomato seeds were given prophylactic 10x trisodium phosphate treatment against Tobamoviruses. Infected samples of maize were salvaged by giving fungicidal treatment with bavistin and thiram.

DNA was extracted from the seedlings of the transgenic lines received and were tested for the terminator gene using primers designed for cre recombinase gene. All these lines showed negative results for the terminator gene. The transgenic planting material was also tested for specific transgenes. Multiplex PCR protocols for simultaneous detection of two or more genes have also been standardized.

4.5.2 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) was tested for host specificity in *M. micrantha* populations from Andaman (6), Assam (7), 32 crop species belonging to Family Asteraceae and

20 samples of sunflower in the National Containment Facility. All the *Mikania* populations were found to be susceptible to the rust, 5 samples of sunflower showed mild chlorotic specks while other test plants did not show any symptoms. Based on the results, Plant Protection Adviser to Govt. of India granted permission for limited field release of the rust inoculum. Screened 20 markers for molecular studies of Trinidad and Peruvian isolates of *P. spegazzinii* using random amplified polymorphic DNA analysis. *M. micrantha* plants from Assam, Kerala and Andaman are being regularly propagated. Regular multiplication of Trinidad and Peruvian isolates of *P. spegazzinii* undertaken for field release.

4.5.3 Network Project on Diagnostics of Emerging Plant Viruses (ICAR): A total of 162 seed samples comprising of black gram (9), cowpea (2), French bean (73), green gram (2) and soybean (76) 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). Studies revealed a seed transmission rate of 10.52-28.30% and 2.12-58.00% of BCMV in green gram and French bean, respectively, 2.89-20.40% ULCD in black gram and 0.63-45.45% of SMV in soybean. A total of 632 leaf samples showing symptoms of BCMV and SMV after sap inoculation were tested against BCMV (325) and SMV (307) using

Direct antigen coating ELISA and Double Antibody Sandwich-ELISA. A total of 248 samples were found positive, of which, 190 for BCMV and 58 for SMV. The newly infected leaves were examined by immunosorbent electron microscopy and flexuous particles of 700-900 nm were detected in case of French bean, black gram, green gram and soybean. The cultures of BCMV, SMV and ULCD are being multiplied in respective host plants under greenhouse conditions. Leaves infected with BCMV, SMV and ULCD are lyophilized and also preserved in vials under calcium chloride. The rabbits were immunized with purified BCMV and antiserum was collected. The IgG to BCMV was purified and conjugated with alkaline phosphatase. DAS-ELISA protocol for detection of BCMV was standardized. The SMV was purified successfully. The rabbits were immunized with purified SMV and antiserum was collected. The IgG to SMV was purified and conjugated with alkaline phosphatase. DAS-ELISA protocol for detection of SMV was standardized. RT-PCR protocols developed for detection of BCMV and SMV were further tested and conformed that the protocols are reproducible. Sap and seed transmission of ULCD was confirmed. Differential display technique was used to identify the mRNA specific for the black gram plants showing crinkling symptoms on leaves. Eleven clones were obtained, sequenced and none matched with any known viral/ viroid sequences.

4.5.4 Development of Technology for Detecting Presence of GMOs in an Unknown Sample and its Utilization in dealing with Bulk Samples (DAC): The procurement of 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) is in progress. All the related equipments have been procured. Polyclonal antiserum to npt-II has been produced and purification of IgG is in progress.

4.5.5 Studies on the Potential of Electron Beam Irradiation as Quarantine Disinfestation Treatment against Insect-pests in Seeds (BRNS, DAE): Preliminary experiments using Electron Beam (EB) irradiation as a disinfestation treatment against insect pests in seeds were conducted in some important crops viz., paddy against *Rhizopertha dominica*, *Sitophilus oryzae* and *Sitotroga cerealella*; gram against *Callosobruchus chinensis*; soybean against *C.*

chinensis/ C. maculatus and cotton (including transgenic) against *Trogoderma granarium*. The insect cultures were raised on their respective host at a temperature of $27\pm 1^\circ\text{C}$ and R.H. $60\pm 5\%$. The seeds infested with different stages of pests and uninfested seeds were irradiated with EB using the facility at Centre of Advanced Technology, Indore. The material was irradiated with different doses of EB viz., 170Gy, 340Gy, 510Gy, 680Gy and 850Gy in three packing materials in three replicated trials. Irradiated infested seeds were observed for different parameters of insect growth and development and uninfested seeds were tested for their germination and vigour as per ISTA rules.

4.5.6 Preparation of Digitized Keys for Quick and Reliable Identification of Insect Pests of Family Bruchidae of Quarantine Significance (DAC): Familiarization with the taxonomic techniques for mounting, labeling, use of taxonomic keys and slide preparation of genitalia of bruchids. Compiled checklist of bruchids of Genus *Acanthoscelides* of quarantine significance to India. Literature collection undertaken for developing the database on bruchids. The annotated checklist of bruchids not reported from India was updated. Procurement of equipments, consumables and related chemicals is in progress.

4.5.7 Development of Quarantine Disinfestation Treatments (Thermal/ Modified Atmosphere) against Storage Insect-pests Infesting Walnut (DAC): Insect cultures of *Ephestia cautella*, *Oryzaephilus mercator*, *Tribolium castaneum* and *Trogoderma granarium* were raised on walnut at a temperature of $27\pm 1^\circ\text{C}$ and R.H. $60\pm 5\%$ to study the efficacy of thermal and modified atmosphere treatments.

4.5.8 Development of Farmer Friendly Diagnostic Kits for Transgenic Event Seed Purity: The objectives of the project are: To develop farmer usable 'on-the-spot' rapid immunodiagnostic kits (5 min. test) to detect specific transgenic products/ events released for commercial cultivation in India; to develop an ubiquitous test kit for the detection of any GMOs/ LMOs at the port of entry and within the country for transgenic food, feed or processed products imported unintentionally, deliberately or through clandestine means; to develop standard quantifiable parameters for specificity, sensitivity, repeatability, reproducibility, limits of detection, overall accuracy and robustness (includes product stability and user friendliness) of transgenic detection

kits for validated regulatory testing purposes and to develop methodology for detecting the presence of transgenes in a bulk sample not declared as transgenic and stipulate appropriate sampling and statistical procedures. The database on markers, promoters & genes has been developed and procurement of consumables is in progress.

4.6 Additional Activities

National Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops was organized from

November 27 –December 3, 2007 at NBPGR, New Delhi. 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.

Research Projects (Code, Title, PI, CoPIs 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 (P.C. Agarwal, Usha Dev, Shashi Bhalla, D.B. Parakh, Kavita Gupta, Charan Singh, Dinesh Chand, Ashok Maurya, K.D. Joshi and Naresh Kumar)
- PGR/PQR- BUR-DEL-01.02 Post-entry Quarantine Processing of Exotic Germplasm (R.K. Khetarpal, Arjun Lal, P.C. Agarwal, B. Lal, D.B. 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, Gurinder Jit Randhawa, 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, Naresh Kumar)
- 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, K.D. Joshi)
- PGR/PQR-BUR-DEL-01.07 Detection and Identification of Viruses in Quarantine and Supportive Research. (V Celia Chalam, D.B. 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, K.D. 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, P.C. Agarwal, Usha Dev, Dinesh Chand, K.D. Joshi)
- 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 and Naresh Kumar)
- PGR/PQR-BUR-DEL-01.12 Detection of Viruses in *In vitro* Cultures of Germplasm Meant for Conservation (D.B. Parakh V. Celia Chalam, Ashok Maurya)

Externally funded projects

- National Containment/ Quarantine Facility for Transgenic Planting Material (DBT)(R.K. Khetarpal, Gurinder Jit Randhawa, Manju Lata Kapur, V. Celia Chalam, 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) (R.K. Khetarpal, D.B. Parakh, V. Celia Chalam)
- Development of Technology for Detecting Presence of GMOs in an Unknown Sample and its Utilization in dealing with Bulk Samples (DAC) (R.K. Khetarpal, Gurinder Jit Randhawa, V. Celia Chalam, Kavita Gupta)

- Studies on the Potential of Electron Beam Irradiation as Quarantine Disinfestation Treatment against Insect-pests in Seeds (BRNS, DAE) (Shashi Bhalla, S. K. Sharma, B. Lal, Kavita Gupta)
- Preparation of Digitized Keys for Quick and Reliable Identification of Insect Pests of Family Bruchidae of Quarantine Significance (DAC) (Kavita Gupta, B. Lal, Manju Lata Kapur, Shashi Bhalla)
- Development of Quarantine Disinfestation Treatments (Thermal/ Modified Atmosphere) against Storage Insect-pests Infesting Walnut (DAC) (Shashi Bhalla, B. Lal, Manju Lata Kapur, Kavita Gupta)
- Development of Farmer Friendly Diagnostic Kits for Transgenic Event Seed Purity (ICAR) (R.K. Khetarpal, V. Celia Chalam)

5. GERMPLASM EXCHANGE UNIT

Summary: During the period under report 47,517 accessions (1,01,631 samples) were imported from 56 countries, which included germplasm 18,030 accessions (19,192 samples) as well as trial material 29,487 entries (82,439 samples) of different agricultural and horticultural crops. Requirements for germplasm from abroad were met by arranging material from different Indian sources and 77 samples were exported to six countries. A total of 11,596 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 Standard Material Transfer Agreement (SMTA).

5.1 Import of Plant Genetic Resources

The unit continued its efforts for germplasm introduction to meet the specific requirement of scientists working in ICAR research institutes, State Agricultural Universities (SAUs) other public organizations and private sector with R & D and non- governmental organizations (NGOs). Plant Genetic Resources 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

(a) Germplasm :	18, 030 (19,192 samples)
(b) Trials :	29,487 (82,439 samples)
Transgenic material imported (samples) :	221
No. of countries involved :	56
No. of Import Permit issued :	661
No. of cases registered :	396

5.1.1 Cereals and Millets

Aegilops sp. (177) from Afghanistan, Azerbaijan, Egypt, England, Germany, Syria, Iran, Iraq, Israel, Japan, Jordan, Libya, Soviet Union, Turkmenistan, Turkey, USA and Yugoslavia; *Avena sativa* (11) from Australia, USA; *Hordeum vulgare* (4) from USA; *Oryza sativa* (4,552) from Belgium, Egypt, Japan, Kenya, Philippines, Singapore and USA; *Pennisetum glaucum* (423) from Niger; *Sorghum bicolor* (487) from Australia, China, Kenya and USA; *Triticale* (4) from USA; *Triticum aestivum* (2,857) from Australia, Denmark, Egypt, Greece, Mexico, The Netherlands, South Africa, UK and USA; *Triticum araraticum* (2), *T. boeoticum* (19), *T. dalmaticum* (2), *T. dicoceoides* (26), *T. durum* (2), *T. monococcum* (39), *T. turgidum* (26), *T. urartu* (17), *Triticum* sp. (24) from Denmark, England, Ethiopia, Hungary, Iraq, Israel, Japan, Jordan, Mexico, The Netherlands, Serbia, Syria, Turkey, USA and Yugoslavia; *Zea mays* (3,523) from Argentina, China, France,

Indonesia, Italy, Kenya, Mexico, Nigeria, Philippines, Thailand, USA & Zimbabwe and *Zea* sp.(5) from Mexico. Trials: Rice (2,201 accessions, 10,302 samples) from Philippines i.e. AERON, IIRON, IIRON, INEVDUST, IRCTN-2007, IRFAON, IRDTN, IRLON, IRSBN, IRSSTN, IURON, HEAT TOL, 9TH IRBON. Wheat (12,388 accessions, 35,479 samples) from Mexico, Nepal, Syria viz. 11TH EGPSN, 8TH EGPYT, 11TH SAWYT, 1ST g991SRTN, 3RD ISRTN, 2ND IYRTN, 28TH ESWYT, 40TH IBWSN, 28TH ESWYT, 40TH IBWSN, 39TH IDYN, 25TH SAWSN, 15TH SAWYT, 28TH ESWYT, 7TH HLWSN, 15TH SAWYT, 37TH EDUYT, 2ND TEMRRSN, 28TH ESWYT, 18TH HRWSN, 15TH HRWYT, 37TH EDUYT, 2ND STEMRSN, 28TH ESWYT, 40TH IBWSN, 3RD EBWYT, 3RD SAMNYT, CWANA-31ST DON, CWANA31STDYD-LL-MIR, CWANA-31STDYD-MD, CWANA-CA 8TH DSDWYT, CWANA-CA 8TH IRSBWYT, CWANA-LL 2ND IASBWYT, CWANA-TA 8TH DSBWYT, CWANA-2ND HT SBWYT, CWANA-8H SBWON, IBCB-S, IBCSGP, IBLSGP, IBPMGP, IBON-LRA-C, IBON-LRA-M, IBCB-W, IBON-MRA, IBCSGP, IBSP-S, IBSP-W, BSTRGP, IBYT-LRA, IBYT-LRA-M, IBYT-MRA, IBYT-W, IBON-W, INBON, INBYT, ISEBON, INC-YTCRC. Wheat, Barley and Triticale (8893 accessions, 21,541 samples) from Mexico viz., 37TH EDUYT, 2ND STEMRRSN, 28TH ESWYT, 18TH HRWSN, 15TH HRWYT, 37TH EDUYT, 2ND STEMRSN, 28TH ESWYT, 40TH IBWSN, IBCB-S, IBCSGP, IBLSGP, IBPMGP, IBON-LRA-C, IBON-LRA-M, IBCB-W, IBON-MRA, IBCSGP, IBSP-S, IBSP-W, IBSTRGP, IBYT-LRA, IBYT-LRA-M, IBYT-MRA, IBYT-W, IBON-W, INBON, INBYT, ISEBON. Maize (244 accessions, 911 samples) from Mexico, Zimbabwe viz. EIHYB, EPOP, ILHYB, ILPOP and CHTSY Yield Trial.

Oilseeds

Arachis sp. (1) from Brazil; *Brassica juncea* (75) from Canada, *B. napus* (227) from Australia, USA, *Brassica*

rapa (4) from Canada; *Crambe abyssinnica* (1) from UK; *Erucastrum gallicum* (3) from Canada, *Glycine max* (45) from Australia, Brazil, Taiwan, USA; *Helianthus annuus* (654) from France, USA; *Helianthus* sp. (10) from Serbia; *Linum usitatissimum* (1) from UK and *Sinapis alba* (2) from Canada.

5.1.2 Grain legumes

Cicer arietinum (246) from Australia, Israel, Spain, Syria and Ukraine; *Cicer cuneatum* (3), *C. echinospermum* (6), *C. reticulatum* (2) all from Israel; *Glycine max* (1) from USA; *Lens culinaris* (1) from USA; *Phaseolus vulgaris* (12) from Canada, Columbia and USA; *Pisum sativum* (400) from USA, *Vigna radiata* (2) from Australia and *Vigna unguiculata* (60) from Belgium. Trials: Chickpea, Fababean, Lathyrus, Lentil and Vetch (5,761 accessions, 14,206 samples) from Syria viz. CIABN, CICTN, CIDTN, CIEN, CIEN-LA, CIEN-SL1, CIEN-SL2, CIF3N-SL, CIFWN, CILMN, CIEN-S; FBIABN, FBICSNILAT-LS; LICTN, LIDTN, LIENE, LIEN-GLO, LIEN-L, LIEN-MNR, LIEN-S, LIFWN, LIF3N-S, LIRN, LIF3N-E; IVAT-VN and IVAT-VS.

5.1.3 Fibre crops

Gossypium hirsutum (116) from USA and *Gossypium* sp. (924) from USA.

5.1.4 Vegetable crops

Abelmoschus esculentus (90) from Taiwan; *Allium ampleoprasum* (2) from UK; *A. cepa* (43) from UK, USA; *A. fistulosum* (2) from UK; *Brassica oleracea* var. *capitata* (311) from The Netherlands, *Capsicum annum* (748) from Taiwan, Thailand; *Cucumis sativus* (122) from Egypt and USA; *Cucurbita moschata* (3) from USA; *Daucus carota* (25) from USA, *Lycopersicon esculentum* (507) from France, Thailand Taiwan; *Lycopersicon cheesmani* (1), *L. chilense* (2), *L. parviflorum* (2), *L. hirsutum* (4), *L. peruvianum* (4) all from Taiwan; *Phaseolus vulgaris* (1) from Egypt and *Solanum melongena* (11) from Taiwan.

5.1.5 Fruit crops

Citrus reticulata (3), *C. sinensis* (1) from USA; *Ficus carica* (21) from USA; *C. paradisiaca* (1) from Egypt; *Citrullus vulgaris* (152) from Thailand; *Prunus*

armeniaca (12) from USA, Vietnam; *Prunus besseyi* (1), *P. cerasifera* (2), *P. domestica* (1), *P. hybrida* (1), *P. msititia* (1), *P. mahaleb* (1), *P. persica* (4), *P. salicina* (1) all from France; *Prunus* sp. (2) from The Netherlands and *Vitis vinifera* (2) from Brazil.

5.1.6 Forages

Leucaena diversifolia (1), *L. lecucocephala* (1), *L. pallida* (1), *Leucaena* sp. (1) all from USA; *Medicago sativa* (5) from USA; *T. alexandrium* (6) from USA and *Trifolium pratense* (76) from Egypt, Kenya & USA.

5.1.7 Tuber crops

Ipomoea batatas (29) from Peru; *Solanum tuberosum* (51) from Peru; The Netherlands USA; *S. acaule* (4), *S. berthaulii* (4), *S. boliviense* (2), *S. bulbocastanum* (17), *S. chacoense* ssp. *chacoense* (8), *S. demissum* (39), *S. tuberosum* ssp. *andigenum* (10) all from USA and *Solanum* sp. (113) from USA.

5.1.8 Sugar yielding crops

Beta vulgaris (10) from France, USA; *Saccharum officinarum* (1) from USA.

5.1.9 Medicinal and Aromatic Plants

Hypericum species (21) from USA

5.1.10 Ornamental plants

Allium tuberosum (1) from UK.

5.1.11 Narcotics and Beverages

Nicotiana tabaccum (17) from France, USA; *Nicotiana* sp. (90) from USA; *Theobroma cocoa* (77) from Malaysia and UK.

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 following the guidelines. The volume of export of seed/ planting materials during 2007 is indicated below.

Number of requests registered :	25
Number of countries to which material exported:	6
Number of accessions exported :	77

5.2.1 Cereals

Oryza sativa (12) to Philippines; *Eleusine coracana* (40) to Bhutan, Nepal, Sri Lanka and Bangladesh.

5.2.2 Oilseeds

Brassica napus (2), *Brassica juncea* (23) to Australia

5.2.3 Country-wise export

Australia (25), *Brassica napus*, *B. juncea*; Bhutan (10) *Eleusine coracana*; Bangladesh (10) *E. coracana*; Nepal (10) *E. coracana*; Philippines (12) paddy and Sri Lanka (10) *E. coracana*.

Table 1: Promising trait specific material introduced during 2007

Crop (EC Nos.)	Country	Identifying traits	Distribution
Cereals			
<i>Hordeum vulgare</i> 596667	USA	Six rowed spring barley, high yielding, early maturing, resistant to net blotch or smut.	PD, DWR, Karnal (Haryana)
<i>H. vulgare</i> 596668	USA	High B-glucan content, low malt extract, feed barley type	Director, IGFR, Jhansi (UP)
<i>H. vulgare</i> 607790	USA	Low phytate, six rowed spring feed barley which provides phosphorus (p) digestibility and mineral nutrition for humans and non ruminant animals, resistant to rust	PD, DWR, Karnal (Haryana)
<i>Oryza sativa</i> 595767	Egypt	Salinity tolerant types	Director, IGFR, Jhansi (UP)
<i>O. sativa</i> 608591-650	Philippines	CMS, restorer and maintainer lines	OIC, NBPGR RS, Hyderabad Seed for: M/s Metahelix Life Sciences (P) Bangalore (Karnataka)
<i>O. sativa</i> 605403	Philippines	Irrigated type	Director, CRRI, Cuttack (Orissa)
<i>O. sativa</i> 609524-43	Kenya	Inbred lines	OIC, NBPGR- RS, Hyderabad Seed for: Dr.Sukhpal Singh, Devgen Seeds & Crop Technology Pvt. Ltd, Hyderabad (AP)
<i>O. sativa</i> 609544-47	Kenya	TGMS line	-do-
<i>O. sativa</i> 609339-54	Philippines	New plant types	OIC, NBPGR- RS, Hyderabad AP Seed for: Dr. M.J.Abraham, MAHYCO, Medak (AP)
<i>O. sativa</i> 609355-59	Philippines	BLB resistance	-do-
<i>O. sativa</i> 609360-66	Philippines	Drought tolerant lines-Lowland	-do-
<i>O. sativa</i> 609367-74	Philippines	Submergence tolerant	-do-

<i>O. sativa</i> 609375-80	Philippines	Irrigated	-do-
<i>O. sativa</i> 609381-94	Philippines	Salinity tolerant lines	-do-
<i>O. sativa</i> 609612	USA	Indica rice genetic stock mutants	PD, DRR, Hyderabad Seeds for: Dr. Tapash Dasgupta, Professor & Head, Department of Genetics and Plant Breeding, University of Calcutta, Kolkata (WB)
<i>Triticum aestivum</i> 596302	USA	Suitable for dryland areas, high yield potential, resistant to stripe rust and Septoria glume blotch	PD, DWR, Karnal (Haryana)
<i>T. aestivum</i> 596303-08	S.Africa	Russian wheat Aphid (RWA) <i>Diuraphis noxia</i> resistant near isogenic lines (NILs)	-do-
<i>T. aestivum</i> 596664	USA	Superior type, high grain yield potential, resistant to stripe rust	-do-
<i>T. aestivum</i> 596665	USA	High yield potential, high temperature tolerant, adult-plant resistance to local races of stripe rust, partial resistance to Hessian fly, superior dual purpose for noodle and bread products.	-do-
<i>T. aestivum</i> 596713-14	USA	Hard red winter wheat, unique ability to endure and recover from extended and intensive grazing in a dual purpose management system, tolerant to low pH soils with high aluminum starvation, resistant to wheat leaf rust	-do-
<i>T. aestivum</i> 605444	Greece	Broad adaptation, high yielding ability, high protein concentration, and good end use quality in central and northern Greece.	-do-
<i>Triticum</i> sp. 609395-412	Serbia	Winter wheat	-do-
<i>Triticum</i> sp. 609413-14	Serbia	Spring wheat	-do-
<i>T. turgidum</i> var. <i>durum</i> 609335-38	USA	Durum germplasm carrying Glu-d1d with glutenin or gliadin genes	-do-
Oil Seeds			
<i>Brassica napus</i> 597255-74	Australia	Mid maturity, very high oil and protein, resistant to blackleg	Director, NRC on Rape seed & Mustard, Sewar, Bharatpur
<i>B. napus</i> 597253	Australia	Large seeds, early to mid maturity	-do-
<i>B. napus</i> 597254	Australia	Drought tolerance	-do-
<i>B. napus</i> 609294-328	Australia	Screening for drought tolerance	-do-
<i>B. napus</i> subsp. <i>oleifera</i> 596635	USA	Edible quality oil, low glucosinolates and low erucic acid	-do-
<i>B. nuncea</i> 597309-25	Australia	Low glucosinolates, good yield, moderate to high oil	-do-
<i>Glycine max</i> 606917	USA	Var. NC 114 High seed protein content and resistant to <i>Soybean</i> <i>mosaic virus</i> and bacterial pustule (<i>Xanthomonas campestris</i> pv <i>glycines</i>)	PEQN, NBPGR, New Delhi Seed for: Director, NRC Soybean, Indore

<i>G. max</i> 606918	USA	High seed protein 402 g/kg and High oil content 193 g/kg	-do-
<i>Helianthus annuus</i> 595322-33	USA	CMS line and fertility restoration lines	PD, DOR, Hyderabad
<i>H. annuus</i> 595334-48	Australia	High yield and high oil content	OIC, NBPGR- RS, Hyderabad Seed for: M/s Metahelix Life Sciences Pvt. Ltd, Bangalore (Karnataka)
Grain Legumes			
<i>Cicer arietinum</i> 595376-83	Syria	Cold tolerant germplasm lines	Dr. Harsh Nayar, Department of Botany, Punjab University, Chandigarh-160014
<i>C. arietinum</i> 595969	Spain	Recombinant inbred line with pink flowers, non shattering pod, semi erect growth habit, and combined resistance against Ascochyta blight (caused by <i>Ascochyta rabiei</i>) and rust)	Director, IIPR, Kanpur
<i>C. arietinum</i> 599949	Syria	High yielding, resistance to Ascochyta blight	-do-
<i>C. arietinum</i> 600092-93	Israel	Modern high yielding Israeli Kabuli cultivar, late flowering, with good resistance to Ascochyta blight. Currently, leading variety in Israel	OIC, NBPGR- RS, Hyderabad Seed for: Dr. P.M.Gaur, ICRISAT, Patancheru (AP)
<i>C. arietinum</i> 600097	Israel	A breeding line combining early flowering with moderate Ascochyta resistance, selected from cross Sanford X ICC 7344	-do-
<i>Lens culinaris</i> 608175	USA	Winter hardy lentil intended for fall planting directly into cereal stubble small seeds with red cotyledon and absence of seed coat mottling.	Director, IIPR, Kanpur
<i>Phaseolus vulgaris</i> 599950	Canada	Resistant to both yellow and orange strains of bacterial wilt	OIC, NBPGR RS, Phagli, Shimla-171004
<i>P. vulgaris</i> 593020	USA	Small seeded tropically adapted, resistance to common bacterial blight caused by <i>Xanthomonas campestris</i> pv. <i>phaseoli</i> and <i>Rhizoctonia solani</i> , and unique source of resistance to soil fungi, adapted to temperate climates	For PEQN growing
<i>Pisum sativum</i> 595959-63	USA	Ascochyta blight resistance lines	Dr. S.K. Sugha, Department of Plant Pathology, CSK-HPKV, Palampur (HP)
<i>Vigna radiata</i> 605445	Australia	Powdery mildew resistant green gram line	For PEQN growing Seed for: Dr. S.T.Kajjidoni, Prof. of Genetics and Plant Breeding, College of Agril. UAS, Dharwad
Vegetables			
<i>Capsicum annum</i> 596866-918	Taiwan	Pepper inbred lines	OIC, NBPGR- RS, Hyderabad Seed for: Dr. Makarand K. Pande, M/s J.K. Agri. Genetics Ltd, Begumpet, Hyderabad
<i>C. annum</i> 596919-23	Taiwan	Anthracoese resistant lines	-do-
<i>C. annum</i> 596924-30	Taiwan	High yielding lines	-do-

<i>C. annuum</i> 596931-36	Taiwan	CVMV resistant lines	-do-
<i>C. annuum</i> 596937-48	Taiwan	CMS (A and B lines)	-do-
<i>C. annuum</i> 596949-60	Taiwan	Restorer lines	-do-
<i>C. annuum</i> 596749-50	Taiwan	Heat tolerant lines	Dr. Shivendra Kuma, Head, HAFRP, Ranch
<i>Lycopersicon esculentum</i> 600051	Taiwan	Resistant to TY, BW, F-1, TMV	OIC, NBPGR- RS, Hyderabad Seed for: Dr. M. Ramasami, M/s Rasi Seeds (P) Ltd, Attur (Post) Salem Dt.(TN)
<i>L. esculentum</i> 606704	Taiwan	Resistant to BW, F-1,F-2, TMV	-do-
<i>L. esculentum</i> 604747	France	Long shelf life, indeterminate type, elongated fruit	OIC, NBPGR- RS, Hyderabad Seed for: Dr. Pramod Deshmane, Avestha Gengraine Technologies Pvt.Ltd, Bangalore (Karnataka)
<i>L. esculentum</i> 605432-43	Taiwan	Bacterial wilt and late blight resistance.	OIC, NBPGR- RS, Hyderabad Seed for: Dr. Devaraja, Indo American Hybrid Seeds (I) pvt.Ltd, Channasandra Village, Subramanyapura Post Uttarahalli
<i>L. esculentum</i> 606703	Taiwan	Ty, BW,F-1TMV	Dr. J.C. Rajput, Nrmal Seeds Pvt. Ltd, PB 63, Bhadgaon Road, pachora - 424201, MS
<i>L. esculentum</i> 606704	Taiwan	BW,F-1,F-2, TMV	Dr. J.C. Rajput, Nrmal Seeds Pvt. Ltd, Bhadgaon Road,Pachora (MS)
<i>L. esculentum</i> 610636	Taiwan	BW, TMV, F-1	Mr. Jainendra F. Daftari, Director of Research, Daftari Agro Biotech Pvt.Ltd, Seloo, Dist Wardha-442104
<i>L. esculentum</i> 610636	Taiwan	Heat tolerant	-do-
<i>L. esculentum</i> 610627	Taiwan	TY, BW, F-1, TMV, ST	-do-
Cash crops			
<i>Linum usitatissimum</i> 607789	UK	Spring type	Dr. V.S.Rao, Director, M/s Agharkar Research Insitute, G.G.Agarkar Road, Pune-411 004
<i>Beta vulgaris</i> 596298	USA	A heterogeneous disease resistant sugar beet population resistant <i>B eet necrotic yellow vein virus</i> , root rotting strains and root aphid	Director, IISR, Lucknow
<i>B. vulgaris</i> 596299-301	USA	Monogerm sugar beet resistant to Rhizoctonia root rot and moderately resistant to Cercospora leaf spot	-do-
<i>Medicago sativa</i> 596669-71	USA	Broad genetic base population provide resistance to blue alfalfa aphid (<i>Acyrtosiphon kondoi</i>)	Director, IGFRI, Jhansi (UP)
<i>M. sativa</i> 596672-73	USA	Unique combination of a broad genetic base	-do-
<i>Nicotiana glauca</i> 608736	USA	Self-incompatible. Sib pollinate plants to produce seed	OIC, NBPGR- RS, Hyderabad Seed for: Director, CTRI, Rajahmundry (AP)

<i>N. arentsii</i> 608740	USA	Seed can be produced in green house, but mature plants can be induced to flower with growth chamber conditions of 30 °C day/ 16 °C night with 8 hour photoperiod	-do-
<i>N. bonariensis</i> 608745	USA	Self-incompatible. Sib pollinate plant to produce seed.	-do-
<i>N. cordifolia</i> 608748	USA	Prefers cool nights for pollen production , Flowers should have purple color for good pollen production.	-do-
<i>N. forgetiana</i> 608751	USA	Self incompatible. Sib pollinate plants to produce seed	-do-
<i>N. noctiflora</i> 608773	USA	Seed may take 20-30 days to germinate. Self-incompatible. Sib pollinate to produce seed.	-do-
<i>N. otophora</i> 608777	USA	Prefers cool nights for flowering.	-do-
<i>N. petunioides</i> 608786	USA	Seed may take 20-30 days to germinate. Prefers cool nights for flowering. Self-incompatible. Sib pollinate to produce seed.	-do-
<i>N. setchellii</i> 608796	USA	Seed production is improved by sib pollination. Prefers cool nights for flowering.	-do-
<i>N. solanifolia</i> 608798	USA	Self-incompatible. Seed production improved by sib pollination	-do-

Table 2: Transgenic material introduced during 2007

Crop / EC No.	Country	Samples		Distribution
Cabbage EC595547-746	Netherlands	200	Transgenic seeds of cabbage containing cry1Ba cry 1Ca genes.	M/s Nunhems India pvt.Ltd, Gurgaon
Maize EC602543-546	USA	7	Inbred parental lines of Roundup ready corn expressing CP4-EPSPs gene for production of RR corn hybrids to be used in the research trials.	M/s Monsanto India, New Delhi
Maize EC602547	USA	1	Transgenic maize seeds, lyophilized maize leaf and frozen maize leaf containing glyphosate -N-acety 1 transferase (gat) gene for molecular characterization of the integration event.	M/s Metahelix Life Sciences, Bangalore Maize
EC602533-42	Philippines	10	Inbred parental lines of Roundup ready corn expressing CP4-EPSPs gene for production of RR corn hybrids to be used in the research trials.	M/s Monsanto India, New Delhi
Rice EC604745-46	USA	2	Seeds expressing 5 enolpyruvylshikimate-3 phosphate synthase (EPSPS) gene conferring tolerance against glyphosate	M/s Monsanto India, New Delhi
Wheat EC605722	USA	1	Transgenic round up ready ® wheat seed expressing 5- EPSPS gene (MON 71800 event) conferring tolerance against glyphoate, the active ingredient in the roundup spray of agri-herbicides.	M/s Mahyco Seed Co., Mumbai

Table 3: Wild species introduced during 2007

Name of the species (Number of species)	Country	Distribution
<i>Aegilops bicornis</i> , <i>A. caudata</i> , <i>A. columanaris</i> , <i>A. comosa</i> , <i>A. juvenalis</i> , <i>A. kotschyi</i> , <i>A. longissimas</i> , <i>A. ovata</i> , <i>A. peregrina</i> , <i>A. speltooides</i> , <i>A. auschii</i> , <i>A. tauschii var.meyeri</i> , <i>A. triaristata</i> , <i>A. triuncialis</i> , <i>A. umblulata</i> , <i>A. variabilis</i> , <i>A. ventricoda</i> , <i>A. ventricosa</i> (18)	Different countries	GCD, NBPGR, New Delhi
<i>Gossypium australe</i> , <i>G. costulatum</i> , <i>G. darwinii</i> , <i>G. incanum</i> , <i>G. nandewarensense</i> , <i>G. nelsonii</i> , <i>G. tomentosum</i> , <i>G. trilobum</i> (8)	USA	CICR, Nagpur
<i>Helianthus glauciphyllus</i> , <i>H. microcephalus</i> , <i>H. niveus</i> , <i>H. salicifolius</i> , <i>H. silphiooides</i> , <i>H. smithii</i> (6)	Serbia Monte-negro	NBPGR-RS, Hyderabad
<i>Hypericum adpressum</i> , <i>H. cistifolium</i> , <i>H. denticulatum</i> , <i>H. gentianoides</i> , <i>H. hirsutum</i> , <i>H. humifusum</i> , <i>H. hypericoides</i> , <i>H. majus</i> <i>H. mitchellianum</i> , <i>H. monogynum</i> , <i>H. oblongifolium</i> , <i>H. perforatum</i> , <i>H. punctatum</i> , <i>H. tetrapetalum</i> (14)	USA	NBPGR-RS, Hyderabad Seed for: Dr. Ravishankar Rai, Department of Botany and Microbiology, University of Mysore, Mysore
<i>Lycopersicon chessmani</i> , <i>L. chilense</i> , <i>L. parviflorum</i> , <i>L. peruvianum</i> (4)	Taiwan	Dr. Manju Vishwakarma, M/s Ankur Seeds Pvt. Limited, Nagpur
<i>Nicotiana acaulis</i> , <i>N. acuminata</i> , <i>N. africana</i> , <i>N. alata</i> , <i>N.</i> <i>amplexicaulis</i> , <i>N. arentsii</i> , <i>N. attenuata</i> , <i>N. benavidesii</i> , <i>N. benthamiana</i> , <i>N. bonariensis</i> , <i>N. cleelandii</i> , <i>N. clevelandii</i> , <i>N. cordifolia</i> , <i>N. corymbosa</i> , <i>N. debneyi</i> , <i>N. forgetiana</i> , <i>N. fragrans</i> , <i>N. glutinosa</i> , <i>N. goodspeedii</i> , <i>N. kawakamii</i> , <i>N. langsdorffii</i> , <i>N. linearis</i> , <i>N. maritima</i> , <i>N. megalosiphon</i> , <i>N. miersii</i> , <i>N. noctiflora</i> , <i>N. nudicaulis</i> , <i>N. obtusifolia</i> , <i>N. otophora</i> , <i>N. paniculata</i> , <i>N. pauciflora</i> , <i>N. petunioides</i> , <i>N. quadrivalvis</i> , <i>N. raimondii</i> , <i>N. rosulata</i> , <i>N. rotundifolia</i> , <i>N. rustica</i> , <i>N. setchellii</i> , <i>N. simulans</i> , <i>N. solanifolia</i> , <i>N. spegazzinii</i> , <i>N. stocktonii</i> , <i>N. suaveolens</i> , <i>N. sylvestris</i> , <i>N. tomentosa</i> , <i>N. tomentosiformis</i> , <i>N. umbratica</i> , <i>N. velutina</i> , <i>N. wigandioides</i> (49)	USA	NBPGR-RS, Hyderabad Seed for: CTR I, Rajahmundry
<i>Solanum acaule f. acaule</i> , <i>S. berthaultii</i> , <i>S. boliviense</i> , <i>S. bulbocastanum</i> , <i>S. chacoense</i> subsp. <i>chacoense</i> , <i>S. chomatophilum</i> , <i>S. commersonii</i> subsp. <i>commersonii</i> , <i>S. demissum</i> , <i>S. gourlayi</i> subsp. <i>gourlayi</i> , <i>S. hjertingii</i> , <i>S. hougassii</i> , <i>S. infundibuliforme</i> , <i>S. iopetalum</i> , <i>S. kurtzianum</i> , <i>S. megistacrolobum</i> , <i>S. megistacrolobum</i> subsp. <i>toralapanum</i> , <i>S. microdontum</i> , <i>S. oplocense</i> , <i>S. palustre</i> , <i>S. pampasense</i> , <i>S. phureja</i> subsp. <i>phureja</i> , <i>S. pinnatisectum</i> , <i>S. polyadenium</i> , <i>S. raphanifolium</i> , <i>S. sanctae-rosae</i> , <i>S. sparsipilum</i> , <i>S. spegazzinii</i> , <i>S. stenophyllidium</i> , <i>S. stoloniferum</i> , <i>S. trifidum</i> , <i>S. vernei</i> subsp. <i>ballsii</i> , <i>S. vernei</i> subsp. <i>vernei</i> , <i>S. verrucosum</i> (33)	USA	CPRI, Shimla
<i>Triticum araraticum</i> , <i>T. boeoticum</i> , <i>T. dalmaticum</i> , <i>T. lorentii</i> , <i>T. urartu</i> (5)	USA	GCD, NBPGR, New Delhi
<i>Zea diploperennis</i> , <i>Z. luxurians</i> , <i>Z. perennis</i> (3)	Mexico	Dr.B.M.Prasanna, Division of Genetics, IARI, New Delhi

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, 11,596 samples were supplied by the Bureau as per the details given below under the Standard Material Transfer Agreement (SMTA).

Crop group	Crop	Samples	Distribution	
Cereals (4,885) & Millets (448)	Rice	176	IARI, New Delhi; NBRI, Lucknow; Univ.of Madras; NBPGR, Cuttack; GBPUA & T, Pantnagar; BARC, Mumbai	
	wheat	4,318	HPKV; IARI; V.P.K.A.S. Almora; GBPUA & T, Pantnagar; PAU, Ludhiana; HAU Hisar; CSAUA & T, Kanpur; ; DWR, Karnal; MPKV, Rahuri; RAU, Jaipur; WRS, Bhavnagar; NDUAT, Faizabad; SKUAST (K) Leh; Jamia Hamdard, New Delhi; NBPGR, Srinagar; NBPGR, Bhowali, Govt College, Noida	
	Barley	271	NBPGR, Srinagar; DWR, Karnal; RAU, Jaipur; SKUAST (K) Leh	
	Maize	44	CSAUA & T, Kanpur; V.P.K.A.S. Almora	
	Oat	76	IGFRI, Jhansi; HPKV, Palampur; HAU, Hisar	
	Italian millet	206	JNU, Delhi	
	Finger millet	192	GBPUA & T, Pantnagar; ICAR, Res.Complex, Gangtok; ANGRAU, Hyderabad; UAS Dharwad	
	Barnyard millet	50	GBPUA & T, Pantnagar	
	Oil Seeds (258)	<i>Brassica carinata</i>	01	IARI, New Delhi
		<i>B. tourneforti</i>	01	IARI, New Delhi
<i>Brassica compestris</i>		10	Lucknow University, Lucknow	
<i>Brassica sp</i>		147	IARI, New Delhi; NDUAT, Faizabad; HPKV, Kangra; NRC R & M, Bharatpur; MAU, Parbhani	
<i>Brassica napus</i>		60	Jamia Hamdard, New Delhi; NBPGR, Srinagar	
<i>Lepidium sp.</i>		01	NRC R & M, Bharatpur	
Safflower		20	University of Allahbad, Allahbad	
Vegetable crops (1,049)	Tomato	51	Delhi University; HPKV, Bajaura; MLK College, Balrampur	
	Brinjal	55	SKUAST (J); NBPGR, Hyderabad; MLK College, Balrampur	
	Chilli	79	MPKV, Kolhapur; NBPGR, Hyderabad	
	Okra	209	PAU, Ludhiana; NBPGR, Hyderabad;	
	Radish	18	PDKV, Akola	
	<i>Trigonella</i>	55	GJU, Hisar; ARI, Pune	
	<i>Allium spp</i>	11	NRC O & G, Pune	
	Water melon	59	NBPGR, Jodhpur	
	Snap melon	57	NBPGR, Jodhpur	
	Pickling melon	06	NBPGR, Jodhpur	
	Musk melon	216	NBPGR, Jodhpur	
	<i>Cucumis sativus</i> var. <i>hardwickii</i>	20	GBPUA & T, Pantnagar	
	<i>Cucumis</i>	05	NBPGR, Jodhpur	
	Bottle Gourd	15	SKUAST (J)	
	Bitter Gourd	14	NBPGR, Thrissur	
	<i>Momordica dioica</i>	01	Punjab University, Patiala	
	Ash Gourd	31	NBPGR, Thrissur	
	Snake Gourd	09	NBPGR, Thrissur	
	Ivy Gourd	01	NBPGR, Thrissur	
	Pumpkin	167	NBPGR, Thrissur	
Pulses (4,470)	Lentil	146	V.P.K.A.S. Almora; SKUAST (K), IIPR, Kanpur; Govt College Noida	

	Pea	38	V.P.K.A.S. Almora; SKUAST (K); MLK PG College, UP; Govt College Noida; ARC Udaipur
	Cowpea	68	GNDU, Amritsar; SDAU, Banaskantha; CSAUA & T, Kanpur;
	<i>Lablab purpurens</i>	08	NBPGR, Akola
	<i>Vigna sesquipedalis</i> var. <i>sesquipedalis</i>	02	Network project on Arid Legumes, Jodhpur
	<i>Vigna cylendrica</i>	03	Network Project on Arid Legumes, Jodhpur
	Mungbean	293	NBPGR, Jodhpur; JAU, Gujrat; ANGRAU, Guntur; UAS, Bangalore; MLK PG College, Balrampur
	Urdbean	113	GBPUA & T, Pantnagar ; V.P.K.A.S. Almora; GNDU, Amritsar; MLK PG College, UP; SDAU, Banaskantha; JAU, Gujrat; UAS, Bangalore; NARP, Pune
	<i>Vigna</i> sp.	08	Govt. Institute of Science, Aurangabad
	French bean	150	ICAR, Res.Complex, Gangtok; NBPGR, Shimla;
	Cluster bean	3625	NBPGR, Jodhpur; CARI, Port Blair
	Dolichus bean	15	ICAR, Research complex for Eastern Region, Ranchi
M & AP (271)	<i>Mucuna</i>	37	HAU, Hisar; NBPGR, Ranchi; University of Kolkata
	<i>Andrographis paniculata</i>	18	CCS HAU, Hisar
	<i>Aloe vera</i>	04	HAU, Hisar
	Satavar	08	HAU, Hisar
	<i>Rauvalfia serpentine</i> (<i>in vitro</i>)	02	KAU, Thrissur
	<i>Atropa belladonna</i>	01	JNKVV, Jabalpur
	<i>Ocimum basilicum</i>	18	JNKVV, Jabalpur; HAU, Hisar
	<i>Ocimum (Virdii, gratissimum sanctum)</i>	01	JNKVV, Jabalpur
	<i>Asparagus recemosus</i>	10	Dayalbagh, Education Institute, Agra
	Palmarosa	25	CCS University, Meerut
	<i>Tinospora cardifolia</i>	36	HPKV; TFRI, Jabalpur
	<i>Psoralia corylifolia</i>	10	Jamia Hamdard, New Delhi
	<i>Wthania somnifera</i>	08	Ferguson College, Pune; St. Johri College, Agra
	<i>Catharanthus roseus</i>	06	Lucknow University, Lucknow
	Kalmegh	05	IIHR, Bangalore
	Ginger (<i>In vitro</i>)	82	NBPGR, Thrissur
UU Crops (60)	Horse gram	20	GNDU, Amritsar
	Amaranth	28	PDKV, Akola; Govt of W.B.
	Sesbania	03	St. John College, Agra
	<i>Canavalia</i>	09	NBPGR, Akola
Forages (61)	<i>Medicago sp</i>	41	NCPGR, JNU, New Delhi
	Forage & Aromatic grasses	20	IVRI, Muktaashwar
Fruits (08)	Banana (<i>In vitro</i>)	59	NRC Banana, Trichy; IIHR, Bangalore; PAU, Ludhiana; KAU, Thrissur
	Mulberry cuttings	25	CIAH Bikaner
Misc.	<i>Lausonia inermis</i>	10	CCS HAU Hisar
	<i>Zinziber officinale</i> (<i>in vitro</i>)	82	NBPGR, Regional Station, Thrissur

Other Activities:

- Plant Germplasm Reporter Vol.7, Nos.1, 2,3 and 4 were compiled and distributed.

Research Projects (Project Code, Title, PI, CoPIs 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 (I.P. Singh upto July 2007, Arjun Lal w.e.f. August 2007)

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. [Deep Chand, Vandana Tyagi (upto 12.7.2007), Nidhi Verma (w.e.f. 4.8.2007), S.P.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. [Nidhi Verma (w.e.f. 4.8.2007), Deep Chand, Vandana Tyagi (upto 12.7.2007), S.K.Yadav (w.e.f 30.11.2007), S.P.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. (Pratibha Brahmi (w.e.f. 1.8.2007), Deep Chand, Vandana Tyagi (upto 12.7.2007), Nidhi Verma (w.e.f. 4.8.2007), S.P.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. [Nidhi Verma (w.e.f. 4.8.2007), Deep Chand, Vandana Tyagi (upto 12.7.2007), S.K.Yadav (w.e.f 30.11.2007), S.P.Singh and Surender Singh).

PGR/GEX-BUR-DEL-01.05: National Network Project on Underutilized fruits. (Deep Chand, S.K.Malik).

6. TISSUE CULTURE AND CRYOPRESERVATION UNIT

Summary: During the year, a total of 1,957 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 continued on aspects related to *in vitro* slow growth and cryopreservation in aforementioned group of crops. Employing several slow growth strategies, subculture duration could be enhanced to varying periods in alliums and *Bacopa monnieri*. Cost-effective conservation experiments yielded encouraging results in *B. monnieri*, *Kaempferia galanga* and *Musa* sp. Experiments to test the potential of synseeds in *Zingiber officinale* yielded encouraging results. Cryopreservation experiments led to varying degree of pre-and post-freezing success in *Allium sativum*, *Gentiana kurroo*, *Morus* sp., *Picrorhiza kurroa* and *Rubus* sp. Genetic stability studies employing various morphological or molecular marker (RAPD) in *Colocasia esculenta* revealed that there were no significant differences between *in vitro*-regenerants and their respective mother plants. A total of 144 accessions comprising *Z. officinale* (82), *Musa* sp. (60) and *Rauvolfia serpentina* (2) were supplied as *in vitro* cultures to various indentors. A total of 439 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen were cryopreserved during the year totaling to 8459 accessions in the cryogenebank. Successful cryopreservation was achieved in seeds, embryos and embryonic axes of *Salvadora* sp., *Madhuca longifolia*, *M. indica* and *Prunus armeniaca*. Fruit-setting after field pollination, using cryostored mango pollen, indicated successful cryopreservation protocol development.

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, 56 accessions were added in the *in vitro* genebank and these include *Colocasia esculenta* (13), *Curcuma* spp. (8), *Dioscorea* spp. (2), medicinal and aromatic plants (9), *Musa* spp. (7), *Pyrus* sp. (1), *Rubus* spp. (12) and *Vaccinium* spp. (4). A total of 1,957 accessions belonging to different crop groups were maintained *in vitro* and subcultured at periodic interval (Table 1).

6.1.1 Tropical fruits: Work on *in vitro* conservation of banana (*Musa* spp.) and grapes (*Vitis vinifera*) was continued and during the year, 7 accessions of banana were added to the collection. Thus, the total number of tropical fruits accessions stands at 412 (~3,725 cultures) comprising *Musa* spp. (409) and *Vitis vinifera* (3). An experiment was conducted for low cost *in vitro* conservation of banana by using inexpensive substitutes in tissue culture media, in a banana cultivar Karpura Chakkerkelli (AAB). Ten media combinations were prepared using different gelling agents and carbohydrate sources either with distilled water or tap water. Three gelling agents i.e. phytigel, agar and isabgol were used along with two carbohydrate sources i.e. sucrose and granulated market sugar. After 12 months of

conservation, significantly higher survival (100%) was achieved on isabgol-gelled medium compared with 75% on agar-gelled medium and 58% on phytigel-gelled medium. Replacement of LR grade sucrose with market grade sugar had no significant effect on growth of cultures. However, cost of the medium was reduced by 75%. To validate the genetic stability of the cryopreserved banana germplasm (proliferating meristems) using cryopreservation protocol (vitrification technique) devised in the previous years, plants were hardened and transferred to the field. No significant difference was observed in the growth and morphology in 5-month-old plants

6.1.2 Bulb crops: *In vitro* maintenance of 177 accessions belonging to 4 genera comprising 18 species (*Allium* spp., *Cicer microphyllum*, *Dahlia* and *Gladiolus* cv.) was carried out under culture room conditions and/or at low temperature through periodic subculture (4-24 months) or resterilization.

In *Dahlia*, single shoot bearing 3 or 4 culturable cuttings was obtained on NAA and kinetin-supplemented medium. Following supplementation of basal medium with BAP and AgNO₃, basal callusing could be avoided and 6-8 nodal segment explants could be obtained.

Regarding short- to medium-term conservation, in *A. hookeri*, maintenance of cultures on half-or full-strength basal medium was beneficial in prolonging subculture duration to 10 months at 25°C whereas in *Dahlia*, it was not beneficial. In the latter, maintenance of cultures on low sucrose (1%) medium was also not beneficial in

prolonging the subculture duration. In *A. ramosum*, subculture duration could be extended from 3 months to 13 months following incubation of cultures at 4°C.

Regarding cryopreservation in *A. sativum*, shoot tip explants (excised from cloves) pre-cultured on high sucrose medium, exhibited better regrowth following PVS2 dehydration in comparison to those not subjected to sucrose preculture. Following LN freezing, explants exhibited up to 40% survival (greening and swelling of leaves). Using another cryoprotectant i.e., PVS3, non-frozen shoot tip explants exhibited regrowth following cryoprotective dehydration (0-180 mins). Following LN freezing, up to 20% survival of shoot tips was obtained and surviving explants looked healthier than those treated with PVS2.

6.1.3 Medicinal, aromatic and rare / endangered plants: *In vitro* maintenance of existing cultures of 184 accessions belonging to 24 genera and 33 species was achieved through periodic subculture and reesterilization (4-24 months) either under culture room conditions and/or at low temperature.

A total of 9 accessions belonging to 7 genera were added in the *in vitro* genebank and these include *Acorus calamus* (1), *Bacopa monnieri* (3), *Gentiana kurroo*, (1), *Holostema ada-kodien* (1), *Plumbago rosea* (1), *Rauwolfia serpentina* (1) and *Valeriana wallichii* (1). Regarding short-to medium-term conservation, in 3 accessions of *B. monnieri*, encapsulated shoot tips were conserved for 30 weeks in a cryovial without nutrient medium at 25°C. Cultures were successfully conserved in *Kaempferia galanga* and *B. monnieri*, using sugar cubes in place of LR-grade sucrose and isabgol as a gelling agent, for 8 and 15 months, respectively.

In *Picrorhiza kurroa* and *Gentiana kurroo*, cryopreservation experiments continued to optimize preculture conditions to improve survival after cryopreservation of shoot tips. In *G. kurroo*, with modified dehydration conditions, only 10% shoot tips regenerated after LN freezing, using encapsulation-dehydration technique. In *P. kurroa*, non-frozen controls exhibited normal growth while no post-thaw survival could be achieved using droplet freezing technique.

6.1.4 Spices, plantation and industrial crops: A total of 371 accessions (~ 5,000 cultures) comprising 184 of *Zingiber* species, 151 of *Curcuma* species, 7 species

of *Piper*, 5 of *Elettaria cardamomum*, 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 8 new accessions of *Curcuma* spp. were added to the *in vitro* genebank during the year.

Experiments were initiated to test the potential of synseeds or artificial seeds in ginger (*Zingiber officinale*) for micropropagation, *in vitro* conservation and germplasm exchange. Synseeds were developed by nutrient-alginate (2-6%) encapsulation of axenic shoot buds (5-6 mm) derived from *in vitro* shoot cultures of ginger (IC-248890). The encapsulated explants were cultured on MS medium supplemented with four cytokinins i.e. BAP, kinetin, 2ip and zeatin using three different concentrations (0.1 µM, 1.0 µM and 10 µM), with the objective to determine optimum concentration of a particular growth regulator for the germination of synthetic seeds. Of all the four cytokinins tested, BAP, kinetin and 2ip were suitable for synseed germination, whereas it was inhibited on zeatin-supplemented medium. Amongst the three effective cytokinins that gave response, higher number of shoots and roots were formed on BAP-supplemented medium followed by that on 2iP. The optimal concentration at which maximum explants formed shoots were 0.1 µM for BAP (86.3%), 1 µM for 2iP (87.6%) and 10 µM for Kn (80.0%). Synseeds could be hardened and transferred to the field conditions with 50-80% germination rate. Further experiments are being conducted to test the feasibility of dehydrating the encapsulated explants and using them for *in vitro* conservation.

Cryopreservation experiments in ginger (*Zingiber officinale*) were continued using the vitrification method. Shoot buds (0.5-2 mm) isolated from *in vitro* shoot cultures were precultured on liquid MS medium supplemented with 0.4, 0.5 or 0.75 M sucrose for 1, 2 and 3 days 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 (both in cryovial as well as droplet freezing) and rapid thawing. Since very small explants were used, mechanical injury during dissection led to high mortality, even in control explants. Amongst all the treatments tested, 0.5 M sucrose preculture for 1 or 2 days gave the maximum post-thaw regeneration using droplet freezing (20-45%). The endogenous bacteria, which had earlier hampered the formation of plantlets in

cryopreserved explants, was overcome using a combination of three antibiotics at 50-100 mg/l in the culture medium.

6.1.5 Temperate and minor fruit crops: A total of 262 accessions (~4500 cultures) belonging to 9 genera and 37 species were conserved as *in vitro* cultures under culture room conditions and/or at low temperature. The average subculture period varied from 6-12 months. During the year, 17 new accessions of various temperate and minor fruits were added in the *in vitro* genebank and these include *Pyrus* sp. (1), *Rubus* spp. (12) and *Vaccinium* spp. (4).

In pear, experiments were conducted to obtain *in vitro* rooting of microshoots by treating them with various auxins (IAA, IBA or NAA). The shoots showed very small roots along with the callus.

Cryopreservation experiments were initiated in apple

using dormant vegetative buds. During pre-freezing treatment, excised buds turned brown due to oxidation of phenolic compounds present in the vegetative tissues and subsequently exhibited no growth. Following LN freezing, no post-thaw survival could be achieved in excised buds. Five accessions of *Rubus* and three of *Morus* were cryopreserved using encapsulation-dehydration technique.

6.1.6 Tuber crops: A total of 546 accessions (~9456 cultures) comprising 3 of *Alocasia indica*, 176 of *Colocasia esculenta*, 103 of *Dioscorea* spp., 255 of *Ipomoea batatas*, and 9 of *Xanthosoma sagittifolia* were maintained under short- to medium-term conservation. During the year, 15 accessions of tuber crops including *C. esculenta* (13) and *Dioscorea* spp. (2) were added in the *in vitro* genebank. A total of 50 accessions of taro were transferred to the medium (MS + 6% sucrose + 5.0 mg⁻¹ BAP + 0.1 mg⁻¹ NAA), which promoted *in vitro* corm formation.

Table 1: Status of *in vitro* conserved germplasm in TCCU (As on December 31, 2007)

Crop group	Genera (no.)	Species (no.)	Cultures (no.)	Accessions (no.)
Tropical Fruits (banana, grape)	2	18	3,275	412
Temperate and Minor Fruits (mulberry, strawberry, apple, pear, blackberry)	9	41	4,310	262
Tuber crops (sweet potato, yam, taro)	5	12	9,756	546
Bulbous and other crops (garlic, gladiolus)	4	18	2,634	177
Medicinal and aromatic plants (Species of <i>Bacopa</i> , <i>Mentha</i> , <i>Rauvolfia</i> , <i>Tylophora</i>)	25	34	5,130	189
Spices and industrial crops (ginger, turmeric, pepper, cardamom, hops, jojoba)	7	34	5,000	371
TOTAL	52	157	30,105	1,957

6.2 Genetic Stability of *In Vitro* Conserved Germplasm

Genetic stability assessment was done in 20 accessions of taro (*C. esculenta*) using morphological markers namely (i) predominant position of leaf lamina, (ii) leaf blade margin, (iii) leaf blade colour, (iv) leaf vein pattern and (v) petiole colour. There was uniformity for these traits among the R₀ plants established in the pots. The DNA extraction and purification was done in 10 plants each of all the 20 accessions using CTAB method. Using RAPD markers, genetic stability assessment was done in 10 accessions. There were no significant changes in the RAPD profiles of regenerated plantlets as compared to those of their donor mother plant DNA. Genetic

stability assessment was also done in 10 accessions of taro (*C. esculenta*), using isozyme (peroxidase) markers.

6.3 *In Vitro* Germplasm Supply

Germplasm of banana (60 accessions) were multiplied and supplied to NRC on Banana, Trichy (42 accessions), KAU, Kannara (8 accessions), PAU, Ludhiana (6 accessions), IIHR, Bangalore (3 accessions) and BARC, Mumbai (1 accession), and those of ginger (82 accessions) were supplied to NBPGR, Thrissur for conservation purpose. Two accessions of *Rauvolfia serpentina* were supplied to KAU, Kerala for research purpose.

6.4 Seed, Pollen and Dormant Buds Cryopreservation

A total of 8,459 accessions comprising orthodox, intermediate and recalcitrant seed species, dormant buds and pollen have been conserved in the cryobank (Table 2). A total of 550 accessions of diverse germplasm were received from NBPGR regional

stations viz., Shimla and Thrissur. During the year, four exploration trips were undertaken to collect germplasm of non-orthodox seeds species in different zones namely parts of Gujrat and MP (tropical minor fruits and nuts), Himachal Pradesh (temperate minor fruits e.g *Prunus*, *Rubus* etc.), Abohar, Punjab (for *Citrus* and *Poncirus* spp.) and Garo hills, Meghalaya (for *Citrus* spp.). In all, 265 accessions were collected.

Table 2: Status of Cryopreserved Germplasm in TCCU (As on December 31, 2007)

Categories	Accessions (no.)
Recalcitrant & Intermediate	
Fruits & Nuts	2,260
Spices & Condiments	128
Plantation Crops	19
Agro forestry & Forestry	1,639
Industrial crops	831
Orthodox	
Cereals	240
Millet and Forages	287
Pseudo-cereals	76
Grain Legumes	632
Oilseeds	470
Fibers	64
Vegetables	432
Medicinal & Aromatic Plants	783
Narcotics & Dyes	34
Miscellaneous	15
Sub-total	7,911
<i>Dormant buds</i>	238
<i>Pollen grains</i>	310
Total	8,459
Wild Relatives*	911
Rare & Endangered plants*	78
Varieties*	647
Elite*	4
Registered germplasm*	22
Number of species	718

*- Included in respective categories stored as orthodox seeds

A total of 439 accessions were cryostored as seeds/ embryonic axes / dormant buds/ pollen during this period at temperatures between -160 to -180°C. Cryostored accessions comprised temperate fruits and nuts (316), spices (13), M & APs (23), and industrial crops (87), and these also included released varieties, wild species and wild relatives of crop plants. Pollen grains of 56 accessions of mango and *Prunus* spp were also cryostored. In addition, dormant buds of 41 accessions of mulberry were also processed for cryostorage.

Basic studies on seed viability, moisture content, desiccation and freezing sensitivity were conducted on chironjee (*Buchnanania lanzan*), khirni (*Manilkara hexandra*), wild apricot (*Prunus armeniaca*), lasora (*Cordia myxa*), *Citrus sinensis*, *C. paradisi*, *C. grandis*, *C. indica*, *C. reticulata* and *Poncirus trifoliata* and hybrids. Seeds of *Madhuca longifolia* and *M. indica* were highly sensitive to desiccation and freezing indicating recalcitrant seed storage behaviour. Germination requirements were standardized for

Prunus spp. dormant buds.

Successful cryopreservation was achieved in seeds, embryos and embryonic axes of *Salvadora* sp., *M. longifolia*, *M. indica* and *Prunus armeniaca*. Vitrification and encapsulation technique was attempted with embryonic axes of *M. longifolia* and *M. indica*.

Longevity experiments were continued on karonda (*Carissa carundus*), phalsa (*Grewia asiatica*), walnut (*Prunus armeniaca*) and date palm (*Phoenix sylvestris*).

Periodic testing for viability of 40 accessions of orthodox and non-orthodox seeds, 3 accessions of mulberry dormant buds using *in vitro* methods and 7 accessions of pollen of *Prunus avium* and *Pyrus communis* using field pollinations was undertaken.

Fruit-setting after field pollinations using cryostored mango pollen indicated successful development of cryopreservation protocol. Retesting of 50 cryostored accessions of non-orthodox and orthodox seeds revealed retention of original viability in most of the accessions.

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

PGR/TCCU-BUR-01 *Ex situ* conservation of genetic resources of vegetatively propagated crops using *in vitro* and cryopreservation techniques (R.K. Tyagi)

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

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

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

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

PGR/TCCU-BUR-01.06 *In vitro* conservation of temperate and minor fruit crops. (Sandhya Gupta, K. Pradeep since May 2007)

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

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

PGR/TCCU-BUR-02.01 Cryopreservation of non-orthodox and orthodox seed species in various forms using standard protocols (Rekha Chaudhury, S.K. Malik, Davender Nerwal)

PGR/TCCU-BUR-02.02 Investigating desiccation and freezing tolerance in non-orthodox seed species, dormant buds and pollen for cryopreservation (S.K. 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 for a on issues related to PGR management.

7.1 Achievements

7.1.1 Implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture

National Consultation on Implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture was conducted on 7 November 2007. Participants included officials and scientists from Indian Council of Agricultural Research (ICAR), Department of Agriculture and Cooperation (DAC), Department of Agriculture Research and Education (DARE), Protection of Plant Varieties and Farmers' Right Authority (PPVFRA), National Bureau of Plant Genetic Resources (NBPGR) and Project Directors/ Project Coordinators. Salient recommendations that emerged at the consultation included constitution of an inter-ministerial group for implementation of the Treaty and for meaningful and effective participation on GB meeting of the Treaty. National legislative treatment for exchange of material under the Treaty is needed, and identification of material for the Multilateral System (Annex 1 and non Annex 1 crops) needs to be decided. Awareness generation about the implications of the Treaty and its benefit sharing provisions was also considered essential.

Inputs on the formulations of the Standard Material Transfer Agreement (SMTA) were also provided to ICAR, including the role of FAO as a third party beneficiary in the SMTA

7.1.2 Processing application of extant varieties for registration (Protection) with the PPVFRA Authority

Two meetings of the ICAR Task Force constituted for this purpose were conducted for submission of applications of ICAR in October and November, 2007.

Over 450 applications of Extant-notified varieties released at central level were screened at NBPGR till December, 2007 and submitted to PPVFRA Authority. A database of submitted application is also being maintained.

7.1.3 Institute Technology Management Committee (ITMC)

A Memorandum of Understanding (MoU) with National Research Development Corporation, New Delhi was finalized regarding portfolio management of Intellectual Property (IP) generated at NBPGR including patents, copy rights and commercialization of technologies. One application for registration of copy right on software was submitted (IINDUS) to NRDC for processing.

7.1.4 FAO Project on Monitoring the Implementation of Global Plan of Action

Report on Status of PGRFA in India was compiled and published during January 2007. The report included status of four sets of activities related to management of plant genetic resources in India as part of the Global Plan for Action.

7.2 Inputs provided to the following Organizations/ Ministries

7.2.1 ICAR/DARE

1. MTA between NBPGR and PPVFRA for keeping seeds of registered varieties in the National Genebank at NBPGR.
2. Export of designated germplasm for ICRISAT to Svalbard Global Seed Vaults under the Global crop Diversity Trust initiative.

3. MoU between CIMMYT and ICAR for establishment of a centre in India for export of their mandate crops.
4. Standard Material Transfer Agreement for INGER nurseries from IRRI.
5. Export of Mango to Mozambique.
6. Comments provided on the standards and safety limits of Cyanogens in Sago Tapioca imposed by PFA
7. Proposed areas for trilateral cooperation among India, Brazil and South Africa as follows:
 - Exchange of information on the availability of trait specific plant genetic resources amongst the three countries.
 - Facilitate movement of elite germplasm collections for the crops agreed under Work Plan with Brazil (viz., amaranth, banana, cashew, cassava, citrus, cocoa, coconut, cotton, groundnut, guava, jatropa, macadamia nut, maize, oil palm, pineapple, strawberry, soybean, sugarcane and wheat for other additional crops)
 - Import of elite germplasm in India from South Africa of the crops viz., avocado, barley, chickpea, coffee, cotton, cowpea, flax, macadamia nut, okra, peas, pearl millet, sesame, *Solanum* spp., sorghum, watermelon and yams.
 - Sharing of endemic pest database to facilitate risk analysis for facilitating exchange of germplasm.
 - Capacity Building in the following areas of *In-vitro* conservation and cryo-preservation and biosafety issues and detection of transgenes
 - Development of diagnostic kits for pests and transgenes for certification purposes.
8. Participated in Indo-US SPS Seminar under Agriculture Knowledge Initiative Programme Organized by USDA at Washington DC, USA from June 11- 15, 2007

7.2.2 National Biodiversity Authority

- As member of Expert Committee for export of material outside India and IPRs applied (applications)

- Drafting guidelines for transfer of research results as member of their Expert Committee. Final draft guidelines have been submitted, after two consultations meeting.
- Comments on guidelines for designation of repositories under the Biological Diversity Act

7.2.3 Ministry of Agriculture

- Provided input to the Department of Agriculture and Cooperation on Plant Quarantine (Regulation for Import into India) Order 2003 as follows:
 - Undertook PRA for pea, chickpea and lentil for import from USA and Canada
 - Prepared Comments on the wheat PRA for its import from USA
 - Participated in Indo-US negotiations on wheat, pulses import and mango, pomegranate and litchi export
 - Participated in the discussions with United States Department of Agriculture, USA on Import of Wheat from US and other Phytosanitary Issues from 16- 23 May 2007
 - Submitted Generic PRA for 50 plant species of which 38 notified in August 2007.
 - Discussions held with Additional Secy and JS, PI Prot, DAC for developing modality for PRA and import of germplasm.
- Based on problems in plant protection and quarantine areas identified issues DAC identified five Task Forces of which NBPGR was assigned responsibility for strengthening phytosanitary capacity in India to ensure a consistent and high level phytosanitary capacity across the Indian plant quarantine system.
 - Four meetings of the Task Force held at NBPGR, New Delhi (on 20, 25, 27 and 28 August 2007) for discussions on the following priority areas
 - Update and develop Standard Operating Procedures
 - Develop information sharing tools
 - Undertake capacity building
 - Develop a strategy for public awareness on plant biosecurity/ plant quarantine matters

- Creation of Plant Quarantine Authority
- Comments provided to High level Shadow Committee of DAC on the 2nd revision of Specifications for Technical Panel No. 1 and 2
- Technical comments were provided for revision of the following draft International Standards on Phytosanitary Measures (ISPMs)
 - Sampling of Consignments
 - Developing a Strategy to Reduce or Replace the Use of Methyl Bromide for Phytosanitary Purposes
 - Classification of Commodities into Phytosanitary Risk Categories
 - Establishment of Areas of Low Pest Prevalence for Fruit Flies (Tephritidae)
- Comments also provided on
 - Guidelines for the importation of plant breeding material for scientific research and development purposes.
 - Regional Standards for Scale Insects
- Inputs provided regularly in various meetings of EXIM and trade negotiations with other countries.

7.2.4 Ministry of Environment and Forests

- Participation in regular meetings of the Consultative Group on Biodiversity
- Technical inputs provided to
 - Expert Group on Consistent Interpretation of the Precautionary Principle
 - Expert Group on Liability and Redressal issues under Cartagena Protocol
 - Committee for revision of list of pests under EPA Rules 1986 to the National Committee of Weapons of Mass Destruction and their Delivery System Act

7.2.5 Department of Biotechnology

- Regular input provided in meetings of Review Committee of Genetic Manipulation, Monitoring and Evaluation Committee and Project Evaluation Committee

7.2.6 Ministry of Home Affairs

- Provided inputs in regular meetings of Inter-ministerial Working Group of Experts on Bioweapons as nodal person of Ministry of Agriculture and prepared the chapter on “Agroterrorism” for inclusion in the National Disaster Management Guidelines- Management of Biological Disasters

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

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, Vandana Tyagi)

PGR/PPU-BUR-DEL-01-02: Policy issues related to plant biosecurity (R.K. 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 (finger millet, sorghum, pearl millet), 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). More than 2500 varieties in different crops were fingerprinted till December 2007. 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.

8.1 DNA Fingerprinting of Released Varieties:

8.1.1 Rice (*Oryza sativa* L.): Seventy two extant varieties were fingerprinted employing 28

microsatellite markers. Out of these 28 markers, 14 were polymorphic. Fifteen allele specific primers were designed for allele mining of quality traits in rice.

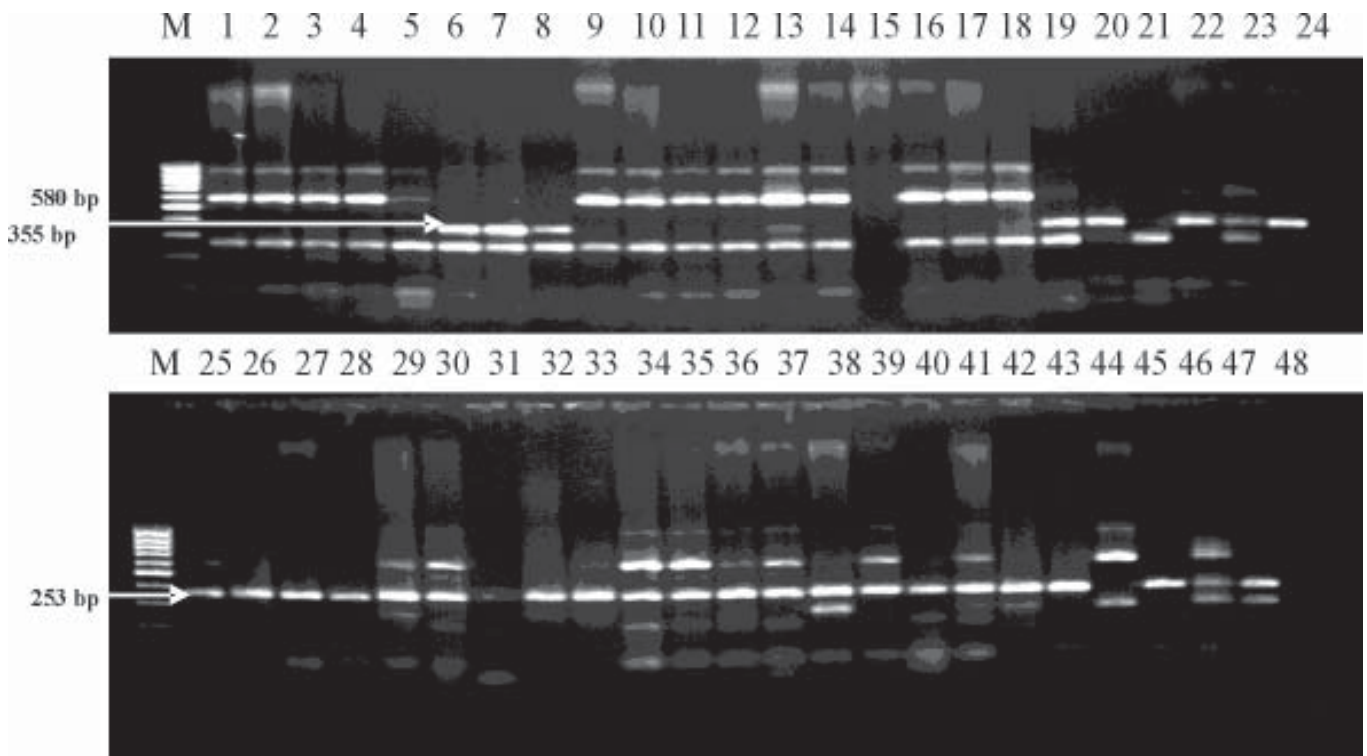


Figure 1. Allele specific primer *badh2* used for fingerprinting of rice varieties. M- Molecular weight maker (100bp), Lane 1-48 are aromatic and non aromatic varieties of rice. 580 bp band is control band. 355 bp band should appear in non aromatic varieties and 253 bp band should appear in aromatic varieties. Heterozygous pattern confirms more than one gene is responsible for aroma.

8.1.2 Chickpea (*Cicer arietinum* L.): Thirty eight extant varieties of Chickpea had been procured from the IIPR, Kanpur and were sown in the NBPGR green house for DNA extraction. Forty-seven SSR

primers were used for the fingerprinting of all 38 varieties (Table 1). Out of which thirty five primers showed clear polymorphism among the varieties (Figure 2). Data Scoring is in progress.

Table 1: List of extant varieties of chickpea used for fingerprinting

S. No.	Varsities Name	S. No.	Varities Name
1	GNG 663 (Vardan)	20	Pusa Kabuli 1003
2	GNG-469 (Samrat)	21	DCP 92 – 3
3	GNG-1292	22	ICCV-10 (Bharti)
4	RSG-888	23	JGG-1
5	Aadhar	24	Vaibhav (RG-9218)
6	CSJD 884 (AKASH)	25	Jawahar Gram Kabuli-1
7	Haryana Kabuli chana-2	26	Jawahar Gram 16
8	SADA BAHAR-13	27	JG 11
9	Uday (KPG 59)	28	GG-1 (Gujarat Gram-1)
10	KWR-108	29	Vishal Phule
11	JG-218	30	Vijay (Phule C-81-1-1)
12	Hirwa Chaffa	31	Virat (Phule G95418)
13	ICCV-2 K (Sweta)	32	Gujarat gram 4 (GCP 105)
14	Pusa 372	33	PDG-3 (GF-89-133)
15	Pusa-329	34	PBG-5
16	Pusa 362	35	L- 551 (Kabuli)
17	Pusa 391	36	GPF 2 (GF 89-36)
18	BGD 72	37	Jawahar Gram 130 (JG 130)
19	Pusa Chamatkar	38	KAK-2 (PKV Kabuli-2)

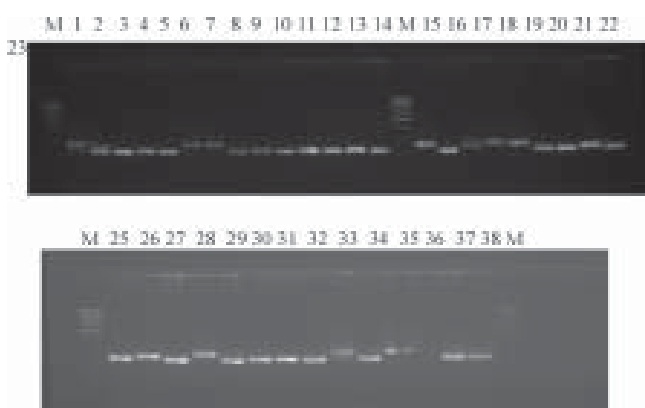


Figure.2 Fingerprint profile of 38 chickpea varieties with TA_106 SSR marker. M- 100 bp molecular weight maker (MBI fermentas), Lane 1-38 – chickpea varieties mentioned in Table 1

8.1.3 Khus (*Vetiveria zizanioides* L.): Leaves of thirty one accessions were collected from the Issapur farm of NBPGR. These accessions were collected from reserve forest of Bharatpur district in 1984 and are maintained at Issapur farm of NBPGR. Total genomic DNA was isolated from the leaves using Dellaporta method (1983). Twenty-five RAPD primers were also employed to fingerprint all the accessions (Fugure 3).



Figure.3. Fingerprint profile of 18 Khus accessions with OPD-20. M- 100 bp molecular weight maker (MBI fermentas), Lane 1-18 – Khus accessions.

8.1.4 Giloe (*Tinospora cordifolia*): Leaves of twenty-five accessions were collected from the Issapur farm of NBPGR. DNA isolation protocol of this crop has been standardized in the laboratory for the first time. PCR conditions for two marker systems i.e. RAPD and ISSR were standardized.

8.1.5 Kalmegh (*Andrographis paniculata*): Leaves of twenty-two accessions were collected from the Issapur farm of NBPGR. DNA isolation protocol of this crop has been standardized in the laboratory for the first time addition of different concentration of PVP (Ploy vinyl pyrrolidone) has been found effective is removing the secondary metabolites. PCR conditions for two marker systems i.e. RAPD and ISSR were standardized.

8.2 Genetic Diversity Analyses

Genetic diversity analyses and DNA profiling was conducted in mungbean (145 accessions of core collection), rice landraces from southern India (45), cotton (41 parental lines), oats (35 landraces), Perilla, an oilseed crop of northeastern region (72 landraces) and wheat (112 released varieties) using STMS, ISSR and RAPD markers. The analyses helped in the estimation of available genetic diversity in the collections and also in generating DNA fingerprints of these indigenous cultivars. Details of a few of the analyses are presented below:

8.2.1 Mungbean: 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, STMS-based molecular analysis was initiated. The results indicated the need to make more elaborate collections from the Indian-subcontinent to capture the diversity existing for green gram and also to add more accessions from under-reported, diversity rich regions such as Andhra Pradesh and Tamil Nadu to increase diversity in the core. Further, there is also a need to develop polymorphic STMS markers to assess the genetic diversity in the green gram collection.

8.2.2 Rice (*Oryza sativa* L.): Kerala has rich genetic diversity for the traditional rice landraces adapted to various seasons and agro climatic conditions. A total of 45 rice landraces from Kerala and adjacent regions were characterized using 25 Sequence Tagged Microsatellite Site (STMS) markers selected for genome coverage and high polymorphism. The DNA profiles revealed high degree of genetic diversity between the landraces. The STMS markers used in the analyses efficiently clustered the landraces into specific groups based on their geographical location of collection. Out of the 179 alleles detected among these landraces, 17 (9.49%) were unique to specific landraces. The gene flow estimated from the F_{ST} values indicated that there is substantial exchange

of pollen between the populations. The F_{ST} value of 0.131 obtained from the AMOVA analysis indicates that there is moderate genetic differentiation among the sub populations. Therefore, the analysis indicates an urgent need for characterization of many such landraces, particularly those available with the traditional rice growing regions, so that divergent types are precisely identified, properly conserved so that all the available alleles are preserved for posterity and efficiently utilized for rice improvement.

8.2.3 Bitter gourd (*Momordica charantia*): The genetic relatedness of 38 Indian cultigens was determined by amplified fragment length polymorphism (AFLP) analysis. Six primer combinations yielded a total of 519 bands of which 404 (77.8%) were polymorphic among the accessions examined (Figure 4). Genetic similarities among accessions ranged between 0.44 to 0.88, indicating that the bitter gourd cultigens examined were genetically diverse. Moreover, putative AFLP loci defined genetic relationships that allowed for partitioning of cultigens into two distinct groups. With rare exception, cultigens grouped with respect to geographical region, where cultigens within a group and subgroups possessed high degrees of genetic similarity. The relatively high marker indices (6.2 to 19.4), polymorphic information content of the markers employed (0.20 to 0.25), and multiplex ratios (28.9 to 77.4), collectively indicate that the AFLP markers employed are discriminatory in bitter gourd.

8.2.4 Cashew (*Anacardium occidentale* L.) diversity analysis: Cashew is an introduced tree species distributed widely in the coastal regions of India. The present study was aimed at investigating the level of morphometric and genetic variation, and genetic structure of cashew populations collected from different geographical regions of India. A total of 91 individuals from four populations were analysed using morphometric and AFLP marker data. AFLP analysis based on 354 polymorphic loci revealed Indian cashew to have low but relatively substantial genetic diversity ($H_E=0.262$ and $I_s=0.404$). Bayesian cluster analysis for genetic differentiation indicated the existence of four distinct genetic groups albeit with weak structure. However, when individuals from four distinct geographical populations (Maharashtra and Goa, Karnataka and Kerala, Andhra Pradesh, and Tamil Nadu) were assigned to these groups, there was no definite population differentiation. AFLP-based AMOVA allocated the

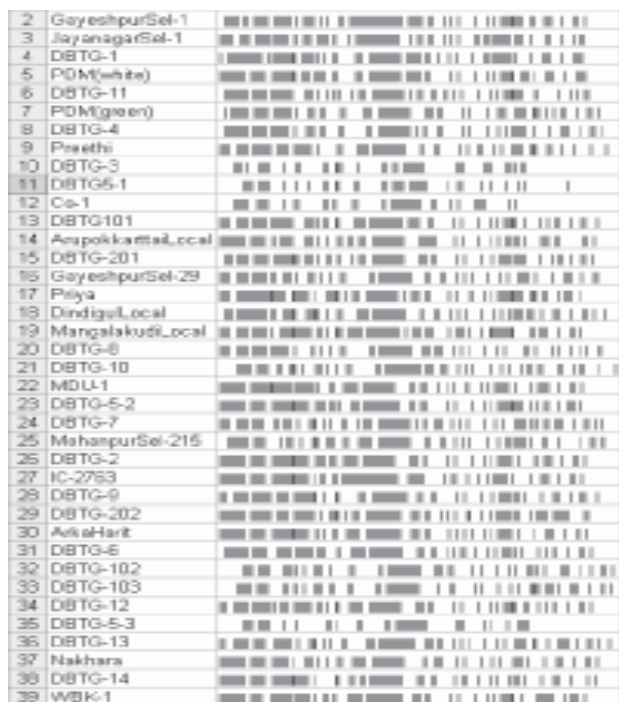


Figure 4. Band map of 38 cultigens of bittergourd using 110 AFLP markers.

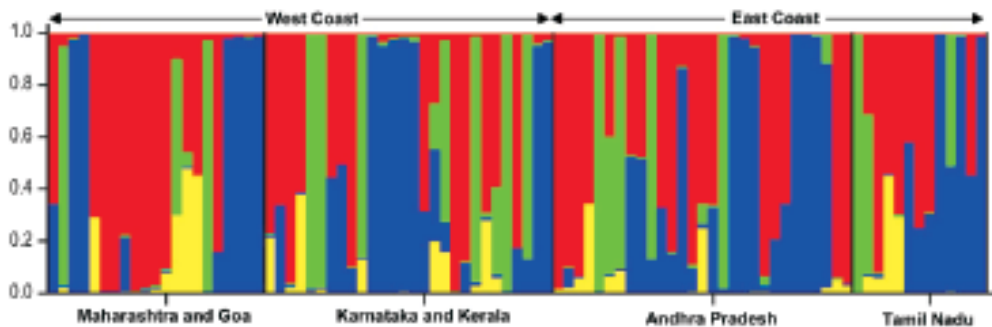


Figure 5. Assignment of individuals to the geographical populations of cashew. Four populations are indicated on the abscissa. Blue, green, red and yellow represent clusters of individuals grouped into four genetic clusters based on allele sharing (ranging from zero to one). Model based analysis revealed no definite population differentiation.

variation observed in the cashew individuals entirely to within populations. However, analysis based on twenty-seven morphometric traits allocated 6% variation between east and west coast populations, and 12% variation among all the four populations (Figure 5). AFLP based analysis revealed low but substantial genetic diversity in Indian cashew for an introduced species. However, model analysis indicated the absence of genetic differentiation between geographical populations. These results support the possibility of cashew being introduced into India repeatedly over a period of time but at a single location (west coast). Keeping in view the absence of genetic structuring of the populations and extent of variation in quantitative traits, appropriate sampling strategies for *ex situ* germplasm conservation are suggested.

8.3 Markers Developed for Transgene Identification

8.3.1 Development of PCR based markers for detection of transgenics:

- Detection protocols for endogenous gene *LAT 52*, *osmotin* gene and 35S promoter using PCR/multiplex PCR in GM tomato have been standardised (Figure 6).

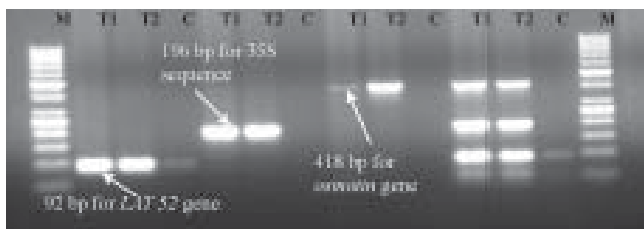


Figure 6. Multiplex PCR for detection of *osmotin* gene, endogenous *LAT 52* gene and 35S promoter in GM tomato lines with *osmotin* gene M: Molecular weight marker (50 bp ladder); T1, T2: Transgenic tomato lines (T1: Line 528, T2: Line 564); C: Non-transgenic tomato

- Simultaneous detection of *cry1Ac* gene and 35S promoter has been done in *Bt* cauliflower (Figure 7) and *Bt* brinjal using multiplex PCR

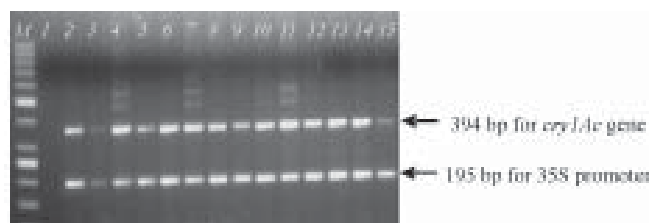


Figure 7. Multiplex PCR for detection of *cry1Ac* gene and 35S promoter in *Bt* cauliflower; M: Molecular weight marker (50 bp ladder), 1: Non-transgenic cauliflower, 2-15: *Bt* cauliflower

- PCR-based detection protocols have been standardized for the following transgenic planting materials:
 - Multiplex PCR for 35S promoter, endogenous gene *Sad1* and *cry1Ac* gene in *Bt* cotton (event MON 531); for *cry1Ac*, *cry2Ab* genes, endogenous gene *Sad1* and 35S promoter in Bollgard II (event MON 15985) (Figure 3); for 35S promoter and *cryX* gene in transgenic cotton (GFM event) using multiplex PCR
 - Detection of *bar* and endogenous gene *SPS* in transgenic rice using multiplex PCR (Figure 8)
- PCR-based molecular detection and validation of endogenous genes in cotton, rice, and potato has been done.

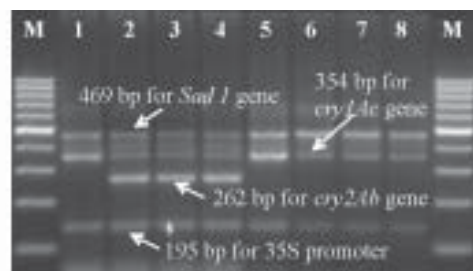


Figure 8. Multiplex PCR in *Bt* cotton with *cry1Ac*, *cry2Ab*, 35S promoter and endogenous gene *Sad1*; M: 100 bp ladder; 1, 5-8: Bollgard I; 2-4: Bollgard II

8.3.2 Testing for the absence of terminator gene (*cre* gene) in the imported transgenic crops:

The planting materials/ seeds of the 332 accessions of

six transgenic crops (Table 2) have been tested for the absence of *cre* gene using PCR amplification with *cre* specific primers (Figure 9) and also for the presence of specific transgenes (Figure 10).

Table 2: List of imported transgenic planting material

Crop	No. of accessions	Gene	Trait
<i>Brassica oleracea</i> var. <i>capitata</i>	200	<i>cry1Ba, cry1Ca</i>	Insect resistance
<i>Oryza sativa</i>	17	<i>cry1Ab and bar</i>	Insect resistance, glufosinate ammonium herbicide resistance
<i>Zea mays</i>	1	<i>Gat (glyphosate-N-acetyl transferase)</i>	Glyphosate (herbicide resistance)
<i>Zea mays</i>	10	<i>Cp4epsps</i>	Glyphosate (herbicide resistance)
<i>Zea mays</i>	01	<i>Cp4epsps</i>	Glyphosate (herbicide resistance)
<i>Triticum aestivum</i>	01	<i>epsps</i>	Glyphosate (herbicide resistance)
<i>Oryza sativa</i>	02	<i>epsps</i>	Glyphosate (herbicide resistance)
<i>Oryza sativa</i>	44	<i>cry1C/ cry1A/ bar</i>	Insect resistance and glufosinate ammonium herbicide resistance
<i>Lycopersicon esculentum</i>	01	<i>AVP1</i>	Increased salt and drought tolerance
<i>Zea mays</i>	05	<i>Cry1A.105, cry2Ab2</i>	Insect resistance
<i>Gossypium hirsutum</i>	50	<i>Cry1Ac, cry2Ab</i>	Insect resistance

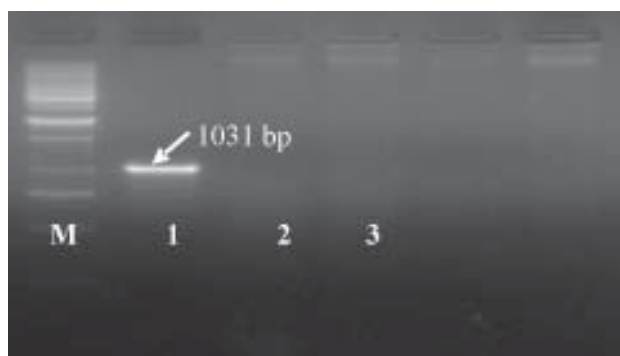


Figure 9. PCR based detection of terminator gene *cre* in transgenic rice with *CP4epsps* gene Lane 1: Positive control; Lanes 2, 3: Transgenic rice with *CP4epsps* gene

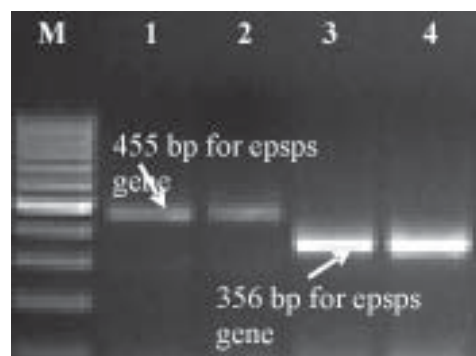


Figure 10. PCR based detection of CP4 *epsps* in imported transgenic rice. Lane 1-2: Amplified by primer EPSPS-455; Lane 3-4: Amplified by primer EPSPS-356

8.4 Analysis of Species Relationships

8.4.1 Molecular phylogeny of cultivated brinjal:

Twenty-two accessions representing nine species related to *Solanum melongena* were identified based on the results of previous morphological studies and used for the DNA sequence analyses. The primer sequencing specific *rbcL*, ITS1 and ITS2 regions were identified from related *Solanum* species were used for PCR amplifications of target regions. The PCR products were cloned into pGEM-Teasy cloning vector of M/S

Promega Corporation, USA. Single colony in each case was picked, multiplied and the inserts isolated were sequenced.

Sequences generated for each of the regions, namely, *rbcL*, ITS1 and ITS2 were analysed independently. CLUSTALW was used to align the sequences. The aligned sequences were used to construct neighbour-joining tree and minimum evolution trees using the MEGA software. *S. aculeatissimum* was used as an outgroup to root the trees generated. Reliability of the

branching patterns was tested by analysing 2000 bootstrap samples. For each of the trees, the branches with lesser than 50% bootstrap values were collapsed

and the final cladograms obtained are presented below (Figure 11)

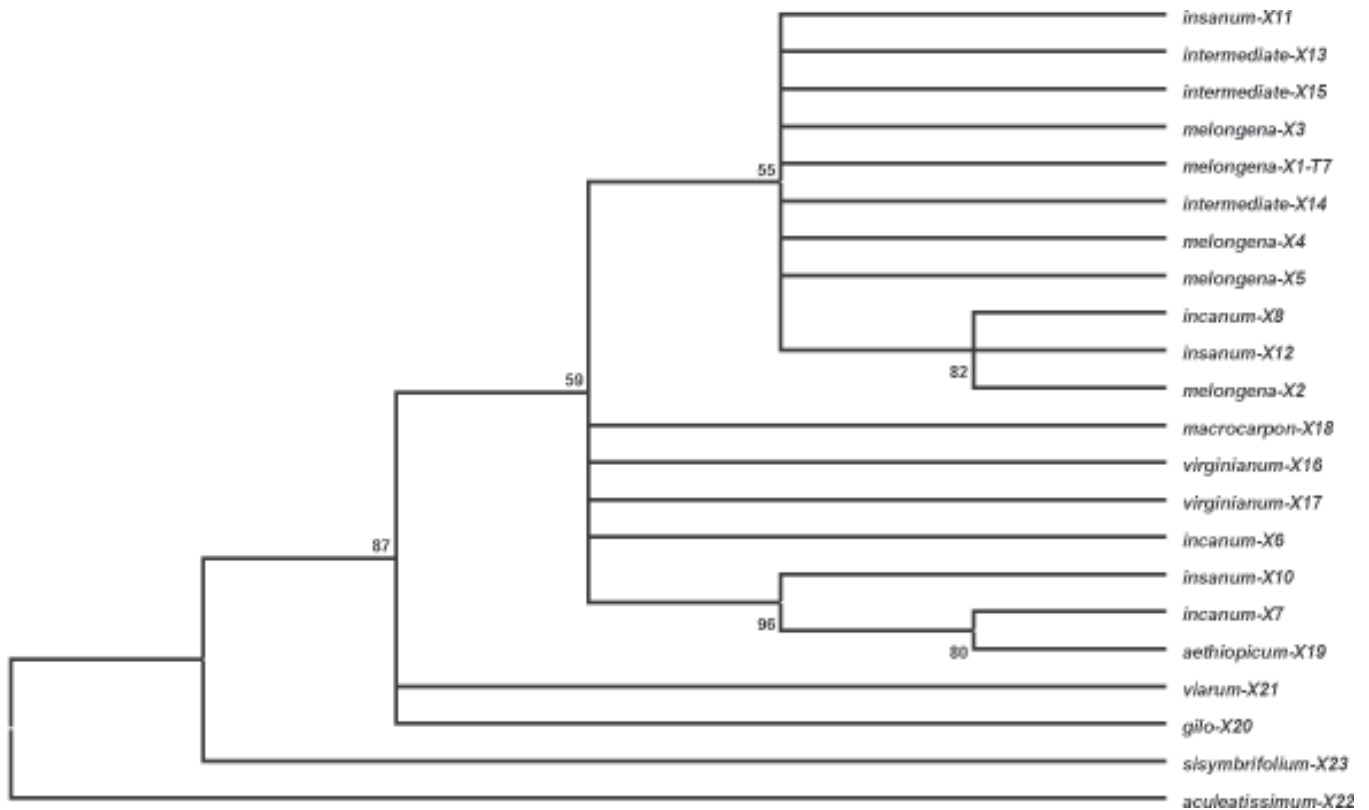


Figure 11. Neighbor joining tree based on *rbcL* sequences with the bootstrap values indicated at the nodes. The tree was rooted using *S. aculeatissimum* as an outgroup. The branches with lesser than 50% bootstrap values were collapsed.

The results indicate common origin of *S. melongena*, *S. incanum*, *S. insanum*, *S. macrocarpon*, *S. sisymbriifolium*, *S. aethiopicum*, *S. virginianum* and *S. gilo*. However, within this group, *S. aethiopicum*, *S. virginianum* and *S. gilo* appear to have differentiated from the close relatives of *S. melongena*. Further, *S. viarum* and *S. aculeatissimum* appear to have differentiated to a greater extent from the Asiatic relatives of egg plant. The one accession of *S. incanum* collected from African region appear to have differentiated to a larger extent from the Indian *S. incanum* which fully agrees with the results of our earlier studies based on STMS and ISSR analyses. Analyses of *rbcL* region indicated existence of about three different paths of species differentiations; the first path included the close relatives of *S. melongena* (namely, *insanum*, *incanum*, *aethiopicum*, *macrocarpon*, *virginianum*); the second group included *S. gilo* and *S. sisymbriifolium* and the third comprised only *S. aculeatissimum*.

8.4.2 Phylogenetic analyses of *Vigna* species: The group *Ceratotropis* of the genus *Vigna* has contributed pulses of importance to the Southeast Asia, and these include greengram, blackgram, ricebean, adzuki bean and mothbean. India has over 15 distinct wild species of *Vigna* that are related to these pulses. This analysis was initiated to study the extent of differentiation among the wild *Vigna* species. DNA sequence analyses of 51 *Vigna* species (135 accessions) for two rDNA (ITS1 and ITS2) and two cpDNA regions (*trnC-trnD* and *psbA* intergenic spacer) was conducted to precisely define the relationships among the cultivated and the wild species. The results indicated 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. The species *V. hainiana* appears to

be closer to *V. radiata* than to *V. mungo* and this species appears to be more primitive in comparison to the close wild relatives for greengram and blackgram. 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 mechanism different from members of *Ceratotropis* group.

8.4.3 Phylogeny of cultivated okra (*Abelmoschus esculentus*): The Indian sub-continent is an important centre of diversity for *Abelmoschus* species and the species found here are *A. angulosus*, *A. caillei*, *A. crinitus*, *A. esculentus*,

A. ficulneus, *A. manihot*, *A. moschatus*, *A. tuberculatus*, *A. tetraphyllus* and *A. pungens*. Relationships between these species were analysed by sequencing the Internal Transcribed Spacers (*ITS-1* & *ITS-2*) from nrDNA and the three intergenic spacers (*trnC-trnD*, *trnE-trnF*, and *trnH-psbA*) from cpDNA. The results (Figure 12) indicated *A. moschatus*, *A. ficulneus* and *A. esculentus* are closely related contrary to the earlier reports, *A. tuberculatus*, a species proposed to be one of the progenitors was found to form a distant cluster in all the analyses. Further, the West African taxon, *A. caillei* was found to be closer to *A. tuberculatus* than to cultivated okra, *A. esculentus*.

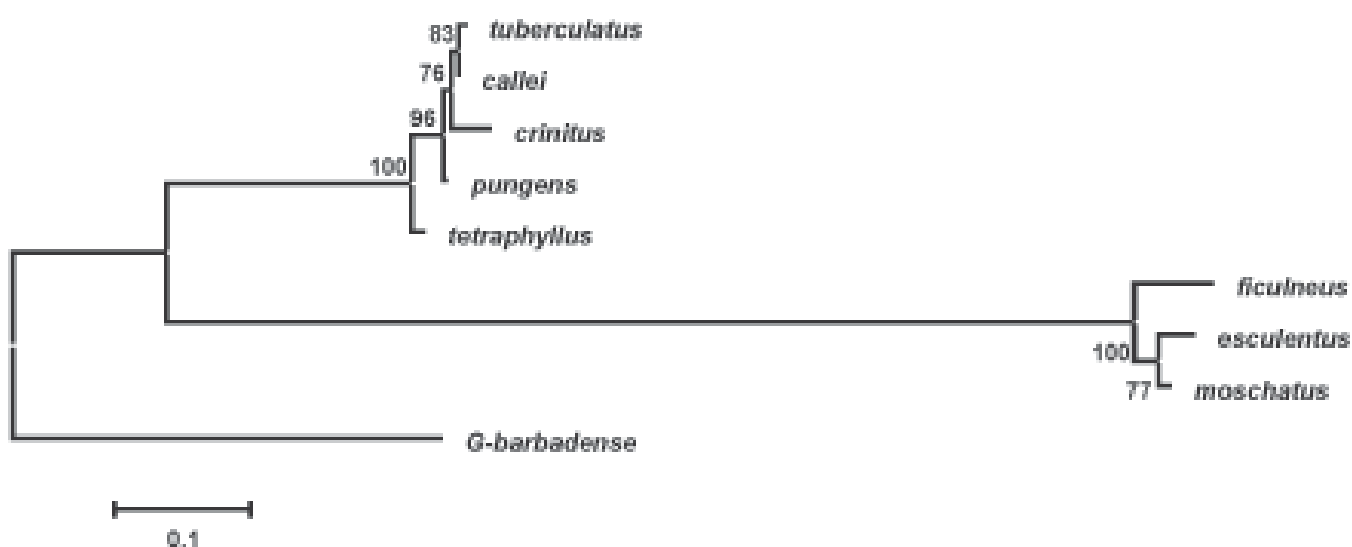


Figure 12. Minimum Evolution tree based on the aligned sequences from *trnH-psbA* region among 8 *Abelmoschus* species and the outgroup *G. barbadense*.

8.5 Database and Bioinformatics

- Crop DNA Fingerprint Database and Statistical Analysis Package

User Manual for the software “Crop DNA Fingerprint Database has been developed. This manual is important for understanding installation and operations of various forms and reports of the software. 150 copies of the manual were sent to different SAUs and ICAR institutes for wide publicity.

- Bioinformatics Software Portal: Bioinformatics Software Portal is a newly approved project in Institute Research Council, 07. The objectives of the project are as follows:
 - To develop server based portal
 - To integrate programs and softwares for following

functions: Diversity analysis, Sequence analysis programs, Species related /phylogeny softwares, Structural analyses and Plant genetic resources

- To develop facility for uploading data in standard format.
- To develop facility for viewing graphical output on screen and printing.
- To develop user manuals in printed and online web based version.
- To maintain and upgrade portal from time to time.

By this time emphasis has been laid to develop pages for sequence alignment. In this context, page for sequence alignment, global and local alignment, pair wise alignment, multiple sequence alignment, software tools of sequence alignment and page Needleman-Wunsch Algorithm has been developed.

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

- PGR/DFP-BUR-DEL-01 Technology Development for DNA Fingerprinting of Agri-horticultural Crops (S.K. Sharma)
- PGR/DFP-BUR-DEL-01.00 Technology Development for DNA Fingerprinting of Cereals and Millet Crops (Lalit Arya, Rakesh Singh, G.J. Randhawa, S.S. Malik and Manjusha Verma)
- PGR/DFP- BUR-DEL-02.00 Technology Development for DNA Fingerprinting of Pulses, Oilseeds and Fibre Crops (K.V. Bhat, M.K. Rana, Rakesh Singh and A.B. Gaikwad)
- PGR/DFP- BUR-DEL-03.00 Technology Development for DNA Fingerprinting of Horticultural Crops (A.B. Gaikwad, Sunil Archak and K.V. Bhat)
- PGR/DFP- BUR-DEL-04.00 Technology Development for DNA Fingerprinting of Medicinal and Aromatic Plants. (Rakesh Singh and G.J. Randhawa)
- PGR/DFP- BUR-DEL-05.00 Crop DNA Finger Print Database and Statistical Analysis Package (Madhu Bala)
- PGR/DFP- BUR-DEL-06.00 Technology Development for DNA Fingerprinting of Forage and Fodder Crops. (M.K. Rana, Manjusha Verma and Lalit Arya)
- PGR/DFP- BUR-DEL-07.00 Analysis of Genetic Diversity and DNA Fingerprinting of Cucurbitaceous Crops (Manjusha Verma, M.K. Rana, Lalit Arya and A.B. Gaikwad)
- PGR/DFP-BUR-DEL-08.00 Bioinformatics Softwares Protal (Madhu Bala, Sunil Archak and R.C. Agarwal)

Externally-funded projects

- Development of PCR based methods for testing of transgenic planting material (DBT) (G.J. Randhawa)
- Analysis of genetic diversity and phylogenetic relationship in Solanum melongena L. and related wild and weedy taxa (DBT) (K.V. Bhat)
- GEF-WB aided capacity building project for implementation of the Cartagena Protocol on Biosafety (MoEF) (G.J. Randhawa)
- Network Project on Molecular Breeding (ICAR) (S.K. Sharma)
- Application of Microorganisms in Agriculture and Allied Sectors (AMAAS) (ICAR) (K. V. Bhat)
- Referral centre for Molecular Diagnosis of Transgenic Planting Materials (DBT) (G.J. Randhawa)
- Development of STMS and SCAR markers in bittergourd (Momordica charantia L.) and their utilization for genetic characterization and tagging of gynoecious trait (DBT) (Ambika Baldev Gaikwad)
- Molecular characterization of cotton germplasm (TMC MM 1) (Mukesh Rana)
- DNA Fingerprinting and Molecular Characterization of Jatropha Germplasm Collected from Diverse Agroclimatic Zones of India (NOVOD Board) (K.V. Bhat)

9. REGIONAL STATION, AKOLA

Summary: Two collaborative exploration and collection missions one to the tribal pockets of western Maharashtra and the other to Pune and adjoining districts of Maharashtra were undertaken and a total of 258 accessions of germplasm of spine gourd and wild relatives of crop plants were collected. During *rabi* 2006-07, 2,544 accessions comprising amaranth (635), chickpea (1,006), grass pea (118), linseed (192), Safflower (538) and *Carthamus* spp. (55) and during *kharif* 2007, 4,134 accessions of germplasm comprising millets (599), oilseeds (1,979), vegetables (1,435) and under-utilized crops (121) were regenerated and multiplied. During *kharif* 2007, germplasm (148 accessions) of wild relatives of crop plants comprising *Abelmoschus* spp. (120), *Setaria* spp. (25) and *Glycine* spp. (3) were regenerated. A total of 86 accessions of sesame germplasm were characterized for seven qualitative and eight quantitative traits. A total of 893 accessions of germplasm comprising sesame (668), winged bean (91), *Sesamum* spp. (62), soybean (24), *Simarouba* (one) and wild relatives of crop plants (47) were sent for conservation in the National Gene Bank. A total of 807 accessions of germplasm of different crops/species were supplied to various indenters for research purposes.

The Regional Station was established to explore, collect, evaluate, maintain and conserve the PGR of different agri-horticultural crops of the Central Indian region i.e. Maharashtra, Chhattisgarh, Madhya Pradesh and adjoining regions of Gujarat and Karnataka. This station 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 co-operating centers for All India Co-ordinated Research Project on Under Utilized Plants.

9.1 Plant Exploration and Germplasm Collection

Two collaborative exploration and collection missions one to the tribal pockets of western Maharashtra and the other to Pune and adjoining districts of Maharashtra were undertaken and a total of 258 accessions of germplasm were assembled. The first exploration was targeted for the collection of *Momordica dioica* germplasm and the second was for *Sesamum* spp. germplasm. During the first trip 150 accessions belonging to eight species in six genera including 138 accessions of spine gourd germplasm were collected from six districts. During the second

exploration mission, eleven districts were surveyed and collected a total of 108 accessions of germplasm belonging to 15 species in eight genera, comprising 91 accessions in four species of *Sesamum*.

9.1.1 Exploration and collection of spine gourd germplasm

An exploration and collection mission was undertaken in collaboration with the All India Co-ordinated Research Network on Underutilized Crops, MPKV, Rahuri, to the tribal pockets of Maharashtra for the collection of spine gourd (*Momordica dioica*) germplasm. Six districts of Maharashtra viz. Buldana, Aurangabad, Ahmadnagar, Nashik, Dhule and Jalgaon were explored. A total of 150 accessions of germplasm comprising 144 accessions in three different species of *Momordica* were collected to contain the entire morphological and spatial variability available in the surveyed area. Interspecific as well as intraspecific variability was observed in fruit size, shape and tuber size and shape of the *Momordica* germplasm accessions assembled. High altitude Reserve Forest areas namely, Anikan, Garkheda, Manjal, Kaliyakheth and Junapani located in and around Pal in Raved Taluk of Jalgaon District of Maharashtra

Table 1: Exploration and collection of germplasm during 2007

Areas explored	Period of collection	Diversity collected	No. of accessions collected
Tribal pockets of Western Maharashtra	August 27-September 4, 2007	<i>Momordica dioica</i> and wild relatives of crop plants	150
Pune and adjoining districts of Maharashtra	October 29-October 7, 2007	<i>Sesamum</i> spp. and wild relatives of crop plants	108
Total			258

Table 2: List of species collected during August-September 2007

Species	No. of accessions (Tubers)	No. of accessions (Seeds)
<i>Dioscorea bulbifera</i>	1	-
<i>Momordica dioica</i>	130	9
<i>Momordica sahyadrica</i>	2	1
<i>Momordica charantia</i> var. <i>muricata</i>	-	2
<i>Rauvolfia serpentina</i>	-	1
<i>Solanum insanum</i>	-	1
<i>Trichosanthes cucumerina</i>	-	2
<i>Withania somnifera</i>	-	1
Total	133	17

adjoining Madhya Pradesh were explored for the first time by NBPGR. A total of 148 accessions of wild relatives of crop plants and the remaining two accessions were that of medicinal plants were assembled. The species-wise list of germplasm accessions collected is detailed below:

9.1.2 Exploration and collection of *Sesamum* germplasm:

An exploration and collection mission was undertaken in collaboration with the All India Coordinated Research Project on Sesame and Niger, Jabalpur to Pune and adjoining districts of Maharashtra for the collection of wild *Sesamum* germplasm. Eleven districts of Maharashtra namely Jalgaon, Aurangabad, Ahmadnagar, Pune, Satara, Sangli, Kolhapur, Alibag, Thane, Nashik and Dhule were explored and a total of 108 accessions of germplasm comprising 91 accessions of four different species of the targeted genus *Sesamum* namely *S. alatum*, *S. mulayanum*, *S. prostratum* and *S. radiatum* were collected to contain the entire morphological and spatial variability available in the surveyed area. Interspecific as well as intraspecific variability was observed in plant height, branching habit, flower colour and pigmentation, fruit size and shape, days to maturity and seed size, shape and ornamentation of different *Sesamum* species germplasm accessions assembled. The remaining 17 accessions of germplasm collected belong to 11 species spread over seven different genera. 106 accessions of wild relatives of crop plants and two - one accession each of the cultivated horse gram and bitter gourd were collected in wild state.

Table 3: List of species collected during October 2007

Species	No. of accessions
<i>Abelmoschus manihot</i> var. <i>tetraphyllus</i>	2
<i>Cucumis sativa</i> var. <i>hardwickii</i>	4
<i>Cucumis</i> sp.	1
<i>Macrotyloma uniflorum</i>	1
<i>Momordica charantia</i>	1
<i>Sesamum alatum</i>	2
<i>Sesamum mulayanum</i>	49
<i>S. prostratum</i>	34
<i>S. radiatum</i>	6
<i>Solanum incanum</i>	2
<i>S. indicum</i>	2
<i>Vigna radiata</i> var. <i>setulosa</i>	1
<i>V. trilobota</i>	1
<i>V. vexillata</i>	1
<i>Zingiber microstachyum</i>	1
Total	108

9.2 Germplasm maintenance

During the period under report, a total of 6,826 accessions were grown and maintained in the experimental farm, out of which 2,544 accessions were raised during *rabi* 2006-07 and the remaining 4,282 accessions were raised in *kharif* 2007. The crop - wise accessions grown during *rabi* and *kharif* are given in Table-5.

Table 4: Crop-wise accessions maintained during 2007

Season/cropgroup	Crop	No. of accessions	Checks
Rabi 2006-07			
Under utilized crops	Amaranth	635	Suvarna, Akola Local
Pulses	Chick pea	1,006	Chaffa, PG-12
	Grass pea	118	Narayangaon Local
Oilseeds	Linseed	192	J-23-10 & C-429
	Safflower	538	Bhima
Wild relatives	<i>Carthamus</i> spp.	55	
Kharif 2007			
Millets	Barnyard millet	94	K-21, PS-118
	Finger millet	161	VL-149, PR-202
	Foxtail millet	199	K-221, PS-118
	Kodo millet	54	GPUK-3, IPS-147
	Little millet	72	PRC-3, Co-2
	Proso millet	19	PRC-3, Co-2
	Oilseeds	Sesame	1,179	JLT 7, JLT 26, TC 25 & Swetha
Niger		431	CHH-1, CHH-2
Soybean		150	TAMS-38, JS-335
Castor		219	48-1, DCS-9
Vegetables	Okra	1,435	Parbhani Kranti, Selection 2
Under utilized crops	Winged bean	75	AKWB-1
	Spine gourd	46	
Wild relatives	<i>Abelmoschus</i> spp.	120	
	<i>Glycine</i> spp.	3	
	<i>Setaria</i> spp.	25	
Total		6,826	

9.3 Characterization of Sesame Germplasm

A total of 86 accessions of sesame germplasm were grown in an augmented design with a spacing of row length 3 m and a row to row distance of 60 cm.

The checks used were JLT-7, JLT-26, TC-25 and Swetha. A total of seven qualitative and eight quantitative traits were studied. The spectrum of variability observed in qualitative and quantitative traits are given in tables- 6 and 7.

Table 5: Frequency distribution of qualitative traits in 86 accessions of sesame germplasm

Descriptor	Descriptor states	Frequency	Percentage
Early plant vigour	Poor	4	4.65
	Good	32	37.21
	Very good	50	58.14
Branching habit	Non branching	5	5.81
	Basal branching	69	80.23
	Top branching	12	13.96
Density of capsule hairs	Glabrous	1	1.16
	Sparse	79	91.86
	High	6	6.98
No. of capsules per leaf axil	One	83	96.51
	More than one	3	3.49

Table 6: Range, Mean and CV per cent of quantitative traits in 86 accessions of sesame germplasm

Character	Range	Mean + SEM	CV (%) Phenotypic
Plant height (cm)	57.3-178.6	116.6 + 2.33	18.58
Internode length	8.1-101.6	72.1 + 1.74	22.30
No. of capsules/plant	43-40.6	15.3 + 0.81	49.27
Days to 80% maturity	77-130	92.4 + 1.57	15.80
No. of seeds/capsule	6.0-63.3	33.4 + 2.30	63.68
100 seed weight (g)	0.15-0.39	0.27 + 0.004	14.81
Capsule length (cm)	12.3-30.6	23.1 + 0.34	13.70

9.4 Conservation of Germplasm in the National Gene Bank

A total of 893 accessions of germplasm comprising 668 accessions of sesame, 91 accessions of winged bean, 62 accessions of *Sesamum* spp., 24 accessions of soybean, one accession of *Simarouba* and 47 accessions of wild relatives of crop plants were sent for conservation in the National Gene Bank.

9.5 Germplasm Supply

A total of 807 accessions of germplasm of different crops/species were supplied to various indenters for research purposes. These include sesame (421), okra

(150), niger (50), soybean (39), cucurbits (32), dolichos bean (15), bitter melon (7), cowpea (5), melon (4), linseed (2), *Simarouba glauca* (2), egg plant (1), winged bean (1), wild relatives of crop plants (48) and *Sesamum* spp. (30).

9.6 Medium Storage of Germplasm at the Regional Genebank

A total of 15,711 accessions of germplasm comprising millets and minor millets (757), pulses (4,831), oilseeds (9,454), under-utilized crops (230) and wild relatives of crop plants (439) are being maintained in the medium term storage module in controlled conditions at 7 °C and 20% relative humidity.

Table 8: Status of germplasm conserved in the Regional Station Genebank at Akola

Crop group	Crop	No. of accessions
Millets	Barnyard millet	65
	Little millet	53
	Foxtail millet	244
	Kodo millet	91
	Finger millet	233
	Sorghum	50
	Pearl millet	21
Pulses	Horse gram	983
	Chick pea	973
	Pigeon pea	2,052
	Grass pea	150
	Green gram	641
	Black gram	15
	Moth bean	17
Oilseeds	Sesame	6,477
	Linseed	722
	Safflower	1,425
	Castor	83
	Niger	747
Under-utilized crops	Winged bean	230
Wild relatives	<i>Sesamum</i> spp.	150
	<i>Carthamus</i> spp.	74
	<i>Dolichos</i> spp.	212
	<i>Canavalia</i> spp.	2
	<i>Mucuna</i> spp.	1
Total		15,711

Research Projects- (Project Code, Title, PI)

PGR/GEV-BUR-AKO-01.00: Augmentation, 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 oilseeds (sesame, niger, castor, groundnut, safflower, soybean and linseed), millets and minor millets: (N. Dikshit)

10. REGIONAL STATION, BHOWALI

Summary: Three explorations were undertaken and 170 accessions including landraces and primitive cultivars comprising cereals (81), pseudo cereals (09), minor millets (02), pulses (07), spices (16), fruits (22), wild economically useful plants (02) and ornamentals (01) were collected from remote areas of Uttarakhand hills under National Exploration Programme. A total of 547 accessions were received for regeneration, characterization and maintenance. Some of the elite seed samples and live rooted plant material viz. medicinal and aromatic plants (M & AP) and WEUPS (Wild Economically Useful Plant Species): Rose-Geranium (559), Lavender (158), *Marjorana hortensis* (321), *Rosmarinus officinalis* cv. French – 42704, *Rosmarinus officinalis* cv. Italian - 7795; Horticultural Plants: Kiwi (2124 +135 Kg fruit); Agricultural Crops: Wheat – HB-208 (05 kg) were supplied to different farmers/ indentors. A total of 390 accessions were supplied to user scientists in the country and 453 accessions deposited in National Gene Bank for conservation.

The Bhowali Station 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 disease (*Pseudomonas solanacerm*) testing. In 1956, with the commencement of Wheat Improvement Scheme under PL-480, it was transferred to Indian Agricultural Research Institute (ICAR) and its name was changed as Wheat Research Station. In 1984 it was 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 170 germplasm accessions were collected through three explorations (1 region specific and 2 crop-specific). Under the region specific exploration, the crops



Buck wheat (*Fagopyrum tataricum*) germplasm grown at Bhowali for characterization

viz., wheat, barley, rapeseed/mustard, lentil, pea, coriander, fenugreek and spinach were collected. Crop specific exploration was undertaken with the collaboration of NRC on Pomegranate, Sholapur, Maharashtra from the parts of Tarai-Bhabar and hilly parts of Haridwar, Pauri, Tehri, Uttarkashi and Dehradun districts of Uttarakhand. Another crop specific exploration was undertaken collaboration with VPKAS, Almora for cold tolerant paddy from district Bageshwar and adjoining areas of Pithoragarh. The collected germplasm comprised of cereals (81), pseudo cereals (09), minor millets (02), pulses (07), spices (16), fruits (22), WEUP's (02) and ornamental (01) as per the details given in Table 1.

10.1.1 Enrichment: A total of 547 accessions comprising of ricebean (AVT Trial)-10 ; *Perilla frutescence* (18) ; *Coix lacryma-jobi* (25), french bean (148), *Cucumis sativa* var *hardwicki* (10); *C. trigonus* (4) and barley (332) (IBON-W-92 + IBCB08-W-116 + IBSP08-W-124) have been received from Nodal Officer, UUC, NBPGR, New Delhi; OIC, NBPGR, R/S, Shimla, HP, R/S Jodhpur (Rajasthan) and Germplasm Exchange Division, NBPGR, New Delhi.



Pumpkins (*Cucurbita maxima* and *C. moschata*) germplasm grown at Bhowali for characterization and observed fruit variability in shape, size and colour

Table1: Explorations undertaken during 2007

Crop/Crop group	Areas Explored	Germplasm collected	I Cereals	II Pseudo-cereals	III Minor millets	IV Pulses	V Spices	VI Fruits	VII Oil seeds	VIII Vege-tables	IX WEUPs	X Orna-mentals
*Region Specific (Unique and value added germplasm of Rabi Crops) May 14-20, 2007	District of Rudraprayag and Chamoli, Uttarakhand (Specially from cold rainfed areas)	89	43	09	—	—	16	—	15	06	—	—
**Crop Specific (Pome-granate) Sept. 03-12, 2007	Districts of Haridwar, Pauri, Tehri, Uttarakashi, Dehradun, Uttarakhand	23	—	—	—	—	—	21	—	—	02	—
***Crop specific (Cold Tolerant Paddy, Sesamum, Perilla and others) Oct. 03-09, 2007	Districts of Bageshwar and adjoining areas of Pithoragarh, Uttarakhand	58	38	—	02	07	—	01	07	02	—	01
		170	81	09	02	07	16	22	22	08	02	01

- * Region Specific - Unique and value added germplasm of *rabi* crops i.e., wheat, barley, rapeseed/mustard, lentil, pea, coriander, fenugreek and spinach
- **Crop Specific (Pomegranate) - Collaborative tour with NRC on Pomegranate, shelgi, Sholapur, M.S.
- *** Crop Specific - Collaborative tour with VPKAS, Almora, Uttarakhand collected germplasm of *kharif* crops i.e. cold tolerant paddy, sesamum, perilla & others

10.2 Germplasm Evaluation

10.2.1 Germplasm characterization, regeneration and seed multiplication

Garhwal regions of Uttarakhand were grown at Bhowali for characterization, regeneration and multiplication during Kharif and Rabi seasons 2006-2007 (Tables 2-6).

The germplasm accessions collected from Kumaon and

Table 2: Germplasm characterization during *kharif* 2007

Crop	No. of accessions	Checks Used
Barnyard millet	17	VL-172, VL-29, Local Bhowali, Local Pithoragarh, Local Almora.
Buckwheat (<i>F. tataricum</i>)	70	Himpriya, Bhowali Local, Sangla B-1, Ramgarh Local, Pithoragarh Local
Cowpea	13	FTC-27, NS/24/82, Almora Local, Bhowali Local
Cucumber	12	DC-1 & Nepal Local
French bean (Climber)	123	PLB – 10-1, Ramgarh Local, Dharchula Local, Niglat Local and Chaffi Local
Meetha karela	25	Bhowali Local, Bhimtal Local & Bageshwar Local
Perilla	61	Bhowali Local, Shillong Local, Almora Local & Pithoragarh Local
Pumpkin	54	Australian green, Chamoli Local, Bhimtal Local, Bhowali Local
Rice bean IVT Hills 2007	13	RBL-1, PRR-1, PRR-2, BRS-1, Naini
Rice bean	09	RBL-1, PRR-1, PRR-2, BRS-1, Naini
Sesame	33	Baitalghat Local, Bhimtal Local, Pithoragarh Local, Almora Local
Soybean	14	VL-77, VLS-54, VLS-47, VLS-21 & VLS-2
Ridged gourd	54	Pithoragarh Local, Ranikhet Local, Bhowali Local, Bhimtal Local, Ramgarh Local



French bean (*Phaseolus vulgaris*) germplasm grown at Bhowali for characterization



Chilli (*Capsicum annum*) germplasm grown at Bhowali for characterization

Table 3: Multiplication / seed increase for long-term storage (LTS) in national gene bank during *kharif* 2007

Crop	No. of accessions
Bitter gourd	06
<i>Cucumis sativus</i> var. <i>hardwickii</i>	10
French bean (dwarf)	32
Groundnut	02
Okra	08
Paddy	43
Radish	02
Sponge gourd	03
Sunflower	01
Sword bean	01

Table 4: Promising accessions identified in various crops during Rabi 2006-2007 and Kharif 2007

S.No.	Crop	Main attributes	Accessions identified for specific/ desired traits
1.	Garden pea (72) Checks: Selection-18, Arkil, Harbhajan, VL-8 & Lincon	No. of pods/plant (>25) Plant height (cm) (>123) 100 grain weight (cm) (>20.5)	EC299305 (37), IC279013 (26), IC326345 (26) IC328514 (187.60), EC032391 (140.0), EC299395 (130) IC279125 (27.20), IC291541 (21.6), IC469156 (22.1)
2.	Wheat – <i>Triticum aestivum</i> (120) Checks: VL-616, VL-719, VL-738 & HB 208	Spike length (cm) (>13.50) Plant height (cm) (>95.3) Days to 80% maturity (<186) 100 grain weight (g) (>4.23)	IC279046 (16.6), IC278949 (16.3), IC279206 (16.1), IC279205 (14.3) and IC278977 (13.70) EC540811 (171.7), EC540809 (166.7), EC519501 (166.6), EC493708 (165) and EC540810 (164.9) IC335942 (178), IC335933 (180), IC335934 (180) and IC335989 (185) EC514389 (6.30), EC519508 (5.42), EC560467 (5.37), EC519490 (5.18) and IC335957 (4.8)
3.	Wild wheat (27) Checks: Cultivated wheat	Days to 75% ear emergence (127-160)	EC541175 (127)- <i>T. turgidum</i> sub species <i>dicoccum</i> EC541865 (127)- <i>T. tauschii</i> EC399776 (160) - <i>T. monococcum</i>

		Spike length (cm) (5.4-13.0)	EC541173 (13.0)- <i>T. turgidum</i> sub species <i>carthalicum</i> EC541171 (5.4)- <i>T. timopheevii</i> sub species <i>timopheevii</i> .
		Plant height (cm) (75.3-140.3)	EC541182 (140.3)- <i>T. turgidum</i> sub species <i>turgidum</i> EC399776 (75.3)- <i>T. monococcum</i>
		100 grain weight (g) (1.1-6.79)	IC333195 (6.79 g) – <i>T. polonicum</i> EC399776 (1.1)- <i>T. monococcum</i>
		Grain yield / plant (1.13-14.70)	IC333195 (14.61) – <i>T. polonicum</i> EC519495 (14.70)- <i>T. durum</i> EC599776 (1.13)- <i>T. monococcum</i>
4.	Aegilops (13)	Days to 75% ear emergence (148-160)	EC383064 (148) - <i>A. vavilovii</i> EC383069 (148) - <i>A. earsii</i> EC383065 (148) - <i>A. kotschyii</i> EC497597 (160) - <i>A. sharonensis</i>
		Spike length (cm) (2.00-19.80)	EC497597 (19.8) - <i>A. sharonensis</i> EC497596 (3.1) - <i>A. cylindrica</i>
		Plant height (cm) (29.65-80.00)	EC497597 (80.0) - <i>A. sharonensis</i> EC497598 (36.1) - <i>A. geniculata</i>
		No. of tillers (7.50-30.10)	EC497601 (30.1) - <i>A. markgrafii</i> EC383065 (7.5) - <i>A. kotschyii</i>
5.	French bean (123)-Climber/ Pole type Checks: Chaffi Local, Niglat Local, PLB-10-1, Ramgarh Local & Dharchula Local	Days to 50% flowering (<45 days)	EC530923 (30), EC530926 (31), EC530930 (32)
		Plant height (>138.13 cm)	IC538043 (213.60), IC383482 (213.20), IC419868 (202.00)
		Pod length (>12.07 cm)	IC280838 (15.36), IC538043 (13.66), EC530937 (12.40)
		No. of pods/plant (>11.04)	EC530974 (31.00), EC530976 (31.00), EC530993 (24.16)
		No. of seeds/pod (>9.99)	Nil
		100 grain weight (>42.9 g)	Nil
		Seed yield / plant (>19.75 g)	EC530976 (47.70), EC530956 (44.38), N/SS-2711/IC538008 (40.00)
		Days to 80% maturity (<102)	EC530823 (78), EC530819 (86), EC530936 (86)
6.	Meetha karela (25)	Days to 50% flowering (<74)	IC383628 (72), IC436980 (72), IC393313 (72)
		Days to 80% maturity (<185)	IC361337 (176), IC361297 (178), IC392610 (179)
		Fruit weight (g) (>8.60)	IC393318 (12.33), IC422027 (11.80), IC421984 (10.40)
		100 seed weight (g) (>5.87)	IC393318 (6.77), IC422027 (6.10), IC393259 (6.50)
7.	Sesame (33)	Capsule length (cm) (>2.63)	IC393201 (2.77)
		Plant height (cm) (>57.70)	IC393201 (59.10), IC418329 (58.50)
		Days to 80% maturity (<86.67)	IC356589 (74.77), IC538027 (85.00), IC338723(86.00)
		1000 seed weight (g) (>2.16)	IC383607 (2.70), IC361312 (2.66), IC383423 (2.60)
8.	Buckwheat (70)	Petiole length (cm) (>4.98)	IC341582 (8.3), IC341586 (7), IC280369 (6.8)
		Plant height (cm) (>116.98)	IC274431 (170), IC274436 (153.3), IC274428 (148.3)
		Days to 80% maturity (<118)	IC341577 (105), IC280394 (105), SKY/BJ-1204 (105)
		100 seed weight (g) (>1.28)	IC274424 (1.60), IC340879 (1.60), IC340876 (1.50)

Table 5: Range, mean and coefficient of variation in various crops during Rabi 2006-2007 and Kharif 2007

Crop (number of accessions)	Character	Range		Mean	PCV%
		Minimum	Maximum		
Garden pea (72)	Days to 50% flowering	90	122	113.22	7.18
	No. of pods/plant	2	37	13.68	58.04
	Pod length (cm)	5.2	9.3	6.96	14.67
	Plant height (cm)	40.3	187.6	99.58	26.08
	No. of seeds/pod	3.00	9.00	5.19	25.37
	Days to 80% maturity	158	178	166.96	2.21
	100 seed weight (g)	9.7	27.2	15.97	18.74
Wheat - <i>Triticum aestivum</i> (120)	Days to 75% ear emergence	105	180	151.21	11.46
	Spike length (cm)	6.4	16.6	10.01	21.58
	Plant height (cm)	69.6	171.7	124.24	18.04
	Days to 80% maturity	178	213	198.39	3.96
	100 grain weight (g)	1.52	6.30	3.43	23.74
Wild wheat (27)	Days to 75% ear emergence	127	160	145.52	6.55
	Spike length (cm)	5.4	13.0	9.69	19.64
	Plant height (cm)	60.3	158.0	112.81	19.95
	100 grain weight (g)	1.10	6.79	3.63	37.66
	Grain yield/plant	1.13	14.70	7.59	50.02
Aegilops (13)	Days to 75% ear emergence	148	160	153.08	2.45
	Spike length (cm)	2.00	19.80	8.24	55.61
	Plant height (cm)	29.65	80.00	50.19	33.39
	No. of tillers	7.50	30.10	20.20	34.64
Barnyard millet (59)	Days to 50% flowering	61.67	81.00	71.16	4.44
	Ear head length (cm)	9.93	19.90	15.15	18.51
	Days to 80% maturity	100.00	116.67	108.45	3.37
	Plant height (cm)	66	121	97.25	12.99
	100 grain weight (g)	1.50	2.20	1.85	14.16
French bean Climber/ Pole (123)	Days to 50% flowering	30.00	74.00	44.47	20.76
	Plant height (cm)	69.00	213.60	126.97	27.18
	Pod length (cm)	7.40	15.36	10.41	12.41
	No. of pods/plant	1.70	31.00	11.08	65.14
	100 seed weight (g)	12.11	41.54	24.87	25.98
	Seed yield / plant (g)	1.19	47.70	16.18	68.74
	Days to 80% maturity	78.00	137.00	106.97	12.85
Ridge gourd (54)	Days to 50% flowering	70	130	96.5	16.1
	Petiole length (cm)	4	9.8	6.54	27.6
	Peduncle length (cm)	2.2	10.1	7.04	23.71
	No. of ridges / fruit	6	11.5	9.25	10.32
	Days to 80% maturity	117	206	176.2	11.57
	Fruit length (cm)	10	128	34.63	49.7
	Fruit width (cm)	13.5	69	48.56	19.73
	100 seed weight (g)	8.4	47.5	15.75	34.25
Buckwheat (70)	Days to 50% flowering	60	92	72.3	15
	Petiole length (cm)	1.8	8.3	4.0	32.0
	Plant height (cm)	48.3	170	96.54	26.86
	Days to 80% maturity	105	148	118.5	7.11
	100 Seed weight (g)	0.31	1.6	0.99	29.9
Perilla (61)	Days to 50% flowering	125	260	198	13.2
	Petiole length (cm)	2.6	9.5	6.44	22.66
	Inflorescence length (cm)	02	13	7.62	29.39
	Plant height (cm)	65	168	126.75	19.48
	Days to 80% maturity	215	265	235	6.8
	100 seed weight (g)	0.2	0.25	0.14	43.8
Sesame (33)	Days to 50% flowering	61.00	80.33	73.44	9.50
	Capsule length (cm)	1.77	2.77	2.28	12.27
	No. of capsule / plant	4.53	37.73	19.58	68.15
	Plant height (cm)	27.00	59.10	43.19	27.74
	Days to 80% maturity	74.77	112.00	97.79	12.83
	1000 seed weight (g)	1.33	2.70	2.04	19.37
Meetha karela (25)	Days to 50% flowering	72.00	80.67	75.47	5.03
	Petiole length (cm)	4.37	9.07	6.74	27.54
	Days to 80% maturity	176	189	184.24	2.35
	Fruit weight (g)	4.63	12.33	7.56	36.75
	No. of seed / fruit	7.67	10.33	8.70	15.76
	100 seed weight (g)	4.43	6.77	5.41	13.24



Local ratooning okra (*Abelmoschus esculentus*-IC556513): Fruit capsule 20-25 cm long, 10 ridged, 50-100 nos. of fruits / capsules in a plant (per season)



Facultative and Winter Wheat, 1025 acc. (*Triticum aestivum*) germplasm grown at Bhowali for characterization and disease screening.

Table 6: Germplasm evaluation and characterization during Rabi 2007-08

S. No.	Crop	No. of accessions	Date of Sowing	Checks Used
1	Wheat (Late maturing 41 + Indigenous 25 + Exotic - 177)	243	29.10.2007	VL-616, VL-719, VL-738, VL-829, VL-832, HB-208
2	Barley (IBON-W-92 + IBCB08-W-116 + IBSP08-W-124)	332	22.10.2007	VLB-1, VLB-56, VLB-64 and VLB-85
3	Pea (for screening of powdery mildew)	71	22.11.2007	Harbhajan, Lincon, Selection-18, Arkil and VL-8
4	Pea	69	22.11.2007	Harbhajan, Lincon, Selection-18, Arkil, Bhowali Local A, Bhowali Local B, Rachna, DMR-11, HFP-4 and VL-8
Multiplication/Seed increase				
5	Barley	19	22.10.2007	VLB-1, VLB-60 and VLB-64
6	Garlic	126	31.10.2007	Lohit, Bhowali Local
7	Lentil	07	19.11.2007	VL-1, VL-105, PL-406, PL-830
8	Rapeseed/mustard	21	22.11.2007	Hyala, PAC-401, PT-303, , Pusa Jai Kishan, GSL-1, T-9, Kranti
9	Fenugreek	10	19.11.2007	PEB, Bhowali Local
10	Spinach	06	19.11.2007	Early green, Pusa Bharti, All Green
11	Coriander	12	19.11.2007	Pant Harit-1, Kashipur Local, RCR-41, ACR-250, Bhowali Local

10.2.2 Fruit germplasm evaluation- citrus germplasm: A total of 142 accessions comprised of 19 species i.e. *Poncirus trifoliata* (01), *C. aurantifolia* (31), *C. aurantium* (04), *C. canaliculata* (01), *C. decumana* (04), *C. fartunella* hybrid (01), *C. hybrid* (01), *C. grandis* (05), *C. jambhiri* (31) *C.kinkujumshin* (01), *C. limettiodes* (03), *C. medica* (13), *C. obovoidea* (01), *C. paradisi* (01), *C. psudolimon* (05), *C. regulosa* (05), *C. reticulata* (18), *C. sinensis* (35), *C. shunkokan* (01) and *Citrus* species (02) were characterized and evaluated for 65 qualitative and quantitative traits.

In other fruits i.e., peach; the range of variation observed in fruit weight (33-133 g) and fruit volume (12-89.5 cc) and in *Rubus* spp. the range of variation observed in number of vesicles / fruit (3.1-90), no. of trusses/plant (4-176), no. of flower/trusses (1.8-28.5), fruit weight (0.4-3.17 g) and fruit volume (0.35 – 41.7 cc). IC- IC219063 (Uttaranchali Hisalu) found promising as fruit bears the largest size (fruit length 1.66 cm, fruit width 1.71 cm, fruit weight 3.0 g, fruit volume 0.45 cc) with 12⁰ Brix TSS.

Table 7: Range, mean and coefficient of variation in peach (*Prunus* spp.) and rubus (*Rubus* spp.) during Rabi 2006-07

Crop	Character	Mean		Range	CV%
		Minimum	Maximum		
Peach	Tree height (cm)	2.5	1.9	3.2	14.9
	Plant canopy	69477.4	18360	223417	70.93
	Petiole length (cm)	1.1	0.6	1.4	15.6
	10 fruit weight (g)	1005.4	330	1310	25.79
	Fruit volume (CC)	89.5	12	113	30.41
	TSS (Brix)	9.7	6	14	22
Rubus	No. of vesicles / fruit	37	3.1	90	78
	Plant canopy	23317.5	219.5	104839	117.41
	50% flowering	97.55	70	118	17.4
	No. of Trusses/plant	60.5	4	176	93.3
	No. of flower/trusses	12.1	1.8	28.5	71.7
	10 Fruit weight (g)	7.6	4	31.7	111
	10 Fruit volume	27	3.5	417	360
	TSS (Brix)	10.5	8.33	12	12.5

Vegetable germplasm evaluation: Chilli (*C. annuum*) (93) were sown in an augmented block 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. Other species of chilli i.e., *C. frutescens* (07), *C. annuum* var. *annuum* (08) and 24 others were multiplied. The range of variation for plant height (38.6-104.0 cm), number of fruit / plant (15.4–170), fruit length (1.93-12.5 cm), fruit width (0.56-1.92 cm), 5 fruit weight (1.0 – 12.4 g), fruit yield /plant (10 – 250 g) and 100 - seed weight

(0.14-0.95 g) were observed. Promising accessions for number of fruit /plant IC381108 (170), IC337397 (123), IC381091 (98), IC397824 (90) and fruit yield /plant IC381108 (250), IC361908 (225), IC397564 (225), IC397824 (180) were recorded.

Ornamental germplasm: A total of 37 accessions of *Tagetes* spp. were grown for multiplication and initial characterization. Marigold, Hajiri (20) were transplanted and evaluated in Randomised Block Design (RBD) with three local checks viz. Hajiri, Lal hajiri and Peeli hajiri.

Table 8: Promising accessions identified in horticultural crops during Kharif 2007

Crop	Main attributes	Accessions identified for specific/ desired traits
Chilli (93) Checks: Pant C-1, Pant C-2, JCA-283	Plant height (>73.8 cm)	IC342845 (104), IC381091 (101), IC381108 (97.5), IC538029 (95.2)
	No. of fruit/ plant (>72.4)	IC381108 (170), IC337397 (123), IC381091 (98.4), IC397824 and LCF-206 (90.4)
	Fruit yield/ plant (>130 g)	IC381108 (250), IC361908 (225), IC397564 (225), IC397824 (180)
Tagetes (20) Checks: Hajiri, Lal Hazari and Peeli Hazari	Plant height (>71.87 cm)	IC318949 (77.87), IC318941 (74.40)
	Days to 50% flower bud emergence (>64.67)	IC318941 (63.00)
	Number of flower/ plant (>63.27)	IC219065 (71.20)
	Flower weight (>9.61 g)	IC318945 (10.48), IC318925 (9.69)

Table 9: Range, mean and coefficient of variation in horticultural crops during Kharif 2007

Crop	Character	Mean		Range	CV%
		Minimum	Maximum		
Chilli (93)	Plant height (cm)	38.6	104	71.6	18.1
	No. of fruit/plant	15.4	170	52.4	45.0
	Fruit yield/plant (g)	10	250	60.11	78.35
Tagetes (20)	Plant height (cm)	30.80	77.87	48.73	32.42
	Days to 50% flower bud emergence	63.00	76.33	69.37	5.77
	Days to 50% blooming	74.33	88.00	82.73	4.92
	Number of flower/plant	26.53	71.20	43.75	29.66
	Flower weight (g)	6.12	10.48	8.36	16.39

Management and maintenance of horticultural germplasm:

Conservation and maintenance: Fruits (445), vegetables 1221; (chillies –1210, chow-chow-11), flowering perennial plants (109), flowering annual plants and other horticultural crops (78) were maintained in glasshouse/ Field Gene Bank/ MTS at regional station Bhowali.

Biochemical analysis: Kiwi (16), Kagazi Nimbu (21) and Malta (32) were submitted to Department of Horticulture, GBPUA&T, Pantnagar, Uttarakhand for biochemical analysis of fruits.

Transfer of technology: Technical know-how given at Farmer's field - i.) Kiwi propagation through cuttings and grafting and ii.) Citrus propagation through nucellar seedlings / cuttings.

PCPGR – HTM MM -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 (2500 pots).

b. Field Gene Bank maintenance: Exotic horticultural germplasm was established (43 accessions) viz. apple (11), pear (14), walnut (04), citrus (06) and strawberry (08) in Field Gene Bank/ Green House and all regular cultural operations were undertaken.

II. Regeneration/ multiplication/ nursery management: Kiwi and Citrus: Grafting of Hayward, Allision and Tomuri scion and cuttings were maintained



Capsicum baccatum (EC362917)- A successful introduction established at Bhowali.

in field conditions. Plants of Kiwi (EC64093, EC24672, EC64094, EC64090, EC137263, EC64092), Kagazi (IC319045) accessions were regenerated through cuttings, grafting and other vegetative means and through seeds for onward supply to the indentors. Dahlia germplasm were regenerated through cuttings in green house. Budding operation on different intervals for 500 plants in kiwi was done.

Horticultural PGR awareness pertaining to temperate fruits training and pruning, kiwi cultivation in Uttarakhand, on farm field training and demonstration and other horticultural related problems faced by farmers/ NGO/ SMS were imparted in different programmes (07 nos.) organised by SAU's/ ICAR institutions/ NGO's and a total of 333 beneficiaries (personnels) were benefitted.

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 a (92 genera of 50 families of both exotic and indigenous origin) have been maintained in the station's Biodiversity Botanical Garden.

Maintenance of Bamboosetum: A total of 41 accessions comprising of 18 species belonging to seven genera were maintained.



Capsicum pubescence (EC362925)- A successful introduction established at Bhowali.

Maintenance of temperate forage grasses: A total of 54 accessions of temperate forage grasses have been maintained in the field gene bank.

Medicinal and Aromatic Plants

A total of 445 accessions (304 indigenous accessions and 141 exotic accessions: vegetatively propagated - 125; seed producing- 320) of Medicinal and Aromatic Plants (M & AP) comprising of 260 species belonging to 153 genera of 37 families have been conserved in the field gene bank/herbal garden of the station. Nearly 30 species of the promising and high prized aromatic plants such as *Aloe*, *Alpinia*, *Artemisia*, *Asparagus*, *Bunium*, *Carum*, *Centella*, *Chrysanthemum*, *Cymbopogon*, *Hedychium*, *Lavandula*, *Matricaria*, *Marjorana*, *Melissa*, *Mentha*, *Ocimum*, *Origanum*, *Pelargonium*, *Plantago*, *Pyrethrum*, *Rosa*, *Rosmarinus*, *Salvia*, *Spilenthus*, *Stevia*, *Tagetes*, *Thymus*, *Valeriana*, *Withania* and *Zanthoxylum* were multiplied for their supply to the indentors. The essential oil from lemon grass was extracted through steam distillation system.

Determination of percentage of essential oil: A total of 37 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 is as follows: Steam Distillation Unit: *Cymbopogon flexuosus* – Lemon grass (0.26-0.70); Hydro Distillation Unit (Clevenger apparatus): *Artemisia dracuncululus* (2.0), *A. maritima* (0.83), *Callistemon lanceolatus* (DWB-0.93), *Cymbopogon flexuosus* (0.25-1.16), *Heracleum candicans* (0.02), *Hedychium spicatum* (DWB-0.77-2.50), *Lavandula angustifolia* (DWB-0.42-3.83; FWB-0.20-1.60), *Lavandula stoechus* - 0.95, *Marjorana hortensis* (0.27-0.39), *Paulownia tomentosa* - 0.01, *Pelargonium graveolens* (DWB-0.25-0.32, FWB-0.07-0.35), *Pogostemon cablin* (DWB-1.96-2.57, FWB-0.87-0.92), *Rosmarinus officinalis* blue flowered (DWB-0.81); *R. officinalis* white flowers (1.81-3.07), *Salvia officinalis* (0.96-1.56), *Satureja montana* (0.88), *Skimmia lauriola*-FWB (0.50-0.88) and DWB (1.3-1.43), *Thymus serpyllum* (0.52-0.60), *Zanthoxylum armatum* (0.20-2.60).

10.3 Germplasm Conservation

A total of 453 accessions of different crops viz. cereals: maize (09), paddy (13); pseudo-cereals: amaranth (04);

minor millets: barnyard millet (03), finger millet (08), proso millet (08); pulses: adzuki bean (03), black gram (26), cowpea (20), French bean (118), green gram (01), horse gram (03), rice bean (05), soybean (05); vegetables: okra (09), sem bean (04); oilseeds: groundnut (04), sesame (39), sunflower (01); spices: perilla (37), chilli (110); wild relatives: tree tomato (01); ornamental: *Tagetes* (22) were supplied to long term storage (NGB) for their conservation.

A total of 10,786 accessions of germplasm have been maintained in MTS of NBPGR, Regional Station Bhowali include cereals (3644), pseudocereals (585), millet and minor millets (539), pulses (3239), oilseeds (533), vegetables (266), spices and condiments (1484), M. & AP. (173), wild relatives of crops (301) and ornamental crops (22).

10.4 Germplasm Supply

MTA supply: Three hundred ninety accessions of different crops were supplied to various Research Organisations/Indentors under MTA: Agr. Crops: Rice/Paddy (cold tolerant/ rainfed type) (50), barnyard millet (50), finger millet (50) and black gram (30) to Joint Director (R & E) & OIC, GBPUA&T, ZARS, Majhera, Garampani, Distt. Nainital, Uttarakhand; soybean (12), Dr. Anil Khulbe, GBPUA&T, ZARS, Majhera, P.O. Garampani, Dist. Nainital, Uttarakhand. Oat (*Avena sativa*) (05), Dr. H.R. Meena, Scientist, Extension Education, IVRI, Mukteshwar, lentil (*Lens culinaris*) (112), french bean (*Phaseolus vulgaris*) (15) to Dr. G. Singh, VPKAS, Almora, UK.; M & AP (01) of *Artemisia annua* to Dr. Sunita Pandey, GBPUA&T, Pantnagar; *Atropa belladonna* (01), *Ocimum* spp. (04) to Dr. V.K. Agrawal, Prof. & Head, Dept. of Crop and Herbal Physiology, JNKVV, Jabalpur, MP; Insect repellent plants of *Conium maculatum*, *Ocimum viride*, *Pyrethrum cinerifolium*, *Rosmarinus officinalis*, *Ruta graveolens*, *Tagetes minuta* and *Thymus serpyllum* (07) Dr. Hare Krishna, Scientist (Hort.), CITH, R/S Mukteshwar, Distt. Nainital, Uttarakhand; Hort.: (05) plants of kiwi varieties to Dr. Rohatash Kumar, Incharge, GBPUA&T, Uttarakashi Research Station, Uttarakashi; Kiwi (01) to Sh. Sonam Rinchel, Dy. Director, HCCD, Govt. of Sikkim, Gangtok – 737 101 and Kagazi neebu –(01) to Sh. R.C. Puttoo, SMS, Hort. Dept. C/O A-38, Vasant Vihar, Jammu; Wild relatives: *Allium* spp.-11 with 11 species, Dr. Anil Khar, NRC for Onion & Garlic, Rajguru Nagar 410 505, Pune,



Recently introduced ornamental climber (*Thunbergia coccinea* –IC556518) from Assam with scarlet flower collected at an elevation of 1150 m



Officers of Agriculture and Horticulture Development Departments of States / Universities (20 participants) visited at R/S Bhowali during their Model Training Course on “Advanced technologies in production of temperate fruit crops like apple, pear, cherry and kiwi” organized by CITH, Mukteshwar

Maharastra; Temperate forage grasses (15) for Field Gene Bank / Nursery, Dr. H.R. Meena, Scientist, Extension Education IVRI, Mukteshwar, UK.; *Cucumis hardwickii* (20) to Head, Department of Vegetable, GBPUA&T, Pantnagar, U.S. Nagar, Uttarakhand.

Farmers/ indentors supply: Seed samples and live rooted plant material viz. M. & AP.: *Achillia millifolium* (10), *Acorus calamus* (20), *Allium* spp. (400;15), *Aloe barbadensis* (10), *Artemisia annua* (16), *Artemisia dracunculus* (390), *Artemisia maritima* (19), *Curculigo orchoides* (10), *Cymbopogon flexuosus* (3015), *Foeniculum vulgare* spp. *purpurascence* (16), *Ginkgo biloba* (2), *Hedychium spicatum* (12), *Lavendula angustifolia* –1 Kg flower spikes; 158, *Lavendula stoechus* (5), *Marjorana hortensis* (321), *Mentha* spp. (65), *Ocimum* spp. (10; 55 g), *Origanum vulgare* (10), ornamental Geranium (5), *Pelargonium graveolens* cv. Almora (135), *Pelargonium graveolens* cv. Kelkar (410), *Pelargonium graveolens* cv. Haldwani (14), *Plantago* spp.(20), *Rosa damascena* cv. Noorjahana (12), *Rosmarinus officinalis* cv. French (42,704), *Rosmarinus officinalis* cv. Italian (7,795), *Salvia moorcroftianum* (2), *Salvia officinalis* (1425), *Stevia rebaudiana* (54), *Taxus baccata* (5), *Thymus serpyllum* (10), *Valeriana jatamansi* (5), *Wedelia chinensis* (2), *Zanthoxylum armatum* (10); Agricultural Crops: *Brassica* spp. (44), Finger millet

(33 Kg, French bean (mixed grains) (85 Kg), Garlic (14 Kg), Garden Pea (Green pod mixture) (96 Kg), Rice bean (1 Kg), Soybean (16 Kg), Wheat (mixed grains) (152 Kg; HB (208 wheat - 5 Kg seed; Horticultural Crops: Citrus mix fruits (237 Kg), Cryptomeria (12 nos.), Kagazi (4), Kiwi (2089 +135 Kg), Malta (27 Kg), Passion fruit (6), Santara (3), Spiraea (10), Strawberry (35); WEUPS: Bamboo log (35 nos. (25 Ist Gd. + 10 IInd Gd.) 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 13 varieties was conducted. LRB-05 (26.77 q/ha), BRS-1, check (22.08 q/ha), RBL-463 (20.42 q/ha), LRB-10 & LRB-13 (19.17 q/ha) were performed better in grain yield than other entries.

10.6 Registration of Germplasm

Almoria Geranium/ Scented Rose Geranium (*Pelargonium graveolens* L. Heritier) INGR 07042/ IC553286 / NIC023413 / PN-1696 – Citronellol rich-62.03% and accepted by the industry people for its high contents of Citronellol compound and lemon like or odomas like odour has been registered by Plant Gerpalsm Registration Committee, NBPGR, New Delhi.

Research Projects (Project Code, Title, PI, CoPIs)

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

PGR/PGC-BHO-01.0:1 Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of field crops with emphasis on ethno botanical aspects (K.C. Muneem, K.S. Negi, S.K. Verma and P.S. Mehta)

PGR/PGC-BHO-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of temperate horticultural crops (S.K.Verma, K.C. Muneem, K.S. Negi and S. Gupta)

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 (K.S. Negi, K.C. Muneem and S.K. Verma).

11. EXPLORATION BASE CENTER, CUTTACK

Summary: Two explorations were undertaken for collection of variability in jackfruit and custard apple germplasm from Jajpur, Keonjhar, Dhenkanal, Ganjam and Gajapati districts of Orissa. A total of 40 accessions comprising jackfruit (24) and custard apple (16) were collected from 31 collection sites. The species diversity includes *Artocarpus heterophyllus* (23), *A. lacucha* (1) and *Annona squamosa* (16). Wide range of diversity and variability were observed for fruiting duration, fruit size, shape, colour, flake size, number of flakes per fruit, seed size and average yield/plant in jackfruit germplasm whereas in custard apple germplasm variability were observed for fruit size (118g-468g), number of flakes/fruit (34-92), edible parts/fruit (56g-144g) and average yield/plant (10kg-25kg).

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

11.1 Exploration and Germplasm Collection

During the reporting period two exploration and collection missions were executed and a total of 40 accessions comprising jackfruit (24) and custard apple (16) belonging to three species viz. *Artocarpus heterophyllus*, *A. lacucha* and *Annona squamosa* were collected.

The first exploration mission was undertaken in collaboration with CHES, Bhubaneswar for collection of variability in jackfruit germplasm from Jajpur, Keonjhar and Dhenkanal districts of Orissa. A total of 24 accessions were collected and identified from 17 collection sites belonging to two species viz., *Artocarpus heterophyllus* (23) and *A. lacucha* (one) under the family Moraceae. The district wise diversity collected includes 11 accessions from Jajpur, 8 accessions from Keonjhar and five accessions from Dhenkanal districts of Orissa. Wide range of diversity and variability were observed for fruiting duration, fruit size, shape, colour, flake size, number of flakes per fruit, seed size and average yield/plant. Ripe fruits of *Artocarpus lacucha* are reported to be eaten by tribals of Keonjhar district. All the germplasm collected during the tour are being maintained in the field Gene Bank of CHES, Bhubaneswar, Orissa.

The second exploration mission was undertaken for collection of variability in custard apple germplasm from Ganjam and Gajapati districts of Orissa. Custard apple (*Annona squamosa*) (16 accessions) based on desired traits for improvement of the crop were collected/identified during the exploration. The district-wise diversity collected include 11 accessions from Ganjam and five accessions from Gajapati districts of Orissa. Wide range of diversity and variability were observed for fruit size (118g-468g), number of flakes/fruit (34-92), edible parts/fruit (56g-144g) and average yield/plant (10kg-25kg) was recorded.

11.2 Preliminary Characterization of Germplasm

Cultivated rice: A total of 1,131 accessions of cultivated rice germplasm were transplanted in augmented design with five checks for evaluation in second season and seed multiplication. Observations on various morpho-agronomic characters were recorded as per the minimal descriptor. The range of variability recorded for plant height was 44.66cm -192.98 cm between IC514815 & IC515549, the ear bearing tiller varies from 2.6 to 13.8 between IC514902 & IC39960, the panicle length varies from 13.48 to 36.0 cm between IC515478 & IC514824, the leaf length varies from 22.98 to 71.82 cm between IC514146 & IC515626 and the leaf width varies from 0.46 to 0.80 cm between IC515621 & IC515002. In addition, 2656 accessions of cultivated rice were multiplied in association with CRRI, Cuttack.

The seeds of 1,000 accessions of IRRI rice germplasm were multiplied during *kharif*, 2006 out of which 804 accessions were deposited in the NGB.

Promising lines identified: On the basis of grain yield performance the accessions given in the table are found promising over the best check.

Table 1: Promising accessions identified on the basis of grain yield (Kg/ha)

Accession number	Yield (kg/ha)	Superiority over best check (%)
IC514664	4,456	24.2
IC514764	4,684	30.65
IC514944	4,551	26.94
IC514787	4,394	22.56
IC514768	4,380	22.17
IC514143	4,306	20.11
IC514710	4,270	19.10
IC514714	4,269	19.07
IC515378	4,250	18.54
IC514796	4,152	15.81

Check values(kg/ha): Tulsi (3,585), Panidhan (3,583), Jaya (2,413), Mahsuri (2,173)

Horse gram: A set of 87 accessions of horse gram received from NBPGR Regional Station, Hyderabad and Shimla were grown in augmented design with four checks and six blocks. Observation on various traits viz., germination, plant vigour, plant growth habit, leaf and stem characters were recorded during the period

Table 2: Germplasm exchange activities

Crops	Accessions (No.)	Received	Supplied	Purpose
Cultivated rice	2,656	NBPGR, New Delhi	Crop improvement division, CRRRI, Cuttack	Seed multiplication
Horse gram	37	NBPGR RS., Hyderabad	—	Evaluation
Horse gram	50	NBPGR RS., Shimla	—	Evaluation
Wild <i>Oryza</i> species	40	—	Crop Protection Division, CRRRI, Cuttack	Evaluation
M&AP	38	—	GED, NBPGR, New Delhi	Evaluation
Amaranth grain type	16	New collections	NBPGR RS, Shimla	Evaluation
Amaranth leafy type	36	New collections	NBPGR RS, Thrissur	Evaluation
Total	2,873			

11.5 Germplasm Conservation

A total of 1,526 accessions comprising cultivated rice (804), sesame (578), amaranth (104), custard apple (16), jackfruit (24) were deposited at NBPGR, New Delhi.

under report.

11.3 Seed Multiplication

Sesame: A set of 611 accessions of sesame germplasm received from NBPGR Regional Station, Akola was shown in the experimental field in augmented design with 30X10 cm spacing for seed multiplication. Each accession was maintained in two rows of 3m length.

Amaranth: A set of 52 accessions of amaranth germplasm comprising grain type (16) and leafy vegetable type (36) were grown for seed increase.

11.4 Germplasm Exchange

A total of 2,873 accessions comprising cultivated rice (2,656), horse gram (87), wild *Oryza* species (40), M&AP (38), amaranth grain type (16) and amaranth leafy vegetable type (36) accessions were received/supplied to various institutes for research purposes.

11.6 Germplasm Maintenance

A total of 2,287 accessions comprising cultivated rice (1,131), Medicinal and aromatic plants (321), sesame (595), wild *Oryza* species (156), other wild relatives of crop plants (34), silviculturally economic plants (24), banana (17), horticultural crops (06) and betel vine (03) are being maintained at NBPGR Base Centre, Cuttack.

Research Project (Project Code, Title, PI)

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

12. REGIONAL STATION, HYDERABAD

Summary: A total of 17,148 samples (7,691- imports and 9,457 export) were received for quarantine processing during the period under report. A total of 7,613 samples comprising paddy(3,073), maize (1,959), sorghum (884), pearl millet (423), chickpea (226), sunflower (142), chilli (458), tomato (170), carrot (25), tobacco (105), cotton (110), groundnut (13), *Hypericum* sp. (21) and *Leucaena* spp. (4) were released after giving mandatory treatment. Important interceptions in imported samples included *Alternaria padwickii*, *Drechslera oryzae*, and *Sclerotium oryzae* in paddy from Belgium; *Fusarium oxysporum* in maize from Mexico and Thailand; *Drechslera setariae* in pearl millet from Niger; *Alternaria helianthi* and *Botrytis cinerea* in Sunflower from Australia and Serbia Monte-Negro respectively; *Alternaria radicina*, *A. dauci*, *Rhizoctonia solani* in Carrot from USA; *Alternaria solani*, *Colletotrichum capsici*, *Rhizoctonia solani* in Chilli from Taiwan and *Pseudomonas syringae* in tomato from Taiwan. A total of eight explorations were undertaken and 414 germplasm accessions of various crops were collected including *Coccinia indica* (75), wild edible legumes (10), *Cucumis melo* (42), musk melon (41), *Vigna trilobata* (50), Rabi legumes (930), *Pongamia* (115) and *Jatropha* (14). A total of 1,058 accessions of different crops including sorghum (239), black gram (175), green gram (140), horse gram (15), cowpea (194), chillies (133), brinjal (61), *Lycopersicon* species (73), *Canavalia ensiformis* (28) were grown for characterization/ evaluation and multiplication during Rabi 2006-07. In Kharif 2007, a total of 1,370 accessions of black gram (136), finger millet (30), Italian millet (180), little millet (24), barnyard millet (22), cowpea (100), green gram (144), sesame (100), beans (130), brinjal (190) were characterized/ evaluated and multiplied. A total of 219 accessions were multiplied and sent to NGB for long-term storage. A total of 338 accessions of collected material were sent for MTS and 1,946 samples including 104 voucher sesame (77) and groundnut (27) were added to the medium-term module at Hyderabad.

12.1 Import Quarantine

During the year 2007, a total of 17,148 samples of different crops were received and processed for quarantine clearance. Out of these, 7,691 samples (paddy- 2785; maize- 2188; sorghum- 910; pearl millet- 423; chickpea- 207; groundnut- 1; sunflower- 160; cotton- 110; tobacco- 105; chilli- 582; tomato- 170; *Hypericum*- 21; carrot- 25, and *Leucaena* spp- 4) were imported from different countries and the rest 9,457 (sorghum-

4176; pearl millet- 826; chickpea- 3337; pigeonpea- 104; groundnut-667 and small millets- 347) were meant for export to different countries.

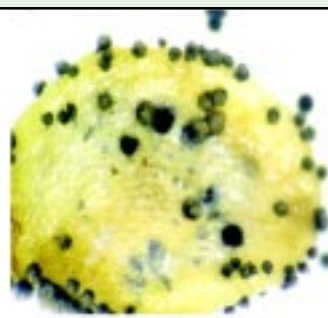
12.1.1 Import quarantine interceptions: All the import samples were subjected to various seed health tests like visual examination, blotter test, X-ray radiography, Enzyme Linked Immunosorbent Assay (ELISA), centrifugation and microscopic examination.

Table 1: Pathogens were intercepted during the reporting period.

Pathogen	Crop	Country
<i>Alternaria padwickii</i> , <i>Drechslera oryzae</i> , and <i>Sclerotium oryzae</i>	Paddy	Belgium
<i>Fusarium oxysporum</i>	Maize	Mexico Thailand
<i>Drechslera setariae</i>	Pearl millet	Niger
<i>Alternaria helianthi</i> <i>Botrytis cinerea</i> Serbia Monte-Negro Serbia Monte-Negro	Sunflower	Australia
<i>Alternaria radicina</i> , <i>A. dauci</i> , <i>Rhizoctonia solani</i>	Carrot	USA
<i>Alternaria solani</i> , <i>Colletotrichum capsici</i> , <i>Rhizoctonia solani</i>	Chilli	Taiwan
<i>Pseudomonas syringae</i>	Tomato	Taiwan

The healthy accessions were released after giving the necessary salvaging treatments.

12.1.2 Imports processed and released: During the period under report, 7,613 samples including paddy samples (3073), maize (1959), sorghum (884), pearl millet (423), chickpea (226), sunflower (142), chilli (458), tomato (170), carrot (25), tobacco (105), cotton (110),



Colletotrichum capsici on chilli from AVRDC, Taiwan



Rhizoctonia solani mycelium on chilli seed



groundnut (13), *Hypericum* sp (21) and *Leucaena* spp. (4) were released to the respective consignees after giving the mandatory treatments.

Total number of samples infested/infected in imports	-	1893
Samples infected with pathogens	-	1564
Samples infested with insects	-	235
Samples infected with nematodes	-	94
Number of samples salvaged	-	1893
Number of samples detained	-	-
Number of samples Rejected	-	Nil

12.1.3 Post-entry quarantine observations:

ICRISAT: Crop germplasm (sorghum: 497; maize: 339 and chickpea: 282, groundnut: 106) that is being grown in the post-entry quarantine isolation area (field and glasshouse) of ICRISAT is inspected at weekly interval. *Sclerotium rolfsii* and *Fusarium oxysporum* f. sp. *ciceri* affected chickpea plants were uprooted and incinerated.

Post-Entry Quarantine Inspections in the fields of private industry: The infected /suspected plants were uprooted and incinerated.

Crop	Country	No. of samples	Private company	Remarks
Transgenic cotton	USA	7	Emergent Genetics, Kallakal, Medak, AP	
Tomato	Taiwan	13	Bioseed Research India Ltd., Hyderabad	<i>Peanut bud necrosis virus</i> & <i>Tomato leaf curl virus</i>
Chilli	Taiwan	10	Indo-American Hybrid, Bangalore	<i>Tobacco mosaic virus</i>
Sunflower	Australia	8	Meta-Helix Pvt Ltd., Bangalore	
Maize	Mexico	17	Meta-Helix Pvt Ltd., Bangalore	
Maize	Brazil	30	Pioneer Overseas Corporation, Bangalore	
Maize	USA	89	Monsanto India Ltd., Bangalore	
	Mexico	104		
	Brazil	30		
	Argentina	30		
Paddy	USA	2	MAHYCO, Andhra Pradesh	
Sunflower	Argentina	80	Advanta India Ltd., Hyderabad	

12.2 Export Quarantine

Pre-export crop inspection: Pre-export crop inspection

was conducted on sorghum crop grown in different plots at ICRISAT and the following observations were recorded:

Field No	Area (Ha)	Remarks
BP1	0.1	Zonate leaf spot, maize dwarf virus (0.1% each) observed on E-36-1
RCW 19A	0.1	SPV 1411 was infected with anthracnose (5%), downy mildew (0.1%), rust (0.1%). Advised to spray Carbendazim(0.2%) on ICSV 93046 to prevent spread from SPV 1411. Downy mildew affected plants were uprooted and incinerated.
BP 6A	0.3	Shoot borer incidence (1%) noticed.
BP 7A	1.2	Sheath blight (0.5%), downy mildew (0.1%). Advised to spray Dithane M 45 (0.2%) on sheath blight (<i>Rhizoctonia solani</i>) affected plants to prevent the spread.

Out of 9, 457 export samples consisting of sorghum (4,176); pearl millet (826); chickpea (3,337); pigeonpea (104); groundnut (667) and small millets (347), eighty-three (83) samples were rejected due to the association of various pests and pathogens. In all, 103 phytosanitary certificates were issued during the reporting period. The details are given as under:

Crop	Samples		
	Processed	Rejected	Released
Sorghum	4,176	21	4,155
Pearl millet	826	11	815
Small millets	347	6	341
Chickpea	3,337	38	3,299
Pigeonpea	104	3	101
Groundnut	667	4	663
Grand Total	9,457	83	9,374

Export interceptions: The rejections in the export germplasm of ICRISAT mandate crops were mainly due to pathogens such as *Fusarium oxysporum*, *Acremonium* spp., *Fusarium* spp., *Rhizoctonia* sp. and *Fusarium udum*, *Bipolaris setariae*, *Rhizoctonia solani* and Gram negative bacteria. Some samples were rejected for export due to lack of necessary documents like DARE certificate, back history and FAO trust.

12.3 Supportive Research

Pearl millet seed (cv. HHVBC Tall-BC) artificially inoculated with smut sori of *Tolyposporium penicillariae* were taken (@ 50 seeds per replication) in a test tube along with the equal quantity of sterile sand and 5 ml of ethyl alcohol. The contents of test tube were stirred for three different periods (1, 2 and 3 minutes), taken out, washed in sterile water twice and then suspended in a thin layer of

sterile water in petri plates. Microscopic examination after incubation for 24h at 30°C revealed no germination of smut sori in all the treated seed irrespective of the duration of the treatment. While in control plates, sporeballs adhering to the seed surface were found germinated. The same experiment was repeated and the treated seeds were plated on potato dextrose agar (PDA) as well as PDA amended with carbendazim and thiram. Results revealed that the treatment for 2 minutes was successful as the seeds were completely devoid of *T. penicillariae* growth compared to control plate.

Seed health testing of *Pongamia* germplasm: *Pongamia pinnata* germplasm (42 samples) collected from Andhra Pradesh were tested for their seed health and majority of the accessions were found infected with *Macrophomina phaseolina*.

Of the 20 cotton cultivars inoculated with *Tobacco streak virus* (TSV), all showed local lesions, but none showed systemic symptoms.

Observations on field evaluated of brinjal (120 lines) indicated mosaic infection ranging from 0-12%. ELISA conducted on 54 samples indicated positive reaction in 23 samples to *Peanut bud necrosis virus* (PBNV) and 21 to *Cucumber mosaic virus* (CMV).

Blackgram (10) and greengram (10) cultivars were sap inoculated with PBNV and *Tobacco streak virus* (TSV) separately and all were found susceptible.

12.3.1 Seed health testing service extended: Seed health testing of 18 samples consisting of paddy (14), chilli (1), sunflower (1), maize (1) and sorghum (1) was completed. Of the 14 paddy samples, 11 were found infected with the target pathogens.

Plant health status of cotton accessions (4,230 plants), grown in the greenhouse of Monsanto India Pvt. Ltd., Kallakal, Hyderabad was undertaken and all were found healthy.

Soil testing of 11 samples supplied by Advanta India Ltd. was completed and all samples were free from the target nematodes, *Aphelenchoides besseyii* and *Ditylenchus angustus*.

Seed health testing services were extended to Advanta India Ltd. on payment basis for paddy and pearl millet samples (5 each) supplied by and paddy samples (5) from Bayer Bioscience Ltd., Hyderabad was completed and all paddy samples were free from the target pests. Two pearl millet samples were infected with downy mildew (*Sclerospora graminicola*).

12.4 Exploration and Collection of Germplasm

A total of eight explorations were undertaken during the period and 414 germplasm accessions of various crops were collected. Details of explorations and crop diversity collected are as follows:

***Coccinia indica* (ivy gourd):** The survey was undertaken in collaboration with ANGRAU in the districts of Krishna, Guntur, Prakasam, Nellore and Kurnool of South Coastal and Rayalaseema regions of Andhra Pradesh. A total of 75 accessions of ivy gourd (cultivated and wild forms) germplasm and 16 accessions of other agri-horticultural/ wild/ medicinal plants were collected. Diversity was observed for fruit shape, size and presence/ distribution of cream markings on fruits. The wild forms were characterized by bitter taste and conspicuous markings on the fruits. Germplasm collected was shared with ANGRAU.

Wild edible legumes: A survey was undertaken in Rayalseema region of Andhra Pradesh. Sixty accessions of wild edible legumes and 10 accessions of other crops were collected.

***Cucumis melo* (melons):** The survey was undertaken in the districts of Kadapa, Chittoor, Kurnool districts of Rayalaseema region of Andhra Pradesh. A total of 42 accessions consisting of snap and musk melon germplasm (41) and one accession of *Vigna trilobata* were collected. Diversity was observed for fruit shape, size and presence/ distribution of net markings on fruits.



Diversity of melons germplasm from Rayalaseema region of Andhra Pradesh



PSR-12259 –A wild form of *Coccinia indica* characterised by dense green fruits and conspicuous cream markings on surface

The landraces collected included *papaya*, *batasapandu*, *zamin*, *sharbat*, *sharbat anar*, *tellakaya*, *allangir*, etc. Melons are generally referred as *dosakaya* in this region.

***Vigna trilobata* and Rabi legumes :** The survey was undertaken in south coastal region of Andhra Pradesh mainly from districts of Prakasam, Nellore, Krishna and West Godavari. A total of 82 accessions (*Vigna*



Variation in seed size and colour in *Canavalia* germplasm



Vigna trilobata accession IC553524 (VKAP – 07/49)
(M.Nedemalluru, Ongole, Prakasam) with 11 pods/cluster

trilobata-50, *rabi* legumes - 30, others – 2) were collected. In *Vigna trilobata*, variation was observed in leaf lobing, plant height and number of pods/clusters.

Pongamia and Jatropha: Under the state government funded project on biodiesel crops, four explorations were undertaken in parts of Kerala, Tamil Nadu and Pondicherry, Chittoor, Prakasam, Srikakulam, East Godavari, Vizianagaram and Visakhapatnam districts of Andhra Pradesh and Malkangiri district of Orissa. A total of 115 accessions of *Pongamia* and 14 accessions of *Jatropha* were collected. In *Pongamia*, significant diversity was observed in leaf colour (light green/ dark green), branching habit (erect/ semi-erect/ drooping), stem girth, flowering (white/ pink/ purple), pod shape, size, colour, beak characters, seed size, shape and colour. In *Jatropha*, diversity was observed for bearing, bunches/ tree and capsules/ bunch. The material was shared with RARS, Tirupati, Agro-forestry division of ANGRAU, Hyderabad and CRIDA, Hyderabad collaborators under the project.

A total of 82 specimens including wild and weedy legumes, and medicinal and aromatic species and *Lycopersicon* species were submitted for inclusion in the National Herbarium of Cultivated Plants, NBPGR, New Delhi.

12.5 Germplasm Evaluation

12.5.1 Rabi 2006-07: A total of 1,058 accessions of different agri-horticultural crops consisting of blackgram, horsegram, greengram, sorghum, brinjal and chillies were grown for characterization/ evaluation/ multiplication during *rabi* 2006 –07.

Sorghum: In sorghum, a total of 239 accessions were characterised 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 (76-249cm), leaf length (28-73cm), leaf width (2-8cm), total number of leaves (4-11), panicle length (7-42cm) and panicle width (3-24cm). Accessions were identified as promising over the best check for various traits as: among the tall types, IC249107 from Khammam, IC258017 from Visakhapatnam, IC566444 from Karimnagar and IC258019 from Vizianagaram appear to be promising for panicle length and width.

Black gram: A total of 175 accessions were grown for characterization 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 (11.4- 46.9), primary branches (1- 5.7), clusters/plant (1- 27.7), pods/plant (1- 65.7), pods/cluster (1- 5.3), pod length (1-6.2cm), seeds per pod (2- 7.7), 100 seed weight (1- 6) and days to flowering (46- 60). Accessions were identified as promising over the best check for various traits as: Plant height (tall): IC436561 (Medak), IC436604 (Medak, IC398973 (Prakasam); primary branches: IC436565 (Medak), IC261177 (Kurnool), IC398956 (Prakasam): Clusters/plant: IC519801 (Srikakulam), IC436561 (Medak), IC436641 (Medak); Pods/cluster IC436561 (Medak), 436720 (Adilabad), IC436811 (Adilabad), pod length: IC398956 (Prakasam), IC 413305 (Medak), IC335331 (Guntur); seeds/pod: IC436547 (Ranga Reddy), IC436516 (Ranga Reddy), IC436641 (Medak).

Green gram: A total of 140 accessions were grown for characterization and evaluation in ABD with three checks ML-267, LGG-460 and K-851. High diversity was observed in different quantitative traits as follows: plant height (15.8- 47.28cm), primary branches (0-4.6), clusters/plant (1.4- 14.2), pods/cluster (1.2- 5.6), pod length (3.29- 7.4cm), seeds per pod (3.4-10.86), 100 seed weight (2.3-6.4g) and days to flowering (44-62). Accessions were identified as promising over the best check for various traits as: days to flowering: IC436743, IC546485 and IC546488 all from Adilabad, IC546494 (Khammam), IC426771 and IC426772 both from Srikakulam; primary branches: IC470237 (Anantapur), IC369703 (Vizianagaram), IC546475 (Adilabad); clusters/plant: IC436731, IC436723 and IC436700 all from Adilabad; pods/cluster: IC546476, IC546477, IC436746 all from Adilabad; seeds/pod: IC546475, IC546486 both from Adilabad and IC470237 from Anantapur; seed yield/plant: IC546476 and IC546478 both from Adilabad; pod

length: IC426772 (Srikakulam), IC436721 and IC436723 both from Adilabad districts of Andhra Pradesh.

Horsegram: In horsegram 15 accessions identified promising in previous evaluations were evaluated in RBD trials with three check varieties Palem-1, Palem-2 and AK-21. Accessions NS-05/093 and NS-05/137 were found to be promising for pods/plant (64.4) and pod length (8.29) respectively as compared to best check AK-21(44.7) and Palem 2(5.33cm) respectively.

Cowpea: A total of 194 accessions were grown for characterization and evaluation in ABD with three checks C-152, CoVu 702 and GC-3. IC261240, IC436847 and IC282057 were promising for early flowering; IC436845 for pod length and IC343899 for seeds/pod. Accession IC519745 was found resistant to *Black eye cowpea mosaic virus* (BICMV).

Chillies: A total of 133 accessions were characterized and evaluated in an ABD with CA-960, LCA-334 and Pusa Jwala as check varieties during the *Rabi* season of 2006-07. A total of 45 qualitative and quantitative descriptors pertaining to plant, flower, inflorescence and fruit were recorded. A wide range of variation was recorded in different traits viz. plant height (25.3 – 110.3 cm), days to flowering (84 – 163), days to maturity (137 – 215), fruit length (2.0 – 13.6 cm), fruit width (0.9 – 4.5 cm) and fruit weight (4.6 – 51.4 gm). Fruit weight, fruit length, fruit width and plant height seem to be more diverse. Accessions EC405251 appear to be promising

for days to flowering (84 days), EC388995 and EC399556 for days to maturity (137 days), EC9 for fruit length (13.6 cm), EC405251 for fruit width (4.5 cm) and EC399540 for 10 fruit dry weight (51.4 gm).

Brinjal: In brinjal, 61 accessions were grown for characterization and evaluation in ABD with three checks Bhagyamathi, Pusa Purple Long and Shyamala. High diversity was observed in different quantitative traits as follows: days to 50% flowering (41-72cm), fruit length (3 – 20 cm), fruit width (2.9 – 16.2), fruit yield/plant (0.4 – 2.8 kg). Accessions were identified as promising over the best check for various traits as: days to flowering: IC90176, IC11024 and IC 90787; yield/plant: IC89984, IC90975 and IC90950.

Lycopersicon species: A total of 73 accessions were characterized in RBD with Marutham and Pusa Ruby as check varieties. *Lycopersicon pimpinellifolium* was promising for maximum clusters/plant (EC514110) and fruits/cluster (EC514090).

Canavalia species: A total of 28 accessions of *Canavalia ensiformis* were characterised for agrobottanical characters. Variation was observed in seed characters namely: seed length (17.8 – 27.5mm), seed thickness (12.3 – 17.4mm) and 100 seed weight (120.2 – 310.2 g).

12.5.2 Kharif 2007: A total of 1,370 accessions of millets, blackgram, cowpea, beans, sesame, brinjal

Crop	No. of Accessions	Checks	Activity
Black gram	136 (ABD)	T-9, PU-19, LBG-20	Characterization and evaluation
Finger millet	30 (RBD)	PR-202, VL-149	Evaluation
Italian millet	180 (ABD)	Prasad, Narasimharaya, Lepakshi	Characterization and Evaluation
Italian millet	43 (RBD)	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	24 (RBD)	CO-2, OLM-203	Evaluation
Barnyard millet	22 (RBD)	K-1, VL-29	Evaluation
Cowpea	100 (ABD)	GC-153, C-152, CoVu-702	Characterization and Evaluation
Green gram	144(ABD)	ML-267, LGG-460, K-851	Characterization and Evaluation
Sesame	100 (ABD)	Swetha	Multiplication
Beans	130 (ABD)	RND-1, Arka Jay, Arka Vijay	Characterization, Evaluation and Multiplication
Brinjal	190 (ABD)	Bhagyamathi, PPL, Shyamala	Characterization, Evaluation and Multiplication
Chillies	185 (ABD)	CA-960, LCA-334, Pusa Jwala	Characterization, Evaluation and Multiplication
Wild legumes (11 species)	86	-	Characterization and Multiplication

and chillies were grown in the field along with appropriate checks for characterization/ evaluation/ multiplication.

Black gram: Accessions IC398989 (4.9cm, 6.4) and IC 436676 (4.9cm; 6.4) were found superior to the best check (T-9-4.9cm; 5.6) for pod length and seeds/pod.

Cowpea: In cowpea accession IC282138 (20.6cm) was identified better than the best check for pod length (best check CoVu 702 (14.3cm)); and IC282061 (16.9) for seeds/pod (best check C 152 (15.7)).

Brinjal: Analysis of brinjal evaluation data pertaining to 190 accessions is in progress.

Chillies: Accessions IC545689 was the earliest to mature in *Kharif* (145 days) when compared to CA-960 in (152 days) which is the best check.

Dolichos bean: KSAS-06/ 151 is the earliest to mature in 98 days compared to Arka Jay in 111 days, which is the best check.

Field bean: PSR-11860 is the earliest to mature in 155 days when compared to Arka Jay in 158 days, which is the best check.

Tomato: Two tomato accessions found promising for yield potential were analyzed for five biochemical traits viz. TSS, Acidity, Vitamin C, lycopene and carotenoids. Accession IC383108 recorded more lycopene (1119.6 µg/ 100g) and carotenoid content (1299.5 µg/ 100g) than that of the check varieties Pusa Ruby, Marutham and Punjab Chauhara, which recorded values in the range of 950.7 – 1024.7 (µg/100g) of lycopene and 1053.2 –

1198.2 (µg/ 100g) of carotenoids.

Italian millet: For days to maturity, IC257877, IC257878 and IC257879 are the earliest to mature in 67 days when compared to Lepakshi and Narasimharaya in 79 days which are the best checks.

Finger millet: Accession IC438725 is the earliest to flower in 64 days compared to PR-202 in 79 days, which is the best check.

Little millet: Accession IC426667 is the earliest to mature in 87 days when compared to CO-2 in 90 days, which is the best check.

Green gram: Out of 144 accessions evaluated, six accessions namely IC470237 (Ankampalli (V), Biduguppa (M), Anantapur (Dt.); IC546478 (Surdapur (V), Choupanaguda (M), Adilabad (Dt.); IC546486 (Chenur (V), Chennur (M), Adilabad (Dt.); IC546490 (Rajaram (V), Vemanapalli (M), Adilabad (Dt.); IC527034 (Near Gooty (V), Anantapur (Dt.), and IC369703 (Gudarivalasa (V), Parvatipuram (M) Vizianagaram (Dt.) were identified as photosensitive as they did not flower even after 70 days of sowing.

Wild legumes: A total of 86 accessions of wild legumes namely *Atylosia* sp. (4), *Canavalia* sp. (28), *Cassia* sp. (16), *Sesbania grandiflora* (26) and others (12) are being maintained in the field for characterization and multiplication.

12.5.3 Rabi 2007-08: A total of 993 accessions of blackgram, sorghum, horsegram, cowpea, pillipesara, leafy vegetables, brinjal, chillies and wild legumes were grown in the field along with checks for characterization and evaluation / multiplication.

Crop	No. of Accessions	Checks	Activity
Black gram	50	T-9, PU-19, LBG-20	Multiplication
Sorghum	150	M35-1, CSV-15, CSV-16	Evaluation and multiplication
Horsegram	160 (ABD)	Palem-1, Palem-2	Evaluation
Leafy vegetables	61	-	Multiplication
Brinjal	190 (ABD)	Bhagyamathi, PPL, Shyamala	characterization and evaluation
Chillies	185 (ABD)	CA-960, LCA-334, Pusa Jwala	Evaluation and multiplication
Cowpea	80	GC-153, C-152, CoVu-702	Multiplication
<i>Vigna trilobata</i> (pillipesara)	99 (ABD)	-	
Wild legumes	18	-	Multiplication



IC553556 (VKAP – 07/83) (Nallajerla, Nallajerla, W. Godavari) with variation in leaf lobing

Jatropha Project: Under the Andhra Pradesh Govt. funded RSAD Jatropha project, fifty three accessions of *Pongamia pinnata* and twelve accessions of *Jatropha curcas* were analyzed for oil content at Directorate of Oilseeds Research (DOR). The oil content in pongamia ranged from 14.9 – 47.3% and in jatropha from 20.7 – 33.7%. Seven accessions of *Jatropha curcas* (SNES-45, SNES-33, SNES-11, SNES-18, SNES-23, SNES-4 and MJC-26) and four accessions of *Pongamia* (VNK-P-6, VNK-P-11, VNK-P-27 and VNK-P-79) were identified as highly potential

based on the oil content.

12.6 Germplasm Conservation

Long-term storage in the National Genebank: A total of 219 accessions including blackgram (27), greengram (12), tomato (45), chillies (109) and wild *Arachis* (27) were multiplied and sent to NGB for long-term storage.

Medium Term Storage, New Delhi: A total of 338 accessions of diverse germplasm collected during explorations including vegetables (ivy gourd -75), fruits (melons-41), wild edible legumes (149), pulses (32) and others (41), were sent to GHU for storage in the MTS and National accessioning. In addition, voucher samples of *Jatropha* (20) and *Pongamia* (87) collected under the AP Govt. funded Jatropha project were also sent for medium-term conservation and accessioning.

MTS at Hyderabad: A total 1,842 of samples including 1,324 import vouchers: paddy (135), sorghum (844), chillies (253), tomato (48), and sunflower (44) along with 414 samples of exploration material were added to the medium term module (MTM). In addition, 104 voucher samples of sesame (77) and wild *Arachis* species (27) were also stored in the MTS.

Status of germplasm holdings at NBPGR RS Hyderabad – as on 31 December 2007

Crop / Category	Number of samples in MTM
Brinjal	6,116
Blackgram	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
Sesame	77
Import voucher samples	33,475
Export voucher samples	3,301
NBPGR collection (Pre-NATP)	1,789
Collections & augmented samples	11,158
NPTC collection	947
Released & Research Material (Restoration from ICRISAT)	
Sorghum	244
Chickpea	1,168
Pigeonpea	846
Other Institutes	
ANGRAU – Paddy, Vegetables, Sunflower	32
DOR – Sunflower	74
DRR – Paddy	306
CTRI-Rajahmundry (Tobacco)	139
Grand Total	64,210

12.7 Germplasm Distribution

A total of 171 accessions of diverse agri-horticultural crops were distributed to different ICAR institutes/SAUs for evaluation and for crop improvement. The details are given as follows:

- **Chillies (116):** TNAU, Periyakulam (86), Botany Department, University of Allahabad (2), Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya (28)
- **Black gram (7):** Central Research Institute for Dryland Agriculture, Hyderabad.

- **Tomato (50):** Horticultural Research Station, Mahanadi.
- **Horsegram (37):** were sent to NBPGR Cuttack and Shimla for multi-locational evaluation.

Germplasm shared with NAGS: A total of 27 accessions of wild *Arachis* species were sent the NAGS at NRC for Groundnut, Junagarh for evaluation and maintenance.

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

PGR/PQR- BUR-HYD-01.00- Quarantine Processing of Plant Germplasm Under Exchange and Supportive Research (K. S. Varaprasad)

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

PGR/PQR- BUR-HYD-01.04: Post-entry Quarantine Processing of Imported Germplasm (R.D.V.J. 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 (K. S. 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

- Improvement of brinjal and chillies for root-knot nematode resistance using molecular markers (DBT)
- Collection, assembly and conservation of genetic resources of physicnut (*Jatropha L.*) (DBT)

13. REGIONAL STATION, JODHPUR

Summary: Three exploration and collection trips were undertaken and 67 germplasm of different crops and their wild relatives were collected from different parts of Rajasthan. Morpho-agronomic traits of 197 and 5,379 accessions raised during *Summer* and *Kharif* 2007, respectively were recorded. Trait specific accessions for determinate habit in guar and trilobed leaves in mungbean were identified and characterized during *Kharif* 2007. A crop germplasm field day for kharif crops was organized on October 6, 2007. Blocks of horticultural plants and plants of economic importance were maintained and data were recorded in *Aloe barbadensis*, anola, bael, *Capparis decidua*, jamun, mulberry, *Salvadora* spp., *Jatropha curcas* and jojoba germplasm. In all 29,411 germplasm accessions were conserved in the MTS facility, including 4,367 accessions processed and kept in MTS facility during 2007. A total of 55 accessions were sent to NGB for LTS. A total of 758 germplasm accessions of different crops were maintained in the field gene bank at this station. Seed samples of 936 germplasm accessions were supplied to various indentors and seed samples of 3,944 accessions were received from different sources.

13.1 Exploration and Collection

Three exploration and collection trips were undertaken and 67 germplasm collections were made from different parts of Rajasthan. The target species, area covered and the numbers of germplasm collections made in *Carthamus oxyacantha* (6) from Rajasthan (Ajmer, Bhilwara, Dungarpur, Pali, Sirohi and Udaipur districts); in *Cordia* spp. (10) from Rajasthan (Ajmer, Bundi and Kota districts) and in Wild species of *Vigna* and primitive weedy forms of guar (51) from Rajasthan (Barmer, Bikaner, Churu, Jaisalmer, Jodhpur and Sikar districts).

The germplasm collections included wild relatives of crop plants namely adak guar (37), adak moth (8), *Carthamus oxyacantha* (6), *Vigna trilobata* (6) and minor fruit crops namely *Cordia crenata* (3), *C. myxa* (3) and *C. rothii* (4).



Vigna trilobata (chidi moth) – a wild relative of mothbean, collected from northwestern Rajasthan

Three germplasm accessions of *Cordia crenata*, a minor fruit tree species endemic to Ajmer district of Rajasthan have been collected for the first time for conservation. Adak guar with typical shattering habit is weedy form of cultivated guar found to occur along with cultivated guar in the fields of northwestern Rajasthan.



Cordia crenata, an endangered minor fruit species collected from Ajmer



Adak guar – a primitive weedy form of cultivated guar with shattering habit occurring in northwestern Rajasthan

13.2 Germplasm Characterization and Evaluation

Summer 2007

A total of 197 accessions were raised during summer 2007, which includes determinate guar (107) and muskmelon (90) for characterization, evaluation and multiplication. Data on variability in various parameters was recorded on the germplasm accessions as per the descriptor. Photosensitivity in determinate guar was also evaluated.



Variability for fruit size, shape and colour in muskmelon

The variability for different characters observed in determinate guar was recorded (Table 1).

Table 1: Variability observed in determinate guar grown during summer 2007

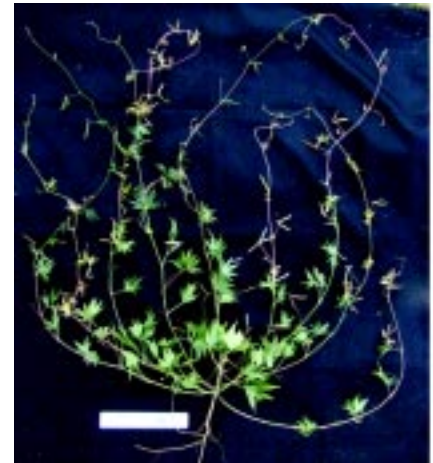
Character	Mean	Minimum	Maximum	C.V. (%) - Phenotypic	C. V. (%) - Error
Plant height (cm)	42.9	25.9	75.5	19.8	13.1
Clusters/ plant	13.8	7.0	22.2	16.9	11.7
Cluster length (cm)	7.4	4.9	14.7	39.5	19.9
Pod length (cm)	4.5	3.6	5.8	8.7	6.9
Seed yield/ plant (g)	7.6	4.4	11.9	21.0	19.2

Table 2: Germplasm accessions of various crops grown during Kharif 2007

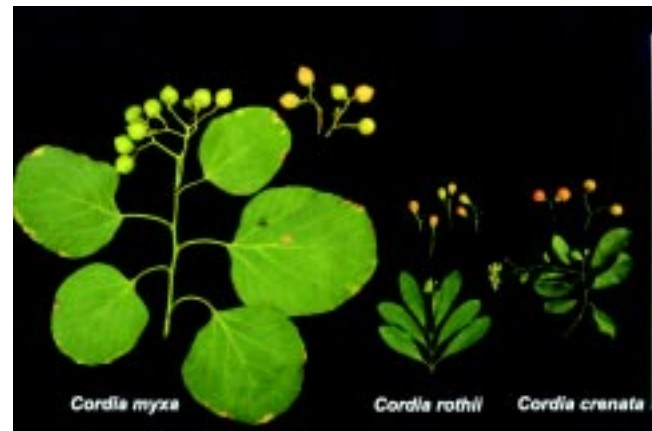
Crop	No. of Accessions	Checks	Activity
Pearl millet	96	CZP-9802, Raj-171, ICMV-221, Pusa-383, JBV-2	Characterization
Cowpea	230	FTC-27, GC-3, NS-24/8-2, V-240, V-585	Characterization (60); Multiplication (170)
Guar	4,159	GDM-1, PLG-85, RGC197, Durga Kanchan, IC11388, PLG-85, Pusa Navbahar, Suvidha	Characterization (91) Evaluation (191); Multiplication (3877)
Mothbean	220	Jadiya, Maru moth, RMO-40	Evaluation (120); Rejuvenation (100)
Mungbean	98	M1319B, Pusa Vishal, Pusa 105	Characterization (84); Evaluation (14)
Castor	56	48-1, DCS-9, TMV5-1	Characterization and Multiplication (56)
Sesame	520	-	Multiplication
Total	5,379		

Kharif 2007

In all, 5,379 accessions of field crops namely pearl millet (96), cowpea (230), guar (4,159), mothbean (220), mungbean (98), castor (56) and sesame (520) were raised for characterization/evaluation/multiplication during Kharif 2007 (Table 3).



Adak moth - a weedy form of cultivated mothbean collected from northwestern Rajasthan



Variability for leaf and fruit characters in the three species of *Cordia* collected from parts of Rajasthan



Guar Leaf Determinate



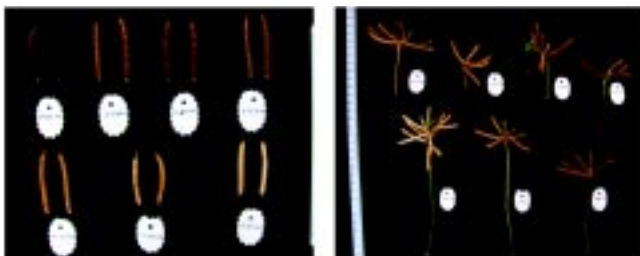
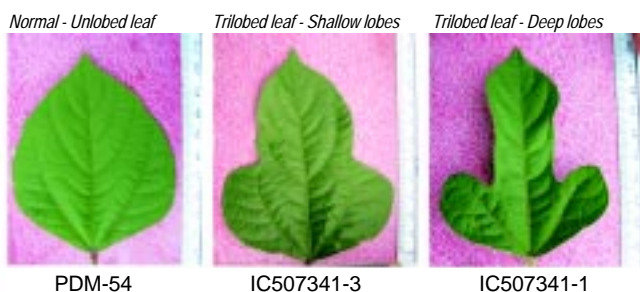
Guar Stem Determinate



Guar Inflorescence Determinate

Trait Specific Accessions: In guar, germplasm accessions for specific traits such as determinate habit and branched with all node cluster bearing were identified during *Kharif*2007. The determinate guar was further characterized into three different types namely (i) guar leaf determinate type (the stem terminates into leaf) (ii) guar stem determinate type (the stem terminates into an racemous inflorescence) and (iii) guar inflorescence determinate type (the stem terminates into a cluster of inflorescence).

In mungbean, trait specificity was observed for leaf lobation. The accessions identified were grouped into two groups: (i) germplasm selection with trilobed leaves - shallow lobes and (ii) germplasm with trilobed leaves - deep lobes.



Pod variability in moth bean

Cluster variability in moth bean

Horticultural Plants

Sowing: Sowing was carried out in 10 accessions including *C. crenata* (3), *C. myxa* (4) and *C. rothii* (4) in the pots and germination was observed in five of these accessions.

Establishment of Germplasm: A total of nine germplasm accessions of fruit crops namely pomegranate (1), ker (2), phalsa (1), guava (1), *Pithecelobium dulce* (1), *Carissa grandiflora* (1), jamun (1) and tendu (1) have been transplanted and established in the field gene bank.



EC541512 – A promising early maturing mungbean accession



Seedling of *Cordia crenata* raised from the germplasm collected during May 2007

Data recording: Monthly data on plant height and canopy were recorded in the horticultural plant germplasm namely aonla, bael, ber, *Carissa carandus*, *C. grandiflora*, custard apple, datepalm, guava, jamun, ker, lasora, lemon, mulberry, phalsa, pomegranate and tendu.

Economically important plants: Sowing was carried out in *Acacia* spp. (24), *Atriplex* spp. (13), *Jatropha curcas* (13) and *Prosopis cineraria* (11) during this period. A spacing trial for *Aloe barabdensis* with 10

different spacing patterns was initiated from April 2007. *Agave americana* (1) and *Withania coagulens* (1) were transplanted in the field. Data on plant height, canopy and number of branches were recorded in different accessions of *Jatropha curcas* (14), jojoba (15) and *Prosopis cineraria* (49).

13.3 Germplasm Conservation

MTS Facility: During this period a total of 4,367 accessions of different crops were added to the MTS facility at this station. The germplasm additions include castor (73), guar (92), *Cucumis callosus* (21), *C. hardwickii* (10), *C. prophetarum* (6), *C. trigonus* (4), *Carthamus oxyacantha* (6), *Cordia crenata* (3), *C. myxa* (4) and *C. rothii* (4) collected/ multiplied at the regional station, Jodhpur; guar (3745), *Cucumis* spp. (5), cucumber (28), muskmelon (216), phoot/ kachri (28), pickling melon (6), snapmelon (57) and watermelon (59) received from NBPGR, New Delhi. A total of 29,411 germplasm accessions have been conserved at the MTS facility of this station.

Field Gene Bank: The field gene bank at this station holds 725 accessions belonging to 101 taxa, which includes fruit crops (263), ornamental plants (50), oil yielding plants (211), medicinal and aromatic plants (145), multipurpose trees (28), fibre yielding plants (8), forage grasses (14) and other economic plants (6).

Germplasm sent to LTS: During 2007, a total of 55 germplasm accessions of different crops namely pearl millet (53), guar (1) and jojoba (1) were sent to NGB, NBPGR, New Delhi for long-term conservation.

13.4 Germplasm Exchange

Germplasm supplied: A total of 936 germplasm accessions including pseudo-cereals and millets (189), legumes (626), horticultural crops (77) and economically important plants (44) have been supplied to different indentors (Table 4).



Cissus quadrangularis a medicinal plant known as "Hadjor" maintained at the Regional Station, Jodhpur.



Sarcostemma acidum – an important medicinal plant of the dry areas maintained at Regional Station, Jodhpur.

Table 4: Germplasm supplied to various indentors during 2007

Name of the crop (No. of accessions)	Indenting Institute
Pseudocereals & Millets	
<i>Amaranthus</i> spp. (39)	NBPGR, Shimla
Pearl millet (150)	NBPGR, New Delhi
Legumes	
Cowpea (50)	Jai Narain Vyas University, Jodhpur
Vegetable type guar (25)	GKVK, Bangalore
Guar (101)	NBPGR, New Delhi (1); PAJANCAO, Pondicherry (100)
Mothbean (200)	ARS, RAU, Mandore
Mungbean (250)	RARS, ANGRAU, Lam (150); MLK (PG) College, Bahrampur (100)

Horticultural Crops	
<i>Ziziphus mauritiana</i> (1)	IINRG, Ranchi
<i>Z. nummularia</i> (1)	IINRG, Ranchi
<i>Cucumis sativus</i> var. <i>hardwickii</i> (10)	NBPGR RS, Bhowali
<i>C. trigonus</i> (4)	NBPGR RS, Bhowali
Muskmelon (50)	NBPGR, New Delhi
Pomegranate (11)	NRC on Pomegranate, Sholapur
Economically Important Plants	
<i>Jatropha curcas</i> (31)	NBPGR, New Delhi (20); University of Kolkata Kolkata (10); St. Johns College, Agra (1)
<i>Lawsonia inermis</i> (11)	CCSHAU, Hisar
<i>Cymbopogon jwarencusa</i> (1)	St. Johns College, Agra
<i>Sesabania sesban</i> (1)	St. Johns College, Agra
Total	936 accessions

Germplasm received: A total of 3,944 germplasm accessions of legumes (3529) and horticultural crops (415) have been received from different sources, which are summarized in Table 6.

Table 6. Germplasm received from different sources during 2007

Name of the crop (No. of acc.)	Source
Legumes	
Guar (3526)	Germplasm Conservation Division, NBPGR, New Delhi (3525); CAZRI, Jodhpur (1)
Mungbean (3)	Germplasm Exchange Division, NBPGR, New Delhi
Horticultural Crops	
<i>Cucumis</i> spp. (5)	Germplasm Exchange Division, NBPGR, New Delhi
<i>Cucumis callosus</i> (12)	NBPGR RS, Akola
Cucumber (28)	Germplasm Exchange Division, NBPGR, New Delhi
Muskmelon (220)	Germplasm Exchange Division, NBPGR, New Delhi (216); NBPGR RS, Akola (4)
Phoot/ Kachri (28)	Germplasm Exchange Division, NBPGR, New Delhi
Pickling melon (6)	Germplasm Exchange Division, NBPGR, New Delhi
Snapmelon (57)	Germplasm Exchange Division, NBPGR, New Delhi
Watermelon (59)	Germplasm Exchange Division, NBPGR, New Delhi
Total	3944 accessions

Research Projects (Project Code, Title, PI, CoPIs)
PGR/ GEV-BUR-JOD-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources in arid and semi-arid regions (N. K. Dwivedi)
PGR/ GEV-BUR-JOD-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of cereals, pearl millet, minor millets and horticultural crops (Gopala Krishnan S, N.K. Dwivedi, Neelam Bhatnagar)
PGR/ GEV-BUR-JOD-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of legumes and oilseeds. (N.K. Dwivedi, Neelam Bhatnagar, 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, N.K. Dwivedi, Gopala Krishnan S.)
Externally Funded Projects
Collection, assembly and conservation of genetic resources of physicnut (<i>Jatropha curcas</i> L.) (DBT) (N.K. Dwivedi)

14. EXPLORATION BASE CENTER, RANCHI

Summary: During the period under report, two explorations were undertaken and 65 samples of different agri-horticultural crops including the wild relatives and wild economic types were collected. A total of 338 accessions of kulthi and 32 of *Mucuna* germplasm for qualitative and quantitative traits. Medicinal and aromatic plants (160 species) and *Jatropha curcas* (180 accessions) germplasm collected from different states of India are being maintained at National *Jatropha* Garden at the farm of Ranchi.

The 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 of very primitive order. The region is well known for its immensely rich primitive crop plant diversity including wild related species 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 exploration and collection of crop diversity in Bihar.

14.1 Plant Exploration and Germplasm Collection

Two explorations were undertaken and 65 samples of different agri-horticultural crops including the wild types were collected (Table 1).

Table 1: Plant exploration and germplasm collection

S.N	Regions (duration)	Crops/ Species (no. of accessions)	Collections (accessions)
1.	Ranchi, Saraikela, East & West Singhbhum district of Jharkhand (19.04.07 to 27.04.07)	<i>Moringa oleifera</i> .(16), <i>Mucuna prurience</i> . (8), <i>Butea monosperma</i> (1) and <i>Woodfordia fruticosa</i> (1)	26
2.	Ranchi, Ramgarh, Hazaribagh, Deoghar & Giridih districts of Jharkhand (23.12.07 to 30.12.07)	<i>Guizotia abyssinica</i> (5) and <i>Macrotyloma uniflorum</i> (34)	39

Moringa oleifera (14), *Woodfordia fruticosa* (1) were established in the field gene bank, Ranchi. *Mucuna* (8) were multiplied for characterization. *Guizotia abyssinica* (5) and *Macrotyloma uniflorum* (34) were multiplied and characterized.

14.2 Germplasm Evaluation

Kulthi germplasm (338 accessions) were sown in an augmented design with two checks, Madhu and Birsa Kulthi-1. The row length was three metres with a spacing of 30x10 cm. The recommended agronomic practices were followed in raising the crop. Observations on growth habit, growth pattern, leaf colour, number of primary branches, days to flowering, pods per plant, pod length, plant height and number

of seed per pod and yield per plant were recorded. Due to abnormal weather condition like extreme cold, the most of accessions did not bear the pods. In some accessions, bearing of the pods was there but grain did not mature.

A total of 32 *Mucuna* germplasm with two replications was sown using RBD on 17.08.07. The row length was two metres with spacing of 1 x 0.6m. Observations on leaflet length and width, days to flowering initiation, inflorescence length, number of inflorescence per plant, flower per inflorescence, number of pods per cluster, number of pod clusters per plant, pod pubescences colour, pod shape and pod length and width, 100 seed weight, yield per plant was recorded. The range and mean, CD and CV are given (Table 2)

Table 2: Evaluation of *Mucuna* germplasm

Characters	Minimum	Maximum	Mean
Plant height (cm)	9.6 (KC/VK/NP-6)	107.5 (KC/VK/NP-31)	42.98
Leaflet length (cm)	6.5 (IC552857)	17 (KC/VK/NP-41)	9.22
Leaflet width (cm)	3.8 (IC552856)	10.3 (KC/VK/NP-31)	6.00
Days to flower initiation	34 (KC/VK/NP-14, IC552853, IC552854)	56 (IC552860)	42
Inflorescence (raceme) length (cm)	5.3 (KC/VK/NP-1)	11.5 (KC/VK/NP-14)	7.9
No. of Inflorescences per plant	3 (IC552860)	50 (IC552853)	18.33
Flowers per inflorescence	6 (KC/VK/NP-31)	16 (KC/VK/NP-8)	8.9
Days to complete pod maturity	131 (KC/VK/NP-13,14, IC552860)	154 (KC/VK/NP-21,37, IC552854)	140.73
No. of pods per cluster	3 (JBT47/12, IC552860)	11 (IC265577, 385844)	6.6
No. of pod clusters per plant	1 (IC552860)	18 (IC552853)	10.5
Pod length (cm)	4.5 (IC552857)	13.3 (KC/VK/NP-37)	9.17
Pod width (cm)	1.6 (IC391885)	2.2 (KC/VK/NP-37)	1.9
No. of seeds per pod	5 (KC/VK/NP-37, IC552856)	6 (IC385842, KC/VK/NP-13, IC552854, IC552857)	4.8
Seed yield per plant (g)	2.86 (IC552860)	608.6 (IC395926)	217.87
100 - seed weight (g)	17.73 (IC385844)	157.46 (IC385925)	57.12

Germplasm maintenance: Germplasm of jackfruit- (154), barhal (14), jamun (46), bael (53), tamarind (51), aonla (17), mango (19), *Artocarpus lakoocha* (14) and *Lawsonia alba* (25) were maintained.

Wild relatives, dye yielding plants: The wild relatives such as *Abelmoschus moschatus*, *Atylosia scarabaeoides*, *Coix lachryma-jobi*, *Curcuma aromatica*, *C. caesia*, *Dioscorea bulbifera*, *Hibiscus sabdarifa*, *Lycopersicon pimpinellifolium*, *Momordica cochinchinensis*, *Trichosanthes palmata* and *Allium wallichi*.

Dye yielding plants: Several species of dye yielding plants *Bixa orellana*, *Butea monosperma*, *Mallotus phillippensis*, *Nyctanthese arbortristis* were also maintained.

14.3 Field Genebank and Herbal Garden

NBPGR Regional Station, Ranchi developed a field gene bank for fruit crops, perennial medicinal plants etc. and a herbal garden for wild relatives of crop plants and medicinal and aromatic plants. The following species of germplasm were maintained at the centre -

Table 3: Economically important species and medicinal and aromatic plants

Botanical name	Accessions	Botanical Name	Accessions
<i>Abroma augusta</i>	3	<i>Glycosmis pentaphylla</i>	2
<i>Abrus precatorius</i>	7	<i>Gmalina arborea</i>	4
<i>Abutilon indicum</i>	1	<i>Grewia hirsuta</i>	1
<i>Acacia nilotica</i>	1	<i>Gymnema sylvestre</i>	2
<i>Acacia concinna</i>	2	<i>Helicteres isora</i>	1
<i>Achyranthes aspara</i>	1	<i>Hemidesmus indicus</i>	4
<i>Acorus calamus</i>	4	<i>Holarrhena antidysenterica</i>	1
<i>Adhatoda vasica</i>	2	<i>Hygrophila spinosa</i>	1
<i>Adiantum capillus-veneris</i>	1	<i>Indigofera tinctoria</i>	1
<i>Albizzia procera</i>	1	<i>Jatropha curcas</i>	9
<i>Aloe sp.</i>	5	<i>Jatropha gossypifolia</i>	1
<i>Alpinia galanga</i>	4	<i>Hedichium spicatum</i>	3
<i>Alstonia scholaris</i>	1	<i>Lagerstroemia speciosa</i>	2
<i>Androgaphis paniculata</i>	8	<i>Leea macrophylla</i>	1
<i>Aristolochia oncocephalous</i>	1	<i>Leucas aspra</i>	1
<i>Artemisia annua</i>	3	<i>Litsea polyantha</i>	1
<i>Artemisia scoparia</i>	1	<i>Lycopodium clavatum</i> (syn. <i>L. flexuosun</i>)	1
<i>Asparagus racemosus</i>	10	<i>Madhuca indica</i>	1
<i>Atylosia scarabaeoides</i>	2	<i>Martynia diandra</i>	1
<i>Azadirachta indica</i>	4	<i>Melia azadirach</i>	1

<i>Bacopa monnieri</i>	2	<i>Mimosa pudica</i>	1
<i>Barleria prionitis</i>	3	<i>Mirabilis jalapa</i>	3
<i>Bauhinia purpurea</i>	2	<i>Moringa oleifera</i>	3
<i>Bauhinia</i> sp.	2	<i>Mucuna prurita</i>	2
<i>Bombax ceiba</i>	2	<i>Murraya koenigii</i> (Kari pata)	1
<i>Bryonopsis laciniosa</i>	1	<i>Neolitis</i> sp.	1
<i>Bryophyllum</i> sp.	2	<i>Nigella sativa</i> (Kala jira)	2
<i>Buchanania lanzan</i>	6	<i>Nyctanthes arbortristis</i>	1
<i>Bulbophyllum</i> sp.	2	<i>Ocimum basilicum</i>	1
<i>Butea monosperma</i>	3	<i>O. sanctum</i>	2
<i>Caesalpinia crista</i>	3	<i>Ocimum</i> sp.	8
<i>Calotropis procera</i>	1	<i>Oroxylum indicum</i>	4
<i>Canavalia ensiformis</i>	1	<i>Pachyrrhizus angulatus</i> (Misrikand)	2
<i>Canna indica</i>	3	<i>Paederia maxima</i>	1
<i>Cassia alata</i>	1	<i>Pentapetes patela</i>	1
<i>C. angustifolia</i>	1	<i>Phyllanthus amarus</i>	1
<i>C. fistula</i>	2	<i>P. niruri</i>	2
<i>C. occidentalis</i>	1	<i>Piper longum</i>	3
<i>C. sophera</i>	2	<i>Plumbago zeylanica</i>	4
<i>C. tora</i>	1	<i>Pongamia pinnata</i>	3
<i>Catharanthus roseus</i>	4	<i>Portulaca oleracea</i>	1
<i>Celastrus paniculatus</i>	2	<i>Premna herbacea</i>	2
<i>Centella asiatica</i>	2	<i>Psoralea corylifolia</i>	1
<i>Chlorophytum</i> sp.	9	<i>Pterocarpus marsupium</i>	2
<i>Cinnamomum tamala</i>	1	<i>Pterospermum acerifolium</i>	1
<i>C. zeylanicum</i>	2	<i>Pueraria tuberosa</i>	1
<i>Cissus quadrangularis</i>	2	<i>Putranjiva roxburghii</i>	1
<i>Clerodendron indicum</i>	1	<i>Randia dumatorium</i>	1
<i>C. infortunatum</i>	1	<i>Rauvolfia serpentina</i>	5
<i>C. serratum</i>	1	<i>R. tetraphylla</i>	3
<i>Clitoria ternatea</i>	3	<i>Santalum album</i>	1
<i>Coix lachyrema jobi</i>	1	<i>Sapindus mukorossi</i>	1
<i>Colchicum luteum</i>	2	<i>Schleichera oleosa</i>	1
<i>Coleus amboinicus</i>	2	<i>Scopria dulcis</i> (Hazardana)	1
<i>Commiphora wightii</i>	1	<i>Semecarpus anacardium</i>	2
<i>Costus speciosus</i>	5	<i>Shorea robusta</i>	4
<i>Curculigo orchiodes</i>	7	<i>Sida acutifolia</i>	1
<i>Curcuma amada</i>	2	<i>Smilax procera & ovalifolia</i>	4
<i>C. aromatica</i>	1	<i>S. khasianum / Solanum viorum</i>	1
<i>C. caesia</i>	2	<i>S. torvum</i>	1
<i>Curcuma</i> sp.	9	<i>Solanum xanthocarpum</i> (Katrangni)	1
<i>Cymbopogan martinii</i> (Palmarosa)	1	<i>Sphaeranthus indicus</i>	1
<i>C. winterianus</i>	1	<i>Spilanthes paniculata</i>	2
(<i>Citronella java</i>)		<i>Spondias mangifera</i>	1
<i>C. flexuosus</i> (Lemmon grass)	1	<i>Sterculia urense</i>	1
<i>Cyperus rotundus</i> (Nagarmotha)	1	<i>Tectona grandis</i>	9
<i>Dalbergia sissoo</i>	1	<i>Terminalia arjuna</i>	6
<i>Datura alba</i>	1	<i>T. bellerica</i>	5
<i>Desmodium gangeticum</i>	2	<i>T. catappa</i>	2
<i>Dioscorea pentaphylla</i>	1	<i>T. chebula</i>	3
<i>Dioscorea</i> sp.	5	<i>T. tomentosa</i>	1
<i>Diospyros tomentosa</i>	1	<i>Thespesia lampus</i>	2
<i>Eclipta alba</i>	1	<i>Tinospora cordifolia</i>	11
<i>Elephantopus scaber</i>	1	<i>Tribulus terrestris</i> (Gokhuru)	1
<i>Embelia ribes</i>	1	<i>Typhonium trilobatum</i>	4
<i>Entada scandens</i>	1	<i>Urginia indica</i>	4
<i>Erythrina indica</i>	1	<i>Vanda tasselata</i>	3
<i>Euphorbia hirta</i>	1	<i>Vitex negundo</i>	1
<i>Ficus benghalensis</i>	1	<i>Withania somnifera</i>	4
<i>F. religiosa</i>	1	<i>Zingiber</i> sp.	5
<i>Gloriosa superba</i> (Kalihari)	1		

14.3.1 National *Jatropha* garden: One Hundred and eighty (180) accessions of *Jatropha* germplasm collected from across the country were maintained in National *Jatropha* Garden and greenhouse. They represented collections from Uttar Pradesh (14), Himachal Pradesh (4), Punjab (3), West Bengal (10), Haryana (8), Rajasthan (10), Uttranchal (13), Maharastra (3), Goa (2), Karnataka (2), Gujarat (14), Jharkhand (13), Bihar (10), Chhattisgarh (10), Tamilnadu (10), Kerala (10), Assam (5), Arunachal Pradesh (1), Manipur (1), Nagaland (2), Tripura (2),

Meghalaya (1), Orissa (7), Madhya Pradesh (9) and Andhra Pradesh (10).

The observations on 86 *Jatropha* germplasm sown on June 7, 2006 was recorded for the traits viz. number of primary branches, number of effective branches, number of male flowers, number of female flowers, female/ male ratio, capsule per plant, maximum capsule per plant, capsule yield per shrub (g), seed yield per shrub (g), 10 seed weight (g), per cent seed yield to capsule yield.

Characters	Minimum	Maximum	Mean
Number of primary branches	1 (NBPGR-JHAR-Ranch-0206-C-10)	11 (NBPGR-JHAR-Garhw-1005-C-7)	5
Number of effective branches C-33)	1 (NBPGR-CHH-Ambik-0306-1005-C-7)	8 (NBPGR-JHAR-Garhw-	4
Male flowers	20 (NBPGR-CHH-Ambik-0306-C-33)	267 (NBPGR-JHAR-Esingh-1005-C-13)	110
Female flowers	5 (NBPGR-CHH-Ambik-0306-C-33)	126 (NBPGR-BIH-Nawa-0206-C-24)	104
Female/ male ratio	1:1.3 (NBPGR-CHH-Mahasm-0206-C-26)	1:9.2 (NBPGR-JHAR-Garhw-1005-C-7)	-
Capsule per plant	6 (NBPGR-BIH-Begu-0206-C-20)	114 (NBPGR-BIH-Nawa-0206-C-24)	88
Maximum capsule per plant	2 (RRL-ASM-Golag-1105-C-1)	9 (NBPGR-CHH-Raip-0206-C-27)	6
Capsule yield per shrub(g)	11.78 (NBPGR-JHAR-Guml-1005-C-9)	279.89 (NBPGR-BIH-Nawa-0206-C-24)	158
Seed yield per shrub(g)	9.6 (NBPGR-JHAR-Guml-1005-C-9)	227.49 (NBPGR-BIH-Nawa-0206-C-24)	121
10 seed weight(g)	5.66 (NBPGR-BIH-Bihasar-0206-C-23)	6.99 (NBPGR-BIH-WCham-0206-C-15)	6.28
% of seed yield to capsule yield	61.35 (NBPGR-BIH-WCham-0206-C-16)	95.71 (FRI-WB-Banku-0306-C-34)	80.15

Research Projects (Project Code, Title, PI, CoPIs)

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

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 (J.B. Tomar and V.K. Gupta)

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

Externally funded projects

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

Establishment and maintenance of herbal garden and capacity building in the production about the medicinal plants of Jharkhand and adjoining areas. (J.B. Tomar)

15. REGIONAL STATION, SHILLONG

Summary: A total 400 accessions of various crop germplasm were collected from six trips in NEH region. The covered areas were parts of Meghalaya, Nagaland, Arunachal Pradesh, Assam and Sikkim. The first time collection has been made this year from the Peren district of Nagaland. A few novelty collections have been made from Arunachal Pradesh. A total of 2,073 accessions covering 12 crops were characterized, while 1,872 accessions were harvested. Promising accessions were identified for each crop, based on the yield data. As many as 169 accessions of rice, ginger, spine gourd, *Colocasia* were supplied to the five indentors. Four mutant genotypes of *Persea bombycina* Kost. were conserved in the field gene bank of the station, while 101 accessions of lowland rice germplasm were sent for conservation in LTS of the National Gene Bank, New Delhi.

15.1 Plant Exploration and Germplasm Collection

During the reporting period, six exploration trips were conducted/ coordinated (Table 1).

15.1.1 Ramie germplasm from lower Assam districts and adjoining areas of Garo Hills: Ramie (*Boehmaria* spp.), a fibre yielding plant and cultivated jackfruit (*Artocarpus heterophyllus*) was collected from districts of lower Assam and Garo Hills of Meghalaya. A total of 37 accessions of fibre crop germplasm comprising *Boehmaria*, *Agave* and *Sensiviera* was collected. Additionally, 14 accessions of jackfruit genotypes were also collected. The germplasms are under maintenance by the respective institutes according to their crop mandate.

15.1.2 Temperate fruits and their wild relatives from Meghalaya and Arunachal Pradesh: Ninety accessions of different temperate fruits and their wild relatives including the wild ornamental crop species were collected from various temperate areas of Meghalaya (East Khasi, West Khasi and Jaintia Hills districts) and West Kameng and Tawang districts of Arunachal Pradesh.



Maize genotypes collected from Peren district of Nagaland

15.1.3 Maize germplasm from Nagaland: A total of 48 accessions of different crop germplasm were collected comprising maize (*Zea mays*) (18), rice (*Oryza sativa*), bhanjira (*Perilla frutescens*), chillies (*Capsicum frutescens* and *C. grossum*) and rice bean (*Vigna umbellata*). The materials are under maintenance and multiplication of NBPGR Regional Station, Umiam, Meghalaya.

15.1.4 Buckwheat, *Rubus* and medicinal plants: A total of 58 accessions of medicinal and minor edible fruit were collected from to West Kameng and Tawang districts of Arunachal Pradesh. Buckwheat is the staple food crop for temperate zone of this belt. The represented species are *Fagopyrum esculentum* and *F. tataricum*. The important material collected belong to *Diospyros*, *Allium*, *Rheum*, *Sassurea* and *Delphinium*. Two rare species i.e. *Momordica subangulata* Bl. and *Panax bipinnatifidus* Seemann var. *angustifolius* (Burkill) J. Wen. were collected. A few collected accessions have been retained at this station for their necessary introduction.

15.1.5 Aromatic rice from Upper Assam and japonica race of rice from parts of Arunachal Pradesh: In this collaborative trip with ICAR Complex for NEH Region the Scientist of NBPGR, New Delhi surveyed the Upper Assam districts (North Lakhimpur, Sonitpur, Dhemaji) and parts of Arunachal Pradesh (East Siang and West Siang). A total 108 rice accessions was collected and most of those samples belongs to local landraces. *Kalajoha*, *Nunia* are the common aromatic rice grown in this belt. A part of all these collected samples, partitioned among the collectors and facilitator.

15.1.6 Cultivated and wild ricebean germplasm from Sikkim: A total of 45 accessions comprising *Vigna* (39), *Glycine* (02) and *Perilla* (04) were collected. Under the genus *Vigna*, species like *V. mungo* (14), *V. umbellata* (23), *V. umbellata* var. *gracilis* (01) and *V. vexillata* (01), were classified.

Table 1: Exploration trips conducted during 2007

Area surveyed	Crop accessions collected	Total accessions collected
Lower Assam and Garo Hills districts	<i>Boehmeria</i> (31); <i>Agave</i> (3); <i>Sensiviera</i> (3) and jackfruit (14)	51
Khasi & Jaintia Hills (Meghalaya) and W. Kameng and Tawang districts (Arunachal Pradesh)	Fruit and Nut crops (28); wild relatives of economic plant species (59); Ornamental plants(3)	90
Peren district of Nagaland	Rice (19); Maize(18); Foxtail millet (1); <i>Perilla</i> (1); Rice bean (1); <i>Capsicum</i> (6); Others (2)	48
W. Kameng and Tawang district of Arunachal Pradesh	Various medicinal and economic important plants	58
Upper Assam and parts of Arunachal Pradesh	Paddy (108)	108
Various parts of Sikkim state	Rice bean (23); Mung bean (14); wild <i>Vigna</i> (2); soybean (2); <i>Perilla</i> (4)	45

15.2 Germplasm Characterization and Maintenance

A total 2,073 accessions of germplasm belonging to different agri-horticultural crops were characterized. The process was done continuously over the period of three years for each germplasms accessions, before it

is sent to the National Gene Bank for LTS conservation. In addition to this, mandate crop germplasm received from outside the NE 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.

Table 2: Crops and their respective accessions characterized during the year 2007

Crop	No. of germplasm accessions		Yield (q/ha)	Superior genotype (Single locations)
	Sown	Harvested		
Upland Paddy	205	202	40.0	IC540249
Lowland Paddy	312/223	215	43.0	IC527250
Maize	174	161	90.0	IC419593
Ricebean	301	296	48.0	LRB-290
<i>Perilla</i>	85	81	15.6	RS 66/99
Buckwheat	88	87	20.0	IC394880
Job's tear	54	54	12.5	IC203985
Ginger	195	182	230.0	IC319569
Turmeric	165	154	284.0	IC420565
<i>Colocasia</i>	312	284	200.0	IC527237
Chilli	103	90	30.0	FDI-AKP-21
<i>Dioscorea</i>	79	66	225.0	AAUDA-10
Total	2,073	1,872		

Stresses and susceptibility symptoms were observed in lowland paddy germplasm accessions, during field characterization.

- | | | |
|--|---|----|
| a) Infestation of <i>Tilletia horrida</i> accessions | - | 2 |
| b) Infestation of <i>Ustilago</i> sp. 4 accessions | - | - |
| c) Iron toxicity accessions | - | 24 |
| d) Bacterial leaf blight accessions | - | 14 |

15.3 Germplasm Exchange

A total of 149 accessions of germplasm were distributed to various indentors

15.4 Germplasm Conservation

- Four tetraploid genotypes (mutant plants) of *Persea bombycina* Kost., submitted by the Scientist of Central Muga, Eri Research and Training Institute, Jorhat, Assam, were conserved in the field gene bank of the station.

Institute/ Indentor	Crop	No. of Accessions
Dr. T.K. Ghose, Department of Botany, Bose Institute, Kolkata – 700009	Rice	20
Dr. Alice Kurian, Kerala Agril. University, Vellanikkara, Thrissur-680656, Kerala	Ginger	29
Dr. Pinaki Acharya, Head, Horticulture Dept., Institute of Agril. Sciences, Calcutta University, Calcutta – 700029	Spine gourd (<i>Momordica cochinchinensis</i>)	10
Director, NBRI, Ranapratap Marg, Lucknow – 226001	Rice	100
Professor & Head, SASRD, Medziphema, Nagaland	<i>Colocasia</i>	10

- A total of 101 accessions of rice germplasm were sent to the NBPGR, New Delhi – 12 for LTS conservation in the National Gene Bank.

Research Projects (Project Code, Title, PI)

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

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

PGR/PGC-BUR-SHL-01.02: Augmentation, Characterization, Evaluation, Maintenance, Regeneration, Conservation, and Documentation of Genetic Resources of indigenous and exotic lines of Chillies, Ginger, Turmeric, Yams, Taros, Citrus, Banana and Passion fruits. (D.K. Hore)

Externally funded project

National Gene Bank for medicinal and aromatic plants (G-15) continued till 9.1.08 (Sanction Order No. BT/MAP/01/GB-N/98 dated 10-01-2003). (DBT) (D.K. Hore)

16. REGIONAL STATION, SHIMLA

Summary: Three explorations were conducted and 220 accessions comprising cereals (44), pulses (39), vegetables (2), fruits and nuts (29), medicinal & aromatic plants (9), spices and condiments(1), ornamentals (5) and wild species (61) were collected from Himachal Pradesh, part of Jammu (J&K), Meghalaya and Arunachal Pradesh. Genetic erosion has taken place in maize and french bean due to introduction of maize hybrids and preferential selection in french bean. Local maize landraces are facing threat of extinction especially from the hybrids, despite the fact that their yield levels are at par and sometimes better than released varieties. A total of 3775 germplasm accessions of various agri-horticultural crops were characterized and multiplied for conservation. The promising accessions identified in pea for pod number were IC341382, IC342029, IC396094, IC469165, IC394026, for powdery mildew resistance IC469155, IC394027, IC381445, IC381054, IC311066; in peach EC552644 exhibited earliest fruit maturity while EC468324 for high TSS; IC019392 high fruit weight and high pulp juiciness in pear; EC552694 and EC393741 early maturity and high productivity in plum; IC349933 high TSS in apricot. In apple, quality fruits along with high productivity were noticed. 551 germplasm accessions of different crops were deposited for Long/Medium-Term Storage in the National Gene Bank while 1,153 accessions of fruit crops, their wild relatives, medicinal plants and ornamentals were conserved and maintained in field genebank. A total of 9,443 accessions are being conserved in MTS and 201 herbarium specimens were submitted to NHCP.

The National Bureau of Plant Genetic Resources, Regional Station, Shimla is carrying out the activities on Plant genetic resources management in North-West Himalayan region especially the Himachal Pradesh and adjoining parts of Punjab, Uttarakhand and J&K. Augmentation of crops germplasm, characterization, evaluation, maintenance, documentation, conservation and its distribution to the user scientists/researchers are the prime activities. Germplasm of various temperate fruits, pseudo-cereals, 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/ vegetative propagated plants.

16.1 Germplasm Exploration and Collection

Three explorations were undertaken and 220 germplasm accessions were collected from Himachal Pradesh, parts of Jammu, Meghalaya and Arunachal Pradesh. The germplasm diversity collected in various crop-group were cereals (44), pulses (39), vegetables (2), fruits and nuts

(29), medicinal & aromatic plants (9), spices and condiments(1), ornamentals (5) and wild species (61). The important species collected were *Pyrus pashia*, *Fragaria vesca*, *Bunium persicum*, *Polygonatum cirrhifolium*, *Dioscorea deltoidea*, *Gentiana kurroo*, *Aconitum heterophyllum*, *Dactylorhiza hatagirea*, *Chaenomeles cathayensis*, *Elaeagnus latifolia*, *Rosa webbiana*, *Rosa eglanteria*, *Rosa longicuspis*, *Rosa roxburghii*, *Rosa sericea* var. *omeiensis*, *Actinidia callosa*, *Castanopsis* sp., *Corylus ferox*, *Diospyros kaki*, *Elaeagnus umbellata*, *Fragaria daltoniana*, *Malus baccata* var. *baccata*, *Prunus ceracifera*, *P. jenkinsii*, *P. nepaulensis*, *P. salicina*, *P. carmesiana*, *P. cornuta* var. *cornuta*, *P. cornuta* var. *villosa*, *P. phaeosticta*, *P. rufa*, *P. venosa*, *Rubus acuminata*, *R. alpestris*, *R. andersonii*, *R. assamensis*, *R. calycinus*, *R. hexagynus*, *R. lasiocarpus*, *R. lasiocarpus* var. *pauciflorus*, *Rubus macilensis*, *Rubus moluccans*, *R. niveus* var. *pedunculatus*, *R. opulifolius*, *Rubus rosaefolius* var. *rubrifolius*, *Rubus thomsonii*, *Sorbus cuspidata*, *S. foliolosa*, *Syzygium fruticosum*, *Juglans regia*.

Table 1: Germplasm explorations undertaken from January to December, 2007

Exploration	Duration	Area explored	Germplasm collected
High value medicinal Plants	16.7.07-25.7.07	Kullu, Lahaul-Spiti, Mandi and Shimla	15
Temperate fruits and their wild relatives	5.8.07-2.9.07	Ri Bhoi, East Khasi Hills, West Khasi Hills, Jaintia Hills in Meghalaya and West Kameng and Tawang in Arunachal Pradesh	90
Maize landraces and walnut	24.9.07-3.10.07	Part of Jammu, Kangra and Chamba	115



Actinidia agruta- A wild species of kiwi having no hair but sweeter



IC469165- an accession of pea found resistant to powdery mildew

16.1.1 Collection of germplasm from Western Himalayas Facing Threat of Genetic Erosion:

During an exploration from Chamba, Kangra and parts of Jammu, variability in germplasm was collected in maize, french bean and walnut. Genetic erosion has taken place in maize and French bean due to introduction of maize hybrids and preferential selection in french bean. Local maize landraces are facing threat of extinction especially from the hybrids, despite the fact that their yield levels are at par and sometimes better than released varieties. The maize genepool has been largely eroded in the areas considered to be hot-spot for maize variability, for instances, Chamba, Kangra, Sirmour in HP and Doda region in Jammu in the last 10 years. In fact, farmers adopted maize hybrids with great enthusiasm but they never realized or otherwise taught by seed companies or agriculture department that the

seed of hybrids is required to be procured purchased every year. Many farmers were growing the same hybrid even after five years of its procurement.

16.2 Germplasm Characterization and Evaluation

16.2.1 Agricultural crops: A total of 3,498 germplasm accessions comprising French bean (2,889), amaranth (224), buckwheat (193), chenopod (78), adzuki bean (25), horsegram (89), were characterized and evaluated. The germplasm was characterized in augmented block design along with standard checks. Data were recorded as per the descriptors developed by NBPGR. The data recorded were analysed for mean and range and promising accessions identified for important traits (Table 2).



Local maize collected from Kangra



Variability in walnut before shelling

Table 2: Range, mean and promising accessions identified for important traits

Character	Range	Mean	Promising accessions
Amaranth			
Plant height (cm)	100-327.05	206.52	IC415262, IC415264, IC540812, IC540900, IC325880
Leaf length (cm)	9.40-29.20	20.65	IC415297, IC421885, IC547395, IC396961, IC35645, EC169652
Inflorescence length (cm)	31.30-109.35	68.94	IC415262, IC415250, IC547393, IC35645, IC35501
Days to maturity	131-172	152.32	IC33327, IC26264, IC35416, IC35404
1000 seed weight (g)	0.40-0.80	0.69	IC415264, IC26264, IC35416, IC35404, IC35408
Grain yield/plant (g)	20.21-96.72	58.88	EC223656, EC170327, IC415232, IC415448, IC325880
Chenopod			
Plant height (cm)	114.15-340.30	218.56	IC329184, NIC22531, IC258332, IC363733, IC540837
Inflorescence length (cm)	26.25-61.75	46.28	IC341706, IC381106, IC381078, IC329184, IC108818, IC329470, IC329521
Leaf length (cm)	5.10-18.15	12.36	IC108087, IC274533, IC540834, IC540837, IC341707
Leaf width (cm)	1.30-20.35	9.80	IC274533, IC109178, IC109249, IC108087, IC107535
Days to maturity	106-163	136.00	IC329184, EC507741, IC540831, IC411825, IC411824, IC106340
1000 seed weight (g)	0.4-1.50	1.10	EC507741, IC411825, IC411824, IC341695, IC341703, IC243192
Grain yield/plant (g)	1.40-50.05	26.32	EC507733, NIC22506, IC382223, IC469276, IC540811, IC540831
Buckwheat			
Plant height (cm)	66.00-202.05	129.63	IC18890, IC18864, IC18802, IC17971, IC17372
Leaf length (cm)	4.00-13.35	8.90	IC42401, IC37308, IC18864, IC17971, IC79238, IC107189
Leaf width (cm)	3.35-14.90	7.86	IC79238, IC42433, IC107265, IC107189, IC42408
No. of Infl./plant	6.00-31.00	18.66	IC16579, IC16556, IC26552, IC25999, IC37277, IC26589
Days to maturity	73-118	86.00	IC16552, IC26583, IC36804, IC24300, IC24301
1000 seed weight (g)	9.43-27.60	18.09	IC108509, IC42433, IC79192, IC79238, IC107285, IC107793
Grain yield/plant (g)	4.00-36.65	21.68	IC107981, IC107970, IC42414, IC107090, IC107216, IC107793
Adzuki bean			
Plant height (cm)	25.4-84.7	52.40	IC341949, EC18257, EC120460, EC240246, EC340244
No. of cluster/plant	4.00-11.00	6.90	EC240246, EC120460, EC87895, EC18257
No. of pods/cluster	2.00-4.50	3.58	IC89957, EC000372, IC341961, EC240246, EC281186
No. of pod/plant	9.00-34.00	22.31	EC240246, EC240244, EC281186, EC18257
Days to maturity	102-122	114.00	IC341944, IC341952, IC341949, IC341953
1000 seed weight (g)	4.20-19.24	12.69	EC000248, EC87895, IC341949, IC469173
French bean			
Pod length (cm)	6.6-29.8	17.28	EC398657, EC394667, EC392488, EC398587
No. of seeds/pod	2-10	6.45	EC394667, IC362086, EC398581, IC382213, IC16544
No. of pod/plant	2-50	21.63	EC385306, EC500807, EC500773, EC18376, EC500391, EC34032
Leaflet length (cm)	7.4-23.4	14.33	EC500369, IC328382, EC325872, EC400403, EC125712, IC382178, EC531071, EC500749
Leaflet width (cm)	5.1-20.6	13.29	IC381102, IC382178, EC537996, EC18609, EC39052
Days to maturity	70-167	128.00	EC94456, IC265913, IC415486, IC415377, EC316064, EC500766
100 seed weight (g)	13.5-56	34.96	EC271529, EC500303, EC500471, IC258275, EC271929, EC324993, EC500449
Grain yield/plant (g)	7.05-69.86	37.68	EC385254, EC500234, EC500773, EC500841, EC500983, EC500807
Pea			
Pod length (cm)	3.70-8.95	6.54	IC279043, IC279124, IC278701, IC2791553
No. of pods	16.50-74.00	41.62	IC342029, IC279125, IC396094, IC469145
No. of seeds/pod	3.00-7.00	5.21	EC269305, IC469143, IC469156, IC469144
100-seed wt. (g)	9.76-43.32	23.70	IC279125, IC469145, IC109409, IC356344
Day to maturity	178-193	184.00	IC279082, IC279120, IC279013, IC278813
Grain yield/plant (g)	4.17-83.17	39.26	NC60953, IC469145, IC208390, IC208370

Screening of pea and french bean for biotic stress:

Shimla is a hot-spot for powdery mildew and anthracnose, therefore, germplasm of pea (552) and french bean (2,889) were screened against these disease. Germplasm accession showed resistance under field conditions are given in table 3.

Table 3: Germplasm accession found resistant

Pea (Powdery mildew)	IC291541, EC414485, IC469155, IC342040, IC381057, IC381054, IC311066, IC311063, EC418020, EC389374, IC267138, IC394030
French bean (Anthracnose)	EC500303, EC500355, EC500448, EC530907, EC530907, EC537993, EC537998, EC537975, EC537996, EC50218, EC385254, EC214425, IC177049, IC084154, IC204120

16.2.2 Horticultural crops: In horticultural crops germplasm accessions of peach (18), plum (29), pear (26), apple (19), apricot (18), walnut (45), wild *Allium* spp. (40), chilli (72) and meetha karela (39) were characterised. The data were analysed for mean, range, phenotypic coefficient of variability and promising accessions identified. In apple, maximum PCV was found for fruit weight (42.5%) followed by pedicel length (27.5%). Fruit weight ranged from 24 to 161g, Baldwin and EC513665 showed more than 160 g fruit weight. EC034045 (Compact Winter Banana), EC200813 (Oregon Spur) and EC492551 (James Grieve) showed high productivity. In peach, fruit weight ranged from 12.6 to 127g and pulp-stone ratio from 3.2 to 29.2. EC552644 (Duke), EC552641 (Co-Smith) and EC468324 (Fertilla) showed high productivity. In pear, fruit weight ranged from 2.9 to 180g and TSS from 8.9 to 23.7%. EC552674 (Kashmir pear) , IC19392 and IC447940 showed high productivity. In plum fruit weight ranged from 5.2 to



Quince



Chinese ber introduced has great potential in mid Himalayan region

156g and TSS 7.9 to 22.5%. EC552685 (Kubo), EC552694 (Black Amber) and EC393741 (Aloo-Zard Karda) found promising for fruit yield. In apricot, fruit weight ranged from 6.2 to 48.1g and TSS 11.4 to 26.2. Indigenous apricot (Chuli) showed invariably high TSS. In walnut, high variation was observed for kernel weight (1.16-6.95g), followed by shell weight (2.45-10.90g). EC24562 (Lake English) showed very soft shell, while other 3 accessions as soft shell. Promising accessions identified for some important characters in fruit crops are given in table 4.

Table 4: Promising accessions in various fruit crops

Crop	Character	Promising accession
Apple	Earliness(<100days)	EC38372, EC200813, EC202706, EC492551
	Fruit weight(g)>150g	Baldwin, EC513665
	TSS (>15%)	Baldwin
	High productivity	EC34045, EC200813, EC492551
Peach	Earliness(<80days)	EC468324, EC552644, IC349929
	Fruit length (>60mm)	EC552641, EC552645, IC538537
	Fruit width (>60mm)	EC468324, EC552641
	TSS (>15%)	EC468324, IC349926, IC349928

	High productivity	EC552674, IC019392, IC447940
Plum	Earliness(<75days)	EC382626, IC100232, EC34050
	Fruit weight(>80g)	EC538999, EC393741, EC552684, EC538999-A
	TSS (>20%)	IC20085, EC25022
	High productivity	EC552685, EC552694, EC393741
Walnut	Nut weight(>15g)	EC38836, IC19369
	Kernel weight(>6g)	IC19369
	Kernel percentage(>55)	EC38837-A, EC82384, IC19371-A
	Soft shelled	EC38837-A, IC19371-A, EC24507, EC24562, EC26891, EC26892, EC26896, EC38833, EC38836
Meetha karela	Earliness(<100days)	NC58678, IC411611
	No. of fruits/pl (>35)	IC20300, IC35326
	Fruit weight>14g	IC20296, IC326922, IC329216
	Tubercle free	IC329216, IC107020, IC326922
Chilli	No. of fruits/pl(>50)	IC321262
	Fruit weight(>6g)	IC334491, IC447696
	High fruit yield(>160g)	IC328864, IC347361
Wild onion	High biomass	IC531680, IC531682, IC531686, IC531720
Garlic	High cloves/bulb(>12)	IC548137, IC548138

16.3 Germplasm Conservation

16.3.1. Germplasm conserved in the LTS: A total of 551 accessions of various crops were sent to the NGB for long-term storage. Crop wise break-up of germplasm deposited in LTS is given in table 5.

Table 5: Germplasm supplied for LTS

Crop	Accessions	Crop	Accessions	Crop	Accessions
Frenchbean	154	Proso-millet	12	Ornamentals	3
Amaranth	22	Foxtail millet	39	Tobacco	1
Buckwheat	35	Barnyard millet	28	Medicinal plants	16
Chenopod	12	Chilli	39	Wild onion	33
Finger millet	146	Mustard	2	Garlic	9

16.3.2. Medium Term Storage: A total of 9,443 accessions of various crops were conserved in MTS. Crop wise break-up of germplasm being conserved in MTS is given in table 6.

Table 6: Germplasm accessions being conserved in the MTS

Crop	Accessions	Crop	Accessions	Crop	Accessions
Amaranth	2958	Adzuki bean	146	Horse gram	101
Buckwheat	848	Finger millet	410	Pea	311
Chenopod	166	Foxtail millet	278	Lentil	54
French bean	3366	Barnyard millet	71	<i>Cuphea</i>	16
Rice bean	235	Proso-millet	160	<i>Meetha karela</i>	40

16.3.3. Field Gene Bank: A total of 1,153 germplasm accession of perennial crops such as fruits, medicinal and aromatic plants and other economic plants conserved in the field gene bank. Crop wise break-up of germplasm being conserved in FGB is given in table 7.

Table 7: Germplasm accessions being conserved in the field gene bank (FGB)

Crop	Accs.	Crop	Accs.	Crop	Accs.
Apple	233	Strawberry	5	Olive	6
Pear	67	Grapes	11	<i>Crataegus</i>	3
Peach	44	Cherry	6	<i>Mespilus</i>	4
Plum	42	Persimmon	9	Fig	5
Apricot	35	Chinese ber	3	Viburnum	3
Walnut	271	<i>Rubus</i> spp.	10	Mulberry	4
Pecan nut	51	<i>Ribes</i>	5	<i>Elaeagnus</i>	1
Almond	20	<i>Docynia</i>	2	<i>Rosa</i> spp.	31
Hazelnut	21	<i>Quince</i>	9	M & AP	70
Kiwi fruit	9	Chest nut	1	Others	54
Pomegranate	102	Hops	6		
Pineapple guava	2	Citrus	5		

16.3.4 Conservation of wild relatives of crop plants: The important wild relatives of agri-horticultural crops are being maintained at the station (Table 8).

Table 8: Status of wild relatives of agri-horticultural crops

Crop	Wild relatives/ species
Amaranth	<i>Amaranthus hybridus</i> , <i>A. retroflexus</i> , <i>A. lividus</i> , <i>A. viridis</i> , <i>A. graecizans</i> , <i>A. dubius</i> , <i>A. spinosus</i> , and <i>A. tricolor</i>
Buckwheat	<i>Fagopyrum emerginatum</i> , <i>F. tataricum</i> var. <i>himalaicum</i> and <i>F. gigataenum</i>
Chenopod	<i>Chenopodium amranticolor</i> , <i>C. botrys</i> , <i>C. murale</i> , and <i>C. ambrasoidesi</i>
French bean	<i>Phaseolus lunatus</i> , and <i>P. coccineus</i>
Faba bean	<i>Vicia hirsut</i> , <i>V. tetrasperma</i>
Apple	<i>Malus baccata</i> , <i>M. baccata</i> var. <i>himalaica</i> , <i>M. baccata</i> var. <i>dringensis</i> , <i>M. sikkimensis</i> , and <i>M. glaucensis</i>
Pear	<i>Pyrus pyrifolia</i> , <i>P. pyrifolia</i> var. <i>kumaoni</i> , <i>P. jacquemontii</i> , <i>P. pashia</i> , <i>P. serotina</i>
Prunus	<i>Prunus nepaulensis</i> , <i>P. arminiaca</i> , <i>P. cerasoides</i> , <i>P. mira</i> , <i>P. cornuta</i> , <i>P. serrulata</i> , <i>P. pissardii</i> , <i>P. laurocerasus</i>
Walnut	<i>Juglans nigra</i> , <i>J. mandshuria</i> , <i>J. ailantifolia</i>
Kiwi	<i>Actinidia callosa</i> , <i>A. arguta</i>
Grapes	<i>Vitis ficifolia</i> , <i>V. arizonica</i> , <i>V. riparia</i> , <i>V. barlandierii</i> , <i>V. acerifolia</i> , <i>V. gerdiana</i> , <i>V. aestivalis</i> , <i>V. amurensis</i> , <i>V. cinerrea</i> , <i>Parthenocissus quinquefolia</i> , <i>V. himalayana</i> , <i>V. vinifera</i>
<i>Pistachio</i>	<i>Pistachio atlantica</i> , <i>P. terebinthus</i>
<i>Rubus</i> spp.	<i>Rubus ellipticus</i> , <i>R. niveus</i> , <i>R. paniculatus</i> , <i>R. racemosus</i> , <i>R. lasiocarpus</i> , <i>R. fruticosus</i> , <i>R. macilentus</i> , <i>R. mallacanus</i> , <i>R. assamensis</i>
<i>Ribes</i> spp.	<i>Ribs nigrum</i> , <i>R. rubrum</i>
Minor fruits	<i>Punica granatum</i> , <i>Cotoneaster acuminata</i> , <i>C. bacillaris</i> , <i>C. salicifolia</i> , <i>C. zabelli</i> , <i>C. franchettii</i> , <i>Crataegus wendlandii</i> , <i>C. malanocarpa</i> , <i>C. oxycantha</i> , <i>C. soongarica</i> , <i>Feijoa sellowiana</i> , <i>Cydonia oblonga</i> , <i>Docynia hookeriana</i> , <i>D. indica</i> , <i>Viburnum cotinifolium</i> , <i>V. lanata</i> , <i>Cornus rugosa</i> , <i>C. nigra</i> , <i>C. kousa</i> , <i>Elaeagnus umbellate</i> , <i>Castanea crenata</i> , <i>Olea cuspidata</i> , <i>Ziziphus jujuba</i> , <i>Diasporas lotus</i> , <i>Ficus palmata</i> , <i>F. carica</i> , <i>Corulus jacquemontii</i>
Wild <i>Allium</i> spp.	<i>Allium fistulosum</i> , <i>A. prezwalskianum</i> , <i>A. carolinianum</i> , <i>A. tuberosum</i> , <i>A. schoenoprasum</i> , <i>A. auriculatum</i> , <i>A. graffithianum</i> , <i>A. consanguinum</i> , <i>Allium sativa</i> var. <i>ophioscordon</i>
Important medicinal plants	<i>Acorus calamus</i> , <i>Asparagus adscendens</i> , <i>A. filicinus</i> , <i>Bacopa monnieri</i> , <i>Habenaria intermedia</i> , <i>Viola serpens</i> , <i>Hedychium spicatum</i> , <i>Taxus baccata</i> , <i>Heracleum candicans</i> , <i>Thymus serphyllum</i> , <i>Dioscorea deltoidea</i> , <i>Roylea elegans</i> , <i>Podophyllum hexandrum</i> , <i>Polygonatum cirrhifolium</i> , <i>P. verticillatum</i> , <i>Valeriana wallichii</i> , <i>Roscoea procera</i> , <i>R. alpina</i> , <i>Achillea millefolium</i> , <i>Betula edulis</i> , <i>Ephedra gerardiana</i> , <i>Lilium polyphyllum</i> , <i>Picrorhiza kurroo</i> , <i>Stevia rebaudiana</i> , <i>Saussura costus</i> , <i>Arctium lappa</i> , <i>Withania somnifera</i>

16.4 Germplasm Supply

Germplasm of agricultural crops (698 accessions) and horticultural crops (702 bud sticks and 258 live plants) were supplied to various indenters as follows. The detail of supply is given below:

- Seeds: Amaranth (225), buckwheat(76), chenopod(18), Frenchbean(204), adzuki bean (25), ricebean (100) and finger millet (50)
- Bud sticks: Kiwi (300), persimmon (30), pecans

(107), pear (30), pomegranate (40), apricot (160), apple (25) and cherry (10)

- Rooted plants: Peach (5), pomegranate (2), plum(5), pear (2), kiwi (17), Chinese ber (2), hazelnut (3), walnut (3), pepino (10), *Stevia* (200)

Herbaria um specimensprepared: 201 herbarium specimens were prepared and submitted to National Herbarium of Cultivated Plants (NHCP) New Delhi.

Research Projects (Project Code, Title, PI & Co PIs)

PGR/GEV/BUR-SHM-01.00: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation, and distribution of genetic resources of the North-Western Himalayan region.

PGR/GEV/BUR/SHM-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation, and distribution of genetic resources of pseudocereals, pulses, and other lesser-known hill crops. (J.C. Rana, K. Pradheep and V.D. Verma)

PGR/GEV/BUR/SHM-01. 02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation, and distribution of genetic resources of temperate fruits, vegetables and medicinal and aromatic plants. (V.D. Verma, K. Pradheep, J.C. Rana and Sandhya Gupta)

Externally funded ad-hoc research projects

- Mass propagation and promotion of cultivation of geranium and lavender in Himachal Pradesh (J.C. Rana)
- Assessing available biomass for meeting demand and supply of energy-A case study in three watersheds of Himachal Pradesh (J.C. Rana)
- On farm conservation and promotion of cultivation of small millets and pseudo-cereals in participatory mode in Himachal Pradesh (J.C. Rana)

17. REGIONAL STATION, SRINAGAR

Summary: Explorations of agri-horticultural crops were undertaken in Kashmir valley. A total of 367 accessions of apple (25), pear (9), walnut (73), almond (123) chilli (131), brinjal (2), tomato (3) and pumpkin (1) were collected. The 356 accessions of wheat (194), barley (98) and mustard (64) were characterized and evaluated during rabi 2006-07 and the 605 accessions of wheat (330), barley (164) and mustard (111) were sown in *Rabi* 2007-08.

The National Bureau of Plant Genetic Resources, Regional Station, Srinagar was established in 1989 with responsibility of undertaken plant exploration and germplasm collection of agri-horticultural crops and their wild relatives from the region and their characterization and evaluation. It is located about 14 km from Srinagar city at KD Farm near old airfield, Rangreth. A brief mention of PGR activities carried out is presented below:

17.1 Germplasm Exploration and Collection

A total of 367 germplasm accessions of different agri-horticultural crops were collected from Kashmir valley.

17.1.1 Collection of apple germplasm: The 25 accessions of apple including landraces and wild relatives were collected from Ganderbal, Budgam, Shopian and Pulwama districts of Kashmir. A genotype known as Quince (in local parlance called Bumchoont) collected from Chak Mohalla of Ganderbal district is very useful for asthmatic and other kind of chest infection. It is bitter in taste, improves digestion, rich in fibre and purgative. Its dishes are served in wazwan (Kashmiri cuisine) served at special occasions, parties of high profiled



Ambri, a landrace of apple known for its attractive colour and juicy fruits collected from Pulwama district



Variability in fruit shape, size and colour of apple collected from Kashmir valley

persons. Its leaves are used to feed sheep on preference basis. Wild apple collected from Tikkim village of Pulwama district bear small fruit but planted in apple orchards for enhanced pollination of cultivated varieties of apple. Another variety “Ambri” known for its attractive fruit colour, sweet and juicy fruit, indigenous to Kashmir was also collected from a village of Pulwama district. The diversity in apple collection was observed for fruit shape, size, weight, taste, colour and juice quantity.



Quince a landrace of apple collected from district Ganderbal

17.1.2 Collection of walnut germplasm: The seventy three accessions of walnut, all indigenous to Kashmir Valley were collected from the villages of Pulwama and Budgam districts of Kashmir. The average weight of a dried nut of one accession namely “Tushu” was 23.07 gm. Tushu has per nut weight advantage 53.80 % and 44.18% over the two released varieties “Hamdan” and “Suleiman”. The diversity was observed for weight, shape, size and skin colour of nut.



Variability in shape and size of walnut collected from Kashmir valley

17.1.3 Collection of pear germplasm: Nine accessions of pears were collected from Gandarbal, Pulwama, Shopain districts of Kashmir valley. The land race “Geejir Tang” produced the heaviest fruit (weight more than 1.2 kg). The diversity was observed for fruit weight, taste, colour, shape, size, juice, etc.



Variability in shape and size of pear collected from Kashmir valley

17.1.4 Collection of diversity of red chilli: One hundred and thirty three accessions of chilli were collected from the villages of Budgam districts of Kashmir. Diversity was observed for pod size, shape and weight. They are considered to be local variants of Kashmir chilli.



Variability in pod shape and size of chilli from Kashmir valley

17.1.5 Collection of almond germplasm: A total of 123 accessions of almond were collected from the villages of Budgam, Gandarbal, Pulwama and Shopain districts of Kashmir. The diversity was observed for nut shape, size, weight and taste.



Variability in shape and size of almonds collected from Kashmir

Besides, accessions of Kashmir brinjal (2), Kashmiri tomato (3) and Kashmiri pumpkin (1) were collected from Budgam district.

17.2 Germplasm Characterization and Evaluation

A total of 356 accessions comprising of wheat (194), barley (98) and mustard (64) were characterized and evaluated in a Randomized Complete Block Design in three replications during *Rabi* 2006-07. Accessions of wheat (330), barley (164) and mustard (111) have been sown in the field for characterization and evaluation under rainfed condition.

17.3 Maintenance of Germplasm

The 33 accessions comprising *Dioscorea deltoidea* (23) strawberry (3), pran (5), mint (1) and *Iris spp.* (1) were maintained as a live plants.

Research Project (Project Code, Title, PI, Associates)

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

18. REGIONAL STATION, THRISSUR

Summary: A total of 331 accessions was collected in 10 exploration and collection missions carried out in 11 districts of Kerala, 18 districts of Tamil Nadu, 2 districts of Puducherry, 2 districts of Karnataka and 2 districts of Andaman & Nicobar (A&N) Islands. This resulted in the collection of 155 accessions from Tamil Nadu, 86 from Kerala, 23 from Karnataka, 64 from A&N Islands and 3 from Puducherry. The collected germplasm included a very rare landrace of upland rice ('Peribera nellu') from Tamil Nadu. Several first-time collections were made which included cowa (*Garcinia cowa*), chaplash (*Artocarpus chama*), teasel gourd (*Momordica subangulata* subsp. *renigera*) and Burmese fish-tail palm (*Caryota mitis*) from A & N Islands; durian (*Durio zibethinus*), noni (*Morinda citrifolia*), Java olives (*Sterculia foetida*) and langsat (*Lansium domesticum*) from Kerala; and mahua (*Madhuca longifolia* & *M.indica*) and Indian laurel (*Calophyllum inophyllum*) from Tamil Nadu. Out of the collected germplasm, 21 accessions of voucher samples were sent for medium-term storage and 42 accessions for long-term storage in the National Genebank, NBPGR, New Delhi. During *rabi* 2006-07, 110 accessions of rice (*Oryza sativa*), 122 of horsegram (*Macrotyloma uniflorum*), 146 of 12 identified wild/run wild tuberising (finger bearing) *Curcuma* taxa, 3 of cinnamon (*Cinnamomum verum*), 22 of mango (*Mangifera indica*), 11 of typical *S.incanum* and 5 of typical *S.insanum* were characterised/evaluated. In summer 2007, 33 accessions of Chinese spinach (*Amaranthus tricolor*) and 5 of kokam (*Garcinia indica*) were characterised/evaluated. During *kharif* 2007, 100 accessions of okra (*Abelmoschus esculentus*), 21 of small bittergourd (*Momordica charantia* var. *muricata*), 10 of Chinese potato (*Solenostemon rotundifolius*), 34 of 12 identified wild/run wild *Curcuma* taxa and 24 of Malabar tamarind (*Garcinia cambogia*) were characterised/ evaluated. 517 multiplied accessions were sent for long-term storage. For cryo-preservation 127 accessions were sent. Nine accessions were sent for *in vitro* conservation. Seeds of 1674 accessions of various crops/wild relatives were added to the MTS facility of the station. Based on material transfer agreement, 616 accessions comprising 8 crops and 4 wild related species were supplied to 10 user agencies. Supplied 165 accessions of collected germplasm to FCRI, TNAU under the TBOs Project. Transferred 63 accessions of under-utilised fruits collected under the ICAR Network Project on Under-Utilized Fruits to CHES (IIHR), Chethalli, Kodagu, Karnataka and 13 accessions of banana and its wild relatives to NRC for Banana, Tiruchirapalli, Tamil Nadu, at the time of collaborative collection missions conducted with each of them. A total of 212 accessions in 5 crops (cassava-42, ginger-144, kokam-6, Malabar tamarind-2 and black pepper-1) including 17 accessions of wild related species (*Dioscorea*-11 & *Curcuma*-6) was maintained in *in vitro* conservation media. One accession of *D.bulbifera* was newly initiated in to *in vitro* culture. Supplied 100 accessions of okra in 7 sets to IIVR, Varanasi and 100 accessions of horsegram to 3 institutions for multi-location evaluation under the All India Co-ordinated Research Project on Vegetable Crops and National Network Project on Arid Legumes, respectively.

The National Bureau of Plant Genetic Resources Regional Station, Vellanikkara, Thrissur is responsible for plant genetic resources related activities in the southern peninsular region of India comprising the States of Kerala, Tamil Nadu, Karnataka and Goa and the Union Territories of Puducherry, Lakshadweep and Andaman & Nicobar (A&N) Islands. This year the prioritized crops for collection were tree-borne oilseeds (TBOs), leafy-vegetables, banana, under-utilized fruits (UUFs) and wild relatives of crops. The exploration and collection mission for UUFs was conducted in association with CHES (IIHR), Chethalli, Kodagu, Karnataka and that for banana and its wild relatives was executed in collaboration with NRC for Banana, Thiruchchirapalli, Tamil Nadu. College of Agriculture (KAU), Vellayani, Trivandrum has released a new variety of okra namely, "Manjima" based on hybridization between Gowreesapattom Local x IC282257 in 2007 as recommended by the State Seed Sub-committee on Crop Standards. This variety is high-yielding (1.34 kg/plant), compact, early maturing and YMV resistant.

18.1 Exploration and Collection

A total of 331 accessions was collected in 10 exploration



Variability in seeds of *Madhuca longifolia*



Variability in seeds and cotyledons of *Pongamia pinnata*

and collection missions carried out in 11 districts of Kerala, 18 districts of Tamil Nadu, 2 districts of Puducherry, 2 districts of Karnataka and 2 districts of Andaman & Nicobar (A&N) Islands. In the first mission, 155 accessions were collected from Tamil Nadu, 86 from Kerala, 23 from Karnataka, 64 from A&N Islands and 3 from Puducherry. The collected germplasm included a very rare landrace of upland rice ('Peribera nellu') from Tamil Nadu. Several first-time collections were made which included cowa (*Garcinia cowa*),

chaplash (*Artocarpus chama*), teasel gourd (*Momordica subangulata* subsp. *renigera*) and Burmese fish-tail palm (*Caryota mitis*) from A & N Islands, durian (*Durio zibethinus*), noni (*Morinda citrifolia*), Java olives (*Sterculia foetida*) and langsat (*Lansium domesticum*) from Kerala and mahua (*Madhuca longifolia* and *M. indica*) and Indian laurel (*Calophyllum inophyllum*) from Tamil Nadu. The details of the targeted germplasm collected, major variability amassed and interesting collections made are as follows:

Districts	State / Union Territory	Target Crop(s)	Target crops collected	Others collected	Total
Kasaragod	Kerala	Tree-borne oilseeds (TBOs)	Kokam (8)	18	38
Dakshin Kannad, Kodagu	Karnataka		Kokam (10)		
Coimbatore, Nilgiris	Tamil Nadu		Physicnut (1), Mysore gamboge (1)		
Andaman, Nicobar	A & N Islands	TBOs, vegetables & wild relatives of crops	Physicnut (10), Neem (3), Karanj (3), Chinese spinach (11), spleen amaranth (4), small bittergourd (1), teasel gourd (1), greater yam (1), elephant yam (1), sesban (1), wild relatives (19)	9	64
Coimbatore, Dharmapuri, Thiruvannamalai, Villupuram	Tamil Nadu	TBOs	Karanj (9), physicnut (1)	8	18
Alappuza, Ernakulam, Kannur, Kollam, Kottayam, Palakkad, Pathanamthitta, Thrissur, Thiruvananthapuram	Kerala (in collaboration with CHES)	Rambutan, Durian, Mangosteen & Jamun	Durian (7), jamun (25), mangosteen (7), rambutan (19)	9	67
Alapuzha, Ernakulam, Kollam, Kozhikode, Palakkad, Thiruvananthapuram	Kerala	TBOs	Physicnut (9),	4	28
Coimbatore, Kanyakumari, Krishnagiri, Nagapattinam, Pudukkottai, Salem	Tamil Nadu		Physicnut (4), khakan (1), neem (1), karanj-8		
Karaikkal	Puducherry		Karanjneem (1)		
Coimbatore, Krishnagiri, Salem, Thiruvannamalai, Viluppuram	Tamil Nadu	TBOs	Mahua (14), karanj (3), physicnut (1),	..	19
Erode, Karur, Krishnagiri, Salem, Thiruvannamalai	Tamil Nadu	TBOs	Mahua (13), physicnut (1)	4	18
Coimbatore, Cuddalore, Dindigul, Perambalur, Salem, Villupuram	Tamil Nadu	TBOs	Mahua (12), <i>Madhuca indica</i> (2) physicnut (2)	..	17
Puducherry	Puducherry		Mahua (1)		
Coimbatore, Dindigul, Erode, Madurai, Theni, Tirunelveli	Tamil Nadu	TBOs	Karanj (17), mahua (13), physicnut (10), Indian laurel (4)	2	46
Kanyakumari, Tirunelveli	Tamil Nadu (in collaboration with NRCB)	Banana & its relatives	Banana (11), <i>Musa acuminata</i> (1), <i>M.laterita</i> (1)	3	16

Among these, the major variability collected in terms of four or more accessions per taxa and the interesting collections made are given below separately:

Crop group	Crop	Botanical name	No. of accessions	State/ UT
Vegetables	Spleen amaranth	<i>Amaranthus dubius</i>	4	A&N Islands
	Chinese spinach	<i>Amaranthus tricolour</i>	11	A&N Islands
TBOs	Neem	<i>Azadirachta indica</i>	3	A&N Islands
			2	Tamil Nadu
	Indian Laurel	<i>Calophyllum inophyllum</i>	4	Tamil Nadu
			8	Kerala
	Physicnut	<i>Jatropha curcas</i>	10	Karnataka
			10	A&N Islands
			9	Kerala
	Mahua	<i>Madhuca longifolia</i>	21	Tamil Nadu
			1	Puducherry
			52	Tamil Nadu
Karanj	<i>Pongamia pinnata</i>	3	A&N Islands	
		1	Puducherry	
			38	Tamil Nadu
Fruits	Banana	<i>Musa hybrids</i>	11	Tamil Nadu
UU Fruits	Durian	<i>Durio zibethinus</i>	7	Kerala
	Mangosteen	<i>Garcinia mangostana</i>	7	Kerala
	Rambutan	<i>Nephelium lappaceum</i>	19	Keraa
	Jamun	<i>Syzygium cumini</i>	1	A&N Islands
			25	Kerala
M&A plants	..	<i>Hedychium coronarium</i>	4	Karnataka

Interesting collections made:

Crop/Com-mon name	Botanical name	Accs. No.	Speciality	District	State
Cowa	<i>Garcinia cowa</i>	IC553714, IC553757	Edible fruit, first time collection	Andaman	A&N Islands
Chaplash	<i>Artocarpus chama</i>	IC553758, IC553769	Wild relative of jackfruit and bread fruit	Andaman	A&N Islands
Teasel gourd	<i>Momordica subangulata</i> subsp. <i>renigera</i>	IC553771	Prolific, early bearing	Andaman	A&N Islands
Burmese fish-tail palm	<i>Caryota mitis</i>	IC553772	A beautiful dwarf ornamental palm with domestication potential	Andaman	A&N Islands
Noni	<i>Morinda citrifolia</i>	IC554286	Fruits with nutraceutical property	Thrissur	Kerala
Indian laurel	<i>Calophyllum inophyllum</i>	IC556624	With very bold seeds	Tirunelveli	Tamil Nadu
Jamun	<i>Syzygium cumini</i>	IC554221	Large fruit size	Thrissur	Kerala
		IC554225	Extra large fruit (14 g)	Thrissur	Kerala
		IC554228	Sweet non-astringent ('Karayilla njaval')	Thrissur	Kerala
Wild jamun	<i>Syzygium caryophyllatum</i>	IC554275	Wild edible jamun, black, sweet fruit	Kollam	Kerala
		IC554276	Red-purple, sweet fruit	Kollam	Kerala
Durian	<i>Durio zibethinus</i>	IC554257	Large fruit, sweet aroma and prolific bearing	Pathanamthitta	Kerala
Rambutan	<i>Nephelium lappaceum</i>	IC554268	High flesh content, sweet, easily separable seed	Pathanamthitta	Kerala

Java Olives	<i>Sterculia foetida</i>	IC554285	Wild tree with ornamental fruits suitable for domestication	Ernakulam	Kerala
Langsat	<i>Lansium domesticum</i>	IC554284	First time collection of a Malaysian fresh fruit	Pathanamthitta	Kerala
Karanj	<i>Pongamia pinnata</i>	IC553376	Profuse bearing and fruiting throughout the year	Dharmapuri	Tamil Nadu
		IC553414	— do —	Salem	Tamil Nadu
Neem	<i>Azadiracta indica</i>	IC553400	Early maturing, profuse bearing and bold seeded	Kanyakumari	Tamil Nadu
Physicnut	<i>Jatropha curcas</i>	IC553413	Highly branched, profuse bearing throughout the year	Krishnagiri	Tamil Nadu
		IC553415	Profuse bearing	Coimbatore	Tamil Nadu
Mahua	<i>Madhuca longifolia</i>	IC554527	More than one seed, extending up to 5 seeds per fruit.	Krishnagiri	Tamil Nadu
		IC554535	Profusely bearing with bold seeds	Vilupuram	Tamil Nadu
		IC554553	Curved seeds and sharp pointed beak	Krishnagiri	Tamil Nadu
		IC554554	Sharp, long pointed beak	Salem	Tamil Nadu
		IC555358	Profuse bearing and more than 10 fruits per bunch	Salem	Tamil Nadu
Mahua	<i>Madhuca indica</i>	IC555367	short, thick, bitter and hairy fruit; the beak of which is protruding and the seed is straight	Vilupuram	Tamil Nadu
		IC555372	— do —	Dindugal	Tamil Nadu

Herbarium sent to NHCP: One accession of *Exacum bicolour*, a medicinal plant of *siddha* and folk systems of medicine under domestication, collected and maintained by KVK (KAU), Thrissur, was procured and submitted as herbarium to National Herbarium of Cultivated Plant (NHCP), NBPGR, New Delhi.



Kokam (*Garcinia indica*) an unique accession with nipple on the fruit (IC552516)

Alangium salvifolium – an under-utilized edible fruit collected from Tamil Nadu (IC552546)

18.2 Characterization and Evaluation

18.2.1 Cereals

Rice (*Oryza sativa*) Rabi 2006-07: One-hundred and ten accessions of rice were evaluated for 10 qualitative and 12 quantitative characters along with four check varieties namely Ahalya, Jaya, Jyoti and Thulasi. No variability was found in leaf pubescence, panicle exertion and threshability. Five accessions viz., IC210077 (15 g), IC210078 (13 g), IC210110 (20 g), IC2482149 (21 g) and IC211228 (14 g) were identified superior for single plant yield compared to the best check, Thulasi (12 g). The variability was observed in nine qualitative characters- early plant vigour, coleoptile colour, basal leaf sheath colour, leaf blade colour, apiculus colour, panicle type, awning, seed coat colour and hull colour .

The superior accessions identified for economically important characters are as below:

Characters	TCR No.	Collector's No.	Accession No.	District	Source*	Value
No. of effective tillers	6444	NKD-2262	IC210118	Dang	Gujarat	26.8
	6626	J/99-265	IC324763	Kozhikode	Kerala	23.0
	6755	IRRI 0129	EC415520	..	Philippines	24.4
	Check: Thulasi	11.4				
Grain length (mm)	6452	NKD-2270	IC210126	Dang	Gujarat	10.8
	6727	IRRI 0101	EC415492	..	Philippines	11.6
		Check: Jyoti	9.3			
100 grain weight (g)	7103	NC/03-82	IC413628	Ernakulam	Kerala	3.1
	7138	N/05-22	IC536546	Malappuram	Kerala	3.1
		Check: Jyoti	2.7			
Grain yield/ plant (g)	6436	NKD-2254	IC210110	Dang	Gujarat	20.0
	6820	VJ/98-110	IC248214	Uttar Kannad	Karnataka	21.0
	6889	300050	IC320130	Andaman	A&N	22.0
	7144	N/05-28	IC536552	Malappuram	Kerala	20.0
	7148	N/05-35	IC536559	Malappuram	Kerala	17.0
	7150	N/05-44	IC536568	Malappuram	Kerala	17.0
		Check: Jyoti	7.6			
Panicle length (cm)	6404	NKD/RMC-2222	IC210078	Panchmahals	Gujarat	22.8
	6422	NKD-2240	IC210096	Valsad	Gujarat	24.0
	6444	NKD-2262	IC210118	Dang	Gujarat	23.4
	6570	NS-5893	IC211246	Khammam	Andhra Pradesh	21.7
	6626	J/99-265	IC324763	Kozhikode	Kerala	25.8
	6678	IRRI 0052	EC415443	..	Philippines	23.4
	6820	VJ/98-110	IC248214	Uttar Kannad	Karnataka	23.2
	6855	JJK/99-624	IC256263	Kannur	Kerala	23.6
	6868	VJ/99-475	IC256115	Palakkad	Kerala	26.8
	6873	VJ/99-540	IC256179	Palakkad	Kerala	24.5
	6887	300047	IC320127	Andaman	A&N	23.9
	6889	300050	IC320130	Andaman	A&N	25.5
	6894	S-017	IC257924	Visakhpatinam	Andhra Pradesh	23.6
	7103	NC/03-82	IC413628	Ernakulam	Kerala	21.3
	7144	N/05-28	IC536552	Malappuram	Kerala	25.0
	7148	N/05-35	IC536559	Malappuram	Kerala	23.7
	7150	N/05-44	IC536568	Malappuram	Kerala	24.1
	7163	N/05-75	IC536599	Malappuram	Kerala	21.5
	7164	N/05-76	IC536600	Malappuram	Kerala	23.2
	7165	N/05-77	IC536601	Malappuram	Kerala	23.4
		Check: Thulasi	20.8			

* states in India/ country

18.2.2 Grain Legumes

Horse gram (*Macrotyloma uniflorum*) Rabi 2006-07: A total of 122 accessions was characterized for 3 qualitative and 6 quantitative characters, along with 6 check varieties namely, AK-21, AK-26, AK-38, HGGP, PHG-9 and DPI 2278. No accession was found superior to any one of the checks used.

18.2.3 Vegetables

Chinese spinach (*Amaranthus tricolour*) summer 2007: Preliminary evaluation of 20 accessions of

Chinese spinach was carried out. Superior accessions identified for total herbage yield were IC536732 (294 g/plant), IC536728 (273 g) and IC536731 (193 g), all collected from Karnataka, when compared with the best check Arka Arunima (183 g). Another set of 13 accessions was characterised for 12 qualitative and 13 quantitative traits. Among them, 2 accessions collected from Karnataka namely, IC550145 with 143g/plant and IC550142 with 127 g/plant were superior to the best check CO-2 (123 g). IC 550145 had dwarf habit with bright red stem and copper coloured leaves, whereas IC550142 was characterised by flesh coloured stem and green leaves.



'Peri bere nelli', an upland rice, drought tolerant landrace of Tamil Nadu (IC554555)



Okra under multi-location evaluation (*Kharif*)

Okra (*Abelmoschus esculentus*) *Kharif* 2007: In 100 accessions taken up under the IIVR-NBPGR collaborative multi-location evaluation trial, 11 quantitative and 2 qualitative traits were studied besides the incidence of yellow mosaic virus (YMV) under field epiphytotic conditions in 0-9 scale. IC113904 (TCR-776, V4331, collected from Malappuram district, Kerala) was superior in multiple traits - for highest single fruit weight of 65 g (compared to best check Salkeerthi-43g); for high yield with 578 g/plant, 12.2 fruits/plant and 65 g/

single fruit (compared to the best check VRO-5 with 256 g/plant, 7.8 fruits/plant and 30 g/single fruit). Single plant yield was more than two times higher than the best check. This accession had multi-ridged, dark-green, thick (31 mm) and long (23 cm) fruits. The other superior accessions identified for different traits are given below:

Traits	Accessions
Days to 50% flowering Checks – Pusa Savani & VR 05 (49 days)	IC218903 (43 days)
Short fruits (14 - 15 cm)	IC090209, IC032855A, IC043751, IC282245, IC282256, IC018542, IC022237, IC026375, IC029119B, IC045732, IC086008, IC089712, IC089948, IC090210, IC090231, IC090262, IC099780, IC111440, IC111443
No. of fruits/plant (above 8, compared to best check VR-05)	IC113904 (12.2), EC329556 (11.4), IC033858A (10.0), IC033065 (9.0), IC008991 (10.0)

Among the second set of 350 accessions regenerated for long-term storage (LTS) during *Kharif* 2007, IC282230, IC006485, IC469548 and IC541224 showed field tolerance to YMV, whereas the remaining 346 accessions showed symptoms of yellowing (on a 3-9 rating).

Small bitter gourd (*Momordica charantia* var. *muricata*) *Kharif* 2007: Twenty-one accessions of wild and semi-domesticated small bitter gourd were characterized for 10 qualitative and 12 quantitative traits. IC541212 (5g) and IC541246 (5.5g) had the least fruit weight among cultivated small bitter gourd, both belonging to the landrace 'Methipavai'. Variability observed in fruit and seed characters is presented below:

TCR No.	IC No.	Fruit weight (g)	Fruit length (cm)	Fruit circumference (cm)	Diameter (cm)	Cavity (cm)	Flesh thickness (cm)	No. of seeds
49	467668	40.0	11.6	11.6	3.5	2.6	0.3	13.0
51	467680	43.3	11.3	11.6	3.2	2.6	0.3	11.5
52	467681	37.5	10.5	10.9	2.7	1.8	0.2	14.0
53	467682	25.0	8.0	10.5	3.0	2.0	0.3	9.0
61	467670	12.5	7.0	9.0	2.8	2.1	0.3	10.0
75*	541448	67.0	10.7	15.2	4.3	2.8	0.5	13.8
76*	541427	25.0	7.5	10.5	3.0	2.6	0.2	12.0
86*	541377	35.0	8.9	11.8	3.5	2.5	0.4	9.8
87*	541384	25.0	7.3	10.0	3.0	2.5	0.4	9.5
96**	541212	5.0	5.3	6.9	2.4	2.0	0.2	5.0
97**	541213	8.6	4.8	6.7	2.5	1.7	0.2	5.0
106**	541241	8.6	5.1	7.9	2.2	1.8	0.2	6.0

108**	541246	5.5	4.7	7.2	2.2	1.6	0.3	7.0
109**	541247	10.0	5.3	7.3	2.2	1.6	0.2	5.5
112**	541251	9.5	6.7	6.1	1.9	1.5	0.2	7.7
113**	541249	14.0	6.7	8.6	2.1	1.4	0.2	5.2
114	550113	17.5	6.3	8.3	2.3	1.8	0.2	8.0
116	467644	16.0	5.5	7.8	2.1	1.6	0.2	8.0
118	467673	22.4	8.0	10.0	2.9	2.0	0.3	8.0
120	550115	40.8	10.6	10.8	3.0	2.1	0.5	17.0
121	550105	75.0	14.5	13.0	4.3	3.0	0.5	22.0
Minimum	5.0	4.7	6.1	1.9	1.4	0.2	5.0	
Maximum	75.0	14.5	15.2	4.3	3.0	0.5	22.0	
Mean	25.9	7.9	9.6	2.8	2.1	0.3	9.9	

* Cultivated, collected from Andaman Islands

** Semi-domesticated, collected from Tamil Nadu

All the accessions showed good degree of field tolerance to fruit fly. Among the wild accessions, IC467670, IC467682, IC550113, IC467645, IC441250, IC541248, IC467680 and IC467644 were drought tolerant, expressing continued growth and fruiting even under moisture stress conditions.

Teaslegourd (*Momordica subangulata* ssp. *renigera*)

Kharif 2007: The accession IC553771 (JJK/07-61), collected from East Begal repatriates of Havlock Island, A&N Islands, maintained in the field genebank showed prolific bearing (31 fruits/plant; 100 g, fruiting from 15th node, 34th day onwards) with possibilities of introducing this crop in the Western Ghats region.



Teasel gourd – *Momordica subangulata* ssp. *renigera* (IC553771)



Lesser yam (*Dioscorea esculenta*) – an under-utilized edible tuber under evaluation

18.2.4 Tubers

Chinese potato (*Solenostemon rotundifolius*)

Kharif 2007: Second year evaluation was carried out in 10 superior accessions with the check variety, Nidhi. Due to unexpected heavy rainfall this year (2,865 mm in 88 rainy days) compared to last year (1,683 mm in 70 rainy days) in 6 months (July to December - the period of crop duration), the crop failed because of poor vegetative growth. Hence, the tuber yield alone was recorded. Accession IC468968 tolerated the unusually high rainfall received during this year, with decrease in tuber yield (from 1,288 g/plant during 2006 to 155 g during 2007) but with less nematode infestation compared to 2006. The tuber yield of the check variety, Nidhi also decreased from 1,154 g/plant during 2006 to 45 g this year but with less nematode infestation compared to 2006.

18.2.5 Fruits

Mango (*Mangifera indica*) Rabi 2006-07: Out of the seedling progenies of 72 accessions of polyembryonic mango, 40 accessions came to flowering during late December 2006 to February 2007. Among these, 56 trees were scored for inflorescence shape, rachis colour and flowering earliness. Twelve accessions had conical, 38 with pyramidal and 6 broadly pyramidal inflorescence shape. Rachis colour varied from pinkish-red (18 accessions), red (18) and green (20). Flower initiation was early in 9 accessions, medium in 28 and late in 19. IC202204, IC202209 and IC470626 were the earliest to flower and fruit. Among the bearing trees, 30 trees in 22 accessions were characterized for 8 quantitative and 16 qualitative traits. Data on mature and ripe fruit and stone characters are given below:

IC No.	Landrace	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Edible part weight (g)	Stone weight (g)	Stone length (cm)	Stone width (cm)	Fruit fly incidence (0-9)*
470614	Vellari manga	312.0	16.0	20.8	282.0	30.0	5.0	4.0	1
202215	Ullitholiyan	92.0	8.7	17.3	70.0	22.0	5.0	4.2	3
470615	Kilichundan	53.0	7.8	13.5	31.0	22.0	5.3	3.8	1
470616-1		125.0	10.0	19.0	100.0	25.0	5.5	4.0	1
470616-2	Kottamanga	180.0	10.0	22.0	155.0	25.0	5.3	4.2	1
202205-1	Olor	130.0	9.2	20.5	99.5	37.5	5.6	4.4	1
202204	Vattan	265.0	13.8	23.2	221.0	44.0	8.9	4.8	1
202207	Nallapuliyan	132.0	9.6	19.5	105.0	27.0	6.0	4.2	1
202211	Moovandan	109.0	8.8	17.8	84.0	25.0	5.0	3.5	3
470622	Perakkamanga	131.0	9.5	19.4	103.0	28.0	6.0	4.2	1
470624	Kotturkonam	200.0	13.0	19.5	150.0	50.0	8.5	4.5	0
212569	Nattumavu	202.5	11.5	22.6	172.0	30.0	7.1	5.0	0
212569-1	Kolombu	28.0	6.7	12.2	18.0	10.0	3.8	3.5	0
470625-1	Kolombu	170.0	12.0	18.6	147.0	23.4	7.9	3.9	0
470625-2	Kolombu	163.0	11.7	18.3	136.0	27.0	9.0	3.8	0
470625-3	Kolombu	162.0	12.1	18.6	105.0	24.0	8.6	3.5	0
470626-1	Priour	137.0	9.5	18.5	125.0	23.0	5.3	3.9	3
470627-2	Kolombu	222.0	13.3	20.3	167.0	55.0	9.0	5.0	3
202209	Priour	163.0	11.6	18.7	138.0	24.0	8.0	4.0	0
212570	Perakkamanga	290.0	13.3	24.3	267.0	23.0	8.5	4.5	3
470630	Kolambu	156.0	11.7	18.8	124.0	25.0	8.8	3.7	1
470632-2	Valyakomanga	260.0	12.0	24.0	195.0	65.0	7.0	5.0	1
470633	Nattumanga	75.0	8.4	16.0	55.0	20.0	4.0	3.1	0
470633-2	Nattumanga	76.0	8.6	15.9	61.0	15.0	5.3	3.2	0
202234-2	Nooranmavu	136.0	10.1	19.5	111.0	25.0	6.3	5.2	5
470616-3		152.0	11.2	20.0	127.0	25.0	5.0	4.5	0
470616-4		114.0	9.8	18.0	91.0	23.3	5.5	4.7	0
202177-1	Nadashala	262.0	13.5	21.5	212.0	50.0	10.0	4.0	1
202177-2	Nadashala	262.0	13.0	23.5	229.0	33.0	7.0	4.0	5
202174-1	Moovandan	86.0	9.0	16.5	61.0	25.0	5.3	4.2	3

*Fruitfly incidence: 0 (Nil) to 9 (Very high)

Early season ripening (March-April) and fruit-fly tolerance were observed in IC470615, IC212569, IC470625, IC470630 and IC202209. IC470615 - 'ullitholiyan', was the earliest among the small fruited sucking types with thin skin. IC212569 - 'kotturkonam' was a table type with firm, orange flesh, prolonged shelf-life, early maturity, attractive red skin. Among the

'kolombu' landrace, IC470625, IC470630 and IC202209 were with medium-sized fruits and semi-firm flesh, suitable for table purpose. Accessions IC202209 (*Kolombu*), IC470661 and IC470644 (*Moovandan*) and IC470624 (*Perakkamanga*) were found to be polyembryonic upon germination of nuts.



Tuber variability in *Dioscorea oppositifolia* – a wild edible tuber under maintenance



Tuber variability in *Kaempferia rotunda* – a medicinal plant under maintenance

18.2.6 Spices

Curcuma species Rabi 2006-07: A total of 146 accessions of wild/run wild and tuberising (finger bearing) taxa of *Curcuma* was evaluated for rhizome yield. This indicated that IC88816 of *C. amada* var. *amada* with 313 g, IC210466 of *C. amada* var. *glabra* with 249 g, IC266609 of *C. zanthorrhiza* with 277 g, IC701106 of *C. aerugenosa* with 308 g, IC88859 of *C. aromatica* with 90 g and IC313084 of *C. caesia* with 188 g were superior for dry rhizome weight.

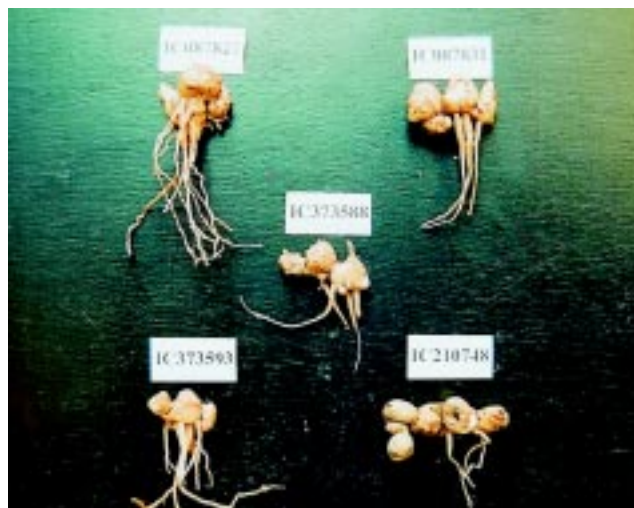
Kharif 2007: Out of 34 identified accessions of 12 wild taxa of *Curcuma* (*C. albiflora*-1, *C. aurantiaca*-8, *C. coriacea*-1, *C. decipiens*-3, *C. inodora*-6, *C. karnatakensis*-3, *C. oligantha* var. *oligantha*-1, *C. oligantha* var. *lutea*-1, *C. mutabilis*-3, *C. pseudomontana*-1, *C. thalakaveriensis*-1 and *C. vamana*-5) scored for incidence of *Taphrena* leaf blotch and *Colletotrichum* leaf spot diseases, 2 accessions namely, IC266516 (*C. aurantiaca*) and IC329329 (*C. albiflora*) were free from both the diseases, when maintained in pots, as given below:

a) No incidence of both <i>Taphrena</i> leaf blotch and <i>Colletotrichum</i> leaf spot					
TCR No.	IC No.	Species	Locality	District	Stae
1665	329329	<i>C. albiflora</i>	Udupi	Udupi	Karnataka
1377	266516	<i>C. aurantiaca</i>	Vellani hills	Thrissur	Kerala
b) No incidence of <i>Taphrena</i> leaf blotch					
0977B	088952B	<i>C. vellanikkarensis</i>	Pathanapuram	Kollam	Kerala
c) No incidence of <i>Colletotrichum</i> leaf spot					
1486	248212	<i>C. inodora</i>	Karwar	Uttar Kannad	Karnataka
1660	322301	<i>C. decipiens</i>	Nelluvai	Thrissur	Kerala
1473	248154	<i>C. oligantha</i>	Kadurur	Kannur	Kerala
1757	427581	<i>C. karnatakensis</i>	Ganeshgudi	Uttar Kannad	Karnataka
1567	313116	<i>C. thalakaveriensis</i>	Hadikasaragodu	Chikmagalur	Karnataka

Observation was also made on 12 underground quantitative characters including yield. This indicated that three accessions - IC313104 (381 g) and IC273580 (194 g) belonging to *C. muatabilis* and IC313115 (112 g) belonging to *C. decipiens* were superior for fresh rhizome yield/plant and so can be potential sources for arrowroot production.

Malabar tamarind (*Garcinia cambogia*) Kharif 2007: Thirty-two trees in 24 accessions bore fruits this year. Among them, IC244077-1, IC244100-2, IC244111-1 and IC244110 continued to be high yielding with 110, 181, 188 and 132 kg fresh fruits/tree. IC136681 continued to bear highest number of fruits of 3105 per tree, but with smaller soft seeded fruits (without seeds).

Cinnamon (*Cinnamomum verum*) Rabi 2006-07: Three accessions of cinnamon flowered during February 2007. They were characterized for 13 quantitative and 23 qualitative characters. There was very less variation with respect to qualitative characters except for flower cup shape and leaf shape. IC329200 from Kerala was the tallest (6.0 m).



Tuber variability in *Kaempferia galanga* – a medicinal plant under maintenance

18.3 Germplasm Conservation

18.3.1 Germplasm sent to National Genebank for long-term storage (LTS): From regenerated and multiplied germplasm at this station, 517 accessions were sent to the National Genebank, NBPGR, New Delhi for

long-term storage, which included 274 accessions of rice, 123 of sesame, 35 of horsegram, 10 of okra, 8 of *Vigna bourneae*, 6 of *V.dalzelliana*, 7 of *Abelmoschus angulosus*, 6 of Chinese spinach, 5 of drumstick, 5 of Indian liquorice, 4 each of brinjal, *Solanum incanum* and *S.insanum*, 3 of physicnut, and 23 accessions belonging to the genera *Abelmoschus*, *Amaranthus*, *Aristolochia*, *Bixa*, *Canavalia*, *Ipomoea*, *Lablab*, *Ocimum*, *Plumbago*, *Salacia*, *Samadera*, *Tinospora* and *Vigna*.

In addition, 4 accessions of Indian laurel, 3 of *Solanum incanum*, 2 each of *Abrus precatorius* and *Cucumis trigonus* and one each of *Amaranthus viridis*, *Aristolochia indica*, *Celtis timorensis*, *Lycopersicon pimpinellifolium*, *Oryza sativa*, *Phyllanthus emblica*, *Terminalia arjuna*, *T. bellirica* and *T. chebula* were deposited for long-term storage immediately after collection.

Voucher samples sent to National Genebank for medium-term storage (MTS): Twenty-one accessions of collected germplasm comprising 11 of *Amaranthus tricolour*, 4 of *A. dubius* and one each of *Vigna radiata* var. *sublobata*, *Canavalia cathartica*, *Mucuna monosperma*, *Sesbania sesban*, *Terminalia bellirica* and *Pterocarpus marsupium* were sent to NBPGR, New Delhi.

18.3.2 Sent to TC & CP Unit for *in vitro*/cryo-preservation: A total of 51 accessions consisting of 20 of black pepper, 8 of long pepper, 2 each of *Alangium salvifolium*, *Artocarpus chaplasha*, *A. gomezianus* subsp. *zeylanicus*, *Baccaurea ramiflora*, *Garcinia cowa*, *Strychnos nux-vomica* and *Syzygium caryophyllatum* and one each of *Cordia obliqua*, *Elaeocarpus tuberculatus*, *Garcinia xanthochymus*, *Knema andamanica*, *Melia azedarach*, *Persea americana*, *Salvadora persica*, *Sterculia guttata* and *Syzygium cumini* was sent for cryopreservation, and 3 accessions comprising one each of *Alpinia galanga* (greater galangal), *A. calcarata* (lesser galangal) and *A. zerumbet* were sent for *in vitro* conservation.

18.3.3 Added to MTS Facility at Thrissur: A total of 1,674 accessions comprising 597 of okra, 516 of rice, 84 of wild *Oryza* taxa, 228 of wild *Vigna* taxa, 183 of horse gram, 22 of *Momordica charantia* var. *muricata*, 10 of physicnut (*Jatropha curcas*), one of karanj (*Pongamia pinnata*) and 33 of medicinal plants were

kept in the MTS facility of the station. In addition, 56 accessions of rice were deposited by Pepper Research Station (KAU), Panniyur as safe duplicates.

***In vitro* propagation and conservation:** Tissue culture work was continued in ginger, Malabar tamarind, cassava, black pepper and kokam, and wild *Dioscorea* and *Curcuma* species. A total of 211 accessions in 5 crops (cassava-42, ginger-144, kokam-6, Malabar tamarind-2 and black pepper-1) and 12 wild related species (*Dioscorea pubera*-1, *D. pentaphylla*-3, *D. intermedia*-1, *D. belophylla*-1, *D. bulbifera*-1, *D. hispida*-1, *D. tomentosa*-1, *D. wallichii*-1, *D. oppositifolia*-1, *Curcuma raktakanta*-2, *C. amada*-2, *C. aeruginosa*-1 and *C. latifolia*-1) were maintained in *in vitro* conservation media. Five accessions, two of kokam and 3 of Malabar tamarind were maintained in initiation media and one of *D. bulbifera* was newly initiated in to *in vitro* culture. Thirty-six accessions of ginger, under *in vitro* conservation were hardened for field evaluation.

18.4 Germplasm Supply

Supply to user agencies: Based on material transfer agreement, 616 accessions comprising 8 crops and 4 wild related species were supplied to 10 user agencies, which included 500 accessions of rice to NBRI, Lucknow; 48 of bitter gourd to Anand Agricultural University, Anand; 20 of horse gram to Guru Nanak Dev University, Amritsar and 10 of rice to Centre for Advanced Studies in Botany, University of Madras, Chennai.

Transfer of germplasm to NAGS: A total of 63 accessions of under-utilised fruits comprising 25 accessions of jamun, 19 of rambutan, 7 of durian, 7 of mangosteen, 2 of *Syzygium caryophyllatum* and 1 each of pulasan, karonda and *Garcinia hombroniana* were collected under the ICAR Network Project on Under-Utilized Fruits and transferred to CHES (IIHR), Chethalli, Kodagu, Karnataka at the time of collaborative collection mission conducted with them. Similarly, 11 accessions of banana and one each of *Musa acuminata* and *M. laterita* were transferred to NRC for Banana, Tiruchirappalli, Tamil Nadu, at the time of collaborative collection mission conducted with them in Tamil Nadu.

Supply for multi-location evaluation: Supplied 100 accessions of okra in 7 sets to Indian Institute of

Vegetable Research, Varanasi under the All India Co-ordinated Research Project on Vegetable Crops and 100 accessions and 6 check varieties of horse gram to 3 institutions namely, University of Agricultural Sciences, GKVK, Bangalore, Karnataka; Dandiwada Agricultural University, Banaskantha, S.K. Nagar, Gujarat and Regional Agricultural Research Station, Kerala Agricultural University, Pattambi under the National Network Research Project on Arid Legumes for multi-location evaluation during 2007-08.

Supply for chemical evaluation at NBPGR, New Delhi: Supplied 67 accessions of *Madhuca longifolia*, 2 of *M. indica*, 5 of *Kaempferia galanga*, 4 of *K. rotunda* and 2 of *Stevia reboudiana* to Germplasm Evaluation Division, NBPGR for chemical analysis.

Germplasm transfer for maintenance/ characterization/ conservation: Transferred 97 accessions comprising 27 of field bean, 10 of physicnut, 29 of *Vigna dazzelliana*, 13 of *V. trilobata*, 10 of *V. vexillata*, 2 of *V. pilosa*, 3 of *Pongamia pinnata* and 1 each of *Canavalia cathartica*, *Mucuna monosperma* and *Sesbania sesban* to NBPGR Regional Station, Hyderabad and 6 accessions comprising 1 each of *Alangium salvifolium*, *Cordia obliqua*, *Melia azedarach*, *Phyllanthus emblica*, *Terminalia bellirica* and *T. chebula* to NBPGR Regional Station, Ranchi.

Germplasm receipt: Received 114 accessions comprising 20 of *Amaranthus caudatus* and 5 of *A. tricolour* from NBPGR Base Centre, Cuttack; 7 of bitter gourd, 6 of *Caesalpinia bonducella*, 3 of *Solanum nigrum*, 1 of *S. incanum*, 18 of *Trichosanthes cucumerina*, 3 of *T. lobata* and 1 of *Vigna radiata* var. *sublobata* from NBPGR Regional Station, Akola for maintenance, characterization and conservation; 82 accessions of tissue cultured material of ginger from TCCU, NBPGR, New Delhi for maintenance and conservation.

IC number allotment: One accession of *Exacum bicolor*, collected and maintained by KVK (KAU), Thrissur was got accessioned at NBPGR, New Delhi.

Feedback information based on past germplasm supply: College of Agriculture (KAU), Vellayani, Trivandrum had released a new variety of okra namely, “**Manjima**” based on hybridization between Gowreesapattom Localx **IC282257** in 2007 as

recommended by the State Seed Sub-committee on Crop Standards. This variety is high-yielding (1.34 kg/plant), compact, early maturing and YMV resistant.

18.5 Externally Funded Projects

Analysis of genetic diversity and phylogenetic relationship in *Solanum melongena* L. and related wild and weedy taxa (up to 31/03/2007) (DBT PROJECT): Sixteen accessions comprising 11 of typical *S. incanum* and 5 of typical *S. insanum* were characterized for 4 quantitative prickly characters of stem and leaf and 7 quantitative inflorescence and fruit characters. In typical *S. incanum*, fruit prickles are more in number, fruits are smaller and spherical with unripe fruit colour green and light green or green and white with netted distribution. Fruits of typical *S. insanum* are oval and larger than those of *S. incanum* and fruit colour is green and white with netted distribution. Style length is shorter in *S. incanum* but longer in *S. insanum*. Pedicel length is shorter in *S. incanum* and longer in *S. insanum*.

ICAR ad-hoc network project on tree borne oilseeds (up to 31/03/2008) (NETWORK PROJECT): Orthodox seed germplasm of 42 accessions of karanj and 40 of physicnut were sent for long-term storage. Recalcitrant seed germplasm of 52 of *Madhuca longifolia* (mahua), 18 of kokum, 4 of *Azadirachta indica* (neem) and 2 of *Madhuca indica* were sent for cryo-preservation. Supplied 165 accessions (*Azadirachta indica*-5, *Garcinia indica*-22, *Jatropha curcas*-41, *Madhuca longifolia*-52, *M. indica*-2, *Pongamia pinnata*-42 and *Salvadora persica*-1) to Forest College & Research Institute (TNAU), Mettupalayam, Tamil Nadu for characterization, utilization and conservation. Sixty-seven accessions of physic nut (*Jatropha curcas*) collected from north Gujarat under the ICAR Network Project on TBOs by Dr. Y. Ravindrababu, SD Agricultural University, Sardarkrushinagar, Gujarat were got accessioned with IC numbers.

Nine trees in 5 accessions of kokam (*Garcinia indica*) bore fruits this year. Five fruiting trees in four accessions were characterised for 13 quantitative yield characters – five of fruit and eight of seed. IC136682-2 was superior for fresh (1.2 g) and dry weight of single seed (0.6 g). Out of this, IC136687-3 and IC136685-1 continued to be high yielding with 58 and 42 kg and 4365 and 3414 fresh fruits/tree.

Collection, assembly and conservation of genetic resources of physicnut (*Jatropha L.*) (DBT Project): Ten accessions of physicnut (*Jatropha curcas*) were collected from Tamil Nadu and were sent

to National Genebank, NBPGR, New Delhi for long-term conservation and a duplicate set kept in medium-term storage (MTS) facility at Thrissur.

Research Projects (Project Code, Title, PI and CoPIs)

PGR/GEV-BUR-THR-01.00: Augmentation, characterization, Evaluation, Maintenance, Regeneration, Conservation, Documentation and Distribution of Plant Genetic Resources in Southern India including Goa and Andaman & Nicobar Islands Program Leader - Z. Abraham

PGR/GEV-BUR-THR-01.01: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of field crops and their wild relatives (K.I. Asha; Z. Abraham, M. Latha; S. Mani)

PGR/GEV-BUR-THR-01.02: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of tuber and fruit crops and their wild relatives (K.C. Velayudhan; K. Joseph John, K.I. Asha; R. Asokan Nair)

PGR/GEV-BUR-THR-01.03: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of spices, their wild relatives and medicinal & aromatic plants (M. Latha; Z. Abraham, K.C. Velayudhan, K. Joseph John; S. Mani)

PGR/GEV-BUR-THR-01.04: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of genetic resources of tropical vegetables and their wild relatives (K. Joseph John; M. Latha; R. Asokan Nair)

PGR/GEV-BUR-THR-02.00: Use of in vitro technology for mass propagation and conservation of clonally / vegetatively propagated crops and their wild relatives (Z. Abraham; K.I. Asha; A. Indira Devi)

Externally funded projects

- DBT Funded: Analysis of Genetic Diversity and Phylogenetic Relationship in *Solanum melongena* L. and related wild and weedy taxa (Z. Abraham) - up to 31/03/2007
- ICAR Funded: Network Project on 'Tree Borne Oilseeds' (Z. Abraham)
- DBT Funded: Collection, Assembly and Conservation of Genetic Resources of physicnut (*Jatropha L.*) (Z. Abraham)

19. GENERAL INFORMATION

19.1 Institute Management Committee

- Dr. S.K.Sharma, Director, NBPGR, New Delhi
Chairman
- Assistant Director General (Seed), ICAR, New Delhi –110 001
Member
- Sh. Surender Singh, C-33/84, Madhopur, Behind MCD Office, Varanasi (U.P.)
Member
- Dr. Sushama Chaphalkar, Director, School for Biotechnology, Vidya Nagiri, Baramati Dist: Pune Maharashtra
Member
- Development Commissioner (Rural), Delhi Government, Delhi
Member
- Director (Agri.) Government of Rajasthan, Jaipur
Member
- Dr. R.K. Khetarpal, Head, Plant Quarantine Division, NBPGR, New Delhi
Member
- Dr. S.S.Malik, Principal Scientist, NRC-on-DNA-FP, NBPGR, New Delhi
Member
- Dr. K.S.Varaprasad, Officer in Charge, NBPGR, Regional Station, Hyderabad
Member
- Dr. K.V.Prabhu, Head, Division of Genetics, IARI, New Delhi.
Member
- Sh. K.K. Hamza, Finance & Accounts Officer, IASRI, New Delhi
Member
- Ms. Sunita Sharma, Sr. Administrative Officer, NBPGR, New Delhi
Member Secretary

IMC meeting was held on 15 September 2007.

19.2 Research Advisory Committee

The IX meeting of Research Advisory Committee (RAC) was held under the Chairmanship of Dr. S S Baghel on 6-7 June 2007. The constitution of the RAC was as follows:

- Dr. S.S. Baghel, Vice Chancellor, Assam Agricultural University, Jorhat-785013, Assam
Chairman
- Dr. K.N. Ganeshiah, Professor, Dept. of Genetics and Plant Breeding University of

Agricultural Sciences, GKVK, Bangalore-560065, Karnataka

Member

- Dr. P. Pushpangadan, Rajiv Gandhi Centre for Biotechnology, Trivandrum- 695014, Kerala
Member
- Dr. N. Anishetty Murthy, Retd. Sr Officer (FAO), 888, Siddartha Nagar, Plot 91, PO-Vengalrao Nagar, Hyderabad- 500038, A.P.
Member
- Dr. A. Seetharam, Former Project Co-ordinator, AIC Small Millets Improvement Project, UAS, GKVK Campus, Bangalore- 560065, Karnataka
Member
- Dr. N.D. Jambhale, ADG (Seeds), ICAR, Krishi Bhawan, New Delhi- 110001
Member
- Dr. S.K. Sharma, Director, NBPGR, New Delhi-110012
Ex-Officio Member
- Dr. R.K. Khetarpal, Head, Plant Quarantine Division, NBPGR, New Delhi- 110011
Member Secretary

19.3 Institute Research Council

Chairman- Director, NBPGR

Member Secretary- Dr. R.K. Tyagi

The first Institute Research Council (IRC) meeting was held from 21-23 May 2007 in which the progress made from April 2006 to March 2007 under the various projects was reviewed. The progress was presented by the PIs of the respective projects. One new project was approved: "Bioinformatics software portal" with PI: Ms. Madhubala; Dr. R.C. Agarwal and Dr. Mukesh K. Rana as CoPIs. Some modifications were also approved by the Chairman, IRC and the Director, NBPGR, regarding the involvement of scientists in projects as PI and Co-PI, according to the magnitude of the work, availability (time) and expertise of the scientists working in the projects. Dr. Pratibha Brahmi was nominated as the Member Secretary of IRC for the next two years.

Chairman- Director, NBPGR

Member Secretary- Dr. Pratibha Brahmi

The Second IRC of 2007 was conducted at divisional level as decided by the Chairman, IRC on December 10 – 13, 2007 (for Divisions, NBPGR, New Delhi) and December 17 – 18, 2007 (for Regional Stations of NBPGR). The progress reports of divisions and regional stations, from April 1, 2007 to November 30, 2007 were presented by respective Heads of the Divisions and Stations Incharges. All the scientists of the respective divisions were present during the presentation of the progress of their divisions. Regional stations were represented by respective Officer-in-Charge and some scientists from the Stations.

19.4 Institute Joint Staff Council

Staff Side

Technical: Sh. Dinesh Chandra Mishra (also Secretary Staff Side), Sh Lal Singh: Member, CJSC

Administrative: Sh.Ganga Nand, Sh. Yogesh Kumar Gupta

a. Scientific Staff

Supporting: Sh. Mahesh Ram, Sh. Sanjeev Paswan, SS

Office Side

1. Dr. (Mrs.) Veena Gupta, Sr. Scientist : Secretary (Office Side)
2. Ms. Sunita Sharma, Sr.Admn. Officer : Member
3. Dr. S.K.Malik, Scientist: Member
4. Dr. Arjun Lal, Principal Scientist: Member
5. Mrs Sanjeevan Prakash, F&AO: Member

The IJSC meeting was held on 26 December 2007.

19.5 Personnel

Name	Designation	Discipline
Dr. S.K. Sharma	Director	Genetics & Plant Breeding
Division of Plant Exploration and Germplasm Collection		
1 Dr. (Ms.) E. Roshini Nair	Head & Principal Scientist	Economic Botany
2 Dr. (Ms.) Anjula Pandey	Senior Scientist	Economic Botany
3 Dr. Rakesh Srivastava	Senior Scientist	Horticulture
4 Dr. K.C. Bhatt	Senior Scientist	Economic Botany
Division of Germplasm Evaluation		
1 Dr. S.K. Mishra	Head	Genetics & Plant Breeding
2 Dr. R.K. Mahajan	Principal Scientist	Agricultural Statistics
3 Dr. S.K. 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. R.P. Dua	Principal Scientist	Plant Breeding
8 Dr. I.S. Bisht	Senior Scientist	Plant Pathology
9 Dr. Ashok Kumar	Senior Scientist	Plant Breeding
10 Dr. R.C. Agrawal	Senior Scientist	Agricultural Statistics
11 Dr. Vandana Joshi	Senior Scientist	Economic Botany
12 Dr. Ambrish Sharma	Senior Scientist	Plant Breeding
13 Dr. K.K. Gangopadhyay	Senior Scientist	Horticulture
14 Mr .N.K. Gautam	Scientist (Selection Grade)	Economic Botany
15 Mr. Gunjeet Kumar	Scientist	Horticulture
16 Mrs. Sangeeta Yadav	Scientist	Biochemistry
17 Dr. (Ms.) Archana Raina	Senior Scientist	Plant Biochemistry

18	Dr. Satish Kumar Yadav	Scientist	Horticulture
Division of Germplasm Conservation			
1.	Dr. A.K. Singh	Head	Plant Breeding
2.	Dr. Sidheshwar Prasad	Senior Scientist	Electrical Engineering
3.	Dr. (Ms.) Neeta Singh	Senior Scientist	Plant Physiology
4.	Dr. Sanjeev Saxena	Senior Scientist	Plant Physiology
5.	Dr. (Ms.) Kalyani Srinivasan	Senior Scientist	Plant Physiology
6.	Dr. (Ms.) Veena Gupta	Senior Scientist	Economic Botany
7.	Dr. (Ms.) J. Radhamani	Senior Scientist	Plant Physiology
8.	Ms Anjali Kak	Scientist (Sr. Scale)	Economic Botany
9.	Dr. (Ms.) Chitra Devi Pandey	Scientist	Seed Technology
Division of Plant Quarantine			
1.	Dr. R.K. Khetarpal	Head & Principal Scientist	Plant Pathology
2.	Dr. Arjun Lal	Principal Scientist	Nematology
3.	Dr. P.C. 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. D.B. 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. I.P. Singh (upto 31-07-2007)	Head & Principal Scientist	Plant Breeding
2.	Dr. Arjun Lal (from 1.8.07)	Head & Principal Scientist	Nematology
3.	Mr. Deep Chand	Scientist (Selection Scale)	Economic Botany
4.	Dr. Vandana Tyagi	Scientist (Sr. Scale)	Economic Botany
5.	Ms Nidhi Verma	Scientist (Senior Scale)	Economic Botany
6.	Dr. S.K. Yadav (from 30.11.07)	Scientist	Economic Botany
Tissue Culture & Cryopreservation Unit			
1.	Dr. B.B. 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. S.K. Malik	Senior Scientist	Economic Botany
9.	Dr. Zakir Hussain	Scientist	Genetics
Policy Planning			
1.	Dr. (Ms.) Pratibha Brahma	Senior Scientist	Economic Botany
Under Utilized & Under Exploited Plants Project			
1.	Dr. B.S. Phogat	Senior Scientist	Agronomy

2.	Dr. Hanuman Lal Raigar	Scientist	Agricultural Statistics
National Research Center on DNA Fingerprinting			
1.	Dr. S.S. Malik	Principal Scientist	Economic Botany
2.	Dr. (Ms.) Gurinderjit Randhawa	Senior Scientist	Plant Physiology
3.	Dr. K.V. Bhat	Senior Scientist	Plant Breeding
4.	Dr. Mukesh Kumar Rana	Scientist (Senior Scale)	Plant Breeding
5.	Mr. Sunil Archak	Scientist(Senior Scale)	Biotechnology
6.	Ms. Lalit Arya	Scientist (Senior Scale)	Biochemistry
7.	Dr. Ambika Baldev	Scientist (Senior Scale)	Biotechnology
8.	Dr. Rakesh Singh	Scientist (Senior Scale)	Biotechnology
9.	Ms. Madhu Bala	Scientist	Computer Applications
10.	Ms. Manjusha Verma	Scientist	Biotechnology
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. K.C. Muneem	Principal Scientist	Plant Pathology
2.	Dr. K.S. Negi	Senior Scientist & In-charge	Economic Botany
3.	Dr. S.K. Verma	Senior Scientist	Horticulture
Base Center, Cuttack			
1.	Mr. Diptiranjana Pani	Scientist & In-Charge	Economic Botany
Regional Station, Hyderabad			
1.	Dr. K.S. Varaprasad	Principal Scientist & In-charge	Nematology
2.	Dr. R.D.V.J. Prasada Rao	Principal Scientist	Plant Pathology
3.	Dr. S.K. Chakraborty	Senior Scientist	Plant Pathology
4.	Dr. B. Sarath Babu	Senior Scientist	Agricultural Entomology
5.	Dr. S.R. 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, 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.	D. J.B. Tomar	Principal Scientist & In-charge	Economic Botany
2.	Dr. V.K. Gupta	Senior Scientist	Plant Breeding
Regional Station, Shillong			
1.	Dr. D.K. Hore	Principal Scientist & In-charge	Economic Botany
2.	Dr. W.L. Barwad (upto 12.01.07)	Senior Scientist	Agricultural Entomology

Regional Station, Shimla			
1.	Dr. V.D. Verma	Principal Scientist & In-charge	Economic Botany
2.	Dr. J.C. Rana	Senior Scientist	Plant Breeding
3.	Dr. K. Pradheep	Scientist	Economic Botany
Regional Station, Thrissur			
1.	Dr. Z. Abraham	Principal Scientist & In-charge	Economic Botany
2.	Dr. K.C. Velayudhan	Principal Scientist	Economic Botany
3.	Dr. Joseph John K.	Scientist (Selection Grade)	Economic Botany
4.	Dr. (Ms) Asha KI	Scientist (Senior Scale)	Economic Botany
5.	Dr. (Ms.) M. Latha	Scientist (Senior Scale)	Plant Breeding
Regional Station, Srinagar (J & K)			
1.	Dr. Om Vir Singh	Principal Scientist & In-charge	Plant Breeding

b. Technical Staff (T-5 and above)

NAME	DESIGNATION
NBPGR Headquarters' at NEW DELHI	
Sh. B.P. Dahiya	T-7-8 (Elect. Engineer)
Sh. Om Prakash	T-7-8 (Tech. Officer)
Sh. Jitender Mohan	T-7-8 (Tech. Officer)
Sh. Abhay Sharma	T-5 (Tech. Officer)
Smt. Rita Rani	T-6 (Tech. Officer)
Sh. Charan Singh	T-7-8 (Tech. Officer)
Sh. Rajiv Mathur	T-5 (Tech. Officer)
Sh. C.S. Raghav	T-6 (Tech. Officer)
Dr.(Mrs.) Manju Upreti	T-7-8 (Tech. Officer)
Dr. Ranbir Singh Rathi	T-7-8 (Tech. Officer)
Miss Sheela Kumari	T-7-8 (Tech. Officer)
Sh. Anil Kumar Singh	T-7-8 (Tech. Officer)
Sh. Ram Prasad Yadav	T-6 (Tech. Officer)
Sh. Rakesh Singh	T-5 (Tech. Officer)
Sh. Mahabir Singh Rathore	T-6 (Tech. Officer)
Miss Poonam Suneja	T-6 (Tech. Officer)
Sh. Harinder Singh	T-6 (Tech. Officer)
Sh. Ram Singh	T-5 (Tech. Officer)
Sh. K.D. Joshi	T-6 (Tech. Officer)
Sh. Daya Shankar	T-6 (Tech. Officer)
Sh. Rajiv Gambhir	T-6 (Tech. Officer)
Sh. Ashok Kumar Maurya	T-6 (Tech. Officer)
Sh. Surender Singh Ranga	T-6 (Tech. Officer)
Sh. Axma Dutt Sharma	T-6 (Tech. Officer)

NAME	DESIGNATION
Sh. Bharat Lal Meena	T-6 (Tech. Officer)
Sh. P.S. Mehta	T-6 (Tech. Officer)
Sh. Rita Gupta	T-5 (Tech. Officer)
Sh. Babu Ram	T-5 (Tech. Officer)
Ms. Sangeeta Tanwar	T-5 (Tech. Officer)
Sh. Narendra Singh Panwar	T-5 (Tech. Officer)
Sh. R.S. Yadav	T-5 (Tech. Officer)
Sh. Devendra Kumar Nerwal	T-5 (Tech. Officer)
Sh. Bhopal Singh Panwar	T-5 (Tech. Officer)
Sh. Y.S. Rathi	T-5 (Tech. Officer)
Sh. Kishan Nath	T-5, (Tech. Officer)
Sh. J.K. Ingle	T-6 (Tech. Officer)
Sh. V.K. Pant	T-5 (Tech. Officer)
Sh. A.S. Rana	T-5 (Tech. Officer)
Sh. Rattan Ram Arya	T-5(Tech. Officer)
Sh. Babu Abraham	T-5 (Tech. Officer)
Sh. R. Gunasekharan	T-5 (Tech. Officer)
Sh. B.C. Bachhawandia	T-6 (Tech. Officer)
Sh. Kheta Ram	T-5 (Tech. Officer)
Sh. Ashok Kumar Gupta	T-5 (Tech. Officer)
Sh. Brij Pal Singh	T-6 (Tech. Officer)
Sh. R. Ashokan Nair	T-6 (Tech. Officer)
Sh. S. Mani	T-5 (Tech. Officer)
Sh. Rajvir Singh	T-6 (Tech. officer)

c. Administrative Staff (Stenographers and above)

NAME	DESIGNATION
Ms. Sunita Sharma	Sr.Admn. Officer
Smt. Sanjeevan Praksh	F&AO.
Sh. Mohar Singh	Asstt. Admn. Officer
Sh. Parmod Chander, Shimla	Asstt. Admn. Officer
Sh. Mahender Kumar	Jr. Accounts Officer
Mrs. Archana Raghav	A.D. (OL)
Sh. Umesh Chamdra Sati	Security Officer
Sh. Subhash Chander	Assistant
Sh. Madan Lal Malik	Assistant
Sh.i Kulwant Singh	Assistant
Sh.Geetam Kumar	Assistant
Mrs. Vijay Laxmi Gulati	Assistant
Sh. Din Dayal	Assistant
Mrs. Vinay Bala Sharma	Assistant
Mrs Kuljeet Kaur	Assistant
Mrs. Pratibha, Shimla	Assistant
Mrs. Soni Laloo, Shillong	Assistant

NAME	DESIGNATION
Sh. P.U. Anjankar, Ranchi	Assistant
Sh. Nandan Singh Patwal, Bhowali	Assistant
Sh. P. Venugopalan	Assistant
Sh. Girish Chandra	Assistant
Sh. S.S.Wange	Assistant
Shri Dinesh Prasad	Assistant
Sh. Subhash Chander	Assistant
Mrs. R.S. Latha Devdas	Stenographer
Mrs. V. Vijayalaxmi	Stenographer
Sh. Ganga Nand	Stenographer
Mrs. Kanchan Khurana	Stenographer
Mrs. Urmila	Stenographer
Mrs. Poonam Batra	Stenographer
Mrs. Neelam Khatri	Stenographer
Mrs. Graciously Dkhar – Shillong	Stenographer
Sh. T.V. Govindan – Thrissur	Stenographer

19.6 Staff Reservations

Category	Total number of Employees	Total number of Scheduled Caste (SC) Employees	Total number of Scheduled Tribe (ST) Employees	Total number of OBC Employees
Scientist	104	10	1	12
Technical	117	3	-	14
Administrative	59	4	1	14
Supporting	118	10	5	6

19.7 Staff Transferred/ Retired

Transfers

- Dr. Ambrish Kr. Sharma Sr. Scientist transferred to IARI, New Delhi w.e.f 13 July 2007
- Dr. Sanjeev Saxena, Principal Scientist, transferred to ICAR, KB, New Delhi w.e.f 4 December 2007

Retirements

- Dr. IP Singh, Head, Germplasm Exchange Unit retired on 31 October 2007
- Smt. Champa Mehra, SSGR-III RS Bhowali retired on 31 August 2007
- Sh. V.K. Pant, Tech. Officer (T-5) RS Bhowali retired on 31 July 2007
- Sh. Bhawani Dutt, SSGR-IV RS Bhowali retired on 31 October 2007
- Sh. Mohan Singh, SSGR-IV RS Bhowali retired on 31 October 2007

19.8 Promotions

i) Promotion to Principal Scientist

Twenty one Senior Scientists were promoted to Principal Scientist (PS) in the following disciplines:

Name	Discipline	Date of Promotion
Rajan	Nematology	19.11.05
Rekha Chaudhury	Economic Botany	29.12.05
Sanjeev Saxena	Plant Physiology	23.01.06
K. Anitha	Pathology	31.01.06
Baleshwar Singh	Pathology	24.06.06
R.C. Agrawal	Agricultural Statistics	27.07.06
R.K. Tyagi	Economic Botany	..
Ruchira Pandey	.. ..	..
Neelam Sharma	.. ..	..
Veena Gupta	.. ..	..
Kuldeep Singh Negi	.. ..	..
Shashi Bhalla	Entomology	..
S.K.Verma	Horticulture	..
Ashok Kumar	Plant Breeding	..
K.V. Bhat	.. ..	..
I.S. Bisht	Plant Pathology	..
D.B. Parekh	.. ..	..
S.K Chakrabarty	.. ..	..
Gurinder Randhawa	Plant Physiology	..
Kalyani Srinivasan	.. ..	..
B. Sarath Babu	Entomology	08.09.06

ii) The following scientists were promoted from Scientist (Senior Scale) to Senior Scientist:

Name	Discipline	Date of Promotion
Kavita Gupta	Agricultural Entomology	23.01.05
Asha K.I	Economic Botany	12.05.05
Joseph John K.	Economic Botany	13.05.05
Vandana Tyagi	Economic Botany	23.01.06
S.K. Malik	Economic Botany	26.11.06
Mukesh Rana	Plant Breeding	12.12.06

iii) The following scientists were promoted from Scientist (Senior Scale) to Scientist (Selection Grade)

Name	Discipline	Date of Promotion
Abdul Nizar	Economic Botany	02.06.04
Anjali Kak	Economic Botany	20.07.04
M. Latha	Plant Breeding	13.02.06
Nidhi Verma	Economic Botany	09.07.06

iv) The following scientists were promoted from Scientist to Scientist (Senior Scale):

Name	Discipline	Date of Promotion
Mr Hanuman Lal Raiger	Agricultural Statistics	02.02.02
Mr Dipti Ranjan Pani	Economic Botany	06.01.03
Dr. Chitra Pandey	Seed Technology	27.10.04
Dr. Manjusha Verma	Biochemistry	16.04.07

v) Administrative Staff

Name	Promoted as	Date of Promotion
Parmod Chander	AAO	26.06.07
Avdesh	Sr. Clerk	17.12.07
Sanjay Dagawal	Sr. Clerk	17.12.07

vi) Supporting Staff

Name	Promoted as	Date of Promotion
Hari Ram,	SS Grade-III	25.05.07
T.K. Mani, K. Premakumaran,	SS Grade II	13.09.06
M.K. Prakashan, T.K. Vasu,		
Smt. V.K. Rugmani,		
V.C. Bhavani, M.K. Gulathu,		
V.S. Bhargavi (RS Thirussur)		
Rohit (RS Shimla)	SS Grade II	12.01.07
Shukhdev (RS Shimla)	SS Grade II	13.01.07
Dilip Singh (RS Shimla)	SS Grade II	17.01.07
Inder Singh (RS Shimla)	SS Grade II	31.01.07

19.9 Awards/Honours

- Best Poster Award for the paper entitled, "Identification of sources of resistance to fungal biotic stresses in paprika chilli germplasm" by SR Pandravada, K Anitha, SK Chakrabarty and K Janardhan Reddy during the National Conference on "Organic waste utilization and Ecofriendly technologies for crop protection" held at Hyderabad during 15-17 March, 2007.
- KS Varaprasad, designated as HONORARY PATRON of the Plant Protection Association of India by the Executive Council for the period 2007-2009 in recognition to his contributions to the Society.

19.10 Deputation/ Visits Abroad

Name/Designation	Purpose of visit	Place and dates
Gurinder Jit Randhawa Sr. Scientist	Visited Canadian Food Inspection Agency, Environment Canada, Canadian Seed Growers' Association, Secretariat, Convention on Biological Diversity, Michigan State University, US Department of Agriculture, World Bank, GEF Secretariat and Cornell University on a study tour	Canada and USA, 29 January - 10 February 2007
S.K. Sharma, Director	Global conservation strategy meeting for chickpea, lentil, grasspea and faba bean, ICARDA, Aleppo	Syria, 17-23 February 2007
S.K. Sharma, Director	International Symposium on Agriculture	Faisalabad, Pakistan 8-13 March 2007
S.K. Sharma, Director	Final meeting of Focal Points of project on 'Establishment of National Information Sharing Mechanism for Global Plan of Action (GCP/RAS/186/JPN)	Bangkok, Thailand, 14-16 March 2007
Gurinder Jit Randhawa Sr. Scientist	ISTA GMO Workshop: Methods for detection and statistical aspects at Ege University, Faculty of Agriculture, Izmir Turkey	Turkey, 27-30 March, 2007,
Gurinder Jit Randhawa Sr. Scientist	International meeting of Academic Institutions and Organizations involved in Biosafety education and training	Kuala Lumpur, Malaysia, 16- 18 April, 2007

R.K. Khetarpal Head, PQ Division	Member of Indian delegation to US to discuss wheat import and other plant health related issues in agricultural trade with USDA	Washington DC, May 15- 22, 2007
N. Sivaraj Scientist	Training on "Contemporary and Participatory approaches in Plant Genetic Resources Conservation and Use"	21 May 2007- 15 June 2007, Wageningen, Netherlands
R.K. Khetarpal Head, PQ Division	Under Indo-US Agriculture Knowledge Initiative to attend the SPS Seminar	Washington DC, USA, June 11- 15, 2007
S.K. Sharma, Director	Training programme on 'LMO Detection and Risk Assessment' under the GEF-World Bank Capacity Building on Biosafety	University of Tsukuba, Japan, 17-22 June 2007,
S.K. Sharma, Director	Symposium on "The Present Status of Management of Plant Research Korean Plant Genetic Resources Gene Bank	Korea, 5- 8 Sept 2007 Korea, 9-10 Sept 2007
S.K. Sharma, Director	Workshop on Performance Indicators in the Genebanks	Netherlands, 16- 19 October 2007
S.K. Sharma, Director	Global Conservation Strategy Meeting for Rice, IRRI	Los Banos, Phillipines, 4- 6 December 2007

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, 518 books related to various aspects of PGR management and Hindi literatures were added to Headquarter and Regional Station libraries through purchase and exchange basis. Library procured 64 journals including 31 foreign and 34 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 PLANT GENE database. Bureau's publications were provided to over 275 different organizations in India and abroad and in return 250 publications as gratis from various organizations. NBPGR Annual Report, Newsletters, Crop Catalogues, Brochures and other publications were distributed to various trainees and visitors from India and abroad.

19.12 Field Days Organized

Germplasm Field Days Organized at NBPGR, HQ:

To promote germplasm utilization four Germplasm Field Days were organized for different crops. These were Rabi pulse crops (26 March 2007), Wheat, Barley and

Triticale (28 March 2007), Maize and Pearl millet (25 September 2007), Kharif pulses, Vegetables, Medicinal and Aromatic plants (5 October 2007). A large number of participants from different parts of country belonging to ICAR institutes, State Agricultural Universities, Govt. Departments, NGOs and private organizations participated in the Germplasm Field Days. The scientists/research workers selected the material of their choice.

Germplasm Field Day at RS Hyderabad:

A germplasm field day on greengram was conducted on 29 August 2007 for the benefit of local breeders working on greengram crop improvement programmes. One hundred and twenty seven germplasm lines were displayed in the field. Five breeders from research institutes located in Andhra Pradesh participated in the programme. The scientists went around the field and selected about 25 accessions of germplasm of their interest. A small millets field day was organized on 30 October 07. Six scientists from different research



Participants at the greengram germplasm field day organized at Hyderabad

stations of Acharya. N.G.Ranga Agricultural University participated and 40 accessions were selected for various traits. A sesame field day was organized on 4 & 5 September 2007. Six scientists from different research stations of Acharya NG Ranga Agricultural University participated and 25 accessions were selected for various traits including those with multiple capsules at a node and multi-locular capsules.



Participants at the sesame germplasm field day organized at Hyderabad

Germplasm Field Day at RS Jodhpur: A crop germplasm field day was organized at the experimental field of the regional station, Jodhpur on October 6, 2007, in which 5,379 germplasm accessions of different *Kharif* crops in which scientists from various ICAR, SAUs, research scholars from Jai Narain University, Jodhpur and farmers participated and discussed various issues of PGR conservation and utilization.



S.K. Sharma, Director, NBPGR addressing the participants of the germplasm field day at Jodhpur



Panelists and participants of Brainstorming Session on "GM Chip Technology: Development and Applications"



Participants of the National Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops



Participating School Teachers of the Training on "DNA fingerprinting and plant biodiversity conservation"



Participants of the One day Workshop on "Finding out suitable sites for on-farm conservation of small millets and pseudocereals in Himachal Pradesh"

19.13 Workshops/ Group Meetings/ Trainings Organized by NBPGR during 2007

#	Title of the Programme	Duration	Venue
1.	Brainstorming Session on "GM Chip Technology: Development and Applications"	12 September 2007	NBPGR, New Delhi
2.	A one day workshop on "Finding out suitable sites for on-farm conservation of small millets and pseudocereals in Himachal Pradesh"	14 November 2007	NBPGR Regional Station, Shimla
3.	A two-day training programme on "DNA fingerprinting and plant biodiversity conservation"	16- 17 November 2007	NBPGR, New Delhi
4.	International training on 'In Vitro and Cryopreservation Techniques for Conservation of Plant Genetic Resources'	15- 29 November 2007	NBPGR, New Delhi
5.	National Orientation Course on Biosafety Considerations for Evaluation of Transgenic Crops	27 November – 4 December 2007	NBPGR, New Delhi

19.14 Participation of Staff in Seminars/ Symposia/ Conferences/ Workshops/ Training programmes

Name of Employee	Title of Seminar/ Symposium/ Conference/ Workshop/ Training programmes	Place and period
N. Sivaraj and M. Srinivasa Rao	Workshop on "Self Renewal"	NAARM, Hyderabad, 3 January 2007
K.C. Muneem and K.S. Negi	Workshop on Identification, Conservation and Traditional Uses of Medicinal Plants	VPKAS, Almora, 17 January, 2007
R.K. Tyagi	India-US Agricultural Knowledge Initiative Joint Workshop on Curriculum Development by DARE/ICAR-GBPUA&T	NASC, New Delhi on 22-23 January 2007
K.S. Varaprasad, RDVJ Prasada Rao, S.K. Chakrabarty, N. Sivaraj and N. Sunil	National Seminar on "Changing Global Vegetable Oil Scenario: Issues and Challenges before India"	Directorate of Oilseeds Research, Hyderabad, 29 -31 January 2007
P. Brahmi	NRDC seminar on Emerging Scenario of Intellectual Property Rights Protection	Patna University (Hotel Patli Putra Ashok) 1 February 2007
Zakir Hussain	Training course on "Advances in Data Analytical Techniques" for 21 days	IASRI, New Delhi, 8-28 February 2007
Kamala Venkateshwaran	Training programme on "Project Formulation and Implementation"	Administrative Staff College of India, Hyderabad 19 February- 2 March 2007
Anuradha Agrawal and R.K. Tyagi	Symposium on 'Launching of the Plant Variety Registration under the PPV&FR Act, 2001	PPVFR Authority, NASC Complex, New Delhi, 20 February 2007
Z. Abraham	National Seminar on "Patenting in Biotechnology"	NRDC, Thiruvananthapuram, 26 February 2007
N. Sivaraj	Training programme "GIS Based Decision Support Systems in Agriculture"	NAARM, Rajendranagar, Hyderabad, 1- 21 March 2007
P. Brahmi	National Seminar on Patenting in Biotechnology	Taj Residency, Ahmedabad (NRDC), 8 March, 2007
J.B.Tomar and V.K. Gupta	Seminar on "Conservation of Medicinal plants of Jharkhand on Inter sectoral coordination in promotion of Medicinal plants"	Torang Trust, NBPGR Ranchi, 10 March 2007

R.K. Khetarpal, K.S. Varaprasad, S.K. Chakrabarty, K. Anitha, B. Sarath Babu, S. R. Pandravada, N. Sivaraj, Kamala Venkateswaran, N. Sunil and Babu Abraham	National Conference on Organic Waste Utilization and Eco-friendly Technologies for Crop Production organised by Indian Society of Plant Protection,	NBPGR, RS Hyderabad, 15- 17 March 2007
Veena Gupta	National symposium on Management of Medicinal and Aromatic Plants in Farming Systems Perspective	CSAUAT, Kanpur, 20 -22 March 2007
K.C. Muneem	National Symposium on Bio diversity and Conservation of Cold Water Fisheries	NRC for Cold Water Fisheries (ICAR) at Bhimtal, 6 April 2007
M. Abdul Nizar	Annual Workshop of Sesame and Niger	UAS, Dharwad, 13-14 April 2007
Vandana Joshi	Annual Working Group Meeting of Forage Crops	Birsa Agricultural University, Kanke, Ranchi, 13- 15 April 2007
P. Suleman	Workshop on "Hindi Engineering Technical Terminology"	NPPTI, Hyderabad, 25- 26 April 2007
M. Latha	One day workshop on "Share your experiences on seed production, marketing, trading, intellectual property rights and its implementation"	Sugarcane Breeding Institute, Coimbatore, 28 April 2007
K.S. Negi	Annual Workshop / Group Meeting of All India Coordinated Small Millets Improvement Project	College of Agriculture, GBPUA&T, Pantnagar, U.S. Nagar, Uttarakhand, 28-30 April, 2007
S.K. Verma	Workshop on HTM MM-I	VPKAS, Almora, 3- 5 May, 2007
Neelam Sharma	National Conference on "Business Opportunities in Production & Processing of Medicinal & Aromatic Plants	PHD House, New Delhi, 7 May 2007
Gopala Krishnan S.	XXIII Annual Workshop on Arid Legumes	MAU, Parbhani 18- 19 May 2007
S.K. Mishra and Ranbir Singh	Germplasm Advisory Committee on Oilseed crops	NBPGR, New Delhi, 4 June 2007
R.C. Agrawal	Task Force of Webmasters of ICAR	NAIP on 29 June 2007
P. Brahmi	Regional Seminar on Patenting in Biotechnology	Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, 17 July 2007
S.K. Chakrabarty	Training programme on "Pest risk analysis"	ANGRAU under Indo-US Knowledge Initiative Programme, 23 July - 2 August 2007
Neelam Sharma	Group Meeting of stake holders as preparatory to National Workshop on Production and Standardization of Quality Seed/ Planting Material of Medicinal Plants	NBPGR, New Delhi, 25 July 2007
K.C. Muneem and KS Negi	International Seminar on Conventional and Bio-technological Approaches for Sustainable Development in Sub - Himalayan Region (CBASD-2007)	IVRI Research Station Mukteshwar, Nainital, 28-29 July 2007
Ranbir Singh	Annual Research Workers' Group Meeting on Rapeseed mustard	SKAUS&T, Jammu (J&K) 2-4 August 2007
R.C. Agrawal	E-learning	NAARM Hyderabad, 20- 25 August 2007
E.R. Nayar	Short-term Certificate Course in Plant Variety Protection and Related issues (as resource person)	Division of Seed Science and Technology, IARI, New Delhi, 24 August 2007
N. Sunil	Two-day workshop on publishing skills for scientists	Cactus communications at CCMB, Hyderabad, 30 -31 August, 2007

Vandana Joshi	National Group Meet of Forage Crops (<i>Rabi-2007</i>)	Directorate of Research Bidhan Chandra Krish Vishwavidyalaya, Kalyani, W. Bengal, 8-9 September 2007
S. Sardana, J.B. Tomar, N.K. Gautam and V.K. Gupta	Rabi Annual Group Meet on Chickpea and MULLaRP crops	BAU, Kanke, Ranchi, 8-10 September 2007
D.K. Hore	National Symposia entitled 'A new vista to Forage Crop Research'.	BCKV, Kalyani, West Bengal, 10-11 September 2007
DR. Pani	Winter School on "Molecular Breeding Approaches in Rice"	CRRRI, Cuttack from 10-30 September 2007
Sandhya Gupta	International Conference on Agricultural Biotechnology: AgriBio 2007 organised by DBT, FICCI and ICAR	FICCI, New Delhi, 17-18 September 2007
D.K. Hore	National Seminar on 'Biodiversity: Herbal Medicine'.	Synod College, Shillong, Meghalaya, 20-21 September 2007
K. Joseph John and K.I. Asha	One-day Hindi Workshop organized by the Town Official Language Implementation Committee (TOLIC)	MSME-Development Institute, Thrissur, 26 September 2007
Arjun Lal	National conference on Seeds	Hyderabad from 2-6 October 2007
R.K. Khetarpal, R.D.V.J. Prasada Rao and Dinesh Chand	10th International Plant Virus Epidemiology Symposium: Controlling Epidemics of Emerging and Established Plant Virus Diseases- The Way Forward	ICRISAT, Patancheru, India, 15-19 October 2007
J.C. Rana	Conference on Leveraging Innovations and Inventions organised by NRDC	India Habitat Centre, New Delhi, 16 October 2007
Anuradha Agrawal and R.K. Tyagi	National Conference on Banana -Production and Utilization of Banana for Economic Livelihood and Nutritional Security	AIPUB and NRC on Banana at Tiruchirapalli, 25-28 October 2007
N.K. Dwivedi	7th joint conference of ISMOCD and IAE entitled "India poised: Investment in public health for health security and quality of life."	DMRC, Jodhpur 27 - 29 October 2007
Veena Gupta, Anjali Kak, Chitra Pandey, Neeta Singh	One day National Seminar on " Intellectual Property Rights: Perspectives of the Developing Nations	Govt. Post Graduate College, Noida (UP), 28 October 2007
J.C. Rana and K. Pradheep	Environmental and livelihood security through resource management in Northern India.	CSWCTRI, Regional Station, Chandigarh 29-31 October 2007
N.K. Dwivedi	Meeting on establishment of IP based video conferencing and IP telephony in ICAR system	CAZRI, Jodhpur 30 October 2007
R.K. Khetarpal and Kavita Gupta	National Symposium on Innovative Approaches for Disease management in Arid Crops for Enhancing Export Potentials	Agricultural Research Station, Jodhpur. 2-3 November 2007
Saroj Sardana	National Symposium on Pulse Crops	IIPR Kanpur, 3 - 5 November 2007
D.R. Pani	Seminar on "Road map for Agricultural development in Orissa"	OUAT, Bhubaneswar, 6-7 November 2007
Arjun Lal, R.C. Agrawal and Nidhi Verma	National Consultation meeting on "Implementation of ITPGRFA" and "To review the status of the registration of extant varieties"	NBPGR, New Delhi on 7 November 2007
R.C. Agrawal	Second Annual Meeting of the Project "Preparation of Plant Variety Protection and DUS Testing through ICAR-SAU System	NBPGR, New Delhi, 10 November 2007
E.R. Nayar	National Conference on Plants in Relation to Man and Biosphere	St. Xavier's College, Mumbai, 16 November 2007
E.R. Nayar	DBT-sponsored workshop for teachers on DNA Fingerprinting and Plant Biodiversity Conservation	NBPGR, New Delhi, 17 November 2007

Usha Dev, Celia Chalam V. and Kavita Gupta	Annual Zonal Meeting and Symposium on Seed Health Testing and Certification: Need for Marching Ahead	National Bureau of Plant genetic Resources, 17 November 2007
D.K. Hore, Z. Abraham, K.C. Bhatt, Neelam Sharma	National Workshop on Production and Standardization of Quality Seed/Planting Material of Medicinal Plants	NBPGR, New Delhi, 20-21 November 2007
D.R. Pani	National Symposium on "Research Priorities and Strategies in Rice Production System for Second Green Revolution"	CRRI, Cuttack, 20- 22 November 2007
S.K. Verma	National Convention and Seminar on Business enabling of aromatic plants and products	HRDI, Selaqui Dehradun (U.K.), 21-22 November 2007
Neelam Sharma and Ruchira Pandey	One-day workshop organized by Biotech Consortium India Limited (BCIL), on "Commercialization of Biotechnology"	India International Centre, New Delhi, 27 November 2007
R.C. Agrawal	61st Annual Conference of the Indian Society of Agricultural Statistics	Birsa Agricultural University, Ranchi, 30 November to 2 December 2007
Zakir Hussain	10 days CWS-2007 on "Recent techniques in Structural and Functional Genomics"	CIMAP, Lucknow, 1-10 December 2007
V. Celia Chalam	International Conference on Emerging and Re-emerging Viral Diseases of the Tropics and Sub-tropics	Indian Agricultural Research Institute, New Delhi, 11-14 December 2007
D.K. Hore	National seminar on 'Biodiversity of Northeast Biotechnological Consortium'.	Indian Institute of Entrepreneurship, Guwahati, Assam, 18 December 2007
E.R. Nayar	Workshop on Herbarium Techniques	National Institute of Science Communication and Information Resources (NISCAIR), New Delhi, 19 December 2007
K.S. Varaprasad, K Anitha, V. Celia Chalam and Kavita Gupta	Second Asian Congress of Mycology and Plant Pathology	Osmania University, Hyderabad, 19-22 December 2007
Veena Gupta	National Seminar on Bioprospecting and Application of Medicinal Plants in Common Ailments	Rama Krishna Ashram Mission, Narendrapur, Kolkatta, 24-25 December 2007

19.15 Publications

I Research papers

Agarwal PC, Usha Dev, Baleshwar Singh, Indra rani, Dinesh Chand and RK Khetarpal (2007) Seed-borne fungi identified from exotic pepper (*Capsicum* spp.) germplasm samples introduced during 1976-2005. *Plant Genetic Resources Newsletter* **140**: 35-38.

Asha KI and C Nair Maya (2004) Inter-relationships in morphotypes of greater yam (*Dioscorea alata* L.). *Indian J. Plant Genet. Resour.* **17 (2)**: 148-153.

Barua U, DK Hore and R Sarma (2007) Wild edible plants of Majuli island and Darrang districts of Assam. *Indian J. Trad. Knowledge* **6(1)**:191-194.

Bhalla S, VC Chalam, B Singh, Rajan, Kavita Gupta, P Firke, N Kumar, A Jain, R Som, GJ Randhawa, Manju Lata Kapur and RK Khetarpal (2007) Quarantine

processing of imported transgenic rice and evaluation of risk in import. *Current Science (In press)*

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19.16 Patents and Copyrights Filed

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19.18 Statement of budget estimates and expenditure for the year 2007-08

(Rs. In lakh)

S.No.	Name of the Head	Budget Estimate	Expenditure upto 31.3.2008
1.	Institute Non Plan	1560.00	1559.97
2.	Non Plan Schemes	0.00	0.00
3.	Pension	70.00	68.42
4.	Loans & Advances	10.00	10.00
5.	Institute Plan (including NRC on DNA (F))	625.00	624.99
6.	Plan NEH Component	12.00	11.99
7.	NAIP	27.68	25.93
8.	Expenditure to KVK of Institute	0.00	0.00
9.	Release of Grant to SAUs under AICRP & Institute AICRP exp. (Separately)	185.00	184.99
10.	Plan Scheme	23.00	23.00

Annexure 1: Meteorological data (temperature in degrees Celsius and rainfall in mm) of NBPGR Regional Stations (January to December 2007)

Station	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Akola	Max temp	29.9	32.3	36.2	41.0	42.2	37.0	31.3	31.0	31.5	33.8	31.7	29.8
	Min temp	12.5	16.2	19.5	24.7	28.2	26.4	23.8	23.4	23.4	17.0	14.2	13.0
	Rainfall	0.0	0.0	0.0	8.6	0.2	158.3	281.2	175.1	134.7	0.0	21.7	0.0
Bhowali	Max temp	13.4	13.8	13.7	23.9	23.1	26.5	24.3	26.1	24.9	25.2	19.1	16.9
	Min temp	-2.6	1.3	4.5	10.3	13.0	17.3	17.9	20.4	14.8	9.4	6.0	1.3
	Rainfall	6.0	188.0	224.4	44.0	155.9	139.4	147.6	421.6	467.0	24.0	2.2	6.0
Cuttack	Max temp	28.1	29.5	32.7	34.4	35.9	33.5	32.0	31.1	30.5	31.3	29.7	27.5
	Min temp	15.3	18.7	22.3	25.1	25.7	26.5	25.9	25.7	25.3	23.5	19.7	15.1
	Rainfall	94.0	94.0	95.0	89.0	87.0	89.0	91.0	91.0	93.0	91.0	91.0	90.0
Hyderabad	Max temp	29.4	31.4	35.7	37.7	39.2	33.2	31.7	30.4	29.7	30.6	29.5	29.6
	Min temp	13.8	15.5	20.5	22.8	26.8	25.0	24.4	23.4	23.1	19.4	13.8	14.3
	Rainfall	0.0	0.0	0.0	17.8	38.6	134.3	50.8	172.5	146.3	14.8	15.8	0.0
Jodhpur	Max temp	10.7	22.0	29.1	40.7	41.7	40.3	36.0	34.7	36.3	36.4	33.6	25.6
	Min temp	0.0	14.9	17.4	24.7	28.2	29.5	27.4	26.1	25.5	18.8	14.5	12.0
	Rainfall	25.8	28.7	32.6	14.8	01.0	22.3	73.4	77.2	83.7	00.0	00.0	00.2
Shillong	Max temp	24.3	24.2	30.3	30.3	31.7	31.5	31.3	32.6	30.6	31.5	27.7	22.7
	Min temp	10.6	12.5	15.4	21.2	22.5	24.0	22.2	22.6	20.8	19.6	15.3	10.0
	Rainfall	0	117.9	21.6	251.2	325.7	560.2	514.2	393.5	469.8	236.0	206.8	03
Shimla	Max temp	14.7	11.3	17.6	24.8	26.1	27.2	25.0	24.6	24.3	22.8	18.4	14.8
	Min temp	5.3	4.1	8.2	15.4	16.9	18.4	17.8	17.7	16.2	13.3	10.5	9.7
	Rainfall	0.0	172.7	102.1	9.1	37.8	206.5	201.2	299.5	89.7	9.9	1.0	22.4
Thrissur	Max temp	32.5	34.0	36.0	35.1	32.8	30.1	28.4	29.0	29.4	30.5	31.7	31.6
	Min temp	22.0	22.2	24.4	25.0	24.6	23.5	22.9	22.8	22.9	22.5	21.6	22.7
	Rainfall	0.0	0.0	0.0	61.0	240.5	826.5	1131.9	549.7	765.9	383.8	24.8	8.7

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