June 1988

Edited by
RAM NATH, V. K. MATHUR and
ARJUN LAL

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 permission of the Director, National Bureau of Plant Genetic Resources, New Delhi except for quoting it for scientific reference.
The National Bureau of Plant Genetic Resources continued to make rapid strides during 1987 to achieve its mandate in respect of various aspects of plant genetic resources programme under the dynamic leadership and guidance of Dr. R. S. Paroda, the then Director (now Deputy Director General, Crop Sciences, ICAR). The Bureau also continued to maintain effective linkages with various ICAR crop-based institutes, All India Crop Coordinated Projects, Agricultural Universities, ICRISAT and several other agencies/department. Additional infrastructural facilities by way of more sophisticated equipment, laboratory facilities and man-power resource etc. were augmented to achieve higher efficiency in research output. In recognition of the contributions made, the scientists of the Bureau were invited to participate in various international conferences, symposia, seminars, workshops etc. A number of eminent scientists from abroad and from within the country visited the Bureau during the year and commended the work being done here.

The Bureau celebrated the decade of its existence by organising a ‘National Symposium on Plant Genetic Resources’ during March, 1987. About 300 scientists from the country and abroad participated and discussed the progress made, present status and future thrusts/priorities with respect to plant exploration and collection, evaluation, exchange, plant quarantine and conservation. Further, several international workshops/seminars/expert consultations were also organised by the Bureau during 1987.

Achievements of the past years have been highlighted in various research monographs, bulletins, research papers, news letters etc. The present report gives details of the achievements during 1987 as a service organisation and significant research contributions. I do hope, the readers will get acquainted with various activities related to plant genetic resources programme being pursued by the Bureau and its coordination role in this direction. I also would like to place on record my appreciation for the sincere efforts put forth by Shri Ram Nath, Dr. V. K. Mathur and Dr. Arjun Lal in bringing out this publication in time.

(R. K. ARORA)

Offg. Director

Dated: May 31, 1988
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Dr. R. S. Paroda joined as Director of the National Bureau of Plant Genetic Resources, New Delhi on 1st March, 1985. Under his dynamic and able leadership NBPGGR rose to soaring heights in the field of plant genetic resources. All the staff members of the NBPGGR take pride in congratulating Dr. Paroda on his appointment as Deputy Director General (Crop Sciences), ICAR, New Delhi w.e.f. 2nd November, 1987 and wish him all success in his new assignment.
INTRODUCTION

Indian Council of Agricultural Research created the National Bureau of Plant Genetic Resources (NBPGR), New Delhi on August 1, 1976 as a national institute to carry out and coordinate national activities connected with plant genetic resources. NBPGR is also entrusted with the responsibility of exchange of germplasm material of agri-horticultural and silvicultural crops with other countries in a pest and disease free condition.

Objectives

The NBPGR, which is primarily a service organisation has the following objectives:

— To undertake introduction and exchange of plant genetic resources through effective linkages with concerned organisations abroad.

— To examine the seed and plant material under exchange for various pests and pathogens and to treat and salvage the infected and infested materials, keeping in view all the quarantine requirements.

— To carry out explorations and collect the crop diversity with specific emphasis on native flora.

— To evaluate and characterise the available germplasm and to co-ordinate such activities with other crop Institutes, co-ordinated Projects and to prepare inventories and catalogues on available genetic resources.

— To conserve germplasm collections for medium- and long-term storage in the National Gene Bank as well as National Tissue Culture Repository.

— To conduct research leading to crop improvement of selected medicinal and aromatic plants used in organised sector of industry and to monitor and co-ordinate the research work under All India Co-ordinated Research Project on Medicinal and Aromatic Plants at constituent centres.

— To develop data documentation for retrieval of available information on plant genetic resources held by the Bureau and other research organisations.

— To carry out research to improve and utilize under-utilized and under-exploited plants and to monitor and co-ordinate the research work under All India Co-ordinated Research Project at constituent centres.
To conduct and co-ordinate research on guar at national level through All India Co-ordinated Research Project.

To impart training in the field of plant genetic resources and associated disciplines.

Organisational Set-up

Headquarters

The Headquarters of the Bureau are located in the IARI Campus, New Delhi. Director coordinates and supervises the functioning of its five Divisions—(i) Division of Plant Exploration and Collection, (ii) Division of Germplasm Evaluation, (iii) Division of Germplasm Exchange, (iv) Division of Plant Quarantine, (v) Division of Germplasm Conservation. Each Division is headed by a Senior Scientist. Apart from the five Divisions, the Bureau also has a National Facility for Plant Tissue Culture Repository, which is funded and supported by the Department of Biotechnology, Govt. of India. A 40 hectare experimental farm of the Bureau is located at Issapur village, about 45 km from the Headquarters. In addition to the farm, about 4 hectares of land available at Headquarters is used for growing exotic plant material in isolation in Post-entry Quarantine Nursery (PEQN).

The Bureau also houses the offices of three Project Coordinators of All India Co-ordinated Research Projects on Medicinal and Aromatic Plants, Under-Utilized and Under-Exploited Plants and on Guar.

Regional Stations/Base Centres

The five Regional Stations of the Bureau, each headed by a Senior Scientist, are located in different agro-climatic regions of the country. These are at Shimla, Shillong, Jodhpur, Trichur and Akola with a Satellite Centre at Amravati. Germplasm of different crops, depending on its climatic requirements, is evaluated at these Stations. Staff at these Regional Stations also undertake plant exploration and collection work in the respective regions. The Plant Quarantine Regional Station at Hyderabad caters to the quarantine needs of ICRISAT and Directorate of Rice Research. Besides this, four new base centres to undertake exploration and collection of germplasm have been established at Hyderabad, Cuttack, Srinagar and Bhowali. The programmes at these Regional Stations/Base Centres/Satellite Centre are supervised and co-ordinated by Heads of the Division of Plant Exploration and Collection, Division of Germplasm Evaluation and Division of Plant Quarantine in their respective disciplines.

Management and Policy Committees

National Policy Planning and Review Committee

The Committee which met on December, 18, 1986 under the Chairmanship of the Director General, ICAR, constituted a sub-committee under the Chairman—
ship of Dr. A. B. Joshi, former Deputy Director General (CS) with six members. The meeting of the sub-committee was held on November 21, 1987 and discussed various aspects related to strengthening of plant genetic resources activities in the country as a whole. It was decided that since plant genetic resources are not confined to agricultural plant wealth only, but include the whole gamut of all useful plants of potential economic value, therefore, effective linkages between various institutions/departments engaged in such activities, particularly BSI, ICFRF (FRI), NBRI, Plant Protection Directorate, Customs Department are essential. It was also decided that priority must be given to germplasm collection programme involving threatened species, threatened areas and endemic areas.

Management Committee

The twelfth meeting of the Management Committee was held on July 24 to review the main achievements of the Bureau and to provide guidelines for its smooth functioning.

The Joint Staff Council of the Bureau met once in three months to discuss and recommend suitable remedial measures of common interest faced by the staff of the Bureau.

The Grievance Cell of the Bureau (constituted as per ICAR rules) also met periodically to look into the staff’s grievances relating to official matters.

Financial Expenditure

A total expenditure of Rs. 89.22 lakhs (non-plan) and Rs. 84.50 lakhs (plan) was incurred during the Bureau's operations in 1987-88. Besides this, an expenditure of Rs. 103.95 lakhs was also incurred out of the grant received from the Department of Biotechnology.

Details of the members of various Committees and budget estimates are given in the last chapter (General Information).

An Overview of Achievements

Details of main achievements of the Bureau during 1987, are given in the following chapters under different Divisions and the Regional Stations/Base Centres. However, a glimpse of the Bureau's activities in 1987 is presented below:

The scientists of the Bureau undertook/coordinated 44 explorations, of which 15 were multicrop/region-specific and 29 crop-specific. The areas explored were western cold arid regions of Ladakh Himalayas, north-western hilly tracts of Uttar Pradesh, Coastal region of Maharashtra, Chotanagpur region of Bihar, tribal belts in four districts of Madhya Pradesh and parts of Tamil Nadu, Kerala and Karnataka. Four collaborative exploration programmes were also undertaken
in India, one each with Japanese scientists, with ICRISAT, IRRI and one in some east African countries with funding from IBPGR. As a result of these programmes, over 5000 accessions were added to the existing germplasm variability in various agri-horticultural crops.

Genetic resources in over 75 different crops were grown for evaluation, characterisation and maintenance during this year. Under the ICRISAT/NBPGR joint evaluation programme, germplasm of pigeonpea, sorghum, pearl millet, groundnut, chickpea and minor millets was grown and evaluated at Issapur farm and at different regional stations. The characterisation and evaluation programmes have resulted in identification of over 600 promising accessions in over 40 different crops, some of them showing tolerance/resistance to pests and diseases. Other activities included multiplication of seed and supply of germplasm to various users.

The Bureau introduced 52,642 samples of diverse agri-horticultural and silvicultural crops from 51 countries. These included the international trials and breeding material of wheat, barley, maize and paddy received from CIMMYT (Mexico), ICARDA (Syria) and IRRI (Philippines). The introductions included paddy material resistant to sheath blight, bacterial leaf blight and drought tolerant; aphid resistant Brassica species; sunflower varieties with high oil content; TMV resistant lines in cowpea; cold-tolerant collections of groundnut; fruit fly resistant collections of cucurbits; Citrullus vulgaris collections exhibiting high degree of resistance to anthracnose, Fusarium wilt and gummy stem blight; high sugar types in sugarbeet etc. Among other potentially important plants were: Chamaecytisus palmensis—a nitrogen fixing tree species and Stevia rebaudiana with eatevin, a glucoside which is 150 times sweeter than sugar. Besides 2,378 samples of different crops were exported to 61 countries.

Out of 83,945 germplasm samples consisting of true seeds and vegetative propagules of different crops imported from all over the world, 1251 samples were infested with insects and mites, 1,326 infested and or contaminated with plant parasitic nematodes and 385 were infected with plant pathogens. Besides, 29 different types of weed seeds were detected in 236 samples. Some of the exotic pests and pathogens intercepted from these samples are yet to be recorded from our country. Wherever possible, infected/infested/contaminated samples were salvaged and considering the total imports, more than 99.8% of the material was released to user scientists. 2,977 samples of different crops meant for export were also examined for freedom from local pests and diseases.

About 25,100 germplasm collections of various agri-horticultural crops were added to the genebank during 1987 for long/medium term storage. The collections stored included indigenous material consisting of old cultivars/released varieties of different crops, promising material identified from trials, exotic germplasm,
parts of collections made by exploration scientists and material received from crop
based ICAR institutes.

Encouraging results where obtained in *in vitro* conservation of onion, garlic, *Dioscorea alata*, *D. esculenta*, ginger, turmeric, *Citrus limon*, *Rauvolfia serpentina* and *Coleus forskohlii*. Cryopreservation was started using recalcitrant seeds of cocoa, tea, clove, nutmeg, jackfruit and coffee. Pollen preservation was also initiated with some of the species of maize, *Coix* and *Sorghum*.

**Developmental Activities**

Expansion of physical facilities both at Headquarters and Regional Stations was given top priority. Some of the major achievements are:

**A. Headquarters**

(i) Construction of sheds over platform for 4 modules and area around, false ceiling, partitions and electrification of this unit, additional growth chamber room, cooling tower, renovation of two Lahore sheds (ground floor), construction of a room for Herbarium at first floor and boundary wall and gate between Bureau's buildings and NSC premises have been completed. (ii) A deep tube well in Plant Quarantine Nursery has been installed. (iii) Construction of a glass-house in Bureau's premises is nearing completion. (iv) At Issapur farm, Office-cum-laboratory building, Workshop block, water storage tank, irrigation channels and laying of underground pipe lines have been completed.

**B. Regional Stations**

A pot house has been constructed at Akola and an additional room has been built at Amravati. At Bhowali, construction of a pump house and three store rooms was completed. Construction of the boundary wall and barbed wire fencing was completed at the Base Centre, Cuttack. Construction of compound wall at the permanent site of the Hyderabad Regional Station has been completed. Two rooms at Jodhpur and a farm shed at Shimla were also constructed. Work on the medium term cold storage is in progress at Shimla.
DIVISION OF GERMPLASM EXCHANGE

The Division is responsible for carrying out and co-ordinating the exchange of plant genetic resources of agri-horticultural and silvi-agricultural crops (including their wild relatives) for various crop improvement programmes.

A. Import of Plant Genetic Resources

Seeds and other plant propagating material were introduced into India, so as to meet specific requirements of various researchers working in central/state research institutes, agricultural universities etc. Introduction comprised of two categories (a) material obtained at the initiative of Bureau, (b) material obtained on the request of the scientists of the Bureau as well as collaborators for international trials/crop breeding experiments to be conducted in India. Introductions of seeds/plant propagules made during the year 1987 are as follows:

Samples procured and handled 52,642
   (a) germplasm 16,740
   (b) trial material 35,902

Consignments received and handled
   Number of countries involved 51
   New Import cases registered 500

Some of the most important accessions introduced are given in the Table—1.

Information on all introduced genetic stocks is presented below. As far as possible, scientific name under which entries were received, have been retained and available information on salient characters, if any, is also included.

CEREALS AND RELATED SPECIES : Triticum aestivum (14610) :
Australia, Chili, Italy, Mexico [GBIEN-BW-BV-87, RBW-CB, RBWON (HAA), RBWON (LRA), RBWON (MRA), RBWYT (MRA), RBWYT (LRA), RBWYT (HAA), KBSN, IDSN, 6th ASRSN, IBWSN-CAND, CBS-87, F1 Spring × Spring (BW), Drought tolerant-87, Scab tolerant-87, LA.AL+++ Aluminium tolerant lines, germplasm group-1 (BW), Group-II (BW), 20th IBWSN (selected lines), 21st IBWSN, 4th heat tolerant SN-87 (selected lines), 5th Helminthosporium resistant lines, 5th Aluminium screening Nursery, 2nd Scab-resistant SN-87, 17th ISEPTON-87, 2nd HSWSN-87, EOLA (BW)-87
Table 1. Important accessions of plant genetic resources introduced during 1987

<table>
<thead>
<tr>
<th>Crops</th>
<th>Accession Nos.</th>
<th>Country</th>
<th>Salient characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oryza sativa</td>
<td>EC 199447-54</td>
<td>Philippines</td>
<td>BPH resistant lines</td>
</tr>
<tr>
<td></td>
<td>EC 199455-57</td>
<td></td>
<td>Bacterial leaf blight resistant lines</td>
</tr>
<tr>
<td></td>
<td>EC 199458-61</td>
<td></td>
<td>Blast resistant lines</td>
</tr>
<tr>
<td></td>
<td>EC 199465</td>
<td></td>
<td>Resistant to sheath blight</td>
</tr>
<tr>
<td></td>
<td>EC 199466</td>
<td></td>
<td>Resistant to stem borer</td>
</tr>
<tr>
<td></td>
<td>EC 199581-712</td>
<td></td>
<td>Aromatic varieties</td>
</tr>
<tr>
<td></td>
<td>EC 201878-975</td>
<td></td>
<td>Resistant to sheath blight, bacterial leaf blight and drought tolerant</td>
</tr>
<tr>
<td>Triticum aestivum</td>
<td>EC 197180</td>
<td>UK</td>
<td>F1 &amp; F2 materials</td>
</tr>
<tr>
<td>T. compactum</td>
<td>EC 198033-37</td>
<td>USSR</td>
<td>Spring types</td>
</tr>
<tr>
<td>Zea mays</td>
<td>EC 201528</td>
<td>Mexico</td>
<td>Early white, semi-dent</td>
</tr>
<tr>
<td>Vigna radiata</td>
<td>EC 198171</td>
<td>Taiwan</td>
<td>Resistant to TMV</td>
</tr>
<tr>
<td></td>
<td>EC 198148</td>
<td></td>
<td>Photoperiod sensitive with wide adaptability</td>
</tr>
<tr>
<td></td>
<td>EC 201572-73</td>
<td></td>
<td>Resistant to lodging, powdery mildew and Cercospora leaf blight</td>
</tr>
<tr>
<td></td>
<td>EC 201575-78</td>
<td></td>
<td>High yield potential lines</td>
</tr>
<tr>
<td>V. unguiculata</td>
<td>EC 216645-48</td>
<td>USA</td>
<td>Apbid resistant lines</td>
</tr>
<tr>
<td>Helianthus annuus</td>
<td>EC 198049-106</td>
<td>Egypt</td>
<td>High yielding hybrids</td>
</tr>
<tr>
<td></td>
<td>EC 209135</td>
<td>France</td>
<td>Resistant to downy mildew</td>
</tr>
<tr>
<td></td>
<td>EC 209140</td>
<td></td>
<td>good sources of self compatibility</td>
</tr>
<tr>
<td></td>
<td>EC 209141</td>
<td></td>
<td>High oil content</td>
</tr>
<tr>
<td></td>
<td>EC 210552-24</td>
<td>Egypt</td>
<td>medium tall with early maturity</td>
</tr>
<tr>
<td></td>
<td>EC 214570</td>
<td>Australia</td>
<td>high yielding type</td>
</tr>
<tr>
<td>H. rigidus</td>
<td>EC 209148</td>
<td>France</td>
<td>wild species resistant</td>
</tr>
<tr>
<td>H. tuberosus</td>
<td>EC 209149</td>
<td></td>
<td>to Alternaria helianthi</td>
</tr>
<tr>
<td>H. debilis-silvestris</td>
<td>EC 209150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brassica campestris</td>
<td>EC 201539-41</td>
<td>USA</td>
<td>Multi-disease resistant and cytoplasmic sterile lines</td>
</tr>
<tr>
<td></td>
<td>EC 203578-80</td>
<td>Canada</td>
<td>high yielding, low Erucic acid.</td>
</tr>
<tr>
<td></td>
<td>EC 218725-25</td>
<td></td>
<td>high oil content (upto 48%)</td>
</tr>
<tr>
<td>Crops</td>
<td>Accession Nos.</td>
<td>Country</td>
<td>Salient characters</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Brassica spp.</td>
<td>EC 217587-92</td>
<td>France</td>
<td>winter rape seed, low in Erucic acid and glucosinolate content high, medium early to late, with resistance to lodging</td>
</tr>
<tr>
<td>Arachis hypogaea</td>
<td>EC 212850</td>
<td>Bangladesh</td>
<td>Matures in 135-145 days in winter and 120-130 days in summer</td>
</tr>
<tr>
<td>Allium cepa</td>
<td>EC 196631-39</td>
<td>Italy</td>
<td>Flat top, long dry, with tolerance to Fusarium oxysporum</td>
</tr>
<tr>
<td>Lycopersicon esculentum</td>
<td>EC 198416</td>
<td>Taiwan</td>
<td>Heat tolerant, wilt resistant lines</td>
</tr>
<tr>
<td></td>
<td>EC 200769-76</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>EC 196588-97</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>EC 202430</td>
<td>Canada</td>
<td>wilt resistant line</td>
</tr>
<tr>
<td></td>
<td>EC 202431</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>EC 204194-98</td>
<td>USA</td>
<td>early maturity for fresh market, resistant to Vetricillus wilt, TMV, Alternaria, Fusarium oxysporum race-I &amp; II, tolerant to Nematodes.</td>
</tr>
<tr>
<td>Capsicum annum</td>
<td>EC 203581-603</td>
<td>Hungary</td>
<td>Conical shape with CMV tolerance</td>
</tr>
<tr>
<td>Daucus carota</td>
<td>EC 198258</td>
<td>USA</td>
<td>high carotene type</td>
</tr>
<tr>
<td>Brassica oleracea</td>
<td>EC 205372-73</td>
<td>USA</td>
<td>Smooth, medium, maturity in 60-70 days and disease tolerance</td>
</tr>
<tr>
<td>var. botrytis</td>
<td></td>
<td></td>
<td>F&lt;sub&gt;1&lt;/sub&gt; hybrids.</td>
</tr>
<tr>
<td>Citrullus vulgaris</td>
<td>EC 210126-27</td>
<td>Holland</td>
<td>moderate to highly resistant to Anthracnose, Fusarium wilt and gummy stem blight</td>
</tr>
<tr>
<td>Lactuca sativa</td>
<td>EC 216893-94</td>
<td>UK</td>
<td>Summer adaptable</td>
</tr>
<tr>
<td>Cucumis sativatus</td>
<td>EC 222198-201</td>
<td>Holland</td>
<td>Resistant to fruit fly</td>
</tr>
<tr>
<td>Gossypium hirsutum</td>
<td>EC 200305</td>
<td>USA</td>
<td>Heliolthis resistant and high yielding</td>
</tr>
<tr>
<td>Malus sylvestris</td>
<td>EC 199375</td>
<td>USA</td>
<td>good fruit size</td>
</tr>
<tr>
<td>Olea europea</td>
<td>EC 206629</td>
<td>Greece</td>
<td>Fruits small, plants tall and frost tolerant</td>
</tr>
<tr>
<td></td>
<td>EC 206630</td>
<td>&quot;</td>
<td>Medium size fruits, low in oil with frost susceptible</td>
</tr>
<tr>
<td></td>
<td>EC 206631</td>
<td>&quot;</td>
<td>Very large fruits, best for pickling, low in oil content (16-22%) and frost resistant.</td>
</tr>
</tbody>
</table>
(Table 1. Continued)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Accession Nos.</th>
<th>Country</th>
<th>Salient characters</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Vitis vinifera</em></td>
<td>EC 209121</td>
<td>USA</td>
<td>Seedless variety</td>
</tr>
<tr>
<td><em>Beta vulgaris</em></td>
<td>EC 218439-43</td>
<td>Sweden</td>
<td>High sugar content</td>
</tr>
<tr>
<td>&quot;</td>
<td>EC 216560-62</td>
<td>USA</td>
<td>Resistant to <em>Cercospora beticola</em> and moderately resistant to curley top virus</td>
</tr>
<tr>
<td><em>Papaver somniferum</em></td>
<td>EC 217013</td>
<td>Romania</td>
<td>Maximum value of morphine (0.84%) in dry matter</td>
</tr>
<tr>
<td><em>Matricaria chamomilla</em></td>
<td>EC 217012</td>
<td>Romania</td>
<td>Promising for green herbage yield and high essential oil content</td>
</tr>
<tr>
<td><em>Valeriana officinalis</em></td>
<td>EC 217014</td>
<td>Romania</td>
<td></td>
</tr>
<tr>
<td><em>Datura inoxia</em></td>
<td>EC 217015</td>
<td>USA</td>
<td></td>
</tr>
<tr>
<td><em>Thymus vulgaris</em></td>
<td>EC 207655</td>
<td>USA</td>
<td>Good source of oil Thymi Oleum, Thymi Stimulent, antiseptic and antiplasmodic quality</td>
</tr>
<tr>
<td><em>Duboisia myoporoides</em></td>
<td>EC 217067</td>
<td>USA</td>
<td>Rich source of Anabasine, Norbicotin, Scopolamine and Hyoscymine contents</td>
</tr>
</tbody>
</table>
BW (CB), KLDN-ICARDA-87, WON-MRA, 18th ISEPTON, 3rd IWWSN, ISWYN, ESWYT, SCAB, DAL-DUROS, 6th DSN, 5th IDTN, 4th KBSN-87, F3 (BW)-87, F4-(BW), F6 (BW), Ist HEWSN, 24th ISWYN-87, rust resistant materials, 9th ESWYT, Karnal bunt resistant lines, 17th IDSN, 18th IDSN, Nepal, Netherlands, Philippines, Syria [RBWCB 1987-88, RBWON (LRA), Heat tolerant obs. Nursery, RBWYT-LRA, RBWYT-MRA], UK, USA [(IWW CB), 20th IWWPNO Nursery].

*T. boeticum* (1) Syria; *T. carthalicum* (1) Syria; *T. compactum* (120) Bulgaria, Germany, Poland, Syria, USA, USSR; *T. dicoccoides* (2), Syria, UK; *T. dicoccum* (2) Syria, UK; *T. durum* (1445) Canada, Mexico [17th EDYT, 19th IDYN, 19th IDWSN, IRWON (LRA), RDWON (HAA), RDWON (MRA), RDWYT (LRA), RDWCB], Syria [DWON (HAA), RDWYT (LRA), RDWON (MRA), RDWYT (MRA) RDWCB, Heat tolerant obs. Nursery, DWRYT (HAA)].

*T. monococcum* (1), Syria; *T. polonicum* (1), Syria; *T. spelta* (2), Syria, UK; *T. spelta-album* (5), UK; *T. sphaerococcum* (250), Bulgaria, Germany, Poland, Romania, USA, USSR; *Triticale* (125), Mexico (19th ITYN-88), USSR.


*Zea mays* (2262): Mexico (EVT-16A-127, EVT-18B-3, EVT-20--46, EVT-14-B-37, OPTT-32-87, OPTT-21-87, OPTT-26-87, OPTT-30-87, OPTT-46-87), Nigeria, Philippines, Thailand, USA and USSR; *Z. diploperennis* (4), *Z. luxurians* (1); *Z. perennis* (1)—all from USA; *Hordeum vulgare* (4485) Syria (RSP-B-LRA, BYT-HAA, BON-LRA, BON-MRA, BYT-MRA, RSP-B-MRA, BYT-LRA, BON-HAA, BSP-HAA BCB, Segregating population—HAA, Seg. pop-LRA, Seg-pop-MRA, cold tolerant lines, resistant to powdery mildew, leaf rust, leaf stripe rust and resistant to scald, forage type lines with large kernels, high protein and heat tolerant nursery.
Avena sativa (660) : Hungary and USA; A. nuda (1), Hungary (Spring oat); Secale cereale (14), USSR; Sorghum spp. (1200), Australia, Italy, Philippines, Tanzania, Somalia, Uganda, USA and USSR; S. bicolor (94) Hungary, UK and USA; S. laxiflorum (1) Australia; Pennisetum americanum (188) Italy, Niger, USA and Zimbabwe; P. alopecuroides (1), USA; P. mollissimum (1) USA; P. pedicellatum (16), Italy; P. ramosum (1), USA; P. violaceum (37), Nigeria.

PSEUDO-CEREALS AND MILLETS: Coix lacryma-jobi (1), UK; Eleusine spp. (14), Tanzania; E. coracana (3), Bhutan and Nepal; E. indica (3), UK; E. kizeziensis (3), UK; Panicum miliaceum (82), Hungary, USSR; P. maximum (1), P. coloratum (1)-from Argentina; Setaria italica (3), Bangladesh and Bhutan; S. glauca (242), Tanzania; S. sphacelata (1), Argentina.

OILSEED CROPS: Arachis hypogaea (803), Bangladesh materials mature in 135-145 days in winter and 120-130 days in summer; Bhutan, Canada, Greece, Italy, Nepal, Pakistan, Sudan, Tanzania, and USA; A. appressipila (1), A. batizocoi (1), A. cardenasii (1), A. chacoensis (1), A. correntina (1), A. chiquitana (1), A. duran­nensis (1), A. hoehhei (1), A. helodes (1), A. igoni (1), A. rigoni (1), A. otavioi (1), A. paraguiensis (1), A. spegozzini (1), A. spinialva (1),—all from Argentina; A. stenosperma (1), A. villosa (2),—from Brazil; Brassica spp. (23), Bangladesh, Canada, France (winter type, low in erucic acid and glucosinolate content and resistant to lodging), Nepal, USA and West Germany; B. campestris (60). Canada (high yielding, low in erucic acid, with 48 per cent oil). France, Nepal, Pakistan, UK and USA; B. carinata (22), France, Ethiopia, and Pakistan; B. deflexa (1) B. des­nottesii (1),—from Japan; B. juncea (80), Australia, France, Hungary, Pakistan, Sweden, USA; B. napus (120), Canada, France, Germany, Italy, Pakistan and UK; B. napocampestris (1), UK; B. rapa (5), China and Hungary; Bronica elongata (1), Japan; Carthamus tinctorius (254), Hungary, Taiwan and USA; Conringia orientalis (3), Diplotaxies virgata (1), Japan; Elaeis guineensis (2), Pupua New Guinea; Enarthrocarpus lyratus (1), Eruca vesicaria (1), Erucastrum gallicum (1), E. variun (1),—all from Japan; Helianthus annuus (272), Australia (promising type), Bulgaria, Egypt (medium tall with early maturty); France (resistant to powdery mildew, good sources of self compatibility and high oil contents), Italy, Hungary, Philippines, USA; H. debilis (1), France (resistant to Alternaria helianthi); H. rigidus (2), France; H. tuberosus (4), France and Holland; Linum perenne (1), France; L. usitatissimum (1), Hungary; Simarubaglauca (1), Italy; Citrullus colocynthis (1), Nigeria; Hatera leptocarpa (1), Japan; Rhynchosinapsis longirostrata (1), Raphanus raphanistrum (1), from Japan; Sinapsis alba (1), Hungary; Trachystoma balli (1); Limnanthes alba (5), USA.

PULSE CROPS: Cajanus cajan (128), Australia, France, Malawi, Morocco, Tanzania and Zambia, Cicere arietinum (867), Morocco, Syria (IYT-winter, MR, IYT-winter-ST International F4 Trial, IYT-large seeded, ICTN-88, International associated blight nursery-B) Tanzania; Dolichos oxillaris (7), USA; Glycine max
Italy, Nigeria, Philippines, Taiwan, USA; *Lathyrus articulatus* (1), *L. cicera* (1), *L. clymenum* (1), *L. ochrus* (1) all from Canada; *L. sativus* (225), Canada and Italy; *L. tingitanus* (2), *L. szowitsii* (1) — from Canada; *Lens culinaris* (580) Syria (IF 3 YT-Early-87, IYT-Small Seeded, ISN-Small Seeded-87, ISN (early), LISN-E-88, LIF3-T-E-88, LISN-T-88, LIYT-E-88, LISN-E-87, LISN-L-87); *Psophocarpus tetragonolobus* (1), Philippines; *Phaseolus* spp. (3), Holland, Philippines and USA; *P. aborigineus* (2), USA; *P. acutifolius* (92), Holland and USA; *P. angustifolius* (2), *P. ansistrietus* (4), — from USA; *P. cocineus* (5), Colombia; *P. demosus* (1), USA; *P. microcarpus* (2), *P. polystachyus* (4), — all from USA; *P. polyanthus* (9), Colombia and USA; *P. trinervius* (2), USA; *P. vulgaris* (22), Costa Rica, Cuba, Holland, Italy and USA; *Pisum sativum* (51), France, Philippines, Sweden and W. Germany; *Vicia faba* (202), Holland, Syria, USA and West Germany; *V. hirsuta* (5), *V. sativa* (48), from Syria and USA; *V. villosa* (42), *V. salmonea* (4), from Syria; *Vigna* spp. (2), Philippines; *Vigna mungo* (3), Taiwan; *V. radiata* (127), Philippines, Taiwan (resistant to TMV, lodging, powdery mildew, Cercospora leaf blight, photoperiod sensitive with wide adaptability and high yield potential lines) and USA; *V. unguiculata* (168), Nigeria, Philippines, Taiwan and USA (aphid resistant).

**VEGETABLE CROPS AND RELATED SPECIES**  
*Allium* spp. (5), France; *A. ampeloprasum* (1), France; *A. cepa* (40) Holland and Italy (top yellow flat, round, short day and white, short day, tolerance to *F. oxysporum*, Egypt, UK and USA; *A. fistulosum* (2), Japan and UK; *A. giganteum* (1), *A. hirtifolium* (1), *A. ledebourianum* (1), *A. nigrum* (1), *A. oblumum* (1), *A. porrum* (4), Holland; *A. ramosum* (2), France *A. sativum* (2), Egypt and USA; *A. scorodoprasum* (1), *A. sphaerocephalum* (1), *A. tuberosum* (1), *A. zebdanense* (1), *A. usinum* (1), *A. viridulum* (1), — all from France; *Asparagus* spp. (3), Italy (tetraploid and F1, all male and from androgenesis); *A. officinalis* (1), Hungary; *Brassica chinensis* (10), Philippines and Taiwan; *B. oleracea* (53), UK and USA; *B. oleracea* var. *botrytis* (24), Denmark, Holland, Taiwan, and USA (mature in 60-70 days and resistant to diseases); *Brassica oleracea* (37) China, Holland, Japan, Taiwan (heat tolerant with varying degree of resistance to diseases) and USA; *B. oleracea* var. *gemmifera* (4), Holland, UK; *Capsicum* spp. (3), Holland; *C. annuum* (77), Costa Rica, Colombia, Hungary (conical shape with TMV tolerance Taiwan, Japan, USA); *C. baccaatum* (10), Costa Rica; *C. chinensis* (16), Costa Rica and Colombia; *C. frutescens* (13), Costa Rica, Colombia and Philippines; *C. pubescens* (10), Costa Rica; *Citrus* spp. (2), USA; *C. vulgaris* (4), Denmark, Egypt, Sudan and USA (moderate to highly resistant to Anthracnose, Fusarium wilt and gummy stem blight); *Cucurbita* sp. (1), Japan; *C. maxima* (2), Peru and USA; *C. pepo* (7), Hungary; *Cucumis melo* (5), Egypt, Japan, Sudan and USA; *C. prophetorum* (2), Holland; *C. sagittatus* (2), Holland (resistant to fruit fly); *C. sativus* (101), China and USA; *Daucus carota* (5), Holland and USA (high carotene and good flavour); *Lactuca sativa* (7), Holland and UK; *Lycopersicon esculentum* (200), Canada (wilt resistant and early maturity for fresh marketing), Egypt, Hungary, Taiwan (heat tolerant and wilt resistant lines) and USA (resistant
FORAGE CROPS AND RELATED SPECIES: Acacia spp. (19), Australia and USA; A. aulacocarpa (3), A. auriculaeformis (11), A. aneura (1), A. brachystachya (1), A. cembayei (1), A. cinclina (1), A. cleroserma × ligulata (1), A. crassicarpa (7), —all from Australia; A. deamii (3), UK; A. erioclada (2), A. farnesiana (2), A. halosertica (4), A. hemignosta (2), A. leptocarpa (4), A. mangium (9), A. mearnsii (1), all from Australia; A. platycarpa (3), Australia and Syria; A. pinnata (1), UK; A. pallida (1), A. polystachya (1), A. salicina (3), A. saligna (5), all from Australia; A. senegal (1), Ethiopia; A. stenophylla (5), A. foliolosa (2), A. fumida (2), A. victoriae (4), from Australia; Albizia cariibea (2), UK; Athylosia sp. (1), Athylosia acutifolia (1), A. goensis (1), ICRISAT; Allocasuarina campestris (1), A. corniculata (1), A. decaisneana (1), A. decussata (1), A. dielsiana (1), A. distyla (1), A. fraseriana (1), A. helmsii (1), A. huogeliana (1), A. humilis (1), A. lehmannii (2), A. lehmaniana (1), A. littoralis (1), A. pinaster (1), A. scleroslada (1), A. fersellata (1), A. ferulosa (1), A. verticillata (1). Casuarina cristata (1), C. cunninghamiana (5), C. equisetifolia (9), C. glauca (5), C. obesa (4), —all from Australia; Cenchrus ciliaris (2), Argentina and Australia; C. pennisetiformis (1), Australia; Clitoria laurifolia (1), USA; C. ternatea (1), USA; Desmodium intortum (3), D. uncinitum (2), D. virgatum (1), Eucalyptus spp. (5), E. camaldulensis (22), E. erythrocorys (2), E. exserta (1), E. fiefolia (1), E. melanophloia (1), E. microtheca (3), E. petlilis (2), E. punctata (1), E. saligna (1), E. straiticalyx (3), E. tereticornis (11), E. torelliana (1), E. urophylla (3), —all from Australia; Leucaena spp. (4), Leucaena collinsii (1), L. diversifolia (1), L. greggii (1), L. lanceolata (2), —all from UK; L. leucocephala (1), Argentina; L. macrophylla (1), L. pulverulenta (1), L. retusa (1), L. trichodes (1) —all from UK; Lupinus angustifolius (5), Egypt and Australia; L. albus, L. cosentini (1), L. luteus (1), Australia; Lolium multiflorum (14), L. rigidum (1), Ethiopia; Medicago spp. (105) Australia and USA; M. arabica (2), M. arboilaris (1), M. arborea (1), USA; M. ciliaris (1), M. cancellata (3), M. coronata (1), M. granatensis (2), M. gerardi (1), M. intertexta (2), M. laciniata (1), M. lineata (1), —all from USA; M. littoralis (2), Australia; M. lupulina (1), M. minima (2), M. murex (2), USA; M. polymorpha (3), Australia, Tunesia and USA; M. rigida (2), M. rotata (1), M. rugosa (2), M. scutellata (2) USA; M. sativa (61), Australia, Argentina, Tunisia and USA; M. tenuiflora (1), USA; M. truncatula (3), USA and Tunesia; M. tribuloides (1), M. turbinata (2), USA; Mimosa spp. (5), Brazil and Denmark; Parkinsonia aculeata (5), UK; Paspalum spp. (3), Argentina and Australia; Perilla sp. (9), Korea; P. frutescens (1), Japan; Prosopis spp. (6), Denmark and USA; P. flexuosa (2), P. cineraria (4), Denmark; P. juliflora (9), Tunisia and UK; P. pallida (3), Denmark;
P. glandulosa (3) P. tamarugo (3), Denmark; Rhynchosia sp. (1), R. auerea (1), R. bracteata (1), R. minima (1), ICRI SAT; Sesbania sp. (1), Philippines; Sesbania forskosa (3), Australia; S. rostrata (8), Australia and Philippines; S. sesan (1), Philippines; Schyzolobium sp. (1), Ecuador; Senna sp. (1), UK; Trigonella spp. (2), UK; Stylosanthes officinalis (1), USA; Trifolium repens (2), Argentina.

**FRUIT CROPS AND RELATED SPECIES:** Prunus arminiaca (13), Portugal, Canada and Tunisia; Carica papaya (8), Taiwan andTanzania; Castania asenita (3), Japan; Citrus spp. (16), Italy, Japan, Portugal and Tanzania; Ficus carica (5), Tunisia and USA; Guazuma ulmifolia (2), UK; Juglans regia (3), USA; Malus pumila (2), Japan; M. domestica (12), Canada; M. sylvestris (18), Japan and USA; Mangifera indica (1), Philippines; Morus spp. (9), France; M. alba (70), M. marioiti (3), M. multicaulis (10), M. nigra (3), M. rubra (2), M. rotundifolia (1), all from France; Olea europea (12), Greece and Portugal; Persea americana (1), Egypt; Prunus spp. (2), Canada and USA; P. avium (51), Canada and USA; P. domestica (7), Canada; P. persica (3), Japan and Philippines; Punica granatum (2), Tunisia; Pyrus communis (1), Philippines; P. malus (34), Canada, Japan and Tunisia; P. serotina (4), Japan; Ribes alpinus (1), Hungary; R. aureum (1), Hungary; Sanatum accuminatum (1), Australia; Vitis sp., Japan; Vitis vinifera (25), Australia and Portugal.

**MEDICINAL AND AROMATIC PLANTS:** Aegopodium podagraria (7), East Germany; Aconitum napellus (1), USA; Ammi majus (2), France and USSR; Anacyclus pyrethrum (1), France (root contains good quantity of Pyrethrin); Andrographis paniculata (1), Taiwan (source of household medicine called Alivi-a powerful, bitter tonic used for dysentery and diarrhea); Angelica archangelica (2), France and Hungary (source of Angelica-used in stomach ache); Anethum graveolens (4), Finland and Hungary; Anthemis altissima (1), A. arvensis (1), A. cotula (1), A. maritima (1), A. montana (1), A. tinctoria (1), all from France; Aipium graveolens (48), France, Philippines and USA; A. graveolens var. rapaceum (44), Philippines; A. minor (1), France; Arctostaphylos uva ursi (1) USA (good source of volatile oil-arbutin and quercetin); Artemisia alba (2), France and Italy; A. absinthium (3), France, Italy and USA (source of bitter oil-absinthol); A. annua (5), France, UK and USA (antimalarial properties); A. dracunculus (2), France and Italy, A. glauca, France; A. gemelina (2), France and Italy; S. mojimier (1), A. velotorum (1), A. vulgaris (1), all from France; Atropa beledonna (2), Hungary and USSR (contain good quality of atropin and hyoscyamine); Baikaea plurijuga (1), Zambia; Belamcanda chinensis (1), Bupleurum falcatum (1), from Taiwan; Caesalpinia velutina (1), UK; Camptotheca acuminata (1), Taiwan; Cannabis sativa (2),
Hungary (contain 15-20% of resin cannabine and essential oil); Carum carvi (2),
Hungary and Holland; Catharanthus roseus (2), Canada and USSR; Chenopodium
quinoa (14), Nepal; Chrysanthemum sp. (14), France; Cichorium endivia (13), USA;
C. intybus (28), France, New Zealand, USA and USSR; C. pumilum (1), USA;
Crocus sativus (2), Holland (1,00,000 flowers produce 1 kg Saffron and contain
crocin—a yellow glucoside used medicinally) and Spain; Datura innoxia (1), Romania;
Digitalis lanata (2), France and Hungary; D. lutea (1), D. orientalis (1), D. purpurea
(1), D. purpurea var. gloxinioides (1) France; Dipteracanthus repens (1), Taiwan;
Duboisia myoporoides (3), Japan (source of Anabasine, Hyoscyamine and Scopolamine);
Echallium elaterium (4), Japan (good source of Elaterium and Elaterin alkaloids which are used medicinally as a strong purgative); Ephedra equisetina (1)
USSR (Source of Ephedrin used as a substitute for andrenaline for asthma and
high blood pressure); Fagopyrum esculentum (25), USA and USSR; Geranium bohemicum (1), G. dissectum (1), G. ibericum (1), from France; Glycyrrhiza echinata (1),
France (root contains 6 per cent glycyrrhizin); G. glabra (1), Heracleum alpinum (1),
France; H. danatum (1), USA; Hedera helix (1), France; Humulus lupulus (7), Hungary
and USA (contains bitter acid, lupuline, humulon and lupulor); Hyssopus
officinalis (1), Hungary; Jasminum frutiscens (1), Lavandula angustifolia (3), France and Hungary;
L. latifolia (1), L. multifida (1), France; L. vera (1), Bulgaria; Levisticum officinale (1), Hungary; Linum catharticum (1), France; Majorana hortensis (1), Hungary (contains a greenish essential
oil, a mixture of borneol and camphor); Malva spp. (7), France; M. sylvestris (1),
UK; Melissa officinalis (1), France; Matricaria chamomilla (2), Romania (promising
for green herbage yield and high essential oil content) and USSR; M. matricarioides
(1), France; M. recutita (1), France; Melaleuca sp. (2), Australia; Mentha aquatica
(2), France and Italy; M. arvensis (3), M. longifolia (2), France and Italy; M. requienii, (1), France; M. rotundifolia (3), France and Italy; M. spicata (2), Italy; Moringa oleifera (2), Philippines and USA; Ocimum basilicum (2), France and Hungary;
O. basilicum var. citriodorum (1), O. basilicum var. purpureum (1), O. basilicum var.
lactucoefolium (1), from France; Ochrosia elliptica (1), New Calodonia (plant is
known to contain around 40 Pyridocarbazole (Ellipticine and its derivatives) and
other indole alkaloids; Origanum majorana (1), France; O. vulgare (1), France;
Papaver atlanticum (2), France and Italy; P. argemone (1), (2), Israel and USA.
(contains Alpinine, Epialpiline, Bractazonine, Muramine and Protopine alkaloids),
P. caucasicum (1), France; P. dubium (2) France and Italy; P. danebrog (1), USA;
P. hybridum (2), P. lateritium (1), P. myabeanum (1), France; P. nudicaule (2),
France and USA; P. orientale (3), France, Israel and Italy (total alkaloid yield
reaches to 3.3 g/m² in 3 years, Thebaine and Oripavine content is 0.76 g/m²,
P. pilosum (2), France and Italy; P. pseudo-orientale (1), Israel; P. rhoas (1),
France; P. somniferum (5), France, Hungary, Italy and Romania (maximum
Morphine is 0.84 per cent in dry matter. Morphine, Codeine and Thebaine are
major alkaloids); P. spicatum (1), France; Pelargonium sp (1), USA; Petroselinium
crispum (1), France; Pimpinella anisum (2), France and Hungary; P. major (1),
P. peregrina (1), P. saxifraga (1), France; Platycodon grandiflorum (1), Taiwan;
Plantago sp. (1), *P. afra* (1), *P. coronopus* (1), *P. indica* (1), *P. lagopus* (1), *P. media* (1), *P. major* (2), *P. macrorhiza* (1), *P. psyllium* (1), *P. sempervirens* (1), *P. serpentine* (1), *Polygonum* spp. (7), all from France; *Rosmarinus officinalis* (2), USA; *Salvia* spp. (23), France; *S. sclarea* (1), Hungary; *Satureia hortensis* (1), Hungary; *Schinus* sp. (1), Australia; *Schizolobium* sp. (1), Ecuador; *Silybum marianum* (2), W. Germany; *Stevia ovata* (1), France; *S. purpurea* (1), France; *Tectona grandis* (1), Ecuador; *Toona sinensis* (1), Taiwan; *Valleriana officinalis* (1), Romania (promising for green herbage yield and high oil content); *Vernonia gallamensis* (4), USA and Zimbabwe; *Vinca rosea* (1), France.

**SUGAR YIELDING CROPS: Beta vulgaris** (52), France, Denmark, Holland, Sweden (high sugar contents), USA, (resistant to *Cercospora beticola* and moderately resistant to curly top virus); *B. vulgaris* ssp. *maritima* (4), *B. vulgaris* ssp. *vulgaris* (9), *B. vulgaris* ssp. *orientalis* (2), *B. vulgaris* ssp. *macrocarpa* (1), E. Germany.


**UNDER-UTILIZED PLANTS:** *Amaranthus* spp. (36), Philippines, Kenya; *A. cruentus* (10), *A. hypochondriacus* (8), *A. hybridus* (2), from USA; *Parthenium argentatum* (143), USA and UK; *Simmondsia chinensis* (1) USA.

**NARCOTICS, BEVERAGE PLANTS AND RELATED SPECIES:** *Nicotiana tabacum* (9) Aden; *N. occidentulis* (1), *N. velutina* (1), *N. glauca* (1), *N. burbedgei* (1), Australia;

**TUBER CROPS:** *Colocasia* spp. (10) Fiji; *Manihot* spp. (29), Brazil; *Manihot esculenta* (10), Colombia, Fiji; *Solanum tuberosum* (671), Peru, USA, Hungary, Switzerland, Sweden, Canada and Japan.

**SPICES AND CONDIMENES:** *Coriandrum sativum* (2) Hungary, France; *Foeniculum vulgare* (2), Hungary, Taiwan;

**ORNAMENTAL PLANTS:** *Cassia fasciulata* (1), USA; *C. obtusifolia* (1), Taiwan; *Gladiolus* spp. (74), Canada, Egypt, Israel and USA; *Lunaria annua* (3), USA.

**MISCELLANEOUS PLANTS:** *Acer* sp. (1), USA; *Bauhinia* sp. (1), Philippines; *Bixa orellana* (1), Argentina; *Bombax malabaricum* (1), USA; *Broussonetia
papyrifera (1), France; Calliandra coloisyrus (4), Australia; Crescentia alata (1), UK; Erythrina sp. (1), Philippines; Enterolobium cyclocarpum (1), UK; Flemingia macrophylla (1), ICRISAT; Gliricidia sepium (40), Haematoxyylon brasiletto (1), UK; Machura sp. (2), France; Macrotyloma spp. (4), Moringa oleifera (1), USA; Myroperum frutescens (1), UK; Orbignya phalerata (1), Italy; Santalum spicatum (2), Italy; Sclerophyllum sp. (2), Philippines; Teramnus uncinatus (2), Australia; Tectona grandis (1), Ecuador.

C. Export of Plant Genetic Resources to Foreign Countries

The seeds and planting materials of agri-horticultural and silvi-agricultural crops were exported on the basis of (a) requests received by the Bureau/ICAR headquarters, (b) requests received by the scientists working in ICAR institutes/Agricultural Universities/other institutes in India (c) under protocols with different countries.

The plant materials intended for export were procured from known Indian sources through correspondence and were forwarded to the indentors in foreign countries along with phytosanitary certificates issued by the Plant Quarantine Division of the Bureau.

Volume of export of seed/planting material during 1987 is indicated below:
Number of consignments exported — 237
Number of new requests registered — 247
Number of countries to which materials exported — 61
Number of samples received/handled for export — 2,378
Details of samples forwarded to different countries are listed below:

**CEREALS, PSEUDOCEREALS AND MILLETS:** Triticum aestivum (873); Argentina, Australia, Bangladesh, Bhutan, Mangolia, Mexico, Italy, Nepal, Thailand, Turkey, UK, USA, USSR, Syria, Pakistan; Hordeum vulgare (32), Italy, Nepal, Syria and USA; Oryza sativa (376), Argentina, Bangladesh, Cuba, Italy, Malaysia, Nepal, Netherlands, Philippines, UK and USSR; Zea mays (103), Angola, Korea, Mexico, Nepal, Nigeria, Syria, Thailand, and West Indies; Sorghum vulgare (53), Sultanate of Oman, USA and USSR; Setaria italica (218), Bangladesh, Bhutan, Canada, Japan, Nepal, Nigeria, Pakistan, Sudan, USA and USSR; Pennisetum spp. (6), China, Nigeria, Oman and USSR; Amaranthus spp. (37), Nepal, Sri Lanka and Thailand; Echinochloa spp. (5), USA; Buckwheat (15), Nepal.

**PULSE CROPS:** Cajanus cajan (2), Zimbabwe; Cicer arietinum (2), Syria; Glycine max (16), Netherlands and UK; Lablab purpureus (2), USA, Djibouti; Phaseolus spp. (3), Italy; Mucuna spp. (3), France and USA; Pisum sativum (128), China and France; Vigna aconitifolius (10), Argentina, Montiallo, Niger, Djibouti; Vigna mungo (3), Canada, UK and Zimbabwe; Vigna radiata (8), UK, USSR and Zimbabwe; Vigna umbellata (1), UK; Vigna unguiculata (1), Sudan.
OILSEEDS: *Arachis hypogaea* (50), Bangladesh, Bhutan, Cyperus, Malaysia, Nepal, Pakistan and Syria; *Brassica* spp. (48), Bangladesh, Bhutan, Korea, France, Mongolia, Nepal, Germany (East), Pakistan, Scotland, Sri Lanka, Singapore, USA and USSR; *Helianthus annuus* (7), Niger and Vietnam; *Sesamum indicum* (15), Philippines, Korea, Syria and USSR; *Linum usitatissimum* (10), Colombia; *Guizotia abyssinica* (2), USA and Canada.

VEGETABLES: *Allium cepa* (14), Angola, Germany (West), Soloman Islands, West Indies and Mangolia; *Allium sativum* (2), Mangolia; *Abelmoschus esculentus* (1), USA; *Solanum melongena* (17), Angola, France, Kuwait, Sri Lanka, and DPRK; *Raphanus sativus* (2), Angola and DPRK; *Capsicum annuum* (20) Argentina, Netherlands, USA and Sri Lanka; *Lycopersicon esculentum* (23) Kuwait, Nepal, Costa Rica, Mangolia and USSR; *Pisum sativum* (2) Nepal and Angola; *Cucurbits* (13), Angola, France, Spain, Kuwait, Mangolia; *Daucus carota* (1), Angola; *Brassica* spp. (8), Mangolia and Spain; *Phaseolus vulgaris* (17), Germany, Ecuador, Poland, Zimbabwe, Monticillo; *Sesbania grandiflora* (1) Hungary; *Cyamopsis tetragonoloba* (1), Canada.

FRUITS: *Vitis vinifera* (12), Malawi and Ivory Coast; *Carica* spp. (5), Philippines; *Mangifera indica* (26), Tanzania, Nepal; *Artocarpus* sp. (1) USA; *Zizyphus* sp. (1), USA; *Annona squamosa* (1), *Psidium guajava* (1), Philippines.

FORAGE CROPS: *Acacia* sp. (2), *Prosopis* sp. (2), *Lasiurus sindicus* (1), Tunisia and Brazil; *Sorghum* (Forage) (3), Lesotho; *Parkinsonia aculeata* (1), *Dalbargia sissoo* (1), Brazil; *Cenchrus ciliaris* (4), USA and Vietnam; *Pennisetum* sp. (1), *Setaria* sp. (1), *Dicanthium* sp. (1), *Panicum* sp. (1), *Chrysopogon* sp. (8), all to Vietnam.

FIBRE AND INDUSTRIAL CROPS: *Gossypium* sp. (31), Bangladesh, Cyperus, Italy and UK; *Hibiscus cannabinus* (1), Bulgaria; *Withania somnifera* (1), USSR.

TUBER CROPS: *Manihot* sp. (1), UK; *Pachyrhizus erosus* (1), Belgiums, *Canna edulis* (1), Belgium.

NARCOTICS: *Nicotiana tabacum* (5), Nepal and Yemen; *Nicotiana benthania* (1), Yugoslavia; *Cannabis sativa* (4), Sweden.

MEDICINAL AND AROMATIC PLANTS: *Plantago psyllium* (1), *Plantago ovata* (1), Brazil; *Vetiveria zizanioides* (1), Nigeria; *Vernonia anthelmintica* (6), USA; *Rauwolfia serpentina* (1), *Solanum lacinatum* (1), *Azadirachta indica* (1) -Canada.

SUGAR YIELDING PLANTS: *Saccharum officinarum* (118), Egypt, Iraq, Japan, Laos, Philippines and USA.

SPICES AND CONDIMENTS: *Trigonella* sp. (1), Bolivia.
ORNAMENTALS: Gladiolus sp. (2), Nepal; Rosa indica (1), Mexico.

MISCELLANEOUS PLANTS: Prosopis cineraria (1), Italy.

C. Inland Supplies of Plant Genetic Resources and Related Information

The seeds and planting materials of diverse agri-horticultural and silvi-agricultural crops were supplied to ICAR Institutes/Co-ordinated projects and Agricultural universities/farmers and industrialists in different states and Union Territories of India based on specific requests received.

Details of germplasm/planting materials supplied to different states during 1987 are listed in Table 2.

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of samples</th>
<th>States/Union Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEREALS, MILLETS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triticum spp.</td>
<td>642</td>
<td>Delhi, Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal</td>
</tr>
<tr>
<td>Hordeum spp.</td>
<td>4</td>
<td>Bihar</td>
</tr>
<tr>
<td>Zea mays</td>
<td>18</td>
<td>Haryana, West Bengal</td>
</tr>
<tr>
<td>Panicum spp.</td>
<td>4</td>
<td>Karnataka</td>
</tr>
<tr>
<td>Eleusine coracana</td>
<td>49</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>OILSEEDS AND RELATED SPECIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brassica campestris</td>
<td>100</td>
<td>Andhra Pradesh, Delhi, Karnataka, Maharashtra</td>
</tr>
<tr>
<td>B. juncea</td>
<td>156</td>
<td>Delhi, Gujarat, Karnataka, Meghalaya, Uttar Pradesh</td>
</tr>
<tr>
<td>Helianthus annuus</td>
<td>168</td>
<td>Andhra Pradesh, Delhi, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Uttar Pradesh</td>
</tr>
<tr>
<td>Sesamum indicum</td>
<td>84</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>Glinzotia abstinica</td>
<td>25</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>PULSE CROPS AND RELATED SPECIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigna unguiculata</td>
<td>208</td>
<td>Andaman &amp; Nicobar, Assam, Andhra Pradesh, Bihar, Haryana, Kerala, Meghalaya, Maharashtra, Madhya Pradesh, Rajasthan, Orissa and Uttar Pradesh</td>
</tr>
<tr>
<td>Vigna radiata</td>
<td>43</td>
<td>Andaman &amp; Nicobar, Himachal Pradesh, Jammu &amp; Kashmir</td>
</tr>
<tr>
<td>V. mungo</td>
<td>52</td>
<td>Rajasthan, Uttar Pradesh, Himachal Pradesh, Punjab</td>
</tr>
<tr>
<td>Crop</td>
<td>No. of samples</td>
<td>States/Union Territories</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td><em>V. aconitifolia</em></td>
<td>3</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><em>Cajanus cajan</em></td>
<td>5</td>
<td>Manipur</td>
</tr>
<tr>
<td><em>Cicer arietinum</em></td>
<td>383</td>
<td>Andhra Pradesh, Maharashtra, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Pisum sativum</em></td>
<td>41</td>
<td>Bihar, Haryana, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Glycine max</em></td>
<td>295</td>
<td>Delhi, Madhya Pradesh, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Phaseolus vulgaris</em></td>
<td>3204</td>
<td>Bihar, Himachal Pradesh, Jammu &amp; Kashmir, Meghalaya, Punjab,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><em>Vicia faba</em></td>
<td>82</td>
<td>Andhra Pradesh, Himachal Pradesh, Karnataka, Rajasthan</td>
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<tr>
<td><em>Macrotyloma uniflorum</em></td>
<td>100</td>
<td>Rajasthan, Uttar Pradesh, West Bengal</td>
</tr>
<tr>
<td><em>Dolichos lablab</em></td>
<td>70</td>
<td>Andhra Pradesh, Haryana, Madhya Pradesh, Meghalaya, Punjab,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rajasthan, Tamil Nadu, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Lens culinaris</em></td>
<td>63</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><em>Canavalia ensiformis</em></td>
<td>6</td>
<td>West Bengal</td>
</tr>
<tr>
<td><em>Mucuna spp.</em></td>
<td>3</td>
<td>Rajasthan, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Vigna umbellata</em></td>
<td>1725</td>
<td>Bihar, Kerala, Meghalaya, Rajasthan, Uttar Pradesh</td>
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<tr>
<td><em>Phaseolus angularis</em></td>
<td>19</td>
<td>Delhi, Rajasthan</td>
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<tr>
<td><em>Cyamposis tetragonoloba</em></td>
<td>35</td>
<td>Andhra Pradesh, Haryana, Karnataka, Madhya Pradesh, Rajasthan,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uttar Pradesh</td>
</tr>
</tbody>
</table>

**VEGETABLE CROPS AND RELATED SPECIES**

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of samples</th>
<th>States/Union Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Abelmoschus esculentus</em></td>
<td>95</td>
<td>Bihar, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pradesh, Madhya Pradesh, Maharashtra, Orissa, Punjab,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rajasthan, Tamil Nadu, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Lycopersicon esculentum</em></td>
<td>258</td>
<td>Andhra Pradesh, Delhi, Gujarat, Haryana, Madhya Pradesh,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu</td>
</tr>
<tr>
<td><em>Solanum melongena</em></td>
<td>14</td>
<td>Nagaland, Maharashtra</td>
</tr>
<tr>
<td><em>Brassica oleracea var.</em></td>
<td>1</td>
<td>Himachal Pradesh</td>
</tr>
<tr>
<td><em>botrytis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Capsicum annuum</em></td>
<td>117</td>
<td>Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Himachal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pradesh, Jammu &amp; Kashmir, Karnataka, Madhya Pradesh,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maharashtra, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><em>Cyclenthra pedata</em></td>
<td>2</td>
<td>Himachal Pradesh</td>
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</table>
Table 2. (Continued)

<table>
<thead>
<tr>
<th>Crops</th>
<th>No. of samples</th>
<th>States/Union Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Allium cepa</em></td>
<td>102</td>
<td>Haryana, Himachal Pradesh, Maharashtra</td>
</tr>
<tr>
<td><em>A. sativum</em></td>
<td>26</td>
<td>Delhi, Gujarat, Haryana, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Lagenaria siceraria</em></td>
<td>6</td>
<td>Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Maharashtra</td>
</tr>
<tr>
<td><strong>FRUIT PLANTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Annona reticulata</em></td>
<td>89</td>
<td>Delhi, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra</td>
</tr>
<tr>
<td><strong>FORAGE CROPS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cichorium intybus</em></td>
<td>41</td>
<td>Jammu &amp; Kashmir</td>
</tr>
<tr>
<td><em>Desmodium sp.</em></td>
<td>3</td>
<td>Bihar</td>
</tr>
<tr>
<td><em>Trigonella foenum-graecum</em></td>
<td>1</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><strong>MEDICINAL AND AROMATIC PLANTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Artemisia annua</em></td>
<td>1</td>
<td>Maharashtra</td>
</tr>
<tr>
<td><em>Plantago psyllium</em></td>
<td>2</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td><em>Ocimum sanctum</em></td>
<td>1</td>
<td>Jammu &amp; Kashmir</td>
</tr>
<tr>
<td><em>Papaver somniferum</em></td>
<td>21</td>
<td>Jammu &amp; Kashmir</td>
</tr>
<tr>
<td><em>Hyoscyamus muticus</em></td>
<td>3</td>
<td>Maharashtra</td>
</tr>
<tr>
<td><strong>UNDER UTILIZED AND UNDER EXPLOITED CROPS AND RELATED SPECIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Amaranthus caudatus</em></td>
<td>1990</td>
<td>Assam, Andhra Pradesh, Arunachal Pradesh, Bihar, Gujarat, Himachal Pradesh, Karnataka, Meghalaya, Maharashtra, Mizo-ram, Orissa, Punjab, Tamil Nadu, Uttar Pradesh</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em></td>
<td>5</td>
<td>Haryana, Rajasthan</td>
</tr>
<tr>
<td><em>Simmondsia chinensis</em></td>
<td>13</td>
<td>Andhra Pradesh, Goa, Gujarat, Haryana, Madhya Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal</td>
</tr>
<tr>
<td><em>Psophocarpus tetragonolobus</em></td>
<td>32</td>
<td>Andhra Pradesh, Gujarat, Rajasthan, West Bengal</td>
</tr>
<tr>
<td><em>Sesbania rostrata</em></td>
<td>4</td>
<td>Delhi, Gujarat, Himachal Pradesh, Madhya Pradesh</td>
</tr>
<tr>
<td><em>Chenopodium spp.</em></td>
<td>18</td>
<td>Himachal Pradesh</td>
</tr>
<tr>
<td><strong>FIBRE CROPS AND RELATED SPECIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Gossypium spp.</em></td>
<td>144</td>
<td>Maharashtra</td>
</tr>
<tr>
<td><em>Crotalaria sp.</em></td>
<td>1</td>
<td>Rajasthan</td>
</tr>
</tbody>
</table>
D. Assembly of literature and Preparation of Inventories on Plant Genetic Resources

The literature on the availability of different plant genetic resources was procured from various research institutes, universities, botanical gardens and nurseries of the world.

Fifty-five Index Seminum of seed lists/catalogues etc. were procured and maintained for ready reference for the procurement of germplasm in different agri-horticultural crop plants from various countries. The information on sources of availability of various crop plants was also supplied to the scientists working in different organizations.

Inventories of species of *Cicer*, *Cajanus*, *Lens*, *Setaria*, *Vigna*, *Helianthus*, *Brassica*, *Capsicum*, *Vitis*, *Mentha*, *Datura*, *Plantago*, *Beta*, *Solanum*, *Ipomoea Manihot* and *Dioscorea* were compiled.

E. Documentation and Dissemination of Information on Plant Genetic Resources

Plant Introduction Reporter (III and IV issues, 1986 and I issue of 1987) was brought out.

F. Preparation of Bibliography on Plant Genetic Resources

Information on worldwide occurrence of plant genetic resources was collected from various published records with the aim of procuring these germplasm collections for various crop improvement programmes. Over 80 journals were consulted to gather 570 references. Based on information collected, over 4500 germplasm collections of various agri-horticultural crops were procured and introduced in the country.

Research Projects (Project Leader; Associates)

1. Procurement of plant genetic resources from foreign countries (B. P. Singh; R. V. Singh, Basant Kumar, M. Kazim, Deep Chand, Pratibha Brahmi).

2. Export of plant genetic resources (B. P. Singh; R. V. Singh, Deep Chand, Basant Kumar, M. Kazim, Pratibha Brahmi).

3. Inland supplies of plant genetic resources and related information to scientists (B. P. Singh; R. V. Singh, Basant Kumar, Deep Chand, M. Kazim, Pratibha Brahmi).

4. Preparation of bibliography on plant genetic resources (M. Kazim; B. P. Singh, Basant Kumar, R. V. Singh, Deep Chand, Pratibha Brahmi).
5. Assembly of literature and preparation of inventories on plant genetic resources (R. V. Singh; B. P. Singh, Basant Kumar, Deep Chand, Pratibha Brahmi).

6. Documentation and dissemination of information on germplasm both imported and collected in the form of 'Plant Introduction Reporter' (Basant Kumar; B. P. Singh, R. V. Singh, M. Kazim, Deep Chand, Pratibha Brahmi).
DIVISION OF PLANT QUARANTINE

The main responsibility of the Division is to examine the germplasm and other research materials under exchange through the Bureau for the detection of pests, pathogens and weeds of plant quarantine importance, to salvage the infested/contaminated materials by using appropriate disinfestation techniques and to conduct research supportive to different aspects of plant quarantine.

During the year, the Division received 86,922 samples of various agri-horticultural crops for quarantine clearance. Out of these, 83,945 samples were imported from different countries and the remaining 2977 samples were meant for export. These samples consisted of true seeds, rooted plants, cuttings, bulbs, rhizomes, nuts etc. of a wide variety of crops viz. cereals, pulses, oilseeds, vegetables, millets, fruit crops, fibre crops, forage crops, plantation crops, ornamentals, medicinal and aromatic plants etc.

A. Import Quarantine
(a) Quarantine Examination

Various seed health and other testing techniques were employed for detecting the presence of exotic insects, plant parasitic nematodes, plant pathogens and weeds in the incoming germplasm materials. Careful examination of materials revealed that 1251 samples were infested with insects and mites, 1326 with plant parasitic nematodes and 385 were infected with plant pathogens viz. fungi, bacteria and viruses. In addition, 236 seed samples were found to carry 29 different types of weeds.

Some of the economically more important exotic pests and pathogens, many of which are yet to be recorded from India, were: Bruchidius sp. on Spartium junceum from Hungary; Memosestes amicus on Acacia pennatula, Merobruchus paquetae on Albizzia caribaea from Honduras; Neltimus arizonensis on Prosopis juliflora from Colombia; Packymerus lacerdae on Orbyghya palerata nuts from Italy; Bootanomyia sp. in Casuarina equisetifolia and C. cunninghamiana seeds; Quadrastichodiella (= Flockiella) eucalypti in seeds of Eucalyptus microtheca; Megastigmus sp. in Casuaria glauca from Australia; Aphelenchoides besseyi in paddy seeds from Philippines, USA; Ditylenchus angustus (?) in wild groundnut kernels from USA; Pratylenchus penetrans and Aphelenchoides sp. on apple from Japan; Tylenchulus semipenetrans on citrus plants from Portugal; soybean downy mildew (Peronospora manshurica) on soybean seeds from Italy, Poland, Japan, USA and Zimbabwe; sugarbeet rust
(Uromyces betae) from Holland and USA; Karnal bunt (Neovossia indica) of wheat from Nepal and UK; sunflower rust (Puccinia helianthi) from Canada; blight (Ascochyta spp.) in Lathyrus spp. from Italy and in pea from USA.

Details of insects, mites, plant parasitic nematodes and plant pathogens intercepted on the imported material are given in Table 1.

Table 1. List of insects, mites, plant parasitic nematodes and pathogens intercepted from planting material in 1987

<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insects, Mites</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanthoscelides obtectus</td>
<td>Vicia faba</td>
<td>Morocco</td>
</tr>
<tr>
<td>Bootanomyia sp.</td>
<td>Casuarina cunninghamiana C. equisetifolia</td>
<td>Australia</td>
</tr>
<tr>
<td>Bruchidius chloroticus</td>
<td>Sesbania formosa, S. bispinosa, S. rostrata, S. sesban</td>
<td>France, Philippines</td>
</tr>
<tr>
<td>B. foveolatus</td>
<td>Spartium junceum</td>
<td>Hungary</td>
</tr>
<tr>
<td>Bruchophagus sp.</td>
<td>Fennel, Sesbania spp., Medicago sativa, Salvia verbenea, Leucaena leucocephala</td>
<td>Philippines, USA</td>
</tr>
<tr>
<td>B. gibbus</td>
<td>Medicago sativa</td>
<td>USA</td>
</tr>
<tr>
<td>Cryptolestes sp.</td>
<td>Paddy</td>
<td>Philippines</td>
</tr>
<tr>
<td>Dickatomus sp. (Eulophid)</td>
<td>Foeniculum sp.</td>
<td>Hungary</td>
</tr>
<tr>
<td>Megastigmus sp.</td>
<td>Acacia amplexps, Casuarina equisetifolia, C. glauca, Sesbania formosa, S. rostrata</td>
<td>Australia, Philippines</td>
</tr>
<tr>
<td>Mimosesites amicus</td>
<td>Acacia pennatula, Cercidium sp.</td>
<td>Honduras, USA</td>
</tr>
<tr>
<td>Merobruchus paquetae</td>
<td>Albizia caribaea, Pseudosamae sp.</td>
<td>Colombia, Honduras</td>
</tr>
<tr>
<td>Neltiumius arizonensis</td>
<td>Prosopis juliflora</td>
<td>Colombia</td>
</tr>
<tr>
<td>Oryzaephilus mercator</td>
<td>Crocus sativus bulbs, Maize</td>
<td>Spain</td>
</tr>
<tr>
<td>Pachymerus lacerdae</td>
<td>Orbignya phalerata nuts</td>
<td>Brazil</td>
</tr>
<tr>
<td>Pentobruchus germani</td>
<td>Parkinsonia aculeata</td>
<td>Nicaragua</td>
</tr>
<tr>
<td>Pieromalus sequester</td>
<td>Sesbania rostrata</td>
<td>Philippines</td>
</tr>
<tr>
<td>Quadrastichodella eucalypti</td>
<td>Eucalyptus microtheca</td>
<td>Australia</td>
</tr>
<tr>
<td>Rhizopertha dominica</td>
<td>Barley, Paddy, Wheat</td>
<td>Nigeria, Philippines, Syria, Tunisia</td>
</tr>
<tr>
<td>Sitophilus oryzae</td>
<td>Barley, Maize, Paddy, Wheat</td>
<td>Indonesia, Mexico, Nigeria, Philippines, Syria, Tunisia</td>
</tr>
</tbody>
</table>


(Table 1. Continued)

<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
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<tbody>
<tr>
<td><em>Sitotroga cerealella</em></td>
<td>Barley, Paddy</td>
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<td><em>Spermophagus albofasciatus</em></td>
<td><em>Hibiscus subdariffa</em></td>
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<tr>
<td><em>Stator limbatus</em></td>
<td><em>Acacia</em> sp.</td>
<td>USA</td>
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<td><em>S. pruinus</em></td>
<td><em>Samanea saman</em></td>
<td>Honduras</td>
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<td><em>Tribolium castaneum</em></td>
<td>Barley, <em>Crocus sativus</em></td>
<td>Spain, Syria</td>
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<tr>
<td><em>Tridymus</em> sp. (Pteromalidae)</td>
<td><em>Acacia</em> sp.</td>
<td>Australia</td>
</tr>
<tr>
<td>Unidentified</td>
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<td></td>
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<tr>
<td>Braconid</td>
<td><em>Acacia deamil</em></td>
<td>UK</td>
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<tr>
<td>Bruchids</td>
<td><em>Acacia</em> spp., <em>Cytisus</em> sp.</td>
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<tr>
<td></td>
<td><em>Lens</em> sp., <em>Leucaena</em> sp.</td>
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<td></td>
<td><em>Lathyrus</em> sp., <em>Mimosa</em> sp.</td>
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<td></td>
<td><em>Parkinsonia</em> spp.,</td>
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<td></td>
<td><em>Prosopis</em> sp.</td>
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<td></td>
<td><em>Phaseolus mungo</em></td>
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<td><em>Pisum sativum</em></td>
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<td></td>
<td><em>Pseudosamania</em> sp.</td>
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<td></td>
<td><em>Sesbania</em> spp.</td>
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<td><em>Samanea saman</em></td>
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<td></td>
<td><em>Trigonella</em> sp., <em>Vicia faba</em></td>
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<td></td>
<td><em>Vigna</em> sp.</td>
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<td>Dermestid larva</td>
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<td>Elaterid beetle</td>
<td><em>Perilla</em> sp.</td>
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<tr>
<td>Mealy bugs</td>
<td>Grape (cuttings)</td>
<td>Portugal</td>
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<tr>
<td>Mites</td>
<td><em>Apple</em> (cuttings), <em>Gladiolus</em></td>
<td>Brazil, Israel, Japan</td>
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<td></td>
<td>(bulbs), <em>Grape</em> (cuttings)</td>
<td>Portugal</td>
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<td></td>
<td><em>Humulus lupulus</em> (rhizomes),</td>
<td>USA, USSR</td>
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<tr>
<td></td>
<td><em>Mulberry</em> (scions),</td>
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</tr>
<tr>
<td></td>
<td><em>Prunus</em> (cuttings),</td>
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</tr>
<tr>
<td></td>
<td><em>Simarauba glauca</em></td>
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21
<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
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<tbody>
<tr>
<td>Psocids</td>
<td><em>Duboisia myoporoides</em></td>
<td>Brazil, Japan, Taiwan</td>
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<tr>
<td>Scales</td>
<td>Apple, <em>Prunus</em> (cuttings)</td>
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<tr>
<td>Scales</td>
<td>Sugarcane (setts)</td>
<td>Japan, USA</td>
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<tr>
<td>Thrips</td>
<td><em>Chloris guyana</em></td>
<td>Argentina</td>
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<tr>
<td><strong>Plant Parasitic Nematodes</strong></td>
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<tr>
<td><em>Tylenchulus</em> sp.</td>
<td><em>Olea europea</em> &amp; <em>Citrus</em> sp.</td>
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<td><em>Helicotylenchus</em> sp.</td>
<td><em>Paspalum vaginatum</em></td>
<td>Australia</td>
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<td><em>Pratylenchus</em> penetrans</td>
<td><em>Pyrus</em> <em>malus</em></td>
<td>Japan</td>
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<td><em>Aphelelenchoides</em> sp.</td>
<td><em>Arachis</em> <em>pustilla</em></td>
<td>USA</td>
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<tr>
<td><em>Ditylenchus</em> angustus (?)</td>
<td><em>Humulus lupulus</em></td>
<td>USA</td>
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<tr>
<td><em>Ditylenchus</em> sp.</td>
<td><em>Crocus sativus</em></td>
<td>Netherlands</td>
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<tr>
<td><em>Aphelelenchoides</em> sp.</td>
<td><em>Gladiolus</em> corms</td>
<td>Israel</td>
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<td><em>Pratylenchus</em> sp.</td>
<td><em>Tylenchorhynchus</em> sp.</td>
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<td><em>Aphelelenchoides</em> sp.</td>
<td><em>Rooted plants</em></td>
<td>Greece</td>
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<td><em>Longidorus</em> sp.</td>
<td><em>Oryza sativa</em></td>
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<td><em>Aphelelenchoides</em> besseyi</td>
<td><em>Setaria italica</em></td>
<td>Bangladesh</td>
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<tr>
<td><em>Aphelelenchoides</em> besseyi</td>
<td><em>Beta vulgaris</em></td>
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<tr>
<td><em>Xiphinema</em> sp.</td>
<td><em>Stylosanthes</em> sp.</td>
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<td><em>Pratylenchus</em> sp.</td>
<td><em>Medicago</em> sp.</td>
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<td><em>Psilenchus</em> sp.</td>
<td><em>Ficus</em> <em>carica</em>, <em>Prunus</em> <em>armeniaca</em> &amp; <em>Punica</em> <em>granatum</em></td>
<td>Tunisia</td>
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</table>
(Table 1. Continued)

<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
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<tbody>
<tr>
<td><strong>Aphelenchoides</strong> sp.</td>
<td><em>Phaseolus</em> sp. &amp; <em>Allium</em> sp.</td>
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<td><strong>Aphelenchoides</strong> sp.</td>
<td><em>Triticum</em> sp.</td>
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<td><strong>Neopsilenchus</strong> sp.</td>
<td><em>Tylenchorhynchus</em> sp.</td>
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<tr>
<td><strong>Pathogens</strong></td>
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<td><em>Botryodiplodia</em> sp.</td>
<td><em>Acacia</em> spp.</td>
<td>Australia</td>
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<td><em>Colletotrichum gloeosporioides</em></td>
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<td>Australia</td>
</tr>
<tr>
<td><em>Fusarium solani</em></td>
<td></td>
<td>Australia, UK</td>
</tr>
<tr>
<td><em>Macrophomina</em> sp.</td>
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<td>Australia</td>
</tr>
<tr>
<td><em>Phoma</em> sp.</td>
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<td>Australia</td>
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<td><em>Phomopsis</em> sp.</td>
<td><em>Albizzia caribae</em></td>
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<td><em>Fusarium solani</em></td>
<td><em>Allium</em> spp.</td>
<td>Egypt</td>
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<td><em>Phomopsis</em> sp.</td>
<td><em>Attalea herbert</em></td>
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<td><em>Claviceps purpurea</em></td>
<td><em>Avena sativa</em></td>
<td>USA</td>
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<td><em>Drechslera sorokiniana</em></td>
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<td><em>Fusarium poae</em></td>
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<td><em>Fusarium solani</em></td>
<td><em>Beta vulgaris</em></td>
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<td>USA, USSR</td>
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<td><em>Alternarlia brassicicola</em></td>
<td><em>Brassica</em> spp.</td>
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<td></td>
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<td>Holland, Nepal,</td>
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<td></td>
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<td>Philippines,</td>
</tr>
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<td></td>
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<td>Taiwan, UK</td>
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<tr>
<td><em>A. brassicae</em></td>
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<td>Canada</td>
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<tr>
<td><em>A. raphani</em></td>
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<td>Canada</td>
</tr>
<tr>
<td><em>Fusarium solani</em></td>
<td></td>
<td>China, France,</td>
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<tr>
<td></td>
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<td>Taiwan, UK</td>
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<td><em>Phoma lingam</em></td>
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<td>Canada, UK</td>
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<td><em>Xanthomonas campestris</em></td>
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<td>Pakistan, Taiwan,</td>
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</table>

(Contd.)
<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Ascochyta sp.</td>
<td>Caesalpinia velutina</td>
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<td>Fusarium culmorum</td>
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<td>UK</td>
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<tr>
<td>Phomopsis sp.</td>
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<td>UK</td>
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<tr>
<td>Macrophomina sp.</td>
<td>Camptotheca acuminata</td>
<td>Taiwan</td>
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<tr>
<td>Drechslera sorokiniana</td>
<td>Capsicum spp.</td>
<td>Hungary, Costa Rica, Hungary, Czechoslovakia, Nigeria, Taiwan, USA, Japan, Bhutan, Nepal, E. Germany</td>
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<tr>
<td>Fusarium solani</td>
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<td>USA, Japan, UK, Italy, USA, Australia, Bulgaria, Canada, USA, Italy, Bulgaria, UK, Ethiopia, Taiwan, USA</td>
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<tr>
<td>C. acutatum</td>
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<tr>
<td>Fusarium solani</td>
<td>Crotalaria sp.</td>
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<tr>
<td>Macrophomina sp.</td>
<td>Echiellum elaterium</td>
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<tr>
<td>Fusarium solani</td>
<td>Eleusine spp.</td>
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<tr>
<td>D. oryzae</td>
<td>Pyricularia oryzae</td>
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<tr>
<td>Botrytis sp.</td>
<td>Evonymus europae</td>
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<tr>
<td>Phomopsis sp.</td>
<td>Glicricidria sepium</td>
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<tr>
<td>Botryodiploida sp.</td>
<td>Glycine spp.</td>
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<td>Peronospora manshurica</td>
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<td>Fusarium solani</td>
<td>Guazuma ulmifolia</td>
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<td>Fusarium solani</td>
<td>Helianthus annuus</td>
<td>Italy, USA, Australia, Bulgaria, Canada, USA</td>
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<td>Ascochyta sp.</td>
<td>Lathyrus odoratus</td>
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<td>Lavandula vega</td>
<td>Bulgaria</td>
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<td>Colletotrichum gloeosporiodes</td>
<td>Leucaena sp.</td>
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<tr>
<td>Drechslera teres</td>
<td>Lolium sp.</td>
<td>Ethiopia</td>
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<tr>
<td>Drechslera sorokiniana</td>
<td>Lycopersicon esculentum</td>
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<tr>
<td>Fusarium solani</td>
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<tr>
<td>Colletotrichum dematium</td>
<td>Macrotyloma uniflorum</td>
<td>USA</td>
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</tbody>
</table>

(Table 1. Continued)
Imported *Orbygnya phalerata* nut cut open to show bruchid infestation

Exotic cowpea germplasm being inspected in Post-Entry Quarantine (net house) at Delhi
Imported date palm suckers being grown in quarantine net house at Bikaner.

Soil samples being collected for post quarantine surveillance of date palm nematode pests, at Beechwal farm, Bikaner.
<table>
<thead>
<tr>
<th>Pest/Pathogen</th>
<th>Planting material</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fusarium solani</em></td>
<td><em>Medicago</em> spp.</td>
<td>Australia, USA</td>
</tr>
<tr>
<td><em>Fusarium solani</em></td>
<td><em>Mentha</em> sp.</td>
<td>France</td>
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<tr>
<td><em>Drechslera oryzae</em></td>
<td><em>Oryza sativa</em></td>
<td>Nigeria, USA</td>
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<tr>
<td><em>D. sorokiniana</em></td>
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<td></td>
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<tr>
<td><em>Fusarium dimerum</em></td>
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<td><em>F. equiseti</em></td>
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<td><em>Rhizoctonia</em> sp.</td>
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<tr>
<td><em>Trichoconis padwickii</em></td>
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<tr>
<td><em>Fusarium solani</em></td>
<td><em>Paspalum</em> spp.</td>
<td>W. Australia</td>
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<td><em>Ascoc hyto</em> sp.</td>
<td><em>Pisum sativum</em></td>
<td>USA</td>
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<td><em>Fusarium salali</em></td>
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<td>France</td>
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<td><em>Fusarium solani</em></td>
<td><em>Prunus</em> spp.</td>
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<td><em>Fusarium solani</em></td>
<td><em>Quinoa</em> sp.</td>
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<td><em>Botryodiplodia</em> sp.</td>
<td><em>Red palm</em></td>
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<td><em>Colletotrichum graminicola</em></td>
<td><em>Saccharum</em> spp.</td>
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<td><em>Macrophomina</em> sp.</td>
<td><em>Schinus</em> sp.</td>
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<tr>
<td><em>Botryodiplodia</em> sp.</td>
<td><em>Sesbania formosa</em></td>
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<td><em>Macrophomina phaseolina</em></td>
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<tr>
<td><em>Phomopsis</em> sp.</td>
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<td><em>Drechslera sacchari</em></td>
<td><em>Setaria</em> spp.</td>
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<td><em>Botryodiplodia</em> spp.</td>
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<tr>
<td><em>Diplodia</em> sp.</td>
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<td><em>Colletotrichum gloeosporioides</em></td>
<td><em>Stylosanthes</em> sp.</td>
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<td><em>Drechslera maydis</em></td>
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<td><em>Claviceps purpurea</em></td>
<td><em>Triticum</em> spp.</td>
<td>Hungary, USA</td>
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<td><em>Neovossia indica</em></td>
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<td>Nepal, Mexico, UK, Australia, Syria, Poland</td>
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<td><em>Tilletia caries</em></td>
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</tr>
<tr>
<td><em>T. foetida</em></td>
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<td></td>
</tr>
</tbody>
</table>

(b) Salvaging of Infested/Infected/Contaminated Germplasm

All out efforts were made to salvage the samples found to carry exotic pests and pathogens by using different techniques to make the maximum germplasm available for use in the country in a healthy state. Thus out of 1251 samples found infested with insects and mites, 614 samples were salvaged through fumigation, 256 samples
through insecticidal dips/sprays, 379 through X-ray radiography and 195 samples were given prophylactic treatment. Only two samples (one of *Eucalyptus microtheca* and one of *Casuarina cunninghamiana*) imported from Australia, which showed almost 100% seed infestation, were rejected. Out of 1326 samples found infested/contaminated with nematodes, 136 samples were given hot water treatment or nematicidal dips and 1188 samples were mechanically cleaned. Only two samples of wild groundnut from USA found infected with *Ditylenchus angustus (?)* were not released. From 385 samples found infected with various plant pathogens, 270 samples were salvaged through hot water treatment, sulphuric acid treatment, alcohol washing (for rusts), dry seed treatment and fungicidal dips. Rest 115 samples which could not be salvaged, had to be rejected. All the 236 seed samples contaminated with weeds were cleaned manually and released. Thus out of 3198 samples carrying exotic pests, pathogens and weeds, 3079 (over 96%) samples were salvaged. Considering the total imports, more than 99.8 per cent of the material was made available to the user agencies in the country. In addition, more than 13,800 paddy seed samples received from IRRI, Philippines and other countries were given mandatory prophylactic hot water treatment before release.

(c) Post-entry Quarantine Inspection

(i) Cereals: During 1986–87, a total of 6597 lines of pesticide treated wheat, triticale and barley received from CIMMYT (Mexico), ICARDA (Syria) and USA were planted in the International Post-entry Quarantine Nursery (IPEQN) for the detection of exotic plant pathogens which do not express during laboratory tests because of seed treatment with pesticides. Daily inspection of the crops revealed loose smut (*Ustilago nuda*) infection in four entries of wheat. Four thousand four hundred thirty entries of wheat and triticale and 705 entries of barley received during 1987–88 have been planted in IPEQN and are being closely monitored for seed-borne pathogens.

(ii) Oilseeds: Three hundred twenty lines of safflower germplasm received from USA were raised in the IPEQN after laboratory salvaging from rust infection. All the germplasm lines were found free from exotic diseases during the growing period. Seeds of six hybrids of sunflower from USA and Yugoslavia were also grown in the Nursery for the detection of downy mildew and other diseases. Although no exotic disease was detected, cultivars Morden and MSH-1 were found susceptible to white rot (*Sclerotinia sclerotium*) and charcoal rot (*Macrophomina phaseolina*).

(d) Detection of Seed-borne Viruses

(i) Cowpea: Out of 627 entries of cowpea received from Nigeiia, Philippines and USA, 110 lines showed a few plants with symptoms of yellow mottling and one line vein banding symptoms during their growth in the insect-proof net house. Serological tests carried out with nine antisera gave positive reaction with cowpea.
mottle and aphid-borne cowpea mosaic antisera. Infected plants were carefully removed and burnt.

(ii) Soybean: Four hundred thirty-nine entries received from Australia, Brazil, Italy, Japan and Poland when grown in the insect-proof net house revealed mosaic symptoms in four accessions.

(iii) Frenchbean: Out of 79 entries grown in the net house two entries exhibited yellow mosaic. Vein banding and marginal chlorosis symptoms were observed in 20 lines.

(iv) Pea: Out of 695 accessions received from France and USA during 1987 and grown in quarantine net house, a few lines showed downward rolling of leaves. Further observations are in progress.

Besides monitoring the material for exotic seed borne viruses at the Bureau, 2277 samples of imported legumes were released to various indenting scientists in the country against undertaking that the material would be grown in insect-proof net houses under the direct supervision of pathologist/virologist for one crop season and that only produce from healthy crops would be grown in the open fields.

All the crops raised in the IPEQN and the net house were regularly sprayed with suitable pesticides to keep them free from local pests/pathogens.

B. Export Quarantine

A total of 2977 germplasm samples meant for export was also examined for associated pests and pathogens. Examination of these samples led to the rejection of 22 wheat samples because of Karnal bunt (*Neovossia indica*) infection and two samples of gram and mungbean heavily infested with bruchids. Phytosanitary certificates were issued in respect of the material cleared for export.

C. Preparation of Check-lists of Insect pests, Nematodes and Diseases of Crops

With a view to know beforehand the risks involved in the import of germplasm of different crops from various countries, available world literature was scanned for collection of information on all aspects concerning quarantine with regard to insect pests, nematodes and diseases.

Insect pest-risk analysis was done for rice, jute, mesta and arid zone fruit crops. Over 825 insect species have been reported on rice in the field and in storage from all over the world, out of which about 27 species are not yet known from India. Similarly, 66 species of insects and mites are reported on jute and 58 on mesta. Out of these, seven species on jute and 14 on mesta have not so far been reported from India. However, none of these infest seeds (except one bruchid reported on mesta seeds which calls for X-ray screening of imported mesta
seeds) and can be safely introduced. On arid zone fruits—Artocarpus, Annona, Carica, Cordia, Ficus, Eugenia, Grewia, Manilkara, Psidium, Phyllanthus, Phoenix, Punica, Syzigium and Ziziphus, over 40 species of Eriophyoid mites have been reported. However, no eriophyoids have been reported on Carissa and Tamarindus.

Information on the association of nematodes with the following crops viz. rice, maize, sugarbeet, soybean, potato, groundnut, sunflower, sesame, linseed, coconut, apple, Alysicarpus vaginalis, Desmodium spp., Lespedeza bicolor, L. cyrtobotrya, L. cuneata, L. stipulacea, L. striata, Stylosanthes hamata, Acrocomia sclerocarpa, Ambrosia artemisia and Brassica spp. was further updated. Some notable additions to check list are: Tylencephrychnus annulatus, Criconemella onoensis and five species of Paratylenchus have been found associated with rice for the first time. Meloidogyne incognita from Costa Rica, Hirschmanniella oryzae from China, Pratylenchus zeae from Cuba are reported on rice for the first time from these countries. On soybean Tylencephrychnus claytoni from USA, Meloidogyne incognita from Italy and Pratylenchus crenatus and Rotylenchulus reniformis from India are recorded for the first time. Besides already known species, following new nematode species have been recorded on different crops: Heterodera phragmitidis on maize from USSR, Merlinius nizamii on coconut from India, Discotylenchus tuberosus on potato from Pakistan, Xiphinema fluminense on maize from Brazil, Paratrophurus costaricanus on rice from Costa Rica and Scutylenechus quettensis on apple from Pakistan. Among the 45 species reported on groundnut, Aphelenchoides arachidis and Pratylenchus brachyurus need to be watched as they are seed-borne and are not known from India.

List of diseases attacking tobacco, jute and fababean was compiled. Blue mould (Peronospora tabacina), leaf spot (Cercospora nicotianae) and anthracnose (Colletotrichum tabacum) on tobacco; black band (Botryodiplodia theobromae), anthracnose (Colletotrichum corchori), leaf spot (Cercospora corchori) and bacterial wilt (Pseudomonas solanacearum) on jute; leaf and pod spot (Ascochyta fabae), charcoal spot (Botrytis fabae), anthracnose (Colletotrichum lindemuthianum) and downy mildew on fababean are some of the important diseases of quarantine significance.

D. Survey of nematodes in Issapur Farm of NBGR and screening of germplasm against nematodes

During this year, identification of nematode species was completed and a map depicting population densities of common species and their distribution in each plot of the farm was prepared for use of the scientists evaluating different crops at the Issapur Farm.

Germplasm lines/collections of sem (Lablab purpureus) and tomato which showed resistance against root knot nematode (Meloidogyne incognita) during preliminary screening, were again screened by inoculating 500 second stage juveniles.
per plant. In *sem* IC-7700/V-16 and Sel. 68/IC-77002 were found highly resistant while IIHR-164 and IC-46158 were moderately resistant. In tomato EC—129606, —129606-P-1, —115950, —141834-1, —120120, —128016, IC-76992, —76999 and —76995 were found highly resistant.

In wheat NC—62379, —59609, —59605, —54221, —60222, —47490, —49607, —66539, —58155, —62334, —63939, —55673, —55659 and —57587 were found resistant against wheat cyst nematode (*Heterodera avenae*) during preliminary screening at inoculum level of two cysts per plant. These, along with 44 moderately resistant lines are being screened again for final evaluation.

**E. New Host Records of Insect Pests**

Seven insect species viz. *Cydnus indicus*, *Cleonus (Cosmogaster) lateralis*, *Holotricha* sp., *Pemelina indica*, *Schizonycha ruficollis*, *Sphenoptera* sp. and *Sminthus viridis* have been recorded for the first time in the world on date palm from India during a survey of major date palm plantations in the country undertaken earlier.

**Research Projects (Project Leader; Associates)**


2. Survey of nematodes in Issapur Farm of NBPGR and screening of germplasm collections against nematodes (A. Lal; Rajan, V. K. Mathur).

3. Analysis of pest risks involved in proposed import of plant material (B. R. Verma; B. Lal, Manju Kapoor).


5. Preparation of check-list of plant diseases of various crops (A. K. Lambat; Ram Nath, A. Majumdar, P. C. Agarwal, S. Singh, Usha Dev).

DIVISION OF PLANT EXPLORATION AND COLLECTION

The main functions of the Division are to plan, undertake and coordinate activities on plant exploration and germplasm collection. Based on crop/area priorities for exploration and specific needs to collect germplasm from different locations of cultivated and/or wild types, 44 explorations were undertaken. Of these 15 were multi-crop or region specific, and 29 were crop specific. Out of these, over 10 were in collaboration with crop-specific institutes, ICAR Coordinated Projects and Agricultural Universities viz., IIHR, Bangalore; CIHNP, Lucknow; CRRRI, Cuttack; JARI, Barrackpore; CTCRI, Trivandrum; CICR, Nagpur; AICRPUII & UEP, AICRP, M & AP, New Delhi; NDUAT, Faizabad; GBPUA & T, Pantnagar; Birsa Agri. Univ., Kanke. Six crop specific explorations as per ICRISAT/NBPGR collaborative exploration programme were also undertaken. One IBPGR funded exploration was also coordinated for sorghum collection in East Africa and one scientist each from IARI and NBPGR participated in it. International participation also included IRRI, Philippines for collection of wild rice in south India, and an Indo-Japanese collaboration programme for collection of minor millets from coastal region of Maharashtra and parts of Orissa.

Eleven explorations were undertaken by the Headquarters, of which nine were taken by Exploration Division Staff. Areas covered under these included the western cold-arid region of Ladakh Himalayas, north-western hilly tracts of Uttar Pradesh, coastal region of Maharashtra, Chotanagpur region of Bihar, tribal belts of Sarguja, Raigarh, Bilaspur and Bastar districts of Madhya Pradesh and parts of Tamil Nadu, Kerala and Andhra Pradesh. Crop diversity of nearly 1100 samples was collected (Table 1). Details of crop diversity collected during various crop-specific and multicrop explorations are discussed below.

A. Multicrop/region specific exploration

(a) Exploration in north-western plains/hills in Uttar Pradesh

In north-western plains/foot hills of Uttar Pradesh, 87 sites were surveyed in districts of Nainital, Muzaffarnagar, Bijnour, Saharanpur, Meerut and adjoining parts and a total of 177 collections of Rabi crops i.e. wheat, barley, lentil, chickpea, pigeonpea and others were made. In wheat, good variability in respect of plant height, tillering potential, earhead length and grain size/colour was collected. In chickpea, variability in seed size and colour was prominent. In pigeonpea, mainly two types occurred, one with early maturity and dwarf (90 — 120 cm) and the -
Table 1. Plant Explorations Undertaken—1987

<table>
<thead>
<tr>
<th>Collector(s)</th>
<th>Period of collection</th>
<th>Regions explored</th>
<th>Crop diversity collected</th>
<th>Number of collections</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-crop/region-specific exploration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. N. Koppar</td>
<td>April</td>
<td>North-western plains/foot hills of Uttar Pradesh (Nainital, Moradabad, Muzaffarnagar, Bijnaur, Saharanpur &amp; Meerut Districts)</td>
<td>Wheat, barley, maize, lentil, chickpea, mustard, several cucurbits and other vegetables</td>
<td>177</td>
</tr>
<tr>
<td><strong>Crop specific explorations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. Mauria</td>
<td>January</td>
<td>Chotanagpur region (Palamau, Gumba, Lohardaga and Ranchi Districts)</td>
<td>Toria and other brassicace</td>
<td>30</td>
</tr>
<tr>
<td>Umesh Chandra</td>
<td>April/May</td>
<td>North-easter Madhya Pradesh (Tribal tracts of Sarguja, Raigarh and Bilaspur Districts)</td>
<td>Cucurbits &amp; other vegetables and medicinal plants</td>
<td>121</td>
</tr>
<tr>
<td>R. K. Arora</td>
<td>August</td>
<td>Central Uttar Pradesh (Musanagar and adjoining areas)</td>
<td>Vetiver</td>
<td>12</td>
</tr>
<tr>
<td>S. Mauria, B. M. Singh</td>
<td>Sept./Oct.</td>
<td>Almora and Chamoli Districts in Uttar Pradesh</td>
<td>Forage grasses, medicinal plants (Coles &amp; Urgenta)</td>
<td>47</td>
</tr>
<tr>
<td>M. N. Koppar (with Japanese team)</td>
<td>Oct./Nov.</td>
<td>Coastal region of Maharashtra</td>
<td>Minor millets mainly</td>
<td>182</td>
</tr>
<tr>
<td>Umesh Chandra</td>
<td>November</td>
<td>Tribal belt of south-western Baster, Madhya Pradesh</td>
<td>Paddy and vegetables</td>
<td>143</td>
</tr>
<tr>
<td>S. Mauria and K. E. Prasada Rao ICRISAT</td>
<td>December</td>
<td>Parts of Tamil Nadu, Kerala and Andhra Pradesh</td>
<td>Sorghum mainly</td>
<td>124</td>
</tr>
<tr>
<td><strong>Local trip</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umesh Chandra</td>
<td>December</td>
<td>Around Delhi (both ridges and other areas)</td>
<td>Medicinal plants—Tinospora cordifolia, Aloe barbadense</td>
<td>9</td>
</tr>
<tr>
<td>B. M. Singh</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Veena Gupta</td>
<td></td>
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<td></td>
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<tr>
<td>Diversity collected in other crops during crop-specific explorations</td>
<td></td>
<td></td>
<td></td>
<td>207</td>
</tr>
<tr>
<td><strong>Total diversity collected</strong></td>
<td></td>
<td></td>
<td></td>
<td>1094</td>
</tr>
</tbody>
</table>
other tall (120 — 210 cm) and late maturing. Seed colour variability was distinct with deep brown, yellow and black. Branching was erect and profuse. In cowpea, long pod (30 — 40 cm) types with 20-22 bold, red seeds/pod were collected. Among vegetables, enormous variability in fruit size and shape in bottlegourd, bittergourd, pumpkin and others was noted.

B. Crop-specific explorations

(a) Exploration for forage grasses from north-western hilly tracts of Uttar Pradesh

Parts of Kumaon and Garhwal sub-himalayan region of Almora and Chamoli (1200 — 3500 m) were covered. Collections made were mainly from wild habitats and fields. Representative samples of vegetative stocks of important grasses, mainly Dactylis, Phleum, Arundinella, Setaria, Panicum and Paspalum were collected. Collections included variability in plant height, tillering capacity and leafiness. Samples were planted at Bhowali regional station for further evaluation and study.

(b) Wild chickpea collection from Kargil and Zanskar ranges in Ladakh Himalayas

The high altitude (3000 — 4500 m) ranges in Kargil and Zanskar (Ladakh Himalayas) were surveyed and samples of wild chickpea (Cicer microphyllum) and natural wild legumes viz., Medicago minima, Astragalus, Trigonella species and some wild fodder grasses viz. Agropyron, Bromus and Elymus were collected. Prongos—an umbellifer used as hay was collected from Dras. Cultivated forage legumes included Medicago falcata, M. sativa and Melilotus alba.

(c) Exploration for collection of native types in paddy from northern, western and south-western parts of Bastar, Madhya Pradesh

Northern, western and south-western portion of Bastar, much of which is under penda/shifting cultivation, was surveyed and diversity collected included mainly paddy as also cucurbitaceous and other vegetables.

In paddy 83 different landraces mainly of upland types were collected from over 60 sites. The germplasm of local types included:

(i) Northern part (Bhanupratappur and Amabeda blocks): Chepati Gurmatiya, Kachna, Kokal, Badshahbhog, Gadakhuta, Santera, Safri, Luchai, Gajo, Daundo, Bharangi, Parewan, Bhatakhuti, Laliajan, Lindhan, Ratanchudi, Lalu, Kondi and Khuraban;

(ii) Western part (Bhairamgarh, Bijapur, Kutru, Medded and Bhopal Patanam blocks): Gudma, Rajbako, Bangabeej, Saumsari, Safri, Chudi, Badshahbhog, Laldhan, Babaibuta, Barongi, Bhatamokdo, Deewari, Ratakusumal, Pachgannel, Pichudi, Luchai, Pisaru, Gallavadiju and Chinabuchi;

(iii) South-western part (Usoor, Gangloor, Awapalli, Basaguda, Jagargunda, Pujari Kanker, Konta and Sukma blocks): Chindhai, Chintakomalu, Sindursinga,
Urginia indica—a collection from wet habitat (collected from village—Semlia, Rajasthan)

Coleus forskohlii—occurring in natural habitat in the hills of Chamoli district, UP
Sorghum roxburghii in natural habitat near Anikatti forest range in Kerala

Variability collected in Bael fruits.
Sindbahini, Nambarlu, Navasinga, Palgunna, Burda, Motinga, Chhinarbuchi, (Chhote Kosavari), Danvar, Saumsari, Vargavark, Dasarasinga, Chandoor, Kudesari/Diari, Neel, Badebuchi (Bade Kosavari), Kadampul, Chindibayani, Samsar, Kaladhan, Sitambai, Pichodi, Bodla, Bodla, Chikhakkottal, Chuttumuchhal (Buchivadlu), Siklakkoral (Eklovanji—Marla), Tolliballu, Atiya, Chandoor, Barangi, Podse, Balancing and Mokdo.

Above types include scented and/or early/late types. Some of the promising types are:

— early upland types such as Nallavadlu, Pachagannel, Bangabeej, Kachna, Balsinga, Chandoor and Kadampul in unbunded lands; and Deewari, Siklakkottal, Kudesari, Vargavark, Sindursinga, Chhinabuchi, Chhote Kosavari, Neel and Navasinga in bunded conditions;

— medium duration types in bunded lands such as Bodla, Pichodi, Safi etc.;

— late duration adapted to extreme lowland situations: Badebachi, Bade Kosavari, Badshabhog, Bhatakuji and Lalitajari;

— highly scented types such as Badshahbhog, Burda, Kadampul and Santera;

— locally preferred tasty types such as Chepati Gurmatya, Daundo, Palguna, Motinga, Chinnabuchi (Chhote Kosavari), Badebuchi (Bade Kosavari) and Chandoor;

— drought tolerant types such as Dasarasinga, Chikhakkottal and Deewari;

— slender fine grain types—Santera, Badshahbhog, Daundo, Lindhan, Ratanchudi, Bangabeej, Babibuta, Nallavadlu, Navasinga, Neel, Sitambai and Chuttumuchhal (Buchivadlu) and

— relatively rare types—Ratakusumal (from Gilgichha forest area), Kachna, Gajo, Saumsari and Lalu.

(d) Collection of sorghum germplasm from parts of Tamil Nadu, Kerala and Andhra Pradesh

An exploration for collection of native variability in sorghum was undertaken jointly with ICRISAT and TNAU, Coimbatore in parts of Tamil Nadu, Kerala and Andhra Pradesh. Areas surveyed included Anaikaiti hills, Bhawani sagar, Mangalapuram, Srivani hills, Palni, Kodaikanal, Periaokulam, Coimbatore, Tirupati, Piler, Bodimetti, Munnar, Anantpur and Nandyal. 124 samples mainly of bicolor—durra, dochnas and roxburghii including a wild type—S. nitidum were collected. Immense variability was observed in ear exertion, straight/goose necked and lax/compact nature of panicle, pericarp colour and glume colour. More variability occurred in durra types as compared to roxburghii types. Alongwith wild Sorghum nitidum, Chrysopogon hackellii and C. asper (related to sorghum) were also collected. In Andhra Pradesh, from Mettur—Krishnagiri, upto Chittor, Anantpur and
Nandyal, prevalent landraces variability was collected. Raichur jonna—a local selection by farmers is much grown in Nandyal and Anantpur parts of Andhra Pradesh.

(e) Cucurbitaceolls and other vegetable collections from north-eastern Madhya Pradesh

North-eastern Madhya Pradesh covering mainly tribal pockets in Sarguja, Raigarh and Bilaspur districts was surveyed and variability collected in different vegetables viz. bottlegourd, pumpkin, spongegourd, ridgegourd, bittergourd, cucumber, Cucumis melo, Trichosanthes dioica, okra, radish, tomato, ashgourd, Capsicum annuum, garlic, onion, turmeric, ginger and taros. Collections include long/round and medium/heavy fruiting types in bottlegourd from Luchki hills; small/long (up to 30 cm, early types with good bearing in spongegourd and ridgegourd, in the latter local type jhingi seemed popular; in pumpkin—local, very tasty types patalkonhada, satpania dodka (from Kharsia, Raigarh) with longer period of fruiting. A wild Momordica species was collected from Ramanujganj area Other collections in vegetables include Colocasia—Stlakhinkanda with high yield and good keeping quality; brinjal, chillies (more pungent types), okra, radish, Lycopersicon pimpinelli-folium and lablab bean.

(f) Toria Collection from Chotanagpur plateau

Chotanagpur plateau comprising of Palamau, Gumla, Lohardaga and Ranchi areas was surveyed in collaboration with Birsa Agricultural University, Kanke, Ranchi. 30 representative collections in various oilseed crops including toria, were made. Collections showed much variation in seed colour (bluish/black/brown/reddish brown) and size.

(g) Indo-Japanese expedition for minor millets

A special crop-specific exploration for collection of minor millets was undertaken jointly with Dr. Kobiyashi (and other two members) from Kyoto University, Japan. In this trip, the coastal region of Maharashtra and parts of Orissa were covered with Dr. M. N. Koppar (NBPRG) and Dr. B. T. S. Gauda (from P. C. millets) as team associates. A total of 82 collections were made. This exploration has yielded variability mainly in finger millet (Eleusine coracana), little millet (Panicum sumatrense) and foxtail millet (Setaria italica). More variability was observed in finger millet, mainly in finger size (short, long and straight/inward curling). Dwarf, medium and tall types occurred with both red and white grains. In some areas particularly in Ratnagiri, the seeds were small in size while in Thane district bold grain types were collected.

In little millet (Panicum sumatrense) diversity was present in panicle length (10 to 25 cm) and seed size (very small to comparatively bold types). Some plants produced pigmented panicles while others had yellow colour on maturity. In foxtail
millet (*Setaria italica*), variability was more prominent in grain colour—black, shining yellow and dull yellow. From paddy fields, wild *Paspalum* was collected.

**(h) Medicinal/Aromatic plants from different areas**

During different explorations emphasis was laid on collection of germplasm of medicinal plants. Diversity collected from north-eastern parts of Madhya Pradesh (Sarguja, Raigarh and Bilaspur districts) included *Psoraria coryphifolia, Urgenia indica, Acorus calamus, Catharanthus roseus, Chlorophytum sp., Withania somnifera, Rauvolfia serpentina, Ocimum sanctum, O. canum* and *Hyoscyamus niger*.

From Almora and Chamoli districts of Uttar Pradesh, 7 samples in *Coleus forskohlii* and in *Urgenia indica* were collected. From south and south-west Rajasthan, *Urgenia indica* and *Aloe barbadense* were collected in collaboration with Jodhpur Regional Station. 8 collections in *Tinospora cordifolia* and one in *Aloe barbadense* were made in a local trip in the Union territory of Delhi.

An exploration was undertaken in Central Uttar Pradesh for collection of variability in vetiver. The areas in and around Musanagar (on Kanpur—Ghatampur route), Unnao—Hardoi route, and between Kannauj and Aligarh were surveyed. 12 collections based on odour type were made. More promising material was collected from a village near Ghatampur in Kanpur district; Peviyar area in Unnao district and from Hasayar near Sikandara Rao in Aligarh district. Clumps collected have been planted at Issapur Farm for performance/assessment with regard to oil yield, quality and acceptance of odour.

**C. Variability collected in other crops during crop-specific explorations**

In crop-specific explorations, efforts were made to collect representative/promising variability in other crops as well:

**(a) While exploring tribal inhabited tracts in Bastar for paddy collections,** diversity in several other crops was also collected. Cucurbitaceous vegetables mainly bottlegourd, cucumber, luffa, pumpkin, bittergourd, brinjal, chillies, okra and others collected in the trip yielded interesting variability. Variation in bottle gourd in fruit shape, with medium to heavy fruiting potential; in case of ridgegourd green/whitish green coloured fruits with good taste and bearing and local type *Veeragijjalu* with 10 ridges and with fruit size 18-20 cm was collected. Local diversity in lablab bean with small/long pods with white/green pod colour and variation in seed-white/black/mottled was also collected. Other crops included diversity in chillies—*Bhiwauri mirch* (long fruits), *murgi mirchi, Lanka mirch*—fruit size only 1—1.5 cm long, and *Nirpakaya*—all highly pungent; in brinjal—local *bhatai* (with good yield) and *Pandhara wanga* (fruits white, in clusters) and wild okra (from Pharsaguda, Jagdalpur area—plant height upto 3—5 m, fruits with 9 ridges). A local type in little millet (*Ika*) and *belia urda* in blackgram were also collected.
(b) In a crop specific mission for cucurbits and other vegetables germplasm collections in tribal parts of Sarguja, Raigarh and Bilaspur districts, rich diversity was collected in rice, wheat and little millet. Local variability in paddy was mainly of indica types. Fine grained/coarse grained types — small bold/slender/long bold types occurred. These were largely represented by the following local types:

Sonkharcha, Chhinmauri, Bishnubhog, Bayalo, Lahsunbhog, Kesar, Dubraj, Parewa and rate types Kholagad, Javaphul and Koria Haslo. Of these, the rare landrace—Javaphul is suitable for marshy land; and Koria Haslo—a black coloured plant is good for upland cultivation. Among others scented types Bishnubhog, Lahsun-Bhog, Dubraj—all slender/fine grained, mild scented/scented/high scented types; lodging tolerant Chhinmauri; and landraces Parewa (black seeded) with black ring at nodes, reddish panicle and coarse grains were collected. In wheat: Jautri—long culmed, drought tolerant landrace and MEDO (little millet), and a local landrace of pigeon pea known as Manpati arhar—a perennial tall, bold grain type were also collected.

(c) Chotanagpur area surveyed for toria collection exhibited much variability in seed size. Diversity collected in other crops included paddy (both upland and lowland types) exhibiting variation in chaff colour—yellow, brown, reddish and blackish colour alongwith variation in glume and awn size and absence/presence of awns. Local types were: Devtabhog, Dakhijeera, Kabri, Bakhpanjar, Tulsimakund, Ketki, Sikki, Karhani, Dahiya, Jhitli, Kalamdhani, Ketka, Sonachul, Prasad bhog, Gurmatiya, Kohraphul, Chanignra, Malchiguda, Paroiyan, Kalamkatwa, Bakaw and Lohsikal. In maize, short/long duration types and Ramrah, a local landrace of Cajanus cajan, which is reported to be very delicious if dal is prepared after the roasting, were collected.

D. Diversity collected in some major crops

In the above multi-crop and crop-specific explorations, much diversity was collected in some major priority crops. These included 144 samples of rice, 187 of vegetables, 70 in oilseeds, 356 in different minor millet crops, 121 in different grain legumes, 69 in forage yielding species, 95 collections in different medicinal and aromatic plants and 52 in wild relatives of crop plants (Table 2). The nature and extent of variability in these has already been described above.

E. Establishment and build up of herbarium of cultivated plants

Nearly 1000 new collections were added to the existing holdings of the herbarium. These are of crop accessions and their wild relatives raised in pot culture and disposed in the herbarium/seed museum as voucher specimens of morphological study such as Vigna spp., Abelmoschus spp., Momordica spp., Trichosanthes etc., and of material of economic plants collected from the field locally and during trips for multi-crop or crop specific explorations. These include variability in crops and
Table 2. Diversity collected in different crops during 1987

<table>
<thead>
<tr>
<th>Crops</th>
<th>Areas covered</th>
<th>Total diversity collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Chhattisgarh region of MP (98), Chotanagpur, (Bihar) (24), Tarai belt &amp; Western parts of UP (14), Maharashtra (8).</td>
<td>144</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>Chotanagpur plateau, Bihar (35), Tarai belt and Western parts of UP (26), Chhattisgarh tribal tract of MP (9).</td>
<td>70</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Chotanagpur, Bihar (7), Maharashtra (1), parts of UP (30), Chhattisgarh, MP (149).</td>
<td>187</td>
</tr>
<tr>
<td>Millets and minor millets</td>
<td>Western parts of UP (8), Parts of Maharashtra (Satara, Ratnagiri, Kolhapur districts of MS) (182), Chhattisgarh region of MP (8), Chotanagpur, Bihar (6), Parts of Tamil Nadu, Kerala and Andhra Pradesh (152),</td>
<td>356</td>
</tr>
<tr>
<td>Pulses/grain legumes</td>
<td>Parts of Chhattisgarh region (47), Chotanagpur, Bihar (8), Tarai belt &amp; Western parts of UP (59), Maharashtra (Satara, Ratnagiri &amp; Kolhapur districts) (7).</td>
<td>121</td>
</tr>
<tr>
<td>Medicinal and aromatic plants</td>
<td>Parts of Chhattisgarh region (32), Kumaun and Garhwal Himalaya (11), Parts of Rajasthan (27), Union Territory of Delhi (9), Central UP (12), Chhattisgarh of MP (4).</td>
<td>95</td>
</tr>
<tr>
<td>Forage species</td>
<td>Ladakh region of J &amp; K (28), northern UP hills (41).</td>
<td>69</td>
</tr>
<tr>
<td>Wild relatives of crop plants</td>
<td>North-western Himalaya (J &amp; K) (19), Ratnagiri, Satara and Kolhapur districts of MS (33).</td>
<td>52</td>
</tr>
<tr>
<td>Total No. of samples collected</td>
<td></td>
<td>1094</td>
</tr>
</tbody>
</table>

wild relatives as *Ricinus, Gossypium, Piper, Solanum*, fruit crops like *Mangifera, Psidium* etc.

An alphabetical system of arrangement and categorisation according to the economic use has been devised for easy reference and retrieval of material in the herbarium and seed museum. An inventory of the collections of already available crops, wild relatives and other economic types has been prepared.

F. Genetic resources of major economic plant families in India

(a) Family: *Malvaceae*

Analysis of the diversity in this group, edible types in *Abelmoschus* and a large number of major and minor fibre plants, such as cotton, *Abutilon, Hibiscus, Urena, Sida* etc. was completed. Of the several centres of diversity recorded for the cultivated genera and genera of economic importance, diversity represented in the Indian centre was mainly of the African element in *Abelmoschus, Gossypium* and
Hibiscus and in part of Sino-East Asian elements with limited build up of native diversity in Abelmoschus, Decashistia, Abutilon and Hibiscus.

Based on evidences of morphology, taxonomy, ecology, crossability and biosystematics the material/areas of maximum importance in India have been delineated. The final analysis with emphasis on cultivated taxa (both major and minor) is being done.

(b) Family: Rutaceae

Rutaceae is one of the economically important plant families, with its members either used as fruit/food plants or in medicines. Of the 23 genera represented in Hooker's Flora and 2 additional Poncirus and Furtunella; Citrus, Murraya and Aegle are more important. However, most of the members are used for various ailments in indigenous systems of medicine. Various genera and species are either native to Indian Gene Centre or have naturalized here. Distribution and economic utility of all species occurring in India has been recorded. Work on preparation of distribution maps of important species/genera, scrutiny of taxonomic status of each species, variability, cytogenetics/biochemical variation etc. is in progress.

G. Studies of wild species and related wild types

About 74 collections belonging to 20 genera, were grown in pot culture during the kharif season for maintenance, multiplication and study. These comprised of the following:

—Wild relatives of cucurbits (Momordica, Cucumis, Trichosanthes, etc.), Abelmoschus, Sesamum and Solanum both seed propagated and tuberous types were grown for morphological studies and multiplication.

—Potentially important fodder crops as Rhynchosia, Alysicarpus, Zornia etc. were raised in pot culture. Preliminary observations on morphology, growth and establishment were recorded and representative variability was preserved in the form of herbarium specimens.

—Comparative morphological studies were undertaken on selected wild plants and related crops for Momordica charantia var. charantia and M. charantia var. muricata and variants of Abelmoschus tuberculatus and other species. Voucher specimens of these were also deposited in the herbarium.

Research Projects (Project Leader; Associates)


3. Multi-crop exploration and germplasm collection in Madhya Pradesh (Umesh Chandra).


5. Building up of genetic resources of cucurbits and other vegetables, their evaluation, conservation, documentation and utilization (Umesh Chandra).

6. Genetic resources of major economic families of India—Malvaceae (E. Roshini Nayar; S. Mauria, Anjula Pandey).

7. Establishment, build up and maintenance of Herbarium and Seed museum of cultivated plants (E. Roshini Nayar; Anjula Pandey).

8. Collection, evaluation, maintenance and utilization of wild economic species/wild relatives of crop plants (K. P. S. Chandel; E. Roshini Nayar).
GERMPLASM EVALUATION DIVISION

The Division is entrusted with the responsibilities of preliminary evaluation and seed increase; characterization, documentation and preparation of catalogues; maintenance, rejuvenation and multiplication of seeds for storage in National Gene Bank and also in the working collection of the Division; breeder's seed production of some of the varieties developed by erstwhile Plant Introduction Division; supply of seeds to various user agencies including coordinated Research Projects, and coordination of multilocal evaluation of germplasm with ICAR Institutes, Agricultural Universities and International Institutes. A brief summary of the work done is given below.

A. Cereals

(a) Wheat and Triticale

During 1986-87 Rabi season, 5401 accessions of wheat and triticale belonging to 21 international nurseries received from CIMMYT, ICARDA and USA were grown in the Post Entry Quarantine Nursery for preliminary evaluation, screening and seed increase. Of these, 1748 accessions in wheat and triticale belonging to 18 international nurseries from CIMMYT and ICARDA were evaluated for a set of seven descriptors and a catalogue was prepared. Number of promising accessions identified from different nurseries are as follows: 20th IBHSN (39), PCE (81), 17th SEPTON (17), 5th DSN (34), 5th HSN (18), 4th HTSN (4), RRM (15), ATDRM (21), 23rd ISWYN (7), 8th ESWYT (4), WON-LRA (13) and WON-MRA (18) in *Triticum aestivum*; 18th IDSN (25), 18th IDYN (12), 16th EDYT (19), DON-LRA (8) and DON-MRA (10) in *Triticum durum*.

During 1987-88 Rabi, 4430 wheat and triticale accessions belonging to 34 international nurseries received from CIMMYT, ICARDA and USA were grown in the Post Entry Quarantine Nursery.

Four hundred eighty indigenous wheat collections were also grown during 1986-87 for evaluation and seed increase and 58 early maturing and 39 high yielding types were identified. A number of promising lines for several other characteristics were also identified.

(b) Barley (*Hordeum vulgare*)

One thousand one hundred ninety-six accessions belonging to 12 international nurseries from CIMMYT and ICARDA were grown in Post Entry Quarantine...
Nursery for screening and preliminary evaluation. Four hundred eight accessions belonging to six international nurseries from ICARDA were evaluated for a set of seven descriptors and the documented data were catalogued. Following promising selections were made: 18th ITSM (18), 18th ITYN (3), BON-LRA (37), BON-HAA (26), BON-MRA (12), BYT-LRA (10), BYT-MRA (7) and BYT-HAA (8).

During 1987-88 Rabi, 705 accessions of barley were grown in the Post Entry Quarantine Nursery for initial evaluation, screening and seed increase.

In the indigenous barley germplasm, 345 collections were evaluated and 19 promising accessions in yield and 49 early types were identified.

(c) Maize (Zea mays)

One thousand three hundred twenty-two germplasm collections were grown at Issapur and 522 at Bhowali and Shillong locations. Detailed observations were recorded. Forty-nine exotic germplasm lines were also evaluated. Most promising germplasm lines in exotics included: EC-178440, 178444, 178446, 178448 and 206794. Among indigenous collections about 20 lines were identified as promising for different traits such as early maturing, high yielding and fodder types. The most promising ones included: IC-77063 and 77022 as prolific types; IC-77403, 77404, 77406 and 77415 as early types and S-35, S-46 and S-70 as good fodder types. Two hundred eight new collections from seven States were also evaluated, which showed good variability.

B. Millets

(a) Sorghum (Sorghum vulgare)

A total of 4430 germplasm lines from ICRISAT comprising of Indian and Yemenese germplasm were grown under ICRISAT/NBPGR collaborative evaluation programme alongside 149 collections made by NBPGR. Observations were recorded on 27 descriptors. Good variability was observed, particularly in respect of following characters: days to 50 per cent flowering (49-175), IS-22092 was the earliest (49 days) followed by IS-1129 (54 days) and the maximum in IS-1556 (175 days). 350 germplasm lines did not flower being photo-sensitive. Plant height ranged from 45-333 cm. The tallest being IS-4107 (333 cm) and IS-5138 (325 cm) and shortest was IS-21960 (45 cm). Stem diameter ranged from 0.30 to 3.56 cm. Minimum was in IS-3226 (0.30 cm) and the highest in IS-4593 (3.56 cm). Number of leaves per plant ranged from 7-36. The highest number of leaves per plant was observed in IS-4280 (36) followed by IS-4249 (33) and minimum in IS-4505 and IS-5267 (7). Leaf length ranged from 31.33 to 97.66 cm. The longest leaves were recorded in IS-5236 and IS-1416 and shortest in IS-5236 and IS-1416. Leaf width ranged from 2.55 to 11.56 cm and maximum was recorded in IS-4164 and minimum in IS-1572.
Seventy-two forage types were identified. The most promising, early flowering lines included: IS-4234, -4240, -5376, -5377 and -5481. In the medium-maturity range types, 13 promising types were identified of which 7 seem to be from the same region (IS-6001 to IS-6006). In the late flowering types retaining greenness for longer duration, 3 lines (IS-3912, -3913 and -3914) were identified as promising.

In the dual purpose types, 35 accessions were identified of which 8 were most promising (IS-24329, -24330, -24331, -6327, -6328, -6329 -5528 and -1560). Five promising tillering types were also identified (IS-4231, -4232, -4276, -6275 and -6276). All had nodal tillering and one accession (IS-1087) had basal tillers.

(b) *Pearl millet* (*Pennisetum typhoides*)

One thousand nine hundred sixty germplasm lines from ICRISAT were evaluated under ICRISAT/NBPGR collaborative evaluation programme. These collections were from India, Middle East, USSR, Africa, Australia and Latin America. Data were recorded on 17 descriptors.

The material showed good range of variability for days to 50 per cent flowering (35-114), plant height (50-377 cm), number of tillers per plant (1-12), number of productive tillers per plant (1-10), spike length (8-92 cm) and spike thickness (0.5-4.5 cm). One hundred fifty-six selections had good seed set, 45 lines had higher fodder production potential, 54 lines were early flowering type and 41 lines were good in all agronomic traits.

C. **Grain Legumes**

(a) *Guar* (*Cyamopsis tetragonoloba*)

A total of 570 germplasm lines comprising of 155 new and 425 received from HAU, Hissar were grown for evaluation in augmented design. In the early maturity group, 115 were branched type, 59 sparsely branched type and 53 single stemmed; in the medium maturity group, 56 were branched type, 15 sparsely branched type and 10 unbranched and in late maturity group, 111 were branched type, 105 sparsely branched type and 54 unbranched. Eight grain and two vegetable types were excellent.

Ninety-six vegetable types were grown, from which 26 promising ones were identified.

A set of 500 germplasm accessions was grown as part of multilocational evaluation. The same set was sent to CAZRI, Jodhpur; HAU, Hissar and GAU, Dantiwada.
(i) **Coordinated trials**: A working group meeting was organised on 3-7-87 for finalizing the technical programme and five trials in breeding, five in agronomy and three in plant pathology were finalised and seeds were distributed accordingly. In the Advanced Varietal Trial I, six genotypes with two controls were tried. There were no significant differences amongst genotypes for most of the characters and HG-75 and RGC-950 topped. In the unbranched type trial PLG-85 topped, followed by RGC-197. In the initial varietal trial with 22 varieties, IGFRI-212-1 topped, though it was late, followed by RGC-967 and GAUG-36. In the late sown varietal trial, PLG-85 topped, followed by 971-1. Naveen topped in the early maturing types.

(ii) **Guar Agronomy**: Six agronomic experiments were conducted at Delhi centre. One experiment was carried out under irrigated conditions and rest five under rainfed conditions. Only the trial with provision for irrigation could be completed successfully. Unprecedented drought conditions during Kharif led to failure of crop in experiments under rainfed conditions. In the experiment conducted under irrigated condition, HG-75, PLG-85 and HG7-2/P2-1 sown with one pre-sowing irrigation and one post-sowing irrigation (30 DAS) in the third week of July, were subjected to three levels of fertilizer doses viz., Control, NOP 30, N15P60 and two row spacings of 30 and 45 cm. Of the three varieties, HG-75 gave maximum grain yield, followed by PLG-85 and HG7-2/P2-1. Grain yield also increased with increase in fertilizer level in all the three varieties but row spacing did not have any pronounced effect on plant growth and yield.

(iii) **Guar Pathology**: A set of 500 germplasm lines of guar were observed for their reactions to bacterial blight. None of the lines were found free from blight infection. Disease development in general was however, poor due to drought conditions hence reaction to bacterial blight infection could not be assessed properly.

Besides, three trials were also conducted. In first trial, tolerance and yield loss studies due to bacterial blight of guar were conducted taking six genotypes viz; PLG-85, HG-75, Durgapura safed, FS-277, IC-9229/P3 and Pusa Navbahar. Data on yield loss due to blight revealed that Pusa Navbahar suffered maximum loss. All the varieties showed tolerance towards bacterial blight. This year disease development in uncontrolled plots was poor. The losses incurred, therefore, were not severe.

Compatibility of streptocycline with other fungicides in controlling important diseases of guar was studied in the second trial. Seed treatment with streptocycline + spray (streptocycline + dithane Z-78) at 5th week of crop growth + spray (streptocycline only) at 7th week was found to be most effective combination in controlling bacterial blight, *Alternaria* and *Myrothecium* leaf spots.

Effect of different time intervals of dipping (A) and number of seed lot dippings (B) in streptocycline solution to eradicate seed borne inoculum of bacterial
blight of _gurar_ was studied in the third trial. Streptocycline seed treatment by giving, 0, 2, 4 and 6 hr dip at 250 ppm concentration revealed that 0 hr dip was least effective in eradicating seed borne inoculum. Other treatments were at par. Streptocycline solution (250 ppm) was quite effective in controlling seed borne inoculum up to 2 seed lot dippings. The effectiveness of the solution decreased thereafter.

(iv) _Gurar Biochemistry_: Guar samples received from different centres of the coordinated project were analysed for endosperm and protein contents. HFG-314 of CAVT-I had maximum endosperm and protein content in the samples from Durgapura and Hisar and the highest protein content in Hisar samples. Genotype LCPNE of CAVT-II from Ankur Centre showed maximum endosperm and protein content. HGS-18 also performed well at all centres _viz_; Durgapura, Ankur and Jodhpur in relation to endosperm content. ARG-8 of CAVT-III (early maturity) topped all others in endosperm and protein content at JNKVV and Durgapura. _Suvidha_ also performed well at Jodhpur Centre. _Gurar_ -80 of CIVT-I had maximum endosperm and protein in Jodhpur and Hisar samples. HFG-257, HGS-57 and CP-74 performed well at Durgapura. ARG-81 of CIVT-II topped by giving the highest content of endosperm in samples from Durgapura and Hisar and protein at Hisar centre.

Fourteen samples received from Ankur were analysed. All varieties were found to contain blackish and non-blackish seeds. Analysis was done after separating blackish and non-blackish seeds from each variety. Out of 14 varieties, 12 of the blackish seeds showed higher endosperm percentage in comparison to non-blackish seeds. Protein content varied a great deal between blackish and non-blackish seeds of different varieties. Non-blackish seeds of eight varieties gave little higher value of protein than their blackish counterparts.

(v) _Cataloguing and Conservation_: Data recorded on 1857 germplasm collections for two years have been compiled for catalogue publication. Seeds of 359 germplasm lines were supplied to gene bank for conservation.

(b) _Urad (Vigna mungo)_: Three hundred seventy-four germplasm accessions were grown for evaluation. Due to severe drought seeds could be harvested from eight collections only.

Data recorded during last two years on 975 accessions were processed for catalogue preparation.

(c) _Mung (Vigna radiata)_: Six hundred ninety-two germplasm lines were grown for seed increase, but due to severe drought, seeds could be harvested from 56 accessions only and data are being compiled.
(d) **Pigeonpea (Cajanus cajan)**

A set of 350 accessions comprising of 126 extra early and 224 early types was grown under ICRISAT/NBPGR collaborative evaluation programme with Prabhat and T-21 as controls. Data on 15 quantitative and 10 qualitative descriptors were recorded. Thirty-three promising germplasm lines were identified, of which 15 were very promising grain types and four promising vegetable types. The crop suffered severely due to drought and 10 lines had excellent stand despite of the drought. ICP—11612 and —10902 were excellent and were most suited to this tract and were better than Prabhat. Twenty resistant and 26 moderately resistant accessions to pod borer were identified.

(e) **Sesbania spp.**

Five new germplasm collections i.e. *Sesbania rostrata*, *S. sesban*, *S. chizea*, *S. aculeata* and *S. china* were grown for evaluation and seed increase. *S. rostrata* was more vigorous and produced aerial nodules. In the old germplasm of 44 collections, five promising, vigorous growing selections were identified.

(f) **Chickpea (Cicer arietinum)**

One thousand two hundred germplasm accessions from ICRISAT and 347 from NBPGR were grown during *Rabi*, 1986-87. The crop suffered severely due to wilt and rot. However, some performed very well. Amongst the indigenous collections, 5 promising early types were identified. Good variability in seed size was observed and 100 seed weight ranged from 5.0 to 22.50 g.

During 1987-88 the same set from ICRISAT was grown again along with 364 germplasm lines collected/introduced by NBPGR. The crop was better this year and 32 early types were identified.

(g) **Lentil (Lens culinaris)**

Among 250 accessions evaluated, wide variability was observed particularly in plant height (12.8 to 52.6 cm), no. of primary branches (4.5 to 20.6), pods/plant (17 to 265) and 100 seed weight (0.9 to 3.5 g). IC—59902, —57760, —73120 and —62525 were early, and IC—59902, —57760, —61515, —52525 and —65258 were high yielders.

One hundred sixty-five exotic germplasm lines were grown in the post entry quarantine. The crop was initially good, subsequently many cultures died and seeds of 30 lines were obtained for further evaluations during *Rabi*, 1987-88.

During *Rabi*, 1987-88, 547 exotic germplasm collections comprising of 15 nurseries were grown for screening and evaluation.

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D. Oilseeds

(a) Oleiferous Brassicae

(i) Toria: A total of 120 germplasm collections of *toria* was grown for maintenance. Twenty-two promising varieties/lines were identified based on preliminary evaluation. These were tested during Rabi, 1987-88 of which eight were early and very promising. Amongst the new collections of *toria*, EC-204233 and EC-204234 were very promising.

One hundred twenty germplasm lines were analysed for their total oil content. Oil percentage varied from 36.92 (IC-76764) to 51.47 (IC-76659). Ninety germplasm lines had oil percentage between 45-48 and four had more than 50 per cent oil (IC-76659 = 51.4 per cent, IC-76661 = 50.59 per cent, IC-76673 = 50.21 per cent and IC-76674 = 50.02 per cent). Seventeen germplasm lines had more than 48 per cent oil.

(ii) Yellow Sarson: Germplasm collections of yellow *sarson* numbering 215 were grown for preliminary evaluation and rejuvenation during Rabi, 1986-87. Observations were recorded on various qualitative and quantitative characters. Ten early maturing lines were identified.

(iii) Brown Sarson: A total of 173 lines were grown in augmented design and observations on 15 qualitative and 12 quantitative characters were taken. Eight early maturing lines were identified.

(iv) Indian mustard (*Brassica juncea*): Two hundred forty nine collections from H.P. and U.P. hills and north-eastern region were grown for preliminary evaluation, seed multiplication and classification of *Brassica* spp. during Rabi, 1986-87.

A total of 990 lines of mustard germplasm was grown for evaluation and rejuvenation.

Three hundred new germplasm lines of mustard received from Project Coordinator (Rapeseed and Mustard), were grown and evaluated for different morpho-agronomic traits.

Twenty-three varieties of mustard received from the coordinated programme were grown in RBD. Yield data and other observations were recorded.

(v) Taramira (*Eruca sativa*): Taramira germplasm comprising of 33 new and 46 old collections were grown in an augmented design and evaluated for different traits.

(vi) Exotic germplasm of *Brassicae allies*: A total of 238 collections of different *Brassica* spp. from UK, USA, Hungary and Sweden was received and grown for preliminary evaluation and seed increase.
Over 1000 germplasm collections of different oleiferous brassicae were grown for rejuvenation and evaluation during Rabi, 1987-88.

(b) Sunflower (Helianthus annuus)

A total of 315 germplasm collections of sunflower was grown during Rabi, 1986-87 for evaluation. A sunflower hybrid trial consisting of 6 entries viz., Morden, BSH:1, EC-68414, MSH-1, NSH-27 RM (ex Yugoslavia) and Surya was also conducted. The Yugoslavia hybrid though slightly late than others, was very promising in head size and yield.

Seventy-three new germplasm collections were grown in Post Entry Quarantine Nursery for seed increase. The head size varied from small to medium and large, seed yield varied from 5.0 to 76.2 g/plant. These lines were also evaluated for their oil contents, which ranged from 27.12 per cent (EC-201847) to 47.64 per cent (EC-201846). Forty-one lines had 38 to 43 per cent oil content and 18 had more than 43 per cent oil. The highly promising oil containing lines/varieties were: EC-201846 (47.64 per cent), EC-198104 (46.01 per cent), EC-198098 (45.49 per cent) and EC-198094 (45.20 per cent). The first one had small head and the others had medium sized head. EC-198095 was the most promising one with very large head size, higher yield (76.2 g/plant) and 43.22 per cent oil content. These lines were again grown for further evaluation during Rabi, 1987-88.

A total of 98 germplasm lines from 1986-87 harvest were also analysed for oil content which ranged from 18.46 to 46.85 per cent.

Six new germplasm lines were also grown for screening and seed increase in the PEQN and 420 lines were grown for maintenance at Issapur Farm.

(c) Safflower (Carthamus tinctorius)

Three hundred germplasm collections were rejuvenated and 88 new ones were grown for preliminary evaluation.

Six hundred ninety-four germplasm lines were analysed for oil contents. The oil contents varied from 19.65 per cent (343-5-955) to 40.64 per cent (EC-138463, EC-99306). About 17 per cent of the total collections had oil contents more than 35 per cent. These are being further evaluated.

(d) Soybean (Glycine max)

Forty-nine soybean lines received from Dr. P. S. Bhatnagar, Director, NRC for Soybean in 1986, were analysed for oil and protein contents. Oil content varied from 17.93 per cent (AGS-2) to 24.08 per cent (R-75-35-75). Only four lines had oil more than 23 per cent. Protein content of the samples varied from 38.27 per cent (PK-308) to 44.64 per cent (RPSP-796). About 50 per cent of the total lines gave protein in the range 40-42 per cent.
Five different experiments were carried out for optimising the NMR instrument to analyse oil percentage of different oil bearing crops.

E. Vegetables

I. Leguminous Vegetables

(a) Cowpea (*Vigna unguiculata*)

(i) Preliminary evaluation/rejuvenation: Three hundred nine new collections were grown for preliminary evaluation and rejuvenation during Kharif. During summer 35 fodder, 10 vegetable and grain types, and 6 varieties for multiplication were grown. The following were the most promising ones identified: IC-20664/P2-2 (fodder), Rituraj and P 460-1-1 (vegetable) and IC-38956-1 (grain type). Wide range of variability was recorded among new collections in days to flowering (29-65), days to maturity (68-141), plant height (35-309 cm), cluster/plant (5-19), pods/plant (10-31) and seed yield/plant (2.9-15.7 g). Out of the total germplasm grown 83 vegetable types, 109 grain types and 117 forage types were classified based on pod quality, seed weight, shape and colour, vegetative growth habit and plant type. Early maturing lines in each group were identified. Twelve for grain and 12 for vegetable purposes were also identified.

(ii) Coordinated vegetable cowpea varietal trial: A trial with 9 genotypes including *Pusa Dofasati*, *Aseem* and 1552 (*Pusa Chicknee*) as controls was conducted in RBD during Kharif as well as spring summer in 1987. *Pusa Barsati* was used as check in place of *Pusa Phalguni* during Kharif season. Selection 460-1-1 (from NBPGR) maintained its superiority as a high green pod yielder during both the seasons. IC-20664 P2-2 (fodder type), Rituraj and IC-38956-1 were other promising accessions identified.

(iii) Initial varietal evaluation trial: Three trials, comprising of promising vegetable types (40), grain types (16) and forage types (26) were conducted to identify the best genotypes for testing under All India Co-ordinated evaluation programme. In the grain types, 6 were promising of which EC-149460 and 340-7606 were the most promising ones with white bold seeds and pink eye. Higher grain yield was given by EC-107171-2 with white bold seeds and pink eye. In the promising vegetable type accessions, 11 were excellent—6 with white long meaty pods, 2 with long green pods and 3 with long purple pods. Yellow mosaic of cowpea was severe this year, 7 promising types were free from yellow mosaic infection.

(iv) Seed multiplication: Seeds of released varieties and selections viz., *Pusa Barsati*, *Aseem*, *Rituraj*, P460-1-1, Red Seeded Selection and P85-2E9A were multiplied to meet the demand of breeders and supply of seed to the coordinated trials.

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Pigeon pea germplasm being evaluated at Issapur farm

Scientists inspecting safflower germplasm in the Post-Entry Quarantine Nursery at Delhi
Scientists of various institutes selecting promising genotypes of wheat grown in PEQN at Delhi

A promising collection of fodder bajra under evaluation at Issapur farm
(v) In the PEQN, 639 new exotic germplasm lines were grown for seed increase and screening. These lines will be evaluated further in the next season.

(b) Lablab bean (*Lablab purpureus*)

Seven hundred germplasm collections were grown for rejuvenation and preliminary evaluation. Data on several qualitative characters have been recorded and other post-harvest observations and quantitative characters are being recorded. Twenty-six very promising vegetable selections were made from early and medium maturity groups, which include 8 with white attractive flat pods. In the grain types, 8 were promising with white seeds and early maturity. Amongst the late group, 8 promising vegetable types and 4 grain types were identified. IC-28824 was very promising with very long and flat pods in the late maturity group. Thirty-one accessions showed field resistance to yellow mosaic and 50 to white fly infestation.

(c) Pea (*Pisum sativum*)

A total of 766 field pea germplasm lines was grown and evaluated during Rabi, 1986-87. Sixty-nine with field resistance to virus diseases were identified of which EC-15184A and PLP-217 were excellent in yield also. Twenty-two good yielding lines were also identified. Nine accessions had resistance to viruses and were also free from powdery mildew infection. EC—109235 and —15272 were free from powdery mildew and were also good in bearing.

During Rabi 1987-88, 1000 germplasm lines were grown at Issapur Farm for rejuvenation and evaluation and 586 new exotic collections were grown in the PEQN for screening and seed increase. Twenty-five very early accessions were identified.

Eight hundred eighty-four accessions including 184 new ones were grown for rejuvenation, evaluation and seed multiplication. Nucleus seed of variety Harbhajan was multiplied. Five hundred eighty-two collections of garden pea were grown for rejuvenation of seed stock.

(d) Sword bean (*Canavalia gladiata*)

Eighty-four germplasm lines including 25 new collections were grown for rejuvenation and preliminary evaluation.

(e) *Mucuna* spp.

Twenty-two germplasm collections were grown for seed increase.

(f) Broad bean (*Vicia faba*)

Twenty-eight indigenous and 282 other collections of *Vicia faba* were grown. The collections comprised of two varieties i.e., *Vicia faba* var. *minor* and *V. faba* var. *major*. The *minor* is hermaphrodite whereas *major* is self compatible. *V. faba*
var. minor is a good bearer with small pods in clusters of 4-6 whereas pods are borne singly or in two's. Indigenous collections were better in yield, early in fruiting and also escaped disease.

Variability in number of seeds/pod, pod length (4—8.5 cm), number of pods/plant (6-13) and days to maturity (110-140 days) was observed. The clustering of pod was less in exotic accessions as compared to indigenous ones. One promising collection UD-223 was identified as better yielder. More accessions of V. faba from Ethiopia, ICARDA and USA were added. Material from USA was early in fruiting as compared to those from other countries with shorter plants and single stem.

(g) **French bean (Phaseolus vulgaris)**

Two hundred sixty-three new exotic germplasm accessions were grown in the Post Entry Quarantine Nursery for screening and seed increase.

Twenty-one samples received from Shimla were analysed for protein contents. Maximum protein content was found in EC-22367, (25.13 per cent), a vegetable type. Among seed types, PLB 10-1 topped by giving 23.76 per cent protein content followed by PLB-24 (23.22 per cent) and Jwala (23.15 per cent).

II. Leafy Vegetables

(a) **Chakwat (Atriplex hortensis)**

A total of 29 accessions of chakwat was grown for rejuvenation of the seed stock. It was observed that IC-34909 was a better yielder with broad leaves as compared to other accessions.

(b) **Coriander (Coriandrum sativum)**

Sixty-eight collections of coriander were grown and it was observed that material from Maharashtra is bold seeded with early maturity.

c) **Chinese cabbage (Brassica pekinensis)**

During the year, 182 collections of chinese cabbage received from Taiwan were grown for assessing their suitability. The collections comprised of chinensis, pekinensis and para-chinensis. Wide variation in leaves, thick white mid-ribbed; thick, green mid-ribbed; some had cabbage like head and some forming root underneath. Detailed observations were recorded. Being self-incompatible, seed production was a problem. Two plants were bagged to produce seed. It was possible to get seed in most of them. A few of the accessions were very late hence, additional crop has been raised at Bhowali Regional Station.

In leafy group, collections of Anethum, Rumex, Spinach, Beta and leafy mustard were also grown for rejuvenation of seed stock.
III. Root Vegetables

(a) **Turnip** (*Brassica rapa*)

Accession EC-178520 with purple top was the most promising line identified. Since it belonged to temperate group, seed setting under Delhi conditions was not obtained.

(b) **Carrot** (*Daucus carota*)

EC-177289, Beta carrot was grown to see its performance. It being of temperate group, can not compare well with adopted varieties like Nantis and *Pusa Kesar*, unless its yielding capacity is augmented.

(c) **Radish** (*Raphanus sativus*)

Radish collections (54) from various sources were grown. Field collections were mostly open pollinated, lot of segregation was, therefore, recorded. K-I036 with white cylindrical roots was the promising line identified. TF-61 was red like Asiatic varieties with staying capacity. EC-117056 (ex France) is a radish with carrot look having yellow outer skin with radish taste.

IV. Cucurbitaceous Vegetables

(a) **Bottlegourd** (*Lagenaria siceraria*)

A total of 58 accessions during summer and 124 collections during *Kharif*, 1987 were evaluated for 37 descriptors using 5 checks. Good range of variability was noticed in vine length (305-1020 cm), number of primary branches (1-6), days to 50 per cent flowering (55-93), days to first fruit set (62-110), days to last fruit set (80—159), number of fruiting nodes on main stem (1-18), fruit girth (21-78 cm), fruit length (18-65 cm), number of fruits/plant (2-32), average fruit weight (0.42-4.22 kg) and fruit yield/plant (3.2-75.0 kg).

Accessions U10-315, U11-10, U8-217, U8-46, U8-198, BDJ-864 were high yielders in the summer crop whereas U11-216A, U11-50, BDJ-535, BDJ-638, BDJ-783, BDJ-896, EC-187247 and BDJ-616 were identified as high yielder in *Kharif* season crop. Late season fructing was noticed in K-3320, BDJ-614 and U11-216A.

(b) **Pumpkin** (*Cucurbita maxima*)

Twenty-eight accessions in summer and 42 in *Kharif* were evaluated using *Pusa Vishwas* as check. Collections U10-142, BDJ-1-557, U8-182, C-1750, U9-59, U8-62, US-274 were identified to be better than check.

(c) **Bittergourd** (*Momordica charantia*)

During summer 1987, 33 collections were evaluated for 37 characters, along-with two checks. Germplasm varied in vine length (105.355 cm), number of primary branches (3-7), number of fruits per plant (1-25), fruit girth (8-27 cm).
fruit length (9.5-20.0 cm) and fruit yield/plant (0.5-2.8 kg). Accessions U8-22, U8-66, IC-74158, C-1621 and K-3274 were better yielders.

(d) Other cucurbits

Fifteen accessions in summer and 43 in Kharif in ridgegourd; 13 in summer and 46 in Kharif in spongegourd, 8 accessions in muskmelon, 7 in snapmelon, 23 in watermelon; 3 in roundgourd and 12 in cucumber were grown for evaluation, rejuvenation and maintenance using standard checks. Accessions U8-270 and K-3847 in spongegourd; U8-30, U8-68 and P-422 in cucumber; EC—173434, 173935, V-1636, K-3236, K-3274A, K-3302, EC-173438, US-12, US-248, V-1494 and K-3228 in watermelon; U11-207 in snapmelon, and K-3235A and U9-64 in muskmelon were identified as better genotypes.

V. Solanaceous Vegetables

(a) Chillies (*Capsicum annuum*)

Two hundred eighty-four germplasm lines were grown for evaluation and seed increase and data were recorded on 31 descriptors. BDJ/NKG-320, NC-67379, NC-67402, BDJ-1027, A-1103, BDJ-277, CA-205, IC-74273, BDJ/NKG-203, BDJ-148 and P-249 were identified as high yielders along with one bunch type exotic (EC-173358).

(b) Tomato (*Lycopersicon esculentum*)

Five hundred sixty-eight germplasm accessions were evaluated for 39 descriptors and 13 high yielding, 21 paste types, 23 heat tolerant and 43 types suited to transportation were identified. A trial of promising germplasm was conducted and 6 most promising types identified were: Bulgarian, EV-125999-1, EC-143593, EC-35256, DM-81-8 and EC-37373. Two hundred germplasm collections were evaluated at 3 locations (NBPGR, IIHR and PAU) as per workshop decision.

During 1987-88, 214 new types were sown for evaluation along with germplasm for rejuvenation.

(c) Brinjal (*Solanum melongena*)

One hundred eighty-six germplasm collections were evaluated for 24 descriptors, of which 8 indigenous and 6 exotic promising collections were identified with different fruit shapes and colours.

VI. Other Vegetables

Okra (*Abelmoschus esculentus*)

Due to adverse climatic conditions, crop stand was poor. Selection G-2-4 showed promise and was free from virus infection also. Some promising selection of G-2 were also identified. Detailed observations were recorded in 1000 germplasm lines including yellow mosaic incidence and pest incidence.
VII. Bulb Crops

(a) Garlic (Allium sativum)

(i) Preliminary evaluation/bulb increase/rejuvenation: A total of 877 germplasm accessions including 139 new collections, were grown for preliminary evaluation/bulb increase and rejuvenation. Variations were observed in plant height (14.0-39.0 cm), fifth basal leaf length (16-48 cm), leaf width (0.8-1.7 cm), stem girth (0.8-3.1 cm), fresh five bulb weight (75-135 g), dry five bulb weight (54.120 g) and cloves/bulb (8-16). Ten excellent types with bold compact bulb and bold cloves were identified. In the exotics three were very promising i.e. EC—182916, —172362 and —9753.

(iii) Promising germplasm trial-cum-multiplication: A set of 126 accessions with good keeping quality coupled with bold and compact bulb habit was grown in a replicated yield trial in RBD.

(iv) Catalogue: A catalogue on garlic germplasm based on two years’ evaluation data is under preparation.

(b) Onion (Allium cepa)

(i) Evaluation/rejuvenation: Seed Crop — A total of 1016 accessions were planted in a pit each to complete the cycle of rejuvenation of these accessions. This set of germplasm was harvested from a bulb crop sown during 1985-86.

Bulb Crop — A set of 1226 germplasm accessions was grown in nursery to raise the bulb crop. This set was evaluated as seed crop sown in last season.

(ii) Seed multiplication: Varieties Pusa Red, Pusa Ratnar, Ratnar Selection; Brown Selection 1 and 2 were grown in isolation for Breeder’s seed multiplication.

(iii) Catalogue — A catalogue on onion germplasm evaluated both for seed and bulb crop based on two years’ evaluation data is under preparation.

(iv) During 1987-88, 639 accessions for seed and 1032 for bulb crop were planted.

F. Forage Crops

Fifty accessions of Cenchrus ciliaris, 3 of C. setigerus, 43 of Pennisetum pedicellatum, and 5 of Paspalum spp. were planted for preliminary evaluation. Promising accessions identified in Cenchrus spp. were: S-59-1, S-303, 421, Molopo, 8-2-3, 2527, 3801 and 392. Promising fodder types identified in Pennisetum spp. were: 1-4-1, 4-4-3, 4-1-3, 862, JP-1, 6-5-1, 3-3-1 and 43-1.

A total of 422 accessions of oat, 342 of Trifolium spp. and 252 of Medicago spp. were grown for seed multiplication and initial evaluation during Rabi, 1986.
In *Trifolium* spp. seeds of only 50 accessions could be harvested as some of the accessions (196) did not germinate and remaining other (96) did not flower and set seed. In *Medicago*, 252 were grown, of which 103 did not germinate and 77 did not set seed. Seeds were harvested from 75 accessions only. Fifty accessions showing regeneration were left in the field for studying their perenniality potential in the subsequent years.

A total of 22 accessions of Barseem were grown for preliminary evaluation for their green fodder potential. JBH-137 yielded at par with the check variety Vardan.

G. Under Utilized Crops

I. Industrial and Hydrocarbon Plants

(a) *Guayule (Parthenium argentatum)*

Periodic sowing of guayule revealed February to be the suitable month for sowing. Some lines from NBRI, and Biocentre showed good germination in November also. February was found to be good time for transplanting November-sown plants under Delhi conditions. Transplantation of February sown plants in first week of May, early June and late August showed 60,100 and 95 per cent mortality, respectively.

Twenty-three accessions of the age of 1-1/2 years were evaluated for different morphological traits. A wide range of variability in different characters viz., plant height (37.5-107.5 cm), number of branches (5-12.5), plant circumference (66-235 cm) and stem thickness (1.5-4.4 cm) was observed. Some promising accessions in respect of different attributes were identified.

Seedlings of 17 accessions have been raised in nursery for conducting trials and transplantation studies.

(b) *Jatropha curcas*

Sixty-six plants of six accessions of Jatropha were transplanted in the field. Three cultivars viz., Dantiwada, Dantiwada Bold and Sardarkurshi Nagar were vigorous in growth.

(c) *Jojoba (Simmondsia chinensis)*

Thirty seedlings of 4 accessions have been raised for conducting trials and transplantation studies.

(d) *Citrullus colocynthis*

Eleven germplasm accessions were studied for different morphological characters. A large range of variability in plant spread (72-405 cm), number of
branches/fruit (2.4-17) was recorded. CH 48-1, CH 84-2 and CH 184-4 were early flowering types (55 days).

II. Food Plants

(a) *Chenopodium* spp.,

Thirteen collections including six indigenous were grown for preliminary evaluation in *Rabi*, 1986-87. Good variability in respect of plant height (219-292 cm), number of branches per plant (4.67-24.33), leaf area (2.78-132.45 cm²) and seed yield (2.66-14.63 q/ha) was recorded. BDJ-285, -519, -1-881, NK 1374, -574 and -579 were observed to be late maturing and tall types. They remained green throughout and showed fodder potential to be used during summer months. Thirty-nine lines have been grown in *Rabi*, 1987-88 for preliminary evaluation.

(b) *Amaranthus* spp.

Sixty lines were grown in *Rabi*, 1986-87 for preliminary evaluation and large range of variability was observed for different characters viz. plant height (39.0-127.5 cm) and number of branches/plant (3-13.5).

One hundred fifty lines including forty-seven new collections are being grown. Accession EC-133839 was found resistant to stem borer attack under field conditions.

(c) *Simaruba* spp.

Two hundred seedlings have been raised in polythene bags of which 32 have been transplanted and have established well.

H. Fruit Crops

(a) Evaluation and Maintenance

During 1987, an effort was made to build up the germplasm and to establish some local elite and introduced varieties of different sub-tropical and low chilling temperate fruit plants viz., apple (9), pear (9), plum (3), peach (4), almond (4) *Citrus* spp. (10), *aonla* (4), guava (4), *ber* (8), fig (1), sapota (1), *Anona* (1), papaya (1). Except few accessions in temperate fruit plants, most of the accessions survived and established well.

(b) Miscellaneous fruit plants

In apple, out of 14 accessions, 4 accessions, viz., Tropical Beauty, Vered, Parlins Beauty and EC-127110 flowered this year. Flowering started in last week of February. In Vered flowering was recorded 3-4 days earlier than others. Maximum fruiting was recorded in Parlins Beauty.
In peach out of 8 accessions, only 5 flowered this year in 1st week of February. Flowering occurred simultaneously in all the five accessions viz., Florida Sun, Florida Bell, Florida Red, Early Amber and Australian Dwarf Peach. Fruiting was maximum in Florida-Sun followed by Florida Red, Early Amber and Australian Dwarf Peach. The fruits of Australian Dwarf Peach were sub acidic in taste and were late in maturity.

In citrus, out of 22 accessions only three flowered this year. The fruiting was scanty.

A good variability in bael was also noticed for height (6-10 m), length of fruit (7.5 to 12.5 cm), diameter of fruit (6.21-11.46 cm), weight of fruit (400-1000 g), thickness of the rind (2-4 mm), number of seed cavities in fruit (9-12) and shape of the fruit (oblong, spherical, round).

Second survey was conducted for local diversity of aonla in Pratapgarh district of U.P. which is a rainfed tract. The range of variation for different traits viz., branching pattern (spreading, erect), fruit shape (oblong, round) fruit length (2.5-2.8 cm), fruit diameter (3.0-4.4 cm), fruit weight (18.0-48.4 g), fruit colour (yellow, green, whitish green, red spot on skin), number of stripes on fruit (6-8), fibre content (low, high), yield/tree (1.5-3.0 q) and height of the plant (5-9 m) was recorded.

I. Medicinal Plants

(a) Opium poppy (Papaver somniferum)

(i) Biosynthesis of alkaloids in opium poppy capsules: Results of a field experiment with six varieties (IC-30, -42, -88, -128, Ranjhatak and Jawahar Apheem) and five stages of growth conducted during 1986-87 showed that the dry weight of capsule as well as of seed increased with the advancement in age. The alkaloid profile analysed by solvent extraction method in unlanched capsule and by traditional lancing method in lanced capsule showed that alkaloid content was more at maturity in unlanched capsule and IC-30 and IC-42 gave higher morphine content. Codeine and thebaine alkaloid contents remained nearly unchanged in lanced capsules. This suggested that the metabolic system responsible for the demethylation of thebaine and codeine was inhibited in lanced capsules leading to accumulation of codeine and thebaine at the cost of morphine. This trial is being repeated during the year 1987-88. Three more coordinated trials have been planted out alongwith two station trials during 1987-88. The first trial includes 9 top entries. Ten best cultures identified in the Workshop are included in second trial and 30 lines are included in third trial. Alkaloid contents will be analysed by solvent extraction method. Besides, an exploratory trial on the use of azotobacter culture and N rates has also been planted. The missing 12 cultures obtained from Mandsour Station, were also grown.
The seed production of IC-42 (Trishna) has also been taken up. A complete set of all germplasm of opium poppy has been sent for conservation in the gene bank.

(ii) Variability in alkaloid contents of some indigenous collections of opium poppy

(i) Four significantly superior selections (IC—30, -42, -88 and -128) with two checks (Jawahar Afeem and Rajhatak) were analysed for five major alkaloids. All the selections were found superior to checks in terms of total morphinane alkaloids.

(ii) Eight new varieties bred by different centres with two checks were analysed for five major alkaloids. The varieties UO—285, -185, NOP—1, -4, -8 and NBPG—2 were found to be better.

(iii) Two papaverine-rich lines alongwith two controls were analysed for five alkaloids. Maximum papaverine content observed was over 6 per cent.

(iv) Opium poppy collections made from Kota district of Rajasthan and evaluated under multi-locational testing at Delhi during 1986-87, were analysed for five major alkaloids. Collections NC—57913, 57923, 57931, 57933, 57945, 57949, 57950, 57955, 57959, 57961, 57966, 57968 and 57971 were superior in terms of morphine contents over controls.

(b) Periwinkle (Catharanthus roseus)

(i) Agronomic Studies: During Kharif 1987, two separate experiments on water management and chemical methods of weed control were initiated. The experiment on water management included 5 accessions (EC-120837, IC-49574, IC-49582, NC-66393 and NC-49581) with three irrigation levels (IW/CPE 0.3, 0.6 and 0.9) in split plot design. The other trial on weed control included herbicides Fluchloraline, Alachlor/Methabenzthiazoram, and Fluazifopbutyle at different concentrations and mode of applications.

(ii) Evaluation and maintenance: Germplasm collections (27), both indigenous and exotic were grown. The seedlings have established well. The data on qualitative and chemical evaluation would be recorded when the crop is 10 month old.

Nine collections were received from NBPG Regional Station, Trichur. Except two, others did not germinate. An exotic collection EC-213584 (ex Canada) is doing well.

Four accessions identified as promising for high root alkaloids in 1986, were planted for yield trial alongwith EC-120837 as check.

c) Vetiver (Vetiveria zizanoides)

(i) Building up of germplasm and evaluation: Twelve new germplasm lines collected from U.P. were planted at Issapur. Forty collections from Bharatpur
planted during 1986, are being evaluated for a set of agro-morphological and chemical characters.

(ii) **Growth analysis of selected vetiver cultures**: Growth analysis was studied in relation to chemical evaluation of selected germplasm lines like hybrid—7, —8, —26, NC —66403, —66404, —66406, —66415 and —66416. NC—66403, —66404 and —66416 were found to be superior.

Studies on aspects covering fertilizer use, water management and weed control through herbicides were initiated. Studies on different methods of planting and cutting of top portion and interseeding of different legumes were also undertaken. The preliminary data revealed that use of Oxadizon at the rate of 0.5 kg a.i/ha controlled the weeds in vetiver. Inter-seeding of legumes like cowpea, black gram, green gram, guar and senna is possible without affecting the vetiver plantation.

Besides, Hybrid-8, —7 and —26 of vetiver were multiplied for supply. At present about 100 collections of vetiver are being maintained.

(d) **Palmarosa (Cymbopogon martinii)**

Sixteen palmarosa lines were evaluated for different agro-botanical characters from July, 1986 to Dec., 1987. Despite severe drought of 1987, accessions IW-4479, Sel-8 and RH-11 performed well followed by IW-4498, IW-31245 and CI-80-68. The final data collected is being analysed.

Studies covering the aspects of N rates and water management and chemical weed control were initiated. The trials are in progress. Over 50 cultures of Palmarosa are being maintained and accession IW-31245 has been multiplied.

(e) **Hyoscyamus muticus**

The results of an experiment conducted in *Rabi* 1986-87, showed that sowing of henbane in first fortnight of November at a spacing of 45 x 15 cm was better under Delhi conditions. The trial has been repeated during 1987-88.

J. **Exploratory Studies in New Introductions**

(a) **Artemisia annua**

Two exotic collections in *A. annua* (EC-202429 and EC-211539) were added during 1987 and grown at Delhi and Bhowali locations. The accession sown in February did not flower at Bhowali Centre up to June end. However, April sown material gave luxuriant growth. Four samples (dried leaves) from Bhowali and Delhi harvested at two different stages (vegetative and flowering) are being analysed for 'artimissinine' content. Good seed setting was observed at Bhowali.
(b) *Coleus forskohlii*

Seven population sample collections from different districts of Kumaon and Garhwal hills, were planted at two locations viz. Bhowali and Issapur.

Five population samples (roots) were evaluated for 'forskohlin' content. The root samples collected from Bhowali gave higher percentage of forskohlin' (0.152 per cent) followed by Bhatrunj Khan (Almora).

(c) *Urginea indica*

All 18 samples of *U. indica* planted at Issapur are being analysed for 'Schi-llerin A and B' percentage.

(d) *Ocimum* and *Mentha* spp.

Twenty *Ocimum* and *Mentha* spp./collections, both exotic and indigenous are being evaluated at Issapur. In *Ocimum*, all collections, mainly basilicum (EC-174145-46 and EC-174518-29) showed good germination. EC-174522 gave higher foliage yield, whereas EC-176934 (ex France) gave highest percentage of oil (0.43) and linalool (76.86).

Accession IC-75730 of *O. sanctum* having high eugenol content (54 per cent) was grown for seed multiplication and 4 kg seed of this variety is now available for distribution.

(e) Maintenance/evaluation of miscellaneous medicinal and aromatic plants

About 16 new accessions including *Silybum, Ammi majus, Melissa, Pimpinella* and *Anethum* were planted at Issapur. Some collections are doing well.

(f) Phytochemical evaluation of some lesser known plants

The species chosen for investigation are Giloe (*Tinospora cordifolia*) Ghrit kunwar (*Aloe barbadense*), Bhumi aonla (*Phyllanthus niruri*) Bharagni (*Clerodendron serratum*) Kalmegh (*Andrographis paniculata*) and Jyoti mati (*Celestrus paniculatus*). These plants are used in a large number of formulations in the indigenous system of medicine.

During the period under report, two collection trips were undertaken and population samples in *Aloe barbadense* (9) were collected from seven districts of Rajasthan and one sample from Delhi.

In *Tinospora cordifolia* 10 samples were collected from Delhi. Field and chemical evaluation of these samples is in progress.
J. Documentation, Cataloguing and Data Management

(a) Catalogue Preparation

The data of four crops viz., maize, foxtail millet, rice and kudumillet were processed and catalogues were prepared. Statistical analysis for estimating various variability parameters were also undertaken. Number of queries were retrieved and reported in the catalogues. Maize catalogue gives report on two locations (Delhi and Bhowali). Rice germplasm evaluated by Dr. R. K. Saxena at IRRRI was also processed and gives information on more than 50 traits. For foxtail millet, 52 descriptors have been studied for more than 100 accessions. Kudumillet catalogue includes the data of Shimla and Akola locations. Catalogues on *Kulthi* and *moth* are under preparation.

(b) Information on introduced material and publication of plant introduction reporter (PIR)

During 1987, an information system for monitoring information on import and export of germplasm was also developed. Germplasm introduction information system (GIIS) will further help in the preparation of various inventories, check lists, plant introduction reporter and reports etc. The data pertaining to the year 1988 and onward will be fed according to the system and the useful information will be available as and when required. During the period under report, third and fourth issues of PIR for the years 1986 and second issue of 1987 were brought out.

(c) First Training Course on Introduction to DSDOS and BASE III (1-6 June, 1987)

One week training course on 'Introduction to MSDOS and d BASE III', was organised. Twelve scientists of different Divisions of the Bureau participated in the programme. The main objective of the training course was to let the trainees get acquainted themselves with the various operating system commands and d BASE III commands for management of their data bases pertaining to various aspects of genetic resources activities.

K. Screening of different crops for their reactions to various pathogens/insect pests

I. Screening of different crops for their field reactions to various diseases and related plant pathological studies

a) Cereals and millets (maize, sorghum and pearl millet)

About 1000 germplasm lines of maize, 4500 of sorghum and 2000 of pearl millet were screened for their field reactions to different diseases. Incidence of *Helminthosporium maydis* and *Curvularia* spp. was noticed in maize with less severity. Anthracnose (*Colletotrichum graminicola*), gray leaf spot (*Cercospora sorghi*) and zonate leaf spot (*Gloeocercospora sorghi*) were the diseases recorded on sorghum.
Pearlmillet was free from all major diseases of this crop. Overall disease built-up was poor in these crops, hence less variability with regard to disease reactions was noticed under field conditions. Some 30 lines in maize and 50 in sorghum were, however, found free from above mentioned diseases of these crops.

(b) **Grain Legumes (Mung, Urad, Kulthi)**

Mung bean lines numbering around 2200 grown at NBPGR Satellite Centre, Amravati were screened for field resistance to Cercospora leaf spots, bacterial blight and powdery mildew. Sixty lines resistant to Cercospora leaf spots, 40 to bacterial blight and 37 to powdery mildew could be identified based on two years observation. Some 18 lines identified as multiple disease resistant were: PLM—24, — 42, —100, — 109, — 309, — 324, — 391, — 429, — 501, — 630, — 1033, — 1573, — 2056, IC—21—3, — 73359, — 73362, — 73375 and EC—5531.

Forty-eight lines of urad identified as field resistant to uradbean yellow mosaic virus were screened under artificial net house conditions. Except few, most of these lines retained their resistance to YMV.

Six hundred fifty-six collections of Kulthi were screened at NBPGR Reg. Stn., Akola against yellow mosaic and other foliage diseases.

(c) **Oilseeds (Groundnut, soybean)**

A total of 1900 groundnut collections including 1500 from ICRISAT was screened for field reactions to leaf anthracnose (*Colletotrichum dematium*) and Tikka disease (*Cercospora* spp.) at NBPGR Reg. Stn, Akola. Most of these lines were susceptible to the above pathogens. However, 69 lines from ICRISAT and 15 lines from NBPGR collections were relatively free from infection.

Soybean germplasm numbering 2563 was also screened for their field reaction to various fungal, bacterial and viral diseases at Akola. About 30 lines showing resistance to more than one diseases were identified.

(d) **Vegetables (Cowpea, Sem, Blindi, Tomato, Cucurbits)**

A total of 450 cowpea lines including 300 new collections and some promising vegetable, fodder and grain types, and disease resistant lines identified during 1986 Kharif, were evaluated for their field reactions to yellow mosaic, Septoria leaf spots, Cercospora leaf spots and powdery mildew. Among new collections, 35 lines were found to be free from yellow mosaic infection. Twelve promising vegetable types, 13 fodder types and 7 grain types were identified showing resistance to yellow mosaic and other foliage diseases. Out of 80 lines exclusively tested against yellow mosaic infection, 48 lines showed stability of resistance this year also.

About 1000 collections of *sem* at Issapur and 421 at NBPGR Satellite, Centre; Amravati were observed for their field reaction to yellow mosaic and other foliage
diseases. About 35 lines were identified showing resistance to yellow mosaic and
one or more other foliage diseases at Issapur. None of the lines was free from
infection at Amravati.

Nearly 1000 lines of bhindi at Delhi and about 300 at Akola were evaluated
for field resistance to yellow vein mosaic. Most of the germplasm lines were found
to be susceptible to the disease. Some 40 lines/cultivars were identified as modera-
tely resistant to yellow vein mosaic.

About 500 germplasm lines of tomato including a few disease resistant lines
(both cultivated and wild) identified during 1986, were screened for field resistance
to fruit rot and Fusarium wilt. Most of the wild accessions and a few cultivated
types were found free from infection.

About 40 lines of ridgegourd and 45 of spongegourd were screened for field
resistance to cucumber mosaic virus (CMV). Eight lines in ridgegourd and 10 lines
in spongegourd were identified showing resistance to CMV under field conditions.

Other Related Plant Pathological Studies

(i) *Effect of yellow mosaic of cowpea on growth components and yield of four cow-
pea varieties*

Studies on the effect of yellow mosaic of cowpea on growth and yield of four
cowpea varieties/lines viz., Rituraj, Red Seeded Sel., Aseem and IC-38956-1 revealed
maximum reduction in growth components and yield in Red Seeded Sel. followed
by Rituraj, IC-38956-1 and Aseem.

(ii) *Effect of mungbean yellow mosaic on growth and yield of mungbean*

Studies on effect of mungbean yellow mosaic on growth components and
yield of four mungbean varieties, PIMS-1,-2,-3 and-4 revealed that PIMS-3 suffered
maximum loss followed by PIMS-4,-1, and-2.

(iii) New disease records: *Phoma medicaginis* and *Colletotrichum gloeosporioides*
on winged bean, *P. tropica* on Kulthi and soybean, *C. caudatum* on *Cymbopogon
martini* were the new reports of occurrence of these pathogens on these crops from
India.

II. Screening of germplasm of different crops against insect pests

(a) Cereals (Sorghum, Maize)

Nearly 4,600 germplasm collections of sorghum and about 1000 collections
of maize were screened for their field reactions to the major pests i.e. shootfly
(*Altherigona* sp.) and the stem-borer, (*Chilo* sp.). These pests were recorded
with high severity on sorghum but with less severity on maize. However, 60 lines
of sorghum and 55 lines of maize were found resistant to these pests. Among the
lines, 15 were found most promising against *Chilo* sp.
(b) **Legumes (Pigeonpea, Cowpea, Mung, Sem)**

Germplasm collections of various legumes namely, pigeonpea (350 lines), cowpea (450 including some promising vegetable, fodder and grain types), Mungbean (2000 collections at NBPGR Regional Station Akola), Sem (1200 at Delhi and 420 at Amravati) were evaluated against the major pests viz., pod-borer (*Heliothis* sp.) whiteflies, (*Bemisia tabaci*) and pod/stem fly (*Melanogromyza* sp.). The incidence of pod-borer was high in pigeonpea and only 20 lines were identified as resistant. In other legumes, pod-borer infestation was low. In cowpea, 17 vegetable, 14 fodder and 10 grain types were identified as resistant. In mungbean, 30 lines were free from pod-borer infestation and 40 lines showed field resistance to bruchids while 25 lines showed multiple resistance to both of these pests.

In *Sem* at Delhi location, 60 lines were found resistant to borer and whiteflies, while at Amravati, whitefly incidence was high. However, 30 lines were found with moderate resistance to this pest.

(c) **Vegetables**

**Brinjal** : Among the 192 collections evaluated against the fruit borer, *Luciodes orbinalis*, 15 lines were found promising.

**Bhindi** : Nearly 1000 germplasm collections at Delhi and 400 at Akola were observed for their field reaction to fruit borer (*Earias* sp.) and mite, (*Tetranychus* sp.). Incidence of these pests was higher at Delhi than at Akola. Most of the collections from Maharashtra region seem to be less susceptible to this pest. However, 50 germplasm collections were identified as moderately resistant.

**Cucurbits** : Germplasm collections of cucurbits, namely bottlegourd (124), ridgegourd (43) and spongegourd (43) were evaluated against fruit flies (*Dacus* sp.). Pest incidence was less in bottlegourd while it was high in ridgegourd and spongegourd. Only 2 ridgegourd collections could be identified as promising. In bottlegourd, heavy aphid attack was observed, however, 14 lines resistant to aphid were identified.

(d) **Oilseeds (Castor, Sesamum, Soybean, Groundnut)**

**Castor** : Among 155 germplasm collections of castor screened against castor semilooper (*Achaea janata*), only 7 lines were identified as showing tolerant reaction to this pest.

**Sesamum** : Among 1968 germplasm collections observed for leaf curling caused by apids/jassids, 22 lines were selected for their comparative resistance to leaf curling. Early varieties with narrow leaves were less susceptible.

**Groundnut** : Among the germplasm collections of three groundnut types - erect bunch type (723 lines), spreading type (321 lines) and runner type were
observed for their field reaction to groundnut leaf miner (*Stomopteryx* sp.). 28 erect bunch and 23 spreading bunch types were identified as promising. Among the runner types infection level was low.

**Soybean**: Out of 2563 germplasm collections of soybean, 46 collections were found promising against leaf miner, jassids, aphids and pod borer.

(e) **Other crops**

*Sesbania*: Out of 44 collections of *sesbania*, only 2 lines were identified as showing resistance to chalcids and bruchids.

*Psoralea*: Among the 22 germplasm collections, 3 lines were found promising against the leaf miner (*Stomopteryx* sp.).

*Amaranth*: About 475 germplasm collections were observed for their field reaction to various pests, incidence of *Amaranth* weevil (*Hypolireus* sp.) was very high. Only one line (EC-133839) could be identified as promising.

**Seed Supply**

During the year about 25,000 seed samples of various crops were supplied to over 400 indentors by the Division. Cropwise details of seed samples supplied are as follows:

- Wheat (11931); Rye (1); Barley (2723); Maize (71); Guar (1584); Cowpea (411); *Sem* (135); Tomato (977); *Kulthi* (136); Winged bean (73); Rice bean (64); *Mung* (364); Urad (88); *Amaranthus* (518); Peas (142); Brassicae (453); Chillies (53); *Moth* (46); *Mucuna* (9); *Canavalia* (37); Bambara nut (4); Garlic (26); *Methi* (5); *Arhar* (15); Gram (110); *Khesari* (66); Yam bean (8); *Chenopodium* (27); *Sesbania* (10); Onion (26); Brinjal (16); Safflower (444); *Simmaruba* (10); Jojoba (11); Lentil (125); Soybean (105); Redgram (15); Paddy (2394); Okra (198); *Ragi* (104); *T1* (180); Castor (174); *Bajra* (105); *Jowar* (210); Sunflower (260); Linseed (10); Poppy (10); *Leucaena* (7); Frenchbean (16); *Gram* (46); Guayule (6); *Crotalaria* (6); Peach (2); Almond (2); Lima bean (2); Opium poppy (10); *Panicum* (4); *Dolichos* (58); and Celery (37).

**Research Projects (Projects Leader; Associates)**


2. Preliminary evaluation, multiplication, conservation and characterization of exotic wheat and barley cultivars grown in post entry quarantine nursery (S. K. Mithal).

3. Building up of genetic resources of various *Kharif* legumes (including guar as a sub-project), their evaluation, documentation and utilization (B. S. Dabas; T. A. Thomas, S. Mandal, B. S. Phogat, I. S. Bisht).
4. Genetic Resources Programme on various vegetable crops, their evaluation, characterisation, documentation, utilization and maintenance (T. A. Thomas; Umesh Chandra, B. S. Dabas, D. Pandey).

5. Genetic Resources Programme on various oilseed crops particularly, sunflower, safflower and oleiferous brassicae, seed increase and utilization (Ranbir Singh; T. A. Thomas).

6. Preliminary evaluation and possible multiplication of exotic maize grown in quarantine nursery (Bhag Singh).

7. Building up of germplasm of lentil (Lens culinaris), its maintenance, evaluation, characterisation and cataloguing (Bhag Singh).


9. Building up of germplasm of chickpea, its maintenance, evaluation, characterization and cataloguing (Bhag Singh).

10. Biochemical evaluation of germplasm of various crops (S. Mandal).

11. Building up of germplasm of various forage crops particularly grasses and legumes, their evaluation, documentation, maintenance and utilization (P. N. Mathur; S. Mauria, I. P. Singh).

12. Screening of germplasm of agri-horticultural crops against major diseases of economic significance (Ram Nath; I. S. Bisht).


14. Building up of germplasm of various horticultural plants, their establishment, multiplication, evaluation, maintenance and utilization with special reference to minor fruits and low chilling crops (M. N. Koppar; D. Pandey).


20. Genetic Resources programme on under-utilized and under-exploited plants (Bhag Mal; Vandana Joshi).
DIVISION OF GERmplASM CONSERVATION

The main objectives of the Division are to conserve and maintain base and active collections of germplasm of agri-horticultural crops in the form of seeds in medium and long term storage under controlled conditions.

A. Establishment of National Repository (Genebank)

Four cold store modules, capable to run at —20°C have been procured from Watford, UK. Construction of overhead structure on the four cold store modules has been completed. Two of these modules have been commissioned on three phase electric AC supply, alternately hooked with diesel generator and are under trial run. Anteroom (air-lock) around the cold store modules with all the basic facilities of controlled temperature (22°—24°C) and relative humidity (35 per cent) is under the process of development. Mobile shelving in two of these units have been completed. Efforts are being made to commission the other two cold store modules. Two rooms have been constructed for laboratory work.

The land for the construction of National Repository has been allotted to the Bureau by IARI on its campus in New Delhi. The architectural plans and other details have been finalised and are being followed with the concerned developmental agencies.

B. Processing of germplasm collections of agri-horticultural plants for medium and long term storage

During this year, 25,101 germplasm collections were added to the gene bank. These include: (i) 14,733 accessions of cultivated germplasm material; (ii) 700 accessions of trial material of barley and wheat received from Evaluation Division of the Bureau; (iii) 80 accessions of released improved varieties of various crops; (iv) 4,767 accessions of exploration material collected by the scientists of Division of Exploration of the Bureau and Bureau’s Regional Stations and (v) 4,821 accessions of exotic germplasm collections procured through Germplasm Exchange Division.

Cultivated Germplasm Material

Fourteen thousand seven hundred thirty-three accessions of cultivated seed stock was received from Bureau's Headquarters; U.A.S. Bangalore, NBPGR Regional Station, Akola and NRCG, Junagadh. These included wheat (1672),
barley (377), *Triticale* (10) among cereals; amaranth (472) among pseudocereals; fingermillet (2028), prosomillet (77), littlemillet (29) among minor millets; *Brassica* (120), castor (25), groundnut (3800), safflower (1813), sunflower (31) among oilseeds; *Lupinus* (30), cotton (206) among fibre crops; chickpea (1813), pea (600), pigeonpea (1196), horsegram (41), greengram (989) among pulses; tomato (400) among vegetables; and poppy (160), celery (50) among medicinal crops. The accessions were checked for duplicates, physical purity and insect damage. The germplasm was tested for viability following ISTA rules (1985).

The accessions having more than 85 per cent viability standard were dried under controlled conditions of 15°C and 25 per cent RH, packed in aluminium foil pouches and stored in the gene bank.

**Released Varieties**

In response to our countrywide request to plant breeders and crop specialists to send seeds of all improved varieties/old cultivars available with them, 235 seed samples were received in gene bank. Out of 235 samples, only 80 samples qualified as per authenticity of the released varieties from “Handbook of Cultivars 1985” (published by the Central Variety Release Committee) and processed for long term storage. These included: *Cereals*—paddy (5); *Pulse legumes*—Bengalgram (4), redgram (5), blackgram (1); *Oil seeds*—groundnut (3), sesame (1); *Fibre crops*—cotton (26); *Vegetables*—beans (4), Okra (2), beet (2), brinjal (2), cabbage (2), *Capsicum* (2), carrot (1), cauliflower (1), cucumber (2), lettuce (1), peas (2), radish (2), squash (2), tomato (4), turnip (3), water melon (1), knol-khol (1) and in *Spices*—fenugreek (1).

**Exploration Collections**

Four thousand seven hundred sixty-seven germplasm accessions with collector’s code number collected by the scientists of Exploration Division at Headquarters and its Regional Stations/Base Centres from multicrop/crop specific exploration trips both independently and in collaboration with crop based institutes/agricultural universities were received for conservation. Germplasm collections included all major *Cereals*—wheat, paddy, maize, barley; *Pseudocereals*—amaranth, buckwheat; *Millets and minor millets*—pearlmillet, sorghum, foxtailmillet, kodo-millet, prosomillet, barnyardmillet, *Paspalum* spp., *Setaria* spp. and *Panicum* spp.; *Pulse legumes*—greengram, blackgram, redgram, horsegram, soybean, cowpea, Frenchbean, swordbean, clusterbean, *Kulthi*, lablab bean, *Lathyrus* spp. and *ricebean*; *Oilseeds*—toria, rai, taramira, sarson, sesame, niger, linseed, groundnut, castor and *Perilla* spp.; *Fibre crops*—cotton, sunhemp, *Crotolaria* spp.; *Vegetables*—okra, tomato, cucumber, *sem*, sweet melon, brinjal, chillies, onion, *palak*, cucurbits and *metha kheera* (*Cyclanthera pedata*); *Medicinal plants*—species of *Plantago*, *Canabis*, *Juniperous celastrus*, *Sarcococa*, *Withania*, vetiver and several other species of fruit plants, forage legumes and their wild relatives. These germplasms were processed for medium term storage in gene bank.
Exotic Germplasm

Four thousand eight hundred twenty-one germplasm accessions of promising genotypes were added to the germplasm assembly in gene bank. These were procured through the efforts of Germplasm Exchange Division from over 50 countries belonging to Asia, Europe, Middle East, Latin America and USSR. These accessions were received and conserved in gene bank as a part of reference collections and processed for medium term storage.

Germplasm lines belonged to all major groups of agri-horticultural and silvicultural crop species viz., Cereals—wheat, paddy, maize, barley and oat; Pseudocereals—amaranth; Millets and minor millets—sorghum, pearl millet, ragi, Setaria; Oilseeds—sunflower, safflower, groundnut, Brassica spp.; Pulses—chickpea, cowpea, Lathyrus spp., Vigna spp., Phaseolus spp. and Dolichos spp.; Medicinal plants—species of Papaver, Chichorium, Datura, Matricaria, Valeriana and several other crops and their wild relatives.

The entire germplasm is conserved for long and medium term as per recommendations of seed storage advisory committee of IBPGR in three layered specially designed laminated aluminium foil pouches (IBPGR standards) and hermetically sealed.

C. Germplasm holdings in genebank

Germplasm holdings in genebank till December, 1987 now stand at 72,217 and are shown in Table 1.

Table 1: Germplasm holdings with genebank

<table>
<thead>
<tr>
<th>Crop groups</th>
<th>No. of accessions stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>13,725</td>
</tr>
<tr>
<td>Pseudo cereals</td>
<td>1,954</td>
</tr>
<tr>
<td>Millets &amp; Minor millets</td>
<td>4,704</td>
</tr>
<tr>
<td>Pulses</td>
<td>2,1341</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>6,501</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1,107</td>
</tr>
<tr>
<td>Fibre crops</td>
<td>232</td>
</tr>
<tr>
<td>Medicinal crops</td>
<td>126</td>
</tr>
<tr>
<td>Exotic germplasm</td>
<td>13,621</td>
</tr>
<tr>
<td>Exploration material</td>
<td></td>
</tr>
<tr>
<td>(a) Accessioned</td>
<td>8,643</td>
</tr>
<tr>
<td>(b) Non-accessioned</td>
<td>9,263</td>
</tr>
<tr>
<td>Total</td>
<td>72,217</td>
</tr>
</tbody>
</table>
D. Development of Simple Algorithms as an Aid to Gene Bank Personnel

Further literature survey was carried out in family leguminosae in relation to the problem of seed germination to imbibition injury/soaking injury, including chiling injury. This phenomenon is prevalent in the family leguminosae. This is particularly of more interest to gene bank personnel. This is caused by very quick imbibition of water by dry leguminous seeds, when they are set to germinate. However, this can be overcome to a greater extent by simple process of humidifying/also called conditioning of dry seeds till their moisture content is around 18 per cent or more. The aim of humidification treatment is to increase seed moisture content slowly between 16–18 per cent. Increase in moisture content by absorption of water vapour instead of quick imbibition of liquid water is more useful. The simplest technique described in literature is to place scarified seeds on metal gauze in sealed container above liquid water at temp. of 20°C for 24 hours. This does serve the purpose, only seeds have to be spread out to ensure that absorption is uniform. Many leguminosae seeds will germinate/respond to this treatment.

Hard Seededness

The algorithms described below may be helpful in devising suitable germination test procedures. The treatments mentioned are obligatory to remove hard seededness and are optional to conditioning/humidification treatment. The steps are:

(a) Chipping of seeds of tropical origin, followed by germination at constant temp. of 23°C & 28°C at light applied to 12 hours each.

(b) If step (a) is not successful to tropical species, then apply alternate temp. of 33°C & 19°C for 12 hours duration each.

(c) If both steps on above do not respond to full germination then third step is to humidity the chipped seeds at 21°C & 100° per cent rh over water for 4 days be followed and later then germinate as per step a & b.

(d) If steps a, b, c do not respond, then 4th steps is to experiment with the conditioning treatment by humidifying the samples of chipped seeds for 4 days at 21°C with 100 per cent RH.

(e) If all the above tests fail, the fith is the tetrazoIium test. This will indicate that dormancy has not been broken by regimes applied so far in the algorithm; then experiments are to be carried out with modifications to the above regimes.

E. Monitoring the viability of seed accessions in genebank

Monitoring of seed accessions stored in the genebank is most essential requirement for efficient management of genebank. Monitoring of seed stocks should
be carried out at fixed intervals of 3–5 years to see the decline in viability. Different crops show decline in seed viability at varying rates for a particular set of conditions.

Monitoring was carried out in the accessions of wheat, safflower, *til* and *Setaria* stored under medium term conditions (10°C temp., & 35 per cent RH). Preconditioning of the seeds at different intervals was done for optimising germination potential. Twenty five seeds each in four replications were tested for standard germination, after preconditioning at 20°C and 35°C (ambient conditions) for the period of 24, 48 and 72 hours.

Results obtained showed non-significant decline in seed viability during two years storage under medium term condition. This information will be usefully employed in advising the user scientists for optimising the germination potential. Seed viability of rice germplasm stored for a year was also monitored by choosing 20 random accessions for germination test. The germination percentage varied from 72-100 per cent in the tested samples. Most of the accessions had viability above the regeneration standard.

F. Effect of some fumigants on seed viability during prolonged storage under controlled conditions of temperature and seed moisture

Work was initiated to investigate the effect of some fumigants on seed viability of *mung* (*Vigna radiata*) during prolonged storage under controlled conditions. To start with, the fumigant chosen was EDCT mixture. No adverse effect of fumigation on seed viability has been found at this stage. This is a long term experiment and is being pursued.

G. Data documentation, storage and retrieval of information on germplasm holdings in Gene Bank

Data of about 30,000 germplasm holdings were computerised. The data comprised of about 8000 accessions of evaluated material of various crops viz., paddy, finger millet, cowpea, pigeonpea, dolichos bean, greengram, blackgram, soybean, horsegram, pea, chickpea, safflower, *Brassica* spp., castor, sunflower, tomato, *Mucuna* spp. and *Vicia* spp. The data of about 15,000 accessions of exotic material, 6,000 accessions of exploration material and about 1,000 accessions of trial material were loaded and processed on the computer.

Research Projects (Project Leader; Associates)

1. Data documentation, storage and retrieval of plant genetic resources conserved in the National Repository. (N. K. Chowdhary)
2. Establishment of National Repository. (P. P. Khanna; S. K. Jain)
3. To develop simple algorithms as an aid to Genebank personnel in conducting routine viability tests. (P. P. Khanna)


6. To study the effect of some fumigants on seed viability during prolonged storage under controlled conditions of temperature and seed moisture. (P. P. Khanna; Manju Kapoor, Neeta Singh, R. K. Saxena and S. K. Jain)
A. **Infrastructural development**

During the year 1987, National Facility for Plant Tissue Culture Repository has made considerable progress in terms of developing infrastructural facility such as laboratory facilities, equipments etc. to carry out work on the *in vitro* conservation/cryopreservation, biosystematics as well as associated aspects of genetic stability.

B. **Research**

(a) *In vitro conservation*

Crop priorities for *in vitro* conservation/cryopreservation were determined through critical discussions on following crops—

(i) **Tuberous/bulbous crops:** *Allium sativum* (garlic) and other wild *Allium* spp., *Colocasia esculenta* (taro), *Ipomoea batatas* (sweet potato), *Dioscorea* spp. and *Trichosanthes* spp.

(ii) **Spices and plantation crops:** *Zingiber officinale* (ginger), *Piper nigrum*, *P. betel*, *Curcuma* spp. (turmeric).

(iii) **Horticultural crops**—*Fruit tree species:* *Musa* spp. (banana), *Citrus* spp., *Carica papaya* (papaya), *Punica granatum* (pomegranate), *Prunus* spp. and *Pyrus* spp.

(iv) **Medicinal/aromatic plants and other wild endangered plant species:** *Rauvolfia serpentina*, *Tylophora indica*, *Pogostemon patchouli*, *Coleus forskohli* and *Coptis teeta*.

*In vitro* cultures of 19 elite accessions of garlic (*Allium sativum*) have been established. Protocols for multiple shoot formation enabling rapid clonal multiplication and also *in vitro* tuber production have been developed. Experiments for *in vitro* conservation using minimal medium and low temperature (4°C) incubation are in progress. Rhizome explants were used to initiate *in vitro* cultures of ginger and turmeric. Techniques for rapid clonal multiplication are being standardized. One culture of turmeric and three cultures of ginger have been initiated. Cultures of *Dioscorea alata* and *D. esculenta* were initiated using nodal cuttings. Browning
of the medium due to exudates from cut ends was noticed. Experiments to check the browning have given highly encouraging results.

In *Citrus limon*, complete plants were regenerated from axillary buds. Hormonal combinations favouring multiple shoot formation have been identified. For the first time *de novo* production of shoot buds directly from root giving rise to complete plants has been achieved in *Citrus limon*. Experiments are in progress to define conditions leading to shoot bud differentiation in root cultures.

Banana tissue cultures were initiated using shoot tip culture technique. In the first instance, a total of 24 genotypes belonging to diploid and triploid forms of *Musa acuminata*, *M. balbisiana* and their interspecific hybrids have been inoculated. Out of these, 19 accessions (cultures) have survived. Considerable genotypic differences in respect of rate of clonal multiplication and growth have been observed in *Musa* cultivars.

In medicinal and aromatic plants, *in vitro* cultures of *Rauvolfia serpentina* and *Coleus forskohli* were initiated from nodal cuttings. A high frequency of multiple shoot formation was noticed in *Rauvolfia*, whereas in *Coleus* nodal cuttings gave rise to complete plants. Work has also been initiated on endangered plant species such as *Coptis teetta* and *Pogostemon patchouli*.

(b) Cryopreservation

Cryopreservation studies currently being undertaken at NFPTCR, include seeds belonging to recalcitrant species (cocoa, tea, clove, nutmeg, coffee) and small seeded orthodox species (Brassicaceae, sesame, onion, pearl millet and tobacco). Pollen preservation has been initiated particularly in *Zea mays*—primitive land races from Mexico and Sikkim and other related taxa such as teosinte, *Zea diploperennis*, *Coix* sp., *Chionachne* sp., *Zea luxuriens* and *Sorghum* fertility restorer line 2077 CB.

(c) Studies on Genetic Stability

(i) *In vitro cultures and cryopreserved germplasm*: High priority is being attached to the study of genetic stability of *in vitro* conserved and cryopreserved material in NFPTCR. A major advantage of electrophoresis over morphological evaluation is the speed with which analysis can be conducted on a large number of individual plants, seeds or seedlings. The techniques of isozyme analysis are being utilized since clones propagated asexually will have identical zymomorphs. Allelic differences between clones are being discovered in *in vitro* cultures. Gel electrophoresis of proteins and isozymes, cytological techniques (Karyotype analysis and differential staining techniques) are being employed. In *Allium* species both, isozymes and C, N and Q banding techniques are being experimented. Studies are in progress to fingerprint the accessions using isozyme analysis of those cultures which have already been put to *in vitro* conservation.
Studies are also being taken up on ontogenetic variation in *Brassica napus* and *Theobroma cacao*. Enzyme systems such as peroxidase, esterase and acid phosphatase in 5 accessions of *B. napus* and 3 accessions of *Cocoa* have been studied.

(ii) **Finger printing of maize races and allied genera**: Finger printing of important maize races and related genera/wild species has already been accomplished using pollen.

A detailed isozyme analysis has been accomplished using the fresh pollen from primitive landraces (both Mexican and Sikkim primitives). Other allied genera which were used for pollen preservation included *Zea mexicana* (teosinte), *Z. diploperennis*, *Z. parviflora*, *Z. luxurians* and distantly related genera *Colix lacrymajobi*, *Chionachne*. Several isozyme systems were studied. However, the best results showing clear differences and repeatable results were obtained from peroxidase, esterase and acid phosphatase.

(d) **Biosystematic studies on wild and related types**

Forty-five accessions of four major cultivated *Vigna* species and their wild related species were studied morphologically and biochemically for their differentiation at species and genotypic level.

Several wild species of genera such as *Vigna*, *Alysicarpus*, *Atylosia*, *Smithia*, *Heylandia*, *Sesamum*, *Cucumis*, *Abelmoschus*, *Momordica*, *teosinte*, *Oryza*, *Trichosanthes* and *Luffa* were maintained. Collections of *Curcuma*, *Zingiber*, *Colocasia*, *Coleus*, *Tylophora* etc. were also maintained and studied.

**Executive Committee Meetings**

The Second Executive Committee meeting of NFPTCR was held in January, 1987 and third Executive Committee Meeting was held in July, 1987.

**Research Projects (Project Leader; Associates)**

   1.1. *In vitro* conservation of tuberous/bulbous and other agri-horticultural crops. (K. P. S. Chandel; Ruchira Pandey)
   1.2. *In vitro* conservation of spices, plantation crops and new industrial crops. (K. P. S. Chandel; S. M. Balachandran)
   1.3. *In vitro* conservation of horticultural crops (Fruit plant species). (S. R. Bhat; K. P. S. Chandel)
1.4. In vitro conservation of medicinal, aromatic and wild endangered plant species. (K. P. S. Chandel; Neelam Sharma)

1.5. Genetic stability studies on in vitro generated cultures. (K. P. S. Chandel; K. V. Bhat)

2. Cryopreservation of seeds, pollens and in vitro cultures. (K. P. S. Chandel; Rekha Chowdhary)

2.1. Genetic stability studies on cryopreserved seeds, pollens and in vitro cultures. (K. P. S. Chandel; Suman Lakhanpal)

REGIONAL STATION, AKOLA

A. Plant Exploration and Collection

Two multicrop exploration and collection tours were undertaken during 1987 to various regions of Maharashtra, adjoining parts of Karnataka and Andhra Pradesh. The districts explored were: Akola, Yavatmal, Adilabad, Nanded, Parbani, Latur, Solapur, Bidar, Gulbarga, Dhule, Nashik, Thane, Osmanabad, Jalna, Buldana, Jalgaon and Amravati. A total of 503 samples was collected from 25 locations. The details of these collections are as follows:

Cereals and Pseudocereals (19) — Paddy (7), maize (4), amaranth (8); Oilseeds (90) — Sesame (67), groundnut (11), niger (6), castor (3), linseed (1), safflower (1), sunflower (1); Grain legumes (215) — Mungbean (109), uradbean (52), cowpea (20), mothbean (7), chickpea (6), pigeonpea (9), kuthi (11), swordbean (1); Vegetables (94) — okra (21), onion (15), guar (20), Luffa (7), chillies (14), bittergourd (4), brinjal (3), tomato (2), sowa (4), cucurbit (2); Millets and Minor Millets (68) — Jowar (6), bajra (3), little millet (38), barnyard millet (12), finger millet (7); Miscellaneous crops (16) — Jatropha spp. (4), Hibiscus spp. (3), Coix sp. (1), custard apple (3), wild okra (4) wild legume (1).

B. Germplasm evaluation

(a) Pigeonpea (Cajanus cajan)

Six hundred fourteen accessions were grown in single 4 m long and 75 cm apart observational rows and evaluated for various agro-botanical characters. The promising collections with respect to various desired attributes are as follows: days to 50 per cent flowering — 127 accessions including IC—73879, —73348, —73330 flowered within 100 days, whereas 18 accessions including IC—73338 and IC—73331 took more than 150 days to flower. Days to 50 per cent maturity — only 20 accessions matured within 140 days while 24 accessions were observed to be very late taking more than 200 days. IC—73340, —73343 and —73349 were very late, Plant height — 81 accessions measured less than 100 cm while 25 accessions recorded more than 175 cm for plant height. Some of the tall growing accessions were: IC—73115, —73313, —73334 and —73339. IC—73882, —73559 and —74070 recorded branch length measuring less than 30 cm while IC—73312 and IC—73338 recorded more than 140 cm, 55 accessions recorded the branch length of more than 100 cm. IC—73308, —73314 and —73313, recorded more than 400 clusters per plant while IC—74070, —73921 and —73818, produced less than 20 clusters/plant.
Forty-two accessions recorded 300 or more pods/plant including IC—73313 (907), —73346 (507) and —73357 (507) while fifty accessions recorded 50 or less pods/plant. Forty-six accessions recorded more than 700 g seed yield per row, while IC—73901 (1230 g), —73859 (1120 g), —73911 (1120 g), —73891 (1070 g), —73883 (1050 g) recorded more than 1000 g seed yield/row.

(b) Winged bean (*Psophocarpus tetragonolobus*)

(i) *All India Co-ordinated Yield Trial*: An yield trial comprising of 11 recommended selections was conducted in RBD with 4 replications. The net plot area was 4.80 sq.m. The observations recorded were: days to 50 per cent flowering, number of plants in two central rows, days to first picking, total number of pickings, number of pods in two central rows, pod length and green pod yield.

On calculated yield basis, EC-114273 B, IIHR Sel-23, IIHR Sel-25, IIHR Sel-21, Mysore Local and EC-38956 were first six in order of merit and were significantly superior to Akola Local used as a check.

(ii) *Initial Evaluation Trial of promising accessions/selections for use as grain crop*: An yield trial comprising of 22 recommended selections including Akola Local (IC-41981) as check was conducted in RBD with 4 replications. The crop was grown in 4 m long and 60 cm apart 4 rows. However, the 2 central rows were taken into consideration for recording data. The observations on days to 50 per cent flowering, maturity, number of plants in two central rows, number of pods, average pod length, flower colour, pod colour, and seed colour were recorded.

Mysore Local outyielded all the accessions with an yield of 486 kg/ha. The other 4 positions were occupied by EC-114273-B (437 kg), IIHR Sel-12 (373 kg), EC—114273 (234 kg) and EC-38824 (299 kg). All the first five varieties were observed significantly superior to Akola Local. The late maturing accessions performed well in comparison to early maturing selections.

(iii) *Preliminary evaluation of germplasm*: The germplasm comprising of 252 accessions from both indigenous and exotic sources was grown in 5 m long and 60 cm apart observational rows. The observations on days to 50 per cent flowering, and maturity were recorded in each genotype. The information on plant population, number of pods/plant, pod length, seeds/pod, 100 seed wt., flower colour, pod colour, seed colour, seed yield/row etc. were recorded from 3 randomly selected plants.

The seed yield per row varied from 2 to 265 g. EC—178337, —178322, —142666, —34865-1, —178319, —49558, —26170, —178268, Mysore Local-1, TPT—IA-1 were identified as promising genotypes.
(c) Grain Amaranth (*Amaranthus* spp.)

(i) *All India Co-ordinated Trials* (Initial Evaluation Trial): In this trial 22 selections along with Akola Local and Annapoorna as checks were tested in RBD with 4 replications of 2 rows each, the plot size being (3 m × 1 m). Observations were recorded on: days to flowering and maturity, plant population, plant height, branches/plant, length of main inflorescence, leaf size, petiole length, plant yield and plot yield besides some of the quality characters such as inflorescence colour, stem colour and growth habit. The yield data were statistically analysed and differences were observed to be significant. *A. edulis* (ex. Taiwan) gave the highest yield (174 kg/plot) followed by IC-49618 (159.5 kg/plot) and *A. edulis* (ex. Canada) (153.7 kg/plot). Yield obtained was 2—3 times more than variety Annapoorna.

In another trial, 12 elite selections along with Akola Local as check were tested in RBD with 4 replications of 2 rows each. The observations recorded were the same as above. *A. edulis* ex Taiwan (599 kg/ha), IC-35696 (463 kg), IC-5564 (399 kg), IC-42006 (373 kg) and Akola Local (300 kg) were first five in order of merit and first three varieties were significantly superior than Akola Local. The seed yield recorded was poor due to enhanced flowering and reduced growth period.

(ii) *Preliminary evaluation of germplasm*: The germplasm comprising of 555 old and 274 new accessions was grown for evaluation and seed increase during *Rabi*, 1986 in 3 m long and 50 cm apart rows. Observations on days to 50 per cent flowering and maturity were recorded in each accession. Other observations recorded were: plant population, stem colour, leaf colour, seed yield per plant and seed yield per row in old (555) collections while in new accessions (274) the additional characters recorded were: plant height, length of main inflorescence, and number of branches.

(d) *Simaruba glauca*

This oil yielding economic plant was introduced from EL-Salvador in 1963. In 1984, about 400 seedlings from the Satellite Centre, Amravati were planted along with farm roads and farm boundaries at Akola. Nearly, 200 plants established and are growing satisfactorily. The flowering and fruiting have not started so far at Akola.

(e) *Guar* (*Cyamopsis tetragonoloba*)

(i) *Yield trial no. 1*: An yield trial comprising of 9 promising selections namely, RGC-950, —954, —971-1, HGP-20-2, HGS-37, HFG-314, HG—75, —258, and IC-9229/P3 was conducted in RBD with 4 replications. HG-258 (711 kg/ha), HGP-20-2 (678 kg), and HG-75 (642 kg) were found superior than IC-2929/P3 (588 kg).
The observations recorded were: days to flower, days to maturity, plant height (cm), number of branches, pod clusters/plant, pods/cluster, pod length (cm), number of seeds/pod, yield/plant (g), plant population, yield/plot (g) and yield/hectare (calculated by multiplying with factor (1234). The yield data were statistically analysed and the differences were observed to be significant.

(ii) Yield trial No. 2: Another yield trial comprising of PIG-119, GGD-122, RGC-197, HFG-314, CP-42, FS-277 and PIG-85 was conducted in RBD with four replications. CP-42 (908 kg/ha) outyielded all the entries followed by RGC-197 (795), HFG-314 (679) and PIG-199 (599).

(f) Soybean (Glycine max)

Soybean germplasm grouped as early, medium, late and very late in maturity, was evaluated separately for yield and yield attributing characters. The following promising collections were identified in each group.

**Early maturity**: EC—30205, —37072, —37097, —39108;

**Medium maturity**: EC—6103, —93743, 95289;

**Late maturity**: EC—104873, —118692, —14478, PLSO-1;

**Very late maturity**: DS-531, AMSS-53, EC-174131, AMSS-99.

(g) Niger (Guzotia abyssinica)

Two hundred eighty four collections were evaluated for yield using Ootacmund, CHH-1 and CHH-2 as control. IC-856, —16399 and —19241 were identified as promising collections on yield basis.

(h) Castor (Ricinus communis)

The germplasm comprising of 135 old and 20 new accessions was sown on 5-1-87 in single 4 m long and 75 cm apart observational rows. The promising types identified were: IC—53464-1, —56186, —56187, —56190, —56191, —59844, 59844-1-A, —59907, —60439, EC-109524, —168483, and —168489.

(i) Groundnut (Arachis hypogaea)

The germplasm comprising of 460 old and 9 new accessions was evaluated in single 4 m long and 75 cm apart observational rows. The range for 50 per cent. flowering and maturity was observed between 24-103 days and 103-123 days respectively. The yield/row ranged from 2-500 g. Jyoti-l, EC—20954, —100717, —21133, —21071 and Faizapur were found high yielding collections.

(j) Linseed (Linum usitatissimum)

A total of 513 accessions with C—429 as control was evaluated in single rows with a 3 m row length and row to row distance of 50 cm.
Plant height ranged from 19.5 cm (EC-41650) to 60.0 cm (Busso mild). Days to 50 per cent flowering ranged from 53 (EC-41762) to 115 (BDJ-1-599), days to 50 per cent maturity ranged from 98 (NC-59015) to 145 (BDJ-1-626), the branches/plant ranged from 3 (T-8-1) to 11 (IC-53285). The number of capsules (bolls) per plant ranged from 12 (IC-1457) to 102 (IC-53285). The 3 plant yield ranged from 0.5 g (BDJ-1-626) to 8 g (IC-53228). The row yield ranged from 73 g for T-67/19 (EC-41495) to 54 g for IC-53260.

(k) **Safflower (Carthamus tinctorius)**

A total of 951 accessions of both the exotic and indigenous types was evaluated in single 3 m long and 1 m apart rows. This included 92 old germplasm lines with the local check Bhima. Days to 50 per cent flowering ranged from 92 (JLA-1383) to 118 (EC-181325). The days to 50 per cent maturity varied from 134 (EC-38466) to 156 (EC-181838). Plant height ranged from 56.4 cm (EC-181758) to 144 cm (JLA-1446). No. of branches/plant ranged from 3 (EC-38466) to 14 (EC-181265). No. of capitula/plant varied from 2 (EC-181436) to 78 (EC-181900). The highest row yield of 305 g was recorded for JLA-896-5R. Plant population per row was in the range of 1 (EC-181900) to 45 (EC-181249).

(l) **Sesame (Sesamum indicum)**

One thousand nine hundred sixty-eight accessions comprising of 1885 old and 83 new collections were evaluated in single 4 m long and 75 cm apart observational rows. On the basis of yield/row, following promising lines were identified: T-73-10, P-8, C-8-1, C-8 and T-73-1.

(m) **Finger millet (Eleusine coracana)**

A total of 1461 germplasm collections was evaluated for yield and yield attributing characters. Genotype differences were observed with respect to seed yield (g/row) which ranged from 438 g (IE-3144) to 3 g (IE-2818). In general, high seed yield was associated with high harvest index.

(n) **Proso millet (Panicum miliaceum)**

Eight hundred thirty-two lines were sown in single observational rows of 3 m length with a 50 cm inter row distance. Data were recorded on days to 50 per cent flowering, seed yield/row (g) and plant population. Fifty lines failed to germinate in the field. Days to flowering ranged from 28 (IPM-2282) to 51 (IC-52802). The highest seed yield was recorded for IPM-79 (283 g/row). Promising accesses identified based on the yield per single row are listed below: IPM-45, —79 (283 g), —264 (255 g), —378 (230 g), —85 (155 g), —144 (150 g), —374 (175 g), —388 (175 g), —2622 (185 g), —2691 (185 g), —2775 (167 g) and 2624 (168 g).
(o) **Kodo millet** *(Paspalum scrobiculatum)*

Six hundred twenty-nine germplasm lines were grown this year for preliminary evaluation and seed multiplication. The days to flowering ranged between 59 (IC-3405) to 69 (IC-52733). Yield/row ranged from 385 g (IPS-199) to 10 g (IPS-5280). IPM-79, —264 and —378 were identified as high yielding lines.

(p) **Little millet** *(Panicum miliare)*

A total of four hundred twenty-three lines consisting of old and new collections was evaluated for days to 50 per cent flowering, seed yield/row and plant population. The minimum days recorded for 50 per cent flowering was 34 (IPMR-704) and the maximum was 77 days (IPMR-727). Some of the earliest cultures for days to flowering were: IPMR-704 (34), —433 (36), —705 (36) and 447 (36). Superior lines for yield were: IPMR-388 (190 g), —433 (175 g), —57-83-1 (175 g), —66 (110 g), —65 (108 g), —41 (192 g), —829 (100 g), —815 (100 g) and IC-28411 (105 g).

(q) **Foxtail millet** *(Setaria italica)*

One thousand four hundred sixty-eight lines consisting of old and new material, were evaluated during the *kharif*-1987. Days to 50 per cent flowering and yield/row were recorded for all the lines. The flowering ranged from 27 days (IS-120) to 64 days (IS-2849). The maximum yield per row was 450 (IS-941) with a minimum of 2 g (IS-170-1). Promising lines for seed yield are listed below (yield in g/row is given in parentheses): IS-941 (450), —905 (415); —943 (377), —944 (385), —945 (355), —955 (360), —969 (352), 893—1 (395) and —894 (348).

(r) **Barnyard millet** *(Echinochloa spp.)*

Preliminary evaluation and seed multiplication of germplasm totalling 636 were carried out during the *kharif*, 1987. Days to 50 per cent flowering ranged from 32 (IEc-34) to 64 (IC-52690). Yield and yield components were recorded at harvest. Seed yield per row ranged from 1 g (IEc-400) to 96 g (IEc-288). Based on the yield per row (g) the following lines were found to be promising: IEc-288 (150), IC-28445 (130), IEc-286 (125), —52 (125), —294 (120), —301 (120), IC-28449 (120), IEc-300 (117), —293 (112) and IC-28430 (103).

(s) **Sorghum** *(Sorghum bicolor)*

A total of 470 germplasm collections was grown for preliminary evaluation and seed multiplication during the *kharif* season. Majority of the cultures flowered between 47 days (IS-620) to 71 days (IS-2309). Flowering was delayed in some cultures due to adverse climate. The germplasm lines were scored for their fodder and grain characteristics in the scale of 1-9 at flowering stage. Considerable differences were observed in respect of each character. Grain yield (g/row) was recorded at harvest. Many cultures failed to produce grain due to terminal drought stress. Promising genotypes identified for high yield were: IS-1087 (700),
C. Evaluation under NBPGR/ICRISAT Collaborative programme

(a) Pigeonpea (*Cajanus cajan*) (Compact type)

A trial of 93 compact type germplasm lines was conducted in augmented block design with 4 rows of 4 m long and 75 cm apart using NP (WR)-15 as check after every 5 accessions. The crop was sown during July, 1986 and harvested in April, 1987 after recording various agrobotanical characters. ICP-8654, -7059, -9255, -7257, -12283, -10258, -9046, -8706, and -6656 were found promising accessions.

(b) Pigeonpea (*Cajanus cajan*) (Spreading type)

A trial with 263 semi-spreading and spreading accessions was conducted in augmented block design during July, 1986, the plot size being 4 rows of 4 m length and 75 cm apart. Gwalior -3 was used as check after every five accessions. ICP-4715, -5610, -8445, -8212, -3373, -8642, -8082, -10095, and -8186 were identified as promising lines on seed yield/plant basis

(c) Chickpea (*Cicer arietinum*)

A trial with 1320 accessions including three checks viz. L-550, Annigiri and BDN 9-3 was conducted in augmented block design with 4 rows of 2 m length and 50 cm apart. Best five accessions were: ICC-10388, -6072, -11047, -12241 and -5784.

(d) Groundnut (*Arachis hypogaea*)

A total of 1500 germplasm lines comprising of 723 erect branch types, 391 spreading bunch types and 386 runner bunch group was evaluated during kharif -1987. The sowing was done on 3-7-87 in 3 m long and 75 cm apart rows. JL.24 and R-23-1 were used as checks after every 20 accessions. The crop was harvested after recording the various agro-botanical characters.

(i) *EB Group* (723 accessions): The germplasm flowered between 23-29 days while maturity ranged from 103 to 117 days. The pod yield/row ranged from 5 to 435 g. Seventy two accessions recorded 250 g or more pod yield per row. Germplasm giving 350 g or more yield were: ICG- 3544, -5488, -7836, -193, -2120, -129, -5847, -5881, -21, -65, and -11608.

(ii) *SB Group* (391 accessions): The range for days to 50 per cent flowering was observed between 24-35 while crop matured between 108-129 days. Plant population varied from 1 to 20 plants/row. The pod yield/row varied from 3 to 290 g. Twenty-six accessions recorded more than 150 g pod yield/row.
Runner Group (386 accessions): In this group, range for days to 50 per cent flowering was observed from 30 to 35 days. The 50 per cent maturity was between 118 to 128 days while plant stand was in the range of 4 to 26 plants/4 m long row. The pod yield/row varied from 7 to 230 g. ICG-79, -5837, -7042, -89, -2465, -7040, 4968, -2899, -4826, -5163, -7052, -4856, -5634 were identified as promising collections.

(e) Sorghum (Sorghum bicolor)

The objective of the present trial was to evaluate sorghum germplasm against mid-season drought under rainfed conditions. One hundred germplasm lines were sown in single rows with two replications during the kharif, 1987 along with NJ 156 as a local check and SPV-475, V-302, SPH-263 as ICRISAT checks. Some of the very early types for days to flowering were: IS-9608 (35), -12737 (37), -9761 (41), -13435 (42), -12740 (43) etc. Twenty-four lines took more than 100 days to flower.

Many cultures flowered early and gave higher yields as they escaped the terminal drought. Among the germplasm, SPH-263 (321 g) topped in yield followed by SPV-475 (217 g), V-302 (177 g), IS-107 (155 g), PA-20 (154 g), IS-2874 (151 g), IS-18451 (137 g), and IS-3511 (135 g). Harvest index varied among the genotypes. It ranged from 64.05 per cent (SPH-263) to 0.40 per cent with an average value of 20.0 per cent. In general, higher grain yield was associated with high harvest index.

(f) Pearl millet (Pennisetum typhoides)

Eighty-one germplasm lines were evaluated in two replications against mid-season drought. They were sown in 4 rows of 4 m long each with an interspace of 50 cm. The crop was raised under rainfed conditions and necessary agronomic practices were adopted. Some of the early flowering cultures (days) were: IP-4042 (33), -4292 (33), -4236 (34), -4194 (34), -4140 (35) and -13579 (35). Seed yield (g/3 plants) among the genotypes ranged from 118 g (IP-13712) to 22 g (IP-4111). For seed yield IP-13712 (118 g) was best followed by IP-13730 (113 g), -13573 (108 g), -13685 (104 g), -12932 (104 g), -13899 (99 g), -13623 (98 g), -13697 (96 g), -13273 (94 g) and 3279 (93 g).

D. Duplicate centre for evaluation and maintenance

As duplicate centre, the following crops were grown for evaluation and maintenance.

(a) Kulthi (Macrotyloma uniflorum)

Seed increase of 656 germplasm lines comprising of 158 early, 168 medium and 330 late accessions was undertaken during kharif, 1987 for supply to Conservation Division (HQ) for long term storage. A catalogue on Kulthi germplasm has already been sent to Headquarters for publication.
(b) **French bean (Phaseolus vulgaris)**

Three hundred forty-six accessions were grown for evaluation and initial seed increase during *Rabi*, 1986. One hundred accessions either failed to germinate or did not set pods. The crop was harvested in March-April, 1987 after recording various agro-botanical characters. Germplasm flowered between 46 days (EC-14288) and 72 days (EC-24759). Ten accessions were observed to be early type taking less than 50 days to flower, while 15 accessions took more than 70 days to flower. The maturity ranged between 80 days (G-2793-43) and 113 days (EC-24759). Seventeen accessions matured within 85 days while 53 accessions took more than 100 days for maturity. The promising types observed were: PLB-10-1, EC-37670, -116179, -205361, -18611A and -42960.

(c) **Cowpea (Vigna unguiculata)**

Forty-one germplasm lines were grown for initial seed increase and evaluation. Seventeen accessions failed to germinate. IC-53344, CuON 11/20, 405 SVS-3 and Peth Manglur were observed as prolific bearer.

(d) **Lentil (Lens culinaris)**

Two hundred forty-seven accessions were grown for seed increase and evaluation. Twelve accessions failed to germinate. The crop was sown on 7-11-86 and harvested in the month of March, 1987. Seed yield per row ranged between 3 g (PLMA-266) and 40 g (PLMA-194). Seventeen accessions recorded more than 30 g seed yield while 19 accessions recorded less than 10 g seed yield per row. Promising ones were: PLMA-194, -129, -72, -49, -64 and -70 recording more than 35 g seed yield per row.

(e) **Okra (Abelmoschus esculentus)**

A total of 345 germplasm lines was grown for evaluation and maintenance. The sowing was done on 4-7-87 in 4 m long and 50 cm apart observational rows. Sel-2 and G-2 were used as controls after every 10 accessions. Twenty-seven accessions either failed to germinate or produce flowers and fruits.

IC-24594, -26315, -27881, -42483, -45813, -45765, -52319, -23619, -49572, -14026, EC-169478, TR/131/82, TR/33/1, G-2 and Sel-2 were identified as promising accessions.

(f) **Onion (Allium cepa)**

(i) **For bulb production**: Ninety-one accessions were grown for bulb production after raising nursery (25-10-86 and planting in the field on 20-11-86). The crop was harvested during March-April, 1987.

The bulb yield per row ranged between 100 g (Til/3) to 4100 g (T 124/3). Eighteen accessions recorded 3000 g or more yield, while 5 accessions yielded less
than 1000 g. The promising accessions along with bulb yield (g) were: T-124/3 (4100),
-59/8 (3850), -47/2 (3750), -83/13 (3800), -122/1 (3650), -93/1 (3600), -8/24
(3300), -118/1 (3250), -102/9 (3200) and -1/4 (3300).

(ii) For seed production: The seed production in 624 accessions was done
by growing the bulbs in 1 m × 50 cm plot on 20-10-86. Only 5 accessions failed
to sprout, and in rest of the accessions good quality of selfed seed was produced.

(g) Garlic (*Allium sativum*)

The garlic germplasm comprising of 226 accessions was evaluated for bulb
production in single 3 m long and 30 cm apart rows. The planting was done on
22-10-86. Thirty accessions failed to sprout. The crop was harvested during Feb-
March, 1987 after recording various plant and bulb characters.

Plant height varied from 27 cm (IC-49057) to 81.2 cm (T-80/8). Sixty-six
accessions measured more than 60 cm in plant height. IC—48913, -49340, T-1/5,
-85/15 and -80/8 recorded more than 70 cm height.

Leaf length varied from 16.1 cm (IC-48986) to 64 cm (IC-28881-1). Fourteen
accessions produced leaves measuring 50 cm or more. The leaf width ranged be­tween
0.6 cm (IC-49075) to 2.3 cm (T-84/34). Nine accessions recorded the leaf
width of more than 2.0 cm. The range for stem diameter was observed between
0.4 cm (IC-49372) to 2.3 cm (T-83/5). The stem diameter in 8 accessions was
found to be more than 1.7 cm while it was less than 1.0 cm in 25 accessions.

The bulb yield per plot varied from 2 g (IC-38445), to 1225 g (T-84/10). Sixty
accessions including IC-38445, -48990, -32683 and T-74/18 were observed poor
yielder with less than 100 g bulb yield while 17 accessions recorded the bulb yield
of more than 700 g.

(i) Garlic Trial No. 1: Sixteen promising selections along with Akola
Local were tested in yield trial during Rabi 1986-87. The trial was conducted in
RBD with 3 replications of 4 rows each, the plot size being 3 m × 1.2 m i.e. 3.6
sq. m. which is 1/2777 of a hectare. IC-49373 (8672 kg/ha), -49381 (7320),
-19084 (6848), -42891 (6137) and -35325-1 (5737) were the first five in order of
merit and superior to Akola Local which occupied 9th position with 5090 kg/ha
yield.

(ii) Garlic Trial No. 2: An initial evaluation trial comprising of 28 selec­
tions was conducted in RBD with 3 replications of 4 rows each, the plot size
being (3 m × 1.2 m) 3.6 sq. m. i.e. 1/2777 ha. The trial was planted on 20-11-86
and crop was harvested during Feb.-March, 1987. Sel. T-66/70-3, IC-49302, White
Bold, IC-45231 and T-85/7 were first five in order of merit.
(h) **Chillies** (*Capsicum annuum*)

Eighty-six germplasm lines were planted for preliminary evaluation and maintenance. The promising accessions identified were: IC-44511, 8/83-22, 37/83-13, 37/83-25, 45/83-18, 51/83-88 and 61/83-7,

(i) **Brinjal** (*Solanum melongena*)

Twenty-seven accessions were grown for evaluation and maintenance. V—1575, —1688 and —1740 were observed as prolific bearers.

(j) **Tomato** (*Lycopersicon esculentum*)

Seed multiplication of PID was done.

(k) **Sowa** (*Anethum sp.*)

Six sowa collections were grown for seed increase and maintenance.

(l) **Other crops**

Limabean (21), Mucuna (2), *Lathyrs* (22), pea (6), *Leucaena* (33), Jute mallow (10), *Canavalia* (2), Coix (7), *Hibiscus subdariffa* (6), Jojoba (1), *Malpighia* (1), Citrus (2), and Pomegranate (2), were also grown for seed multiplication/germplasm maintenance.

E. **Germplasm supply and distribution**

(i) *For long term storage*: The required quantity of seed material in chickpea (1103), pigeonpea (773), *Kulthi* (41) and castor (35) were supplied to the Conservation Division for long term storage.

(ii) *Supply to other organisations*: One thousand seven hundred fifty-six accessions comprising of winged bean (218), soybean (134), sesame (288), safflower (20), niger (64), amaranth (93), *Kulthi* (30), French bean (20), chickpea (70), pea (5), *Sowa* (2), sunflower (2), chakwat (1), *Ragi* (50), onion (1040) and garlic (270) were supplied to 36 different Research Institutes, Farms, Universities and Farmers.

**Research Projects (Project Leader; Associates)**

1. All India co-ordinated research project on under-utilized and under-exploited crops. (D. P. Patel)
2. Building up of various oil seed germplasm, their evaluation, utilization and conservation. (T. R. Loknathan)
3. Assemblage, evaluation, documentation and conservation of pigeonpea (*Cajanus cajan*) germplasm. (D. P. Patel)


A. Germplasm Evaluation

(a) Mung (*Vigna radiata*)

A total of 2196 collections/lines of *mung* were grown in augmented block design and evaluated for various agro-botanical characters using C-1 Kopergaon, C2-Ti, C3-PS-16, C4/TAP/7 and C5-S-8 as controls. Most of the collections matured completely in 67 days while PLM-230 and PLM-234 took more than 107 days to mature. IC-39397, -73476, -39295, -39393, -39467, and -39464 were observed to bear higher number of nodules (85–117 per plant). Ten promising lines viz. PLM-311, -683, -747, -992, -646, -272, -245, -345, -507 and IC-10498-1 were identified as high yielding accessions.

In another yield trial of *mung* for promising lines earmarked in 1986, PLM-140, -539, -120, -267 and -97 were found superior over others on the basis of yield per plant.

(b) Sweet potato (*Ipomoea batatas*)

Out of 275 accessions being maintained at the station, only 100 could establish in the field on transplanting. EC-198820 introduced from USA, could survive and was established at station. A catalogue was prepared for 147 accessions for 35 descriptors. The range of variation recorded for some important characters is as follows: tuber length—5 cm (EC-30928) to 18.3 cm (Pusa Lal); per tuber weight—12 g (EC-30927—P1) to 127 g (EC-30228—P2); tuber yield/vine—31 g (EC-4717) to 601 g (Pusa Safed).

(c) Papaya (*Carica papaya*)

Out of 19 varieties/lines of papaya evaluated for various characters, EC-26495, -109027 and -109092 were identified as early fruit bearing types; Rahatgaon produced the largest fruit weighing 1.25 kg.

(d) Citrus spp.

Amongst five collections viz. EC-61353, -57036, -80580, Seedless lemon and lemon Kagzi, Seedless lemon produced 691 fruits weighing 37.17 kg. EC-80580 did not bear any fruit.
(e) **Grape (Vitis vinifera)**

Seventy-five collections of grapes are being maintained at this station. Flowering and fruiting was not observed due to adverse weather conditions. Out of the 22 new accessions of grapes, 7 accessions could not survive in polythene bags. These were canda, Gastiza, Anabe-shahi (Red), Angoor calan, Panchari-shahibi.

(f) **Moth (Vigna aconitifolia)**

One hundred seventy-one accessions were evaluated for various agro-botanical characters. PLMO—160, —189, IC-10145, —11343, —8980, —10541 and —9709 showed complete maturity in 96 days while PLMO-178 took 140 days to mature. PLMO—15 gave the highest yield (40 g/row of 3 m). The drought resistant lines marked were: PLMO—15, —129, —225, —34-A, —6 and —133.

(g) **Urad (Vigna mungo)**

Out of 111 accessions sown for evaluation, 25 accessions did not flower due to drought conditions. IC—53070, —53075, —53061, —53060 and —53057 were identified as drought resistant lines. The highest yield (125 g per row of 3m) was obtained in IC—53070.

(h) **Ricebean (Vigna umbellata)**

Out of 101 accessions sown for evaluation, 8 accessions failed to germinate and another 26 failed to produce seeds due to prevailing drought. RXS-27-P, CXM-42-P-1, CXM-12-P-3, CXM-12-P-3-1 and CXM-3/01-1 were identified as promising lines under drought conditions.

(i) **Phaseolus trilobus**

IC—24834, —24835 and —24833 were identified as promising accessions on the basis of yield and resistance to drought conditions.

(j) **Ses (Lablab purpureus)**

Four hundred twenty-two accessions were evaluated for various agro-botanical characters using Cl Pusa bunch, C2-D-1, C3-Kalam/Local and C-4-7 as controls. IC—22024 showed complete maturity in 136 days while IC—32840, —33094 and —29284 matured in 261 days. IC—22042 gave the highest yield (865 g/3 m row). IC—22038, —20287, —33395 and —29375 were identified as promising lines. There was heavy incidence of yellow mosaic virus on all the 421 accessions (Seed types) sown in kharif, 1987.

(k) **Tomato (Lycopersicon esculentum)**

Twenty accessions of tomato were transplanted in the field on 9-7-87 in single rows (4 m long and 1 m apart, with plant to plant distance of 25 cm).
EC—130054, —129571, —125480, —128965 and —129606 were identified as promising accessions.

(l) *Pachyrhizus* spp.

Thirty-three accessions were evaluated for various agro-botanical characters. Complete maturity took 172 days (EC-100540 and EC-100549) to 197 days (EC-100542 and EC-100562). The highest seed yield (92.5 g/3 m row) was obtained for EC-100540.

(m) *Garlic (Allium sativum)*

A total of 667 accessions (481 from NBPGR, H. Q. and 186 from Akola) were grown on 30th October, 1987 under irrigated conditions for evaluation and maintenance. The growth is satisfactory.

(n) *Onion (Allium cepa)*

Bulbs of 95 accessions were planted in October, 1987 for seed production while seedlings of 549 accessions were transplanted in plots (2m × 0.5 m) for bulb production. The growth is satisfactory.

(o) *Vernonia galamensis*

EC-211347 a single collection, was planted in pots on 29-7-87 which showed satisfactory growth and produced seeds.

(p) *Sesbania rostrata*

EC-178342 was sown on 19-11-86 in the field. The growth was poor in the summer season. Flowering started on 21-1-87 and seeds matured on 6-3-87; 100 g seed was obtained. The same was sown in *kharif* on 9-7-87. The growth was good. It has produced 3.30 kg seed.

(q) *Anethum graveolens*

Three accessions viz. EC—196640, —196641 and —196642 received on 6-2-87, were planted in the field on the same day. Growth was not very satisfactory and plants failed to set seeds during the hot summer.

(r) *Turmeric (Curcuma spp.)*

Three collections of turmeric were received and planted in pots on 13-2-87 and harvested on 16-12-87. The growth and rhizome production were satisfactory. Their yield is given below: VII-154 (235 g), VII-313 (150 g) and VII-367 (300 g).

(s) *Custard Apple (Annona reticulata)*

Seeds of 62 accessions were sown in polythene bags on 28-5-87. Fourteen lines failed to germinate.
(t) Pomegranate (*Punica granatum*)

Four old accessions and 81 new accessions are being maintained. They are showing satisfactory growth.

(u) Guava (*Psidium guajava*)

Two collections *viz.* Amravati Local and Lucknow/49 are being maintained. The flowering was observed on 10-8-87 in both. Lucknow/49 produced 11.13 kg fruits/tree as compared to 1.0 kg/tree by Amravati Local.

(w) Ber (*Ziziphus mauritiana*)

In all 12 collections are being maintained.

(x) *Simaruba glauca*

Three plants of EC-19701 yielded 63 kg of seed.

(y) Miscellaneous crops

Plants of various miscellaneous crops *viz.* *Phalsa, Khirni, Brosimum alacastrum* (EC-117858), *Maclura aurantiaca* (EC-87859), Sweet tamarind, Hybrid sisal (EC-36443), *Karaonda* (150 plants), *Rauvolfia serpentina* (IC-13581), *Rauvolfia canescens* (IC-13562), Seedless sapota, Mulberry, *Bauhinia blackeana* (EC-31897), *Jatropha curcus* (IW-3472) and perennial chillies, along with various ornamentals are being maintained.

B. Multiplication of seed

Seed of okra (variety Sel. 2), *guar* (Pusa Navbhar) and cowpea (IC-38956-1) was multiplied.

C. Seed Supply

Seed and planting material of *Simaruba glauca, Carica papaya, Phaseolus trilobus, mung, Pachyrhizus, ber, mulberry, West Indian cherry, seedless lemon, Croton and urad* were supplied to various indentors.

Research Projects (Project Leader; Associates)


2. Conservation and Preliminary evaluation of sweet potato (T. G. Kawalkar; V. K. Pandita)

Mung germplasm being evaluated at Amravati

Oryza coarctata—a salt resistant rice collected from Coastal Orissa (Left—young plant; right—panicle)
Salvia selarea—an exotic medicinal plant growing at Bhowali Station

Zizyphus mauritiana in bearing in Kumaon hills, UP
A. Plant Exploration and Collection

During the year 1987, three explorations were undertaken to collect the existing crop diversity in remote areas which could not be covered in earlier trips. In all 683 samples (cereals-220, pseudocereals-22, pulses-110, minor millets-65, vegetables—188, spices and condiments—19, medicinal and aromatic plants—13, oilseeds-30 and miscellaneous-16) were collected from Milam Gori Valley, Devidhura, Lohaghat, Jageshwar, Mukteshwar, remote areas of Pauri, Tehri, Uttarkashi and Dehradun of Kumaon and Garhwal regions, Uttar Pradesh. Salient features of diversity collected in various crops are given below.

(a) Paddy (*Oryza sativa*)

The land races collected from Tarai Bhabar and valleys (irrigated) and hilly regions of Pithoragarh, Almora and Uttarkashi districts (rainfed conditions) are: Rawansaya, Barhataha, Bhadasi, Barahatia, Chawat, Chawar, Dangaya, Jarkhya, Japant, Kumaon Naj, Kumaldi, Pinglu, Sukhurja, Shail, Banpasa, Jawa, Bura, Gurdii, Mansoori, Rajbbog, Andhi Khara, Kajuri, Jhumari, Kapar, Teli, Mujari, Jhapulee, Jhusi, Laljari, Roti, Madguri, Luki, Safed Syal, Mesu, Membree and Jharua.

(b) Maize (*Zea mays*)

Remaining parts of Jaunsar region and new areas in Pithoragarh district were explored and 92 collections were made. Visit of K. C. Pant, Sr. Scientist to Mexico generated an excellent broad genetic base with the collection of landraces of Mexican and Latin American origin. Besides, many wild relatives of maize like *Zea perennis*, *Zea diploperennis*, *Zea mays* ssp. luxurians and *teosinte* (*Zea mays* ssp. *mexicana*) races like Nobegame, Balzas and Chalco were also requisitioned and have already been obtained. This material will be tested and seed multiplication will be carried out in next season under evaluation programme.

(c) Wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*)

Thirty-two and eighteen samples of wheat and barley respectively of local material were collected.

(d) Pseudocereals

Seventeen samples of amaranth and 5 samples of buckwheat were collected from different sites.
(e) Pulses

Good diversity in different pulse crops was collected from remote villages under rainfed conditions and these were: soybean (43), blackgram (8), ricebean (11), lentil (15), field pea (5), kulthi (13), cowpea (14) and pigeonpea (1). In soybean one collection having very bold seed (probably of exotic origin introduced some time back) was collected from Lohaghat area in Pithoragarh district.

(f) Oilseeds

Seven samples of sesamum, 20 samples of mustard and 3 samples of *Perilla* spp. were collected from different sites.

(g) Vegetables

Variability in vegetable crops collected from diverse climatic zones was: Frenchbean (71), chillies (29), spinach (5), cucurbits (18), radish (10), garlic (36), onion (1), *Ram karela* (3), garden cress (*Lepidium sativum*) (2), Hyacinth bean (2), Indian poke (*Phytolacca acinosa*) (2), brinjal (2), bottlegourd (2), snakegourd (1), fenugreek (5).

(h) Minor millets

In minor millet group, finger millet (21), barnyardmillet (28), foxtailmillet (11), prosomillet (3) and only 2 samples of *Sorghum vulgare* (probably improved type) were collected.

(i) Spices and Condiments

A few spices and condiments such as *Ammomum subulatum* (1 rooted plant), turmeric (1 rooted plant), chora (*Angelica glauca*) (1), cannabis (2), coriander (10), were also collected this year.

(j) Wild species

Several wild plant species either related to crop plants or having economic importance, were collected as roots or whole plant. These were: *Hippophae rhamnoides*, *Mahonia nepaulensis*, *Rubus nutans*, *Rosa sericea*, *Bosia amherstiana*, *Rhamnus* sp., jujube (*Ziziphus mauritiana*), *Kharsoo* (*Quercus semecarpifolia*), *Taxus baccata*, *Cedrus deodara* (seeds germinated), nettle tree (*Celtis australis*), margosa (*Azadirachta indica*) and *Indigofera* sp.

(k) Medicinal and Aromatic Plants

Many species of medicinal and aromatic plants were collected from higher altitudes and roots or rhizomes were brought to the station to test their performance under Bhowali conditions. These were: aconites (*Aconitum heterophyllum*), and bish (*A. atrox*), *Ephedra gerardiana*, *Picrorhiza kurrua*, *Saussurea costus*, *Valeriana* sp., *Thymus serphyllum*, *Aristolbe rivularis*, *Heracleum* sp., *Celastrus paniculata*, *Sarcococca salinga*. 
(l) Horticultural plants

Turkish hazelnut (*Corylus jacquemontii*), *Musa* sp. (rooted plant), some exotic ornamentals like, day lily, bird of paradise, tulips, daffodils, Irises, gladioli were collected from private growers.

B. Germplasm Evaluation

About 8,300 accessions of various crops collected during explorations or received from NBPG Regional Stations and Headquarters, were sown for evaluation of various descriptors or multiplication for further evaluation and distribution.

(a) Paddy (*Oryza sativa*)

One hundred eighty-two entries of local landraces with 4 rows per entry, were grown and evaluated for 19 agromorphological characters and for disease resistance. Majority of the collections were landraces from Uttarakhand Himalayas and the most promising ones were: P-21 (Jaunsar), P-8 (Chamba Dhan), P-23 (Ukhad), P-1236 (Bogni), P-246 (Jaintoli), where yields varied from 60-128 g. A wide variation in 1000 seed weight (10-26 g) was observed, boldest seeds being in the *Ukhad Dhan* from Jaunsar and Bhabar region from an elevation of about 5500 ft, which probably will be best suited to the similar climatic zone of the Bhowali station. Otherwise paddy is difficult to grow at this station due to intervening cold spell during the growing and seed filling period. A wide range of variation was also observed in days to flower (124—191). Early flowering collections were: P-875-Rotinga (124 days) from Garbyang region, P-200-Sawa (137 days), P-240-Jaintua (140 days), P-256 (130 days), P-266 (129 days), P-270 Sukhila (137 days), P-1117-Tatania (125 days). Some of the collections found tolerant to leaf blast (*Pyricularia oryzae*) and leaf spot (*Helminthosporium sp.*) were P—8, —109, —134, —135, —334, —1140 and P—1236. A publication in the form of a monograph is being prepared where all the landraces of Uttarakhand will be enlisted along with their chief distinguishing features.

(b) Maize (*Zea mays*)

In maize, 639 accessions were grown in two sets, one set for evaluation and the other for seed multiplication. Fifteen agro-morphological and disease characters were recorded in the collections. The early maturing accessions were from HP and Shillong region such as B-104 and BDJ/NKG-43. Accessions found tolerant to *Helminthosporium turcicum* were: P—16, —19, —35, —63 —77, —81 (all Jaunsar collections) and B-49 and —119 (from Shillong).

(c) Medicinal and Aromatic Plants

It was for the first time in 1987 that a large number of indigenous wild plant
species of medicinal, forage and fuel value were grown and plants of exotic origin were also tried.

(d) Forage Crops

A total of 507 collections of various forage legumes and grasses which included *Dactylis glomerata* (6), *Festuca arundinacea* (10), *Lolium multiflorum* (5), *L. perenne* (5), *L. hybridum* (5), *Paspalum rotatum* (1), *P. dilatatum* (1), *Phleum pretense* (4), *Medicago* spp. (98), *Trifolium* spp. (323) and *Lupinus albus* (47) were evaluated at Bhowal. Certain accessions in *Trifolium* were found resistant to powdery mildew. Among forage and other economic trees, seedlings of the following species were raised and transplanted in the vicinity of regional station: *Cassia sturtii* (6), *Leucaena leucocephala* (5), *Pinus helepensis* (100), *Calliandra calothyrsus* (15).

Pathological Evaluation

During Rabi season, following crops were evaluated for various diseases: wheat, barley, lentil, pea and forage crops.

(a) Wheat (*Triticum aestivum*)

A total of 1089 local germplasm collections of wheat were evaluated under high fertility and irrigated conditions. Artificial epiphytotic condition was created for the maximum development of diseases. Out of 1089 collections, only 19 collections viz. IC-35160, -47540, -31460, -31616, -31982, -47035, -47039, -60193, -60219, -60235, NC-57574, -56170, -57559, -55551, -55693, -5571, 60249 and -60668 were found resistant against yellow rust. NC-60668 was found resistant against yellow, brown and black rusts.

Ninety-eight wheat varieties were artificially inoculated and screened against *Tilletia foetida* (hill bunt). Only five varieties i.e. HD-2329, PBW-154, PBW-186, Kalyansona and K-8027 were found resistant.

Screening of all the trials and nurseries revealed the following wheat varieties to be resistant against powdery mildew under severe epiphytotic conditions: VL-608, -616, CPAN-1922, -1973, HD-2189, Hope/cc, Khapli, MG-25-8, Opal, NS-879/4, Orca, Kavkaj, Aitora, HS-240, K-8538, NI-9075, Carry Super Marilla, Bab White, Sappo, Budifan, PI-185408 and MP-859.

(b) Barley (*Hordeum vulgare*)

Out of 628 cultures of barley screened, only IC-26553, NC-58178, -58192, -60599, -60582, -60607 and -60602 were found resistant against yellow rust. Only 3 cultures i.e. EB-430, -8337 and -7047 were found resistant against *Helminthosporium gramineum*. 

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(c) **Lentil (Lens culinaris)**

One trial and one nursery were evaluated under rainfed as well as under irrigated conditions. Only two cultures i.e. VL-15 and type-36 were found free from rust and wilt.

(d) **Pea (Pisum sativum)**

A nursery comprising of 98 cultures was screened under high fertility conditions against powdery mildew. Only three cultures i.e. P-965, VL-81128 and -8114 were found resistant against the disease. Seeds of all the three varieties have been grown again for multiplication.

(e) **Ragi (Eleusine coracana)**

A total of 1660 local germplasm collections was grown to find out the resistant stocks against leaf blast, finger blast, neck blast and leaf spots. The five collections found tolerant to leaf blast, leaf spots, and finger blast were: IE-14, -21-51, -87 and -101.

(f) **Foxtail millet (Setaria italica)**

Out of 806 accessions, only 675 germinated. Leaf blast was quite prevalent and collections found tolerant were: ISE--161, -162, -181-1, -248, -249, 25-2 M and P-31/14. In most of the collections, leaf tip drying was quite prevalent. In some collections mosaic virus like symptoms were also observed.

(g) **Chinese cabbage (Brassica pekinensis)**

One hundred fifty-two exotic collections of Chinese cabbage were grown. In all the collections Alternaria leaf blight was quite common although EC-182701, -182710, -182708, -182721 and -182734 were tolerant.

(h) **Ricebean (Vigna umbellata)**

Two hundred thirty-six exotic and indigenous collections of ricebean were grown. Yellow mosaic virus which is generally not reported in ricebean elsewhere, was found quite prevalent under Bhowali conditions and only the following collections were found free: IC-14655, -151510, -17646, -15663, -15667, -166994 and -19353. These need to be retested. The crop had shown very good growth despite drought and seeds were multiplied for detailed evaluation.

(i) **French bean (Phaseolus vulgaris)**

A total of 1764 local collections of French bean were evaluated. Five hundred eighty-six collections did not germinate. Out of 1378 collections, 583 accessions were found infected with yellow bean mosaic virus and 572 accessions with powdery mildew. However, most of the accessions were found infected with angular leaf spot disease. Pod blight was also quite prevalent.
C. Maintenance

About 110 plants of various temperate fruits viz. apple, plum, almond and walnut are being maintained at the station.

Research Projects (Project Leader; Associates)


4. Evaluation, characterization and maintenance of winter cereals like wheat, barley and pulses such as lentil (P. C. Joshi; K. C. Muneem).

5. Evaluation, characterization, maintenance and cataloguing of (a) Kharif pulses, (b) Vegetable crops, (c) Pulses, (d) Minor millets (K. C. Muneem; P. C. Joshi, K. C. Pant).
EXPLORATION BASE CENTRE, CUTTACK

A. Plant exploration and collection

Three crop specific/multi-crop and one short-exploration trip for collection of local crop plants were undertaken to the unexplored districts of Orissa during the period under report. The regions explored include Mayurbhanj, Keonjhar, Koraput, Kalahandi, Phulbani, Bolangir, Sambalpur and Cuttack districts. Four hundred sixty-nine accessions of agri-horticultural crop plants were collected. One hundred sixty-eight collection sites covering more than 69 blocks were covered. Details of the area explored and diversity collected are given in Table 1.

Table 1: Plant Exploration and Collections made during 1987

<table>
<thead>
<tr>
<th>Collector</th>
<th>Area explored</th>
<th>Period</th>
<th>Diversity collected</th>
<th>Total collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Dikshit &amp; D.S. Rathore</td>
<td>Koraput, Kalahandi &amp; Ganjam (Orissa)</td>
<td>19.5.87 to 26.5.87</td>
<td>Paddy, minor millets, arhar, mung, kulthi &amp; local mango</td>
<td>36</td>
</tr>
<tr>
<td>N. Dikshit &amp; A.R. Panda</td>
<td>Mayurbhanj &amp; Keonjhar (Orissa)</td>
<td>11.9.87 to 24.9.87</td>
<td>Early paddy, maize, minor millets, vegetables, oilseeds, fibre crops &amp; medicinal plants</td>
<td>176</td>
</tr>
<tr>
<td>N. Dikshit &amp; A.R. Panda</td>
<td>Phulbani, Bolangir &amp; Sambalpur districts (Orissa)</td>
<td>13.11.87 to 24.11.87</td>
<td>Paddy, minor millets, pulses, groundnut, mustard, cotton, vegetables, ginger, lemongrass &amp; Aloe spp.</td>
<td>250</td>
</tr>
<tr>
<td>N. Dikshit &amp; S. D. Sharma</td>
<td>Dangamal &amp; Bhitaranika region (Cuttack district) (Orissa)</td>
<td>26.11.87 to 28.11.87</td>
<td>Oryza coarctata &amp; salt tolerant paddy varieties</td>
<td>7</td>
</tr>
</tbody>
</table>

Total diversity collected 469

(a) Crop specific/multi-crop exploration for collection of rice germplasm

Three hundred accessions of local paddy varieties were collected from the unexplored regions of Mayurbhanj, Keonjhar, Phulbani and Bolangir districts of Orissa.
Orissa. The area explored is mostly tribal dominated, separated by hill boundaries. The varieties collected, therefore, are restricted and show wide range of eco-adaphic conditions. The altitude of the area varies between 270 to 1080 m. Shifting cultivation was observed in the hilly areas. Variations in growth period (maturity), grains, panicle length, size/thickness, husk, kernel apiculus and glume colour including awning/awnless characters were observed.

A total of 104 accessions of early paddy, including extra early varieties viz., sathika (D-0290), kunda dhan (D-0591) and saria (D-0649) were collected. Twenty four accessions of scented varieties varying in grain length/thickness, aroma ranging from mild scent to very good scent on cooking and having very good yield were collected. The early varieties are mostly awned at Mayurbhanj in comparison to other places.

The popular paddy varieties collected from four agroclimatic zones of Orissa are represented by the following:

**Northern plateau**

Abhirman, Bhutia, Karnasal, Kalakalam, Dudhakalama, Jamainadu, Kalakakiri, Junglijata, Sundar bhajna, Nabalkati, Asubhajna, Saruchampa, Kakiri, Malata, Agnisar, Sorubhujuni, Malata, Kranthanaradi, Gangaram, Kalpa, Arnarak humba, Bhutamundi, Kalama.

**Central table land**

Nenka, Barai, Kusuma, Jhuli, Baidahunda, Asamchudi, Harisan kar, Sankaribanka, Jhulipuagi, Kankiria, Chumeikankiri, Magura, Lache, Chinamal, Cheragudi, Suachunti, Mugudhi, Bahalmall, Galheiguti, Dubaraj, Sonapani, Ghumusara, Kakudia.

**Eastern ghat region**

Jhimli Chinamal, Galheiguti, Pathuria, Jhalka, Sathika, Magura, Mugudhi, Raisiri, Surda, Kusama, Kankiria, Harisan kar, Kiaketki, Rangrai, Madhakathaka, Malchina, Chatianaki, Ratnachudi Rangursa, Jaladhan Budadhan, Tabidia, Mahipal, Matasi, Ranisha heb.

**Coastal region**

Rangi, Boula, Sitamarayan, Samuli, Kalakanti, Baunshagaji, Pindari, Pateni, Narda, Bhenda, Dhusara, Kalakattak, Lilabati, Bholanath, Bholki, Chakrakenda, Ratnachudi, Belandi, Mugudhi, Durgabhog, Hunda, Motara, Harisan kar, Magura.

**Variability observed in paddy varieties**

Paddy varieties suitable for different land types, duration and special characters are mentioned below:
Early paddy—Rangi, Dandabari, Boula, Kainchi, Saria, Sathika, Kakiri, Chingidi, Bhutamundi, Lathachauri, Nalitsku, Chauli, Alsanga, Chheligudi, Sargiphul.

Medium—sarabhujni, Malata, Saruchampa, Bhutia, Suryakanti, Mugeisal, Mugei, Nichi, Kasiphul, Sunakhadi, Kalakalam, Kalikuji, Kaberi, Malhunda, Reisiri, Ckadeigudi, Piazig.

Late—Pateni, Dhusara, Mugudhi, Bholanath, Bhalki, Gangaram, Arnakhumba, Agniser, Amakhumba, Nrupati, Salekathi, Ratnachudi, Galehiguti, Asamchudi, Umeriachudi.

Very late—Chakrakenda, Mahipal, Rajgundhi, Jhuli, Jhulibagada, Matasi, Thumba, Haldiganthi.

Elongating type—Ranijholi, Jaladhan, Panidubki, Rabana.

Scented—Lilabati, Bainshibhog, Tulsibas, Nadiakata, Radhaballav, Jubaraj, Sorisaphul, Saragbali, Kalakrushna, Karpurakanti, Durgabhog, Kalajira, Chatianaki, Mugajai.

Popped—Banika, Jhuli, Galhetkuthi, Baidahundar, Luchei, Akul, Bahlmalli, Chinamal, Jhimei, Mahuri, Galheiguti, Baikani, Desimahuri, Kharkol, Raisiri, Kandalal.

Awned—Kindadhan, Tala, Chheligudi, Lohanchi, Sarjama, Surgiphul, Chingidi.

Good to taste—Sundarbhojna, Chinamal, Jhalka, Galheiguti.

Purple anthocyanin pigmentation—Meghabadal, Jualibhanaga, Lalkaini.

Good yielder—Latia, Galheik, Anthi, Jhili, Mahipal, Badchinamal Jhamura, Jhalka, Chinamal.

Wider adaptability—Mahipal, Harisankar, Mugudhi, Ratnachudi, and Saria.

Among the wild relatives, Oryza coarctata Roxb. a salt resistant tetraploid plant was collected from the Dangamal-Bbitarkanika areas of Cuttack. The genes for salt resistance may be transferred from O. coarctata to the cultivated paddy through tissue culture and breeding techniques. The variety is being maintained at the Base Centre for further studies on the species.

It is evident that the genetic diversity of rice in Orissa is remarkable. This indicates that the varieties are developed to suit different agro-climatic conditions within the state. The variation for the ecological factors such as upland, lowland,
deep water has also been exploited profitably by farmers. Duration of rice crop varies widely in the region starting from very early types (about 60 days) to very late types (160 days). Varieties have also been developed with anthocyanin pigments in various plant parts which help as an aid in eradication of wild rices in the paddy fields. Varieties have also been developed for varied uses of rice such as scented rice, puffed rice, popped, wet rice and rice-based sweets. There has been hardly any study of rice varieties for their uses in research laboratories so far. It is, therefore, all the more important that the genetic diversity should be explored and collected.

(b) Multi-crop exploration to Koraput, Kalahandi, Ganjam, Phulbani, Bolangir and Sambalpur districts of Orissa

During the multi-crop exploration to different districts of Orissa, 169 accessions of different agri-horticultural crop plants were collected. The crops other than paddy include cereals and minor millets (35), pulses (39), oilseeds (13), vegetables (44), fibre crops (22), spices (3), aromatic, medicinal and horticultural plants (9) and wild relatives of crop plants (4). The details of the germplasm collections during different explorations are given below.

Cereals and millets: It includes maize (7), jowar (5), ragi (6), kodo millet (1), little millet (9), barnyard millet (2), Italian millet (4) and job's tears (1). Local maize varied in cob size and seed colour. Seed colour noted was mostly yellow, mottled and various grades of purple. Panicum miliare varied in seed colour remarkably.

Pulses: Among pulses, urad (9), mung (7), kulthi (5), arhar (2), whitegram (1), Lathyrus (2), cowpea (10) and minor legumes including Vigna trilobata were collected. Local urad and mung suitable for growing in both the seasons were collected. Local arhar is mostly tall and late duration. Minor legumes including Vigna trilobata were also collected.

Vegetables: Germplasm of different vegetables like brinjal (1), chillies (10), bittergourd (3), ridgegourd (5), spinegourd (1), amaranth (5), okra (3), pumpkin (1), cucumber (1), papaya (1), tomato (2), potato (1), taro (1) and yam (3) were collected. Chillies varied in size and pungency. Brinjal, spinegourd, amaranth, taro, and yam had interesting variability.

Fibre crops: Cotton (19), jute (1), mesta (1) and sunhemp (1) were collected. The local perennial cotton is woody, multi-seeded with attached seeds, short staple length and with or without petal spots. This is grown by the farmers in the backyard fences. It was found sporadically in the districts of Boudh Phulbani and Bolangir districts.
Spices: Ginger (1), turmeric (1) and postok (1) were collected from Phulbani and Bolangir districts of Orissa.

Aromatic, medicinal and horticultural plants: Tulsi (1), lemon grass (1), Andrographis paniculata (1), Phyllanthus niruri (2), Celastrus paniculatus (2), Rauvolfia serpentina (1), Aloe vera (1) and Phyllanthus emblica (1) were collected during the multi-crop exploration to different districts of Orissa.

Wild relatives: Vigna trilobata was collected from the coastal districts of Orissa near the Baitarani river at Bajrapur (Cuttack district).

B. Evaluation of rice germplasm

A preliminary evaluation of 259 accessions of rice germplasm collected from Orissa was carried out for morpho-agronomic characters during kharif, 1987. Vegetative and reproductive characters were taken as per the descriptors for rice (IBPGR-IRRI, 1980). More than 45 descriptors were taken for each accession. Variations in basal leaf sheath pigmentation, blade colour, leaf length/width, ligule length, panicle length, days to 50% flowering, plant height, spikelet length, spikelet width and maturity were observed.

On the basis of basal leaf sheath pigmentation, varieties were classified as green (163), light purple (61), purple line (21), and purple (14). Depending on the grain size/thickness, varieties were classified as long slender (51), long bold (197), medium slender (5) and short bold (6). Variation in plant height (54-171 cm), ear bearing tillers (5-19 nos.), leaf length (24.7-78.4 cm), leaf width (0.6-1.98 cm), days to 50% flowering (54-130 days), panicle length (16.5-34.1 cm), panicle weight (0.64 g-5.8 g), spikelet length (4-11 mm), spikelet width (2-4 mm), maturity (85-160 days) and test weight (1.15-2.95 g) was recorded. Superior genotypes identified on yield data basis are: D-0020 (31.3 g/plant), D-0015 (22.9 g/plant) and D-0078 (20.9 g/plant).

C. Maintenance and conservation

The stubbles of Oryza rufipogon, O. nivara, O. sativa var. spontanea, O. coarctata [Porterseia coarctata (Roxb.) Tateoka] and living plants of Cymbopogon martini (2), Gossypium arboreum (1), Andrographis paniculata (1), Aloe vera (1), Rauvolfia serpentina (1) and wild relatives of Solanum melongena (1), Solanum torvum (1) and tubers of yams (2) and taros are being maintained at the Base Centre. Sorghum, mung, urad, kulthi, niger, sesame and mustard whose seed quantity was very less at the time of collection, were multiplied.

Three hundred four accessions of different agri-horticultural crop plants collected during December, 1986 and May, 1987 were sent to the Division of Germplasm Conservation for conserving the original germplasm in the genebank. One set
of the non-paddy crops was sent to the Division of Germplasm Evaluation for further multiplication and evaluation.

Research Projects (Project Leader; Associate)


2. Exploration and collection of oilseed germplasm from Orissa (R.K. Arora*; N. Dikshit).

3. Exploration and collection of miscellaneous *kharif* and *rabi* crops (R.K. Arora*; N. Dikshit).

*Associated in Advisory Capacity only*
PLANT QUARANTINE REGIONAL STATION, HYDERABAD

This Regional Station has been established to cater to the quarantine requirements of International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Directorate of Rice Research (DRR) and other research organisations in the region. It also serves as the base centre for plant exploration.

A. Quarantine

During the year, a total of 71,041 seed samples were received for quarantine examination and clearance, of which 52,918 (pearlmillet 6,223; sorghum 20,081; pigeonpea 4,389; chickpea 9,354; groundnut 11,677; minor millets 955; rice 224; others 15) were meant for export while 18,123 (pearlmillet 1,911; sorghum 2,519; pigeonpea 315; chickpea 141; groundnut 974; minor millets 201; rice 11,937; celery 90; *Acacia* spp. 17; others 18) were imported into India.

(a) Import Quarantine

(i) Quarantine examination: All the imported seed material was fumigated before opening the packets. Then a common examination involving pathologist, entomologist, nematologist and economic botanist was carried out for insects, fungal fruiting bodies, weed seeds, nematode cysts, soil clods and plant debris. Later, the seed was subjected to various seed health testing techniques like blotter tests, sedimentation tests and X-ray radiography for latent infestation in leguminous crops.

Various seed health testing techniques revealed that most of the seed samples were not infested or infected with the exotic pests and diseases. However, 9 samples of pearlmillet, 3 samples of pigeonpea and 180 samples of sorghum heavily infested/infected with fungi, bacteria and bruchids were detained.

(ii) Salvaging of infested/infected germplasm: Efforts were made to salvage the infested/infected germplasm using various methods so as to release at least few healthy seeds to the consignee.

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Treatment Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearlmillet</td>
<td>Hot water treatment at 52°C for 10 minutes followed by treatment with Ridomil 35 SD (Metalaxyl).</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Treatment with Metalaxyl, Benlate-T and Monosone. Efforts are underway to get rid of the seed borne bac-</td>
</tr>
</tbody>
</table>
teria from 180 samples of sorghum by Nyolate treatment (Alloside Corp., USA).

**Chickpea**
- X-ray radiography. Treatment with thiobendazole.

**Rice**
- Pre-sooking in cold water and treatment at 54°C for 30 minutes.

**Acacia spp.**
- X-ray radiography. Treatment with benlate-T.

### Table 1. List of pathogens/pests/nematodes intercepted during 1987

<table>
<thead>
<tr>
<th>Pathogen/Pest/Nematode</th>
<th>Seed Material</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Drechslera maydis</em></td>
<td>Sorghum</td>
<td>USA</td>
</tr>
<tr>
<td></td>
<td>Pearl millet</td>
<td></td>
</tr>
<tr>
<td><em>Gloeocercospora sorghi</em></td>
<td>Sorghum</td>
<td>Rome</td>
</tr>
<tr>
<td><em>Colletotrichum graminicola</em></td>
<td>Sorghum</td>
<td>Rome</td>
</tr>
<tr>
<td><em>Tolyposporium penicillarum</em></td>
<td>Pearl millet</td>
<td>Rome</td>
</tr>
<tr>
<td><em>Claviceps sp.</em></td>
<td>Pearl millet</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td><em>Fusarium solani</em></td>
<td>Sorghum</td>
<td>Kenya</td>
</tr>
<tr>
<td></td>
<td>Pearl millet</td>
<td>USA</td>
</tr>
<tr>
<td><em>Callosobdricus analis</em></td>
<td>Pigeonpea</td>
<td>Thailand</td>
</tr>
<tr>
<td><em>Stiphilus zeamais</em></td>
<td>Sorghum</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td><em>Aphelenchoides besseyi</em></td>
<td>Paddy</td>
<td>Philippines</td>
</tr>
<tr>
<td><em>Pratylenchus sp.</em></td>
<td>Paddy</td>
<td>Philippines</td>
</tr>
<tr>
<td><em>Rhabditis sp.</em></td>
<td>Paddy</td>
<td>Philippines</td>
</tr>
</tbody>
</table>

(iii) **Post-entry quarantine**: All ICRISAT imported seed material, except chickpea, after quarantine treatment and clearance was grown in the Post Entry Quarantine (PEQ) Isolation area until harvest. The crops grown in PEQ area were inspected weekly throughout the growing period. During the year a total of 47 crop-inspections were made. During the inspection no exotic seed borne disease, except sorghum bacterial stripe and streak, were observed. The sorghum lines showing bacterial infection were removed and incinerated. It was also recommended not to grow sorghum in these plots during the succeeding season. Some of the common diseases like bud necrosis of groundnut, head smut and mosaic in sorghum, smut and ergot in pearl millet encountered now and then were removed and incinerated.

(iv) **Application of Enzyme Linked Immunosorbent Assay (ELISA) for the detection of groundnut seed borne viruses**: ELISA test results of both seeds and plants grown from the same seed of 709 ground nut seed samples imported from USA, 16 from Argentina, 3 from Brazil and 1 from Sudan indicated that none of these seeds carried peanut mottle or peanut stripe viruses.

(v) **Survey for Peanut Stripe Virus and Nematodes of Quarantine Importance in Groundnut**: Peanut Stripe, a seed borne virus disease of quarantine importance:
is reported from U.S.A. and several South East Asian countries from where several groundnut lines have been imported into India during the last few years. During a survey undertaken in 1987 in 12 groundnut germplasm growing research stations, Peanut Stripe virus was observed on a few entries of IET(SB) trial grown at Raichur in Karnataka, Palem (ICRISAT) Hyderabad and Vikarabad in A. P. and Junagadh and Navsari in Gujarat. The IET(SB) trial was taken up at 35 locations. In a bid to contain the disease, IET(SB) trials at all the 35 locations were recommended for destruction.

One hundred fourteen soil and root samples collected from eight groundnut germplasm growing research stations in Tamil Nadu, Karnataka, Anhdra Pradesh and Gujarat were processed for extraction of nematodes. *Aphelenchus avenae*, *Pratylenchus* spp. and *Tylenchorhynchus* spp. were mostly encountered on groundnut in the areas surveyed.

(b) Export Quarantine

A total of 52,918 germplasm samples meant for export to various countries were examined by seed health testing procedures and a total of 604 Phytosanitary Certificates were issued.

B. Germplasm Collection

Two crop specific explorations were undertaken in Andhra Pradesh, one for collection of minor millets in Telengana region and the other in collaboration with I.I.H.R., Bangalore for collection of custard apple in parts of Rayalseema and Telengana regions.

A total of 355 collections were made which included finger millet (120), Italian millet (65), barnyard millet (15), kodo millet (2), proso millet (1), sorghum (42), pearl millet (22), legumes (11), maize (6), custard apple (35) and others (36). A few collections of wild paddy (*Oryza rufipogon*) were also made from Mahboobnagar district.

In finger millet variability was mainly observed with respect to plant height, tillering, stem colour, number/compactness of spike and grain size/colour. In Italian millet variability was noted in plant height, length of spike, bristles etc. In custard apple some variation was noticed in respect of habit (shrubby and tree forms) and leaf morphology.

A local germplasm survey around Hyderabad was undertaken and collections of vegetables (brinjal, okra, bottlegourd, *guar* etc.), legumes (blackgram, greengram, cowpea) and custard apple were made.

-C. Genetic Resources of Andhra Pradesh

Through a survey of the regional flora and other available literature, infor-
mation was compiled on the genetic resources of Andhra Pradesh. Data on the geographical distribution, uses, taxonomy, chromosome number etc. of different species belonging to major groups of economic plants viz. cereals, pseudocereals, millets, legumes, vegetables and oilseeds were recorded.

An ethnobotanical study of the tribes of Andhra Pradesh was made and checklist of wild species used by them for various purposes was prepared.

D. Supportive Research Work

(a) Identification of Urdbean Leaf Crinkle Virus Occurring in Andhra Pradesh

Out of 43 host species tested in host range studies, the virus was found to infect *urad*, *mung*, French bean and cowpea only. Studies carried out on vector and seed transmission confirmed that ULCV is non-persistently whitefly transmitted and seed transmitted in uradbean, mungbean and French bean. The double diffusion serological test using antisera to 9 potyviruses showed that the virus is not serologically related to any of these viruses. Screening of several urad bean varieties against ULCV is in progress.

(b) Identification of Peanut Stripe Virus

The presence of Peanut Stripe in groundnut plants showing stripe symptoms collected during the survey, was initially tested by ELISA using Peanut Stripe virus antiserum obtained from Dr. J. M. Demski, Georgia Expt. Station, U.S.A. Samples that gave positive reaction to PStV were sap inoculated on to groundnut cv. TMV-2 in the net house. Studies on host range, transmission, serology and electron microscopy were carried out to confirm its identity. The characteristic symptoms were in the form of discontinuous stripes along the lateral veins and distinct mosaic mottle on younger leaflets, while the older leaflets developed oak leaf mosaic pattern. The virus was transmitted by *Aphis craccivora* in a non-persistent manner and was seed transmissible up to 24.5 per cent in groundnut cv. TMV-2. Out of 53 plant species mechanically inoculated, the virus infected groundnut, soybean, *urad*, cowpea, clusterbean, *Sesamum*, *Cassia obtusifolia*, *Sesbania rostrata* (symptomless) and *Nicotiana benthamiana*. In ELISA tests, the virus reacted with peanut stripe virus antisera. In dip preparations stained with 1 per cent uranyl acetate, several rod shaped virus particles resembling potyviruses were observed.

(c) Nematode Survey and Screening of Brinjal Germplasm

Sixty-five soil and root samples collected from ICRISAT Post Entry Quarantine Fields having sorghum, pearl millet, chickpea, groundnut and pigeonpea crops were processed for nematode extraction. Species identification is being done for preparation of nematode distribution map.
The then Hon'ble Union Minister of Agriculture, Dr. G. S. Dhillon inaugurating Plant Quarantine Regional Station at Hyderabad.
Peanut Stripe Virus—a new record for the country

Pearlmillet being observed by breeders and quarantine scientists at ICRISAT Quarantine Nursery
Sixty-seven collections of brinjal received from Headquarters were planted both in net house and field. All the collections were inoculated with *Meloidogyne incognita* in 3 replications, each having an equal number of healthy controls. The same collections were transplanted in the field for evaluation and seed collection for further screening. The experiment is in progress and resistance will be evaluated based on gall index, nematode population and plant growth.

(d) Pest Risk Analysis

The pest risk involved in the import of sorghum, paddy, pearl millet, minor millets, legumes was updated and manuscripts prepared. World list of *Crayedon* spp. with distribution and its quarantine importance was also prepared. Information on seed beetles of the world was updated and added to pre 1981 review work.

**Research Projects (Project Leader; Associates)**


3. Studies on nematodes associated with five mandate crops of ICRISAT (groundnut, chickpea, pigeonpea, sorghum and pearl millet) and rice in A.P. (K. S. Varaprasad)


   (a) Identification of urad bean leaf crinkle virus occurring in Andhra Pradesh.

   (b) Identification of Peanut Stripe Virus.
A. Plant Exploration and Collection

In 1987, seven plant exploration trips were undertaken in Rajasthan and Gujrat states and a total of 553 collections of diverse crops were made (Table 1). Because of the severe drought in all the areas explored by the scientists in these two states, collections were very limited. However, efforts were made to collect the germplasm of different crops from rainfed areas in particular to have drought resistant lines.

(a) Multicrop Explorations

(i) *Exploration for wheat, barley, cucurbits etc. in South-West Rajasthan*: A multicrop exploration trip to S. W. Rajasthan was undertaken for the collection of germplasm of *Rabi* crops. In all, 73 sites in seven districts of Rajasthan and adjoining areas of Gujrat (Palanpur) were explored and 124 samples comprising mainly of wheat, barley and *Brassica* spp. were collected from diverse habitats viz., sandy, saline and rocky soils (Table 1). In wheat, germplasm of locally called *Kharachia Gehun, Deshi Gehun, Deshi Lal Gehun, Dhola Gehun, Safed Farmy Gehun, Contoli Gehun* (seed obtained from controlled priced shop was sown by the farmer), *safari kanak* and *pijl kanak* were collected. *Kharachia* wheat, which is known for salinity tolerance was found in cultivation largely in saline areas of Barmer and Jalore districts. A notable collection of wheat germplasm reported to be 50 years old seed collection was made from village Negaria of Udaipur district. Farmers informed that crop raised from these seeds remains disease free without the application of pesticides and seed germinates even if planted deeper than the normal seed depth. Variation was largely observed for plant height i.e. dwarf/tall, no. of spikes/plant, no. of spikelets/spike, colour of awn, size, shape and colour of grains. In barley, germplasm collected includes *deshi jov* and huskless barley from village Bidhani (Tehsil: Senchore: Jalore). Variation in plant height, no. of spikes/plant and length of spikes was prevalent. In *Brassica*, germplasm of both *B. campestris* and *B. juncea* was collected.

(ii) *Exploration for collection of kharif crops in Gujrat*: A multicrop exploration trip to Gujrat was undertaken for the collection of germplasm of *kharif* crops. In all, 63 sites of 12 districts in Gujrat and adjoining parts of Rajasthan were explored and 97 samples comprising mainly the germplasm of pearilmillet, *guar*, groundnut and cotton, were collected. The cultivation was found almost.
<table>
<thead>
<tr>
<th>Collector/s</th>
<th>Region explored</th>
<th>Sites surveyed</th>
<th>Genetic Resources Collected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. C. Bhandari</td>
<td>S. W. Rajasthan, April 6-12</td>
<td>Barmer, Jalore, Sirohi, Pali, Udaipur, Dungarpur, Palanpur</td>
<td>Barley (29), maize (1), rice (1), wheat (71), chickpea (6), sarsoon (17), taramira (1), brinjal (1), radish (1), methi (1), cumin (1), Lepidium sp. (1), Isabgol (2)</td>
<td>134</td>
</tr>
<tr>
<td>D. P. Chopra</td>
<td>Gujrat, Sept. 30-Oct. 8</td>
<td>Mehsana, Rajkot, Ahmedabad, Jamnagar, Amreli, Junagarh, Bhavnagar, Banaskantha</td>
<td>Maize (2), bajra (27), sorghum (4), cowpea (2), guar (31), Moth (2), mung (5), groundnut (10), til (1), cotton (11), bhindi (1), karela (1)</td>
<td>97</td>
</tr>
<tr>
<td>D. C. Bhandari</td>
<td>South Rajasthan, Oct. 10-18</td>
<td>Pali, Bhilwara, Chittorgarh, Banswara, Dungarpur, Udaipur</td>
<td>Maize (20), bajra (7), rice (2), sorghum (8), wheat (1), cowpea (5), guar (8), mung (16), soybean (1), Uradbean (14), groundnut (15), sarsoon (1), til (12), cotton (3), bhindi (1), kachri (12), Kair (1), dhamasia (3), wild cucurbit (1), wild til (2), others (6)</td>
<td>139</td>
</tr>
<tr>
<td>D. C. Bhandari</td>
<td>Gujrat, Oct. 27-Nov. 5</td>
<td>Banaskantha, Kachchh, Mehsana, Sabarkantha</td>
<td>Maize (2), bajra (22), rice (1), sorghum (5), wheat (1), cowpea (2), guar (18), mung (2), arhar (2), Urad (1), castor (1), groundnut (11), til (6), cotton (5), bhindi (1), chillies (1), kachri (2), gugal (1), tulsi (1), others (1)</td>
<td>86</td>
</tr>
<tr>
<td>D. C. Bhandari</td>
<td>N. W. Rajasthan, Nov. 12-22</td>
<td>Barmer, Jaisalmer, Jodhpur, Bikaner, Churu, Nagour, Sriganganagar</td>
<td>Wheat (1), guar (1), til (1), kair (31), ber (24), fig. (1), kinnow (1), mosambi (1), pomegranate (1), dhamasia (1), harmal (1), wild til (1), halophytes (4), others (3)</td>
<td>71</td>
</tr>
<tr>
<td>S. K. Verma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. P. Chopra</td>
<td>Jalore, Feb. 17</td>
<td>Jalore</td>
<td>Pomegranate (20)</td>
<td>20</td>
</tr>
<tr>
<td>D. C. Bhandari</td>
<td>Phalodi &amp; Nachna, Dec. 29-31</td>
<td>Phalodi, Nachna</td>
<td>Ber (1), Haloxylon salicornicum (3), Salsola baryosma (1), Suaeda fruticosa (1)</td>
<td>6</td>
</tr>
</tbody>
</table>
nil in rainfed areas therefore, variability in germplasm was collected mainly from areas which have got irrigation facilities.

(iii) Exploration for millets, pulses and vegetables in Southern Rajasthan:
This multicrop trip to Southern Rajasthan was undertaken for the collection of germplasm of kharif crops mainly millets, pulses and vegetables. In all, 52 sites in six districts of S. Rajasthan were explored and 139 samples comprising germplasm of maize, pearl millet, sorghum, cowpea, guar, mung, groundnut, til and kachri (Cucumis sp.), etc. were collected. In maize, germplasm of locally called malan makki, sati makki, hatti makki and deshi (local) types was collected. In pearl millet, variability in germplasm includes collection from irrigated/partly irrigated/rainfed fields. Germplasm of sorghum collected includes both grain and fodder types.

In case of sorghum, germplasm locally called as kali jawar (because of the black appearance of inflorescence) was collected from Pali district. In case of legumes viz. cowpea, guar, mung and urad germplasm mostly of deshi (local) types was collected. In case of groundnut, cultivation of bunch type locally called as jhumki mungphalli was found prevalent. In case of kachri (Cucumis sp.) rich variability in size, shape, weight, colour of fruits, taste of pulp was noticed. Besides this, germplasm of wild til locally called as adak til and a cucurbit (Turai) was also collected. Because of the prevailing drought condition, cultivation was almost nil or very poor in large areas of Pali district whereas in other districts explored, it was comparatively found well under irrigated conditions where seeds mainly of hybrid varieties of kharif crops were planted by the farmers.

(b) Crop Specific Explorations

(i) Exploration for legumes, groundnut and vegetables in Gujarat:
This trip was undertaken in Banaskantha, Kachchh, Mehsana and Sabarkantha districts of Gujarat for the collection of germplasm of kharif crops mainly the legumes, groundnut and vegetables. Because of severe drought conditions, collections were very limited especially in rainfed areas where farmers do not have any irrigation facility. In all, 45 sites in four districts were explored and 86 samples comprising of pearl millet, guar, groundnut, til and other crops were collected. Variability in pearl millet, guar, groundnut and other crops was collected from the areas and efforts were made to obtain the seeds of local landraces from tribal areas. In pearl millet, germplasm collected includes both grain and fodder types. In the latter, a notable collection reported to be from very old seed collection locally called as mahuda bajra was collected from village Kabrau of Kachchh district. In sorghum, germplasm locally called as gundri, dhorki and other deshi (local) types was collected.

(ii) Exploration for ber and other minor fruits in North-West Rajasthan:
This trip was exclusively assigned for the collection of germplasm of ber (Ziziphus spp.).
and other minor fruits. Because of the prolonged drought conditions for the last 4-5 years in these areas, even in the drought hardy plants like ber (Z. nummularia) the fruit formation was either nil/or very poor this year. At certain places it was noticed that not a single fruit was available in a large population of this species. In all 54 sites in seven districts of N. W. Rajasthan were explored and 71 samples comprising mainly of ber (Z. nummularia) and ker (Capparis spp.) were collected. Rich variability in the size, shape and colour of fruits in both the species was prevalent. During this trip ideal sites for the collection of the halophytes especially Haloxylon salicornicum were also spotted.

(c) Short Explorations

Two short explorations were undertaken by the scientists of this station. In the first trip, germplasm of pomegranate was collected from Jalore. In the second trip, germplasm of halophytes viz. Haloxylon salicornicum, Salsola baryosma and Suaeda fruiticosa was collected from Phalodi and Nachna areas which were spotted during a previous trip to N. W. Rajasthan.

B. Germplasm Evaluation

(a) Groundnut (Arachis hypogaea)

One thousand five hundred collections made from 90 countries were evaluated under the ICRISAT-NBPGR joint evaluation programme at Jodhpur. Crop exhibited good germination, and days to germination were recorded. All the accessions had germinated within 10 days of sowing. However, there was very slow vegetative growth due to scarcity of water. The flowering started in the stand and first flowering was noted. However, the flowers wilted away without any peg formation.

(b) Til (Sesamum indicum)

One thousand seven hundred twenty-five accessions of til received from regional station, Akola, were sown at Mandore Farm in kharif, 1987. Augmented design with 25 test accessions followed by two rows of two controls (T-13 and TC-25) were sown on 25th July, 1987. Due to drought the crop performance was very poor. However, 300 lines showed good performance. In the adjacent field the germplasm evaluation trial of ARS Mandore was being carried out. Some of the accessions were performing very well. Therefore, data were recorded for these accessions also and single plant seeds for three plants/accession were collected.

Some of the promising accessions of til selected on yield/plant basis are: IS-140, ES-108-1-84, CST-781, CST-785, JLT-1, and TC-167.
(c) Castor (*Ricinus communis*)

An evaluation trial using 120 accessions was carried out in the field of the Regional Station. Crop performance was very poor and only nine accessions produced seed.

(d) *Acacia* spp.

Periodical data on the increase in height and branches were observed for the plants transplanted in 1985. So far, *A. ampliceps*, *A. mearnsii*, *A. salicina*, *A. stenophylla* and *A. moconochieona* are performing very well in the field. *A. bidwilli* and *A. nuravana* exhibited very poor performance as apical buds in these species dried off. 26 species of *Acacia* are progressing in the pots and will subsequently be transplanted.

(e) *Calotropis procera*

The 33 collections of *Calotropis* that were transplanted in 1985 in the field, are progressing well.

(f) *Cassia* *sturtii* (EC 129070)

Out of 21 plants in the field, eight were uprooted by the CAZRI as the library construction site was extended towards the field of the Regional Station. The growth of the remaining nine plants is also being affected by the construction work. However, new plants are being raised for rejuvenation.

(g) *Acacia albida* (EC 133772 ex Senegal)

One out of the 16 plants in the field dried off completely. The rest of the plants are progressing well but there is no pod formation this year due to severe drought. The plants were irrigated regularly even then no formation of pods was observed.

(h) *Eucalyptus* spp.

Seven collections of two species of *Eucalyptus* i.e. *E. nitens* and *E. camaldulensis* transplanted in 1986, had to be uprooted and retransplanted due to extension of library construction site of CAZRI. Saplings of these species have been raised in nursery this year and are progressing well. The material will be transplanted in rainy season.

(i) *Atriplex* spp.

Analysis of the morphological data collected for the three species of *Atriplex* revealed that *A. nummularia* produced maximum biomass followed by *A. halimus* and *A. canescens*. The contribution of leaves to biomass was also maximum in *A. nummularia*, thus suggesting its suitability as a fodder dioecious species for saline lands. However, the nature of this species is a limitation for seed production especially in a small population. The other two species are monoecious.
(j) *Simmondsia chinensis*

120 plants are progressing well in the field. First flowering was observed in 19 plants and few fruits were collected. The number of fruits per plant ranged from 1 to 32 in these 3 years old plants.

In May, 1987 the fruit yield obtained was less as compared to 1985–86. A maximum of two kg of seed/plant was obtained in 1987 in accession no. 99690, whereas in other accessions the seed yield ranged from 10 to 1540 g/plant.

(k) *Euphorbia* spp.

The plants pruned in 1986 are progressing well in the field.

(l) *Parthenium argentatum*

The CAZRI collection I, II, III and Guayule Mexican are being maintained at the Regional Station. The new transplantation i.e. CAZRI I, CAZRI II, G-4, Hissar, HG-9 and GAU Arid Zone are progressing well.

(m) *Tumba* (*Citrullus* spp.)

Thirty-eight collections of *tumba* were sown in pots. Out of these, only 4 collections could be transplanted in the field. The plants exhibited poor performance.

C. Maintenance

The station at present is maintaining the plant genetic resources of *Mung, Moth, Til, Guar, cowpea, forage and fodder crops, wax and rubber yielding plants, medicinal and aromatic plants, ornamental plants and fruit plants such as *ber*, pomegranate, custard apple, *mosami*, kinnow, lemon and West Indian Cherry. Other plant species being maintained at the station are: *Brachychitton* spp. (3), *Prosopis juliflora* (5), *Linaloe* sp. (1), *Caesalpinia gilliesii* (6), *Agave americana* (32), *A. angustifolia* (19), *A. nirvana* (3), *Agave hybrid sisal* (32), and *A. jarmani* (3).

Horticultural Plants

A. Collection and Evaluation of Germplasm of Fruit Plants

(a) *Pomegranate* (*Punica granatum*)

During 1987, 20 collections of seedless pomegranate were collected through cuttings from the orchards in Jalore, by Shri D. P. Chopra. The seeds were also collected from Sh. Kesa Ram's orchard. Three-four cuttings and 20–25 seeds per collection were sown in pots on 18th February, 1987 for raising plants and now 2–3 cuttings and 2 seedlings of each collection are progressing well in pots which may be ready for transplantation in July, 1988. Five-six cuttings of pomegranate local and pomegranate ornamental obtained from Fruit Research Station, Peri-
yakulam, Tamil Nadu on 19-9-87, were sown in pots on 23-9-87. Only 4 cuttings of pomegranate ornamental are progressing well in pots.

(b) *Ber (Ziziphus mauritiana)*

Ten-fifteen bud woods each of different cultivars obtained from Horticulture Division, CAZRI, Jodhpur were budded on root stocks grown in nursery on 16-7-87. Out of these, the following bud woods are progressing well at nursery: Rashmi (2), Dandan (2), Kaithali (2), Banarsi Karaka (3), Bag Wadi (3), CAZRI Gola (1), Mehrawali (2), Thornless (1), Sanaur-5 (1). Twenty-four collections of wild *ber (Ziziphus nummularia)* were made from Western Rajasthan during November, 1987. Seeds of Thornless A and Thornless B were also received from Professor of Horticulture, Gujrat Agricultural University, Gujrat on 30-6-87. The seeds will be sown for raising seedlings.

(c) *Custard Apple (Annona reticulata)*

Fifty-five collections numbered K-3784 to K-3839 and 4 collections of U series i.e. U 10, —327, —10-276, —10-232 and —11-4 were obtained from NBPGR Headquarters on 13-2-87. There were 2-3 seeds in each collection. All these collections were sown in pots on 24-2-87 and again on 23-7-87. Only 5 collections i.e. K—3795, —3822, —3813, —3805, and U 10-276 germinated and are progressing well in pots. *Sindhan* variety obtained from Head, Division of Horticulture, Gujrat Agriculture University, Gujrat on 30-6-87 is also progressing well in pots.

(d) *Bael (Aegle marmelos)*

Three types of fruits were collected from B. H. U., Varanasi, U. P. on 18-6-87. They were oval, oblong and small in size. The seeds extracted from the fruits were sown on 30-7-87 in pots for raising plants.

(e) *Phalsa (Grewia subinaequalis)*

Thr fruits were collected from the B. H. U. These were sweet and large in size. The seeds were sown in pots in nursery on 30-7-87.

(f) *Star Goose Berry (Cissca acida)*

Two plants purchased from Horticultural Department, T. N. A. U., Madurai, were grown in the pots on 23-9-87 for transplanting in the rainy season.

(g) *West Indian Cherry (Malpighia puniceifolia)*

Two plants purchased from Horticultural Department T. N. A. U., Madurai were grown in the pots on 23-9-87 for transplanting in the next season.

(h) *Annual Moringa*

The seeds were purchased from Fruit Research Station, Periyakulam,
Tamil-Nadu, and 15 seeds were sown in pots on 23-9-87. Four seedlings are progressing well in pots.

(i) **Kair (Capparis spp.)**

Thirty-one collections of *Kair* were made from Western Rajasthan during November exploration trip. The seeds were extracted from the fruits and stored for pot sowing in next season.

(j) **Kinnow, Mosambi and Fig**

Rooted plants in polythene pack were obtained from the forest nursery, Kola, Rajasthan during exploration trip of Western Rajasthan. Two plants of each collection are progressing well in pots and will be transplanted in the field during rainy season.

(k) **Bougainvillea spp.**

Ten-twenty cuttings of rosevel, delite and shobhrs were grown in pots and 2–3 plants of each are progressing. One mahara plant was also collected from Kola, Rajasthan during an exploration trip which is also progressing well in pot.

B. Maintenance and Rejuvenation

(a) **Ziziphus spp.**


These plants are showing very poor growth with little or no flowering and meagre fruit setting. *Ber* plant No. (33/2) of *Seb hard* established in 1966; No. 34/2 and 34/3 of *Z. rotundifolia* transplanted in Feb, 87; No. (30/10) of *Katha* transplanted in 1969; No. 35/1 & 35/2 *Z. penoplia* transplanted in Feb., 87; No. (40/2) *Chumara* T. P. in 1970, & No. 42/2 *Katha* T. P. in 1969 dried due to severe drought, insect attack and dry hot winds even after life saving irrigation was given through water tankers. The total *ber* yield from different germplasm was 245.2 kg.

In addition to this, budwood of promising collections and those which were very old and showing poor growth were budded from 25-6-87 to 25-8-87 on root stocks raised in the Nursery 2–3 budwoods of *Gola Delhi*, *Seb*, *Soft*, *Ponda*, GS III, Nerma, Umran, *Jogiya*, *Gola*, GS II, Aliganj, *Ilaiuchi* & *Mundiya* were progressing well in pots. Very less success in budding could be obtained this year. The union might have been affected by hot winds and severe drought condition.
(b) Pomegranate (*Punica granatum*)

Agikdona EC 104350 (6), Balua Road IC-24686 (4), Cucudona EC-104348 (10), Dorasta Malus (3), Ganesh (1), Gulsa Rose Pink EC-628121 (3), Gulsa Red EC-62813 (1), Jodhpur Local (5), Kaim Sirin EC-104349 (9), Kurvi-2 IC-24685 (3), Kurvi IC-24684 (3), Seedless EC-S1839 (3), Seedless EC-62813 (1), Seedless EC-628121 (3), Spin Danedar EC-109690 (5), Suicide Local (5), Suicide H. EC-104347 (1), and Yarkand (3) are the pomegranate collections maintained at the Regional Station. Due to severe drought and water shortage, fertilization and pruning was not done. Only life saving irrigation was given to the plants. Very less or no flowering appeared. Fruit setting was also very poor due to heavy fruit drop. The plants are not showing vigorous growth due to saline tube well water. Seedless variety and Kurvi were found suitable for arid zone as fair amount of flowering and fruiting was observed. There was heavy damage to fruits due to birds and squirrels. 2-3 cuttings of Tujatis, Cucudona, Kaim Sirin, Agikdona, Kubakjanar, Spin danedar, Sikari, Yarkand, Buethana Local and Tabest which were pot sown on 22-7-87 and 2-8-87 are progressing well.

(c) *Carissa* spp

Two plants of *Carissa edulis* and one plant of *Carissa grandiflora* flowered profusely but fruit setting was very poor due to water stress conditions. Attempts to plant cuttings of *Carissa carunculata* and other two species did not succeed this year.

(d) *Phalsa* (*Grewia subinqualis*)

Two types, one from Punjab and other from Delhi are growing well. However, 4 plants out of 14 died due to drought. The flowering and fruiting was very poor due to severe water stress and moreover, the water supplied from the tubewell is saline which may cause poor fruit development. Forty-fifty cuttings of each type were tried but after sprouting they all dried due to adverse conditions.

(e) Date palm (*Phoenix dactylifera*)

Artificial pollination was done by taking male flowers from CAZRI and for the first time fruit setting was observed in variety which was established in 1974. 3.1 kg fruits in 8 bunches were obtained in different pickings w. e. f. 20-6-87 to 11-7-87. The fruits were protected from birds using caging method through wire mesh. Six suckers of the same variety were planted in pots but only 3 are progressing. One fruit had 25-28 cm length and 1.3 to 1.5 cm width with 5-7 g weight.

(f) *Citrus* spp.

Most of the citrus plants are root stocks. Only two budded plants of *C. sinensis* are progressing well in pots.
(g) West Indian Cherry (*Malpighia punicifolia*)

Twenty-thirty cuttings were tried for multiplication but only 6 sprouted. Profuse flowering was observed but very less fruit was set due to scarcity of water and dry weather conditions.

In addition to this, other horticultural plants being maintained are: custard apple, *Cordia mixa*, *aonla* and wild *ber* which were also affected by drought and frost. Overall, vegetatively propagated plants showed very poor rooting/sprouting/establishment. The reason may be dry and hot weather condition, saline tube well water and severe drought.

D. Supply and Distribution of Germplasm

Seeds and planting material in varying quantities of jojoba, *Cowpea*, *Guar*, *Moth*, *Atriplex* spp. *Guayule*, *Ber*, *Chillies*, *Mung*, *Pomegranate*, *Phalsa*, *Bambara nut*, *Tumba*, *Acacia albida*, *Wheat*, *Barley*, *Khejri*, *Groundnut*, *Cotton*, *Bhind*, *Korela*, *Urginia indica* and others were supplied to various farmers and other indenters in the country.

Research Projects (Project Leader; Associates)

1. Genetic resources programme for selected field crops suitable under arid conditions (*Guar*, *Moth*, *Cowpea*, *Mung*, *Sesame* etc.) (D. P. Chopra; Neelam Bhatnagar).

2. Genetic resources programme for selected plants of economic importance suited to arid region (D. P. Chopra; Neelam Bhatnagar).

3. Genetic resources programme for selected Horticultural plants for arid region (D. P. Chopra; Neelam Bhatnagar, S. K. Verma)

4. Exploration and collection of germplasm of *Kharif* and *Rabi* crops from arid and semi-arid tracts of Gujrat and Rajasthan (D. C. Bhandari).

A. Plant Exploration and Collection

During 1987, nine exploration trips were undertaken for the collection of crop germplasm in Assam, Meghalaya, Arunachal Pradesh and Mizoram. The explored region lies between 23.7° to 28.5° E latitude, 90.1° to 95° N longitude and 200 m to 3000 m altitude having diverse agroclimatic conditions. Out of the nine trips, 3 trips were exclusively meant for the crop-specific collections. The areas covered and the routes followed in these trips have been shown in the map (Fig. 1). The summary of the trips undertaken and their output have been stated in Table 1.

These explorations yielded a total of 1137 germplasm collections of cultivated crops as well as their wild relatives. The details of crop diversity collected in each trip are given below,

(a) Multicrop exploration in some pockets of East Khasi Hills of Meghalaya

A local trip for four days was conducted during March in order to collect the multicrop diversity. Nine interior villages were explored which are located between 600 m to 1100 m altitude and dominated by the tribal people. A total of 118 germplasm accessions were collected which consisted of the following crops—

Upland rice-12; maize-7; soybean-4; pigeonpea-4; leafy brassicaceae-6; ricebean-9; pumpkin-3; fingermillet-7; cowpea-5; limabeans-4; sem-4; Frenchbean-9; buckwheat-3; blackgram-2; Chenopodium-3; mesta-2; dill-2; chillies-3; brinjal-2; ginger-4; turmeric-2; Colocasia-7; sorghum-1; horsegram-1; sweet potato-1; pea-1; Dioscorea-1; Okra-2; cotton-1; wingedbean-1; radish-1; snakegourd-1; cucumber-1; and Luffa-1.

Most of these crops are being cultivated by the farmers either in their homestead area or in jhoom fields on hill slopes. Different kinds of beans and leafy brassicaceae are grown by almost all the farmers. Pineapple cultivation on the hill slopes is gradually becoming popular. Planting of tree tomato (Cyphomandra sp.) near homestead area is very common with the local people.

(b) Collection of Coptis teeta from Dibang Valley District of Arunachal Pradesh

Coptis teeta Wall., a member of Ranunculaceae, having medicinal value is an endangered plant. It has a localised distribution in Arunachal Pradesh and grows between 2500-3000 m altitude. In order to collect the germplasm of ‘Mishmi
Wild *Musa* species collected from Arunachal Pradesh

Maize germplasm being evaluated at Barapani farm, Shillong
Fig. 1. Explorations undertaken in North-Eastern Hill Region of the country.
<table>
<thead>
<tr>
<th>Trip No.</th>
<th>Collector(s)</th>
<th>Area explored</th>
<th>Period</th>
<th>Diversity collected</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>B. D. Sharma</td>
<td>Some pockets of Meghalaya</td>
<td>19.3.87 to 22.3.87</td>
<td>118</td>
<td>Multicrop exploration</td>
</tr>
<tr>
<td>2.</td>
<td>D. K. Hore</td>
<td>Dibang valley district of Arunachal Pradesh</td>
<td>18.5.87 to 23.5.87</td>
<td>26</td>
<td><em>Coptis teeta</em> plant collection and other crops.</td>
</tr>
<tr>
<td>3.</td>
<td>B. D. Sharma</td>
<td>Assam plains</td>
<td>7.6.87 to 16.6.87</td>
<td>340</td>
<td>Collection of Oilseed Brassicae and other crops.</td>
</tr>
<tr>
<td>4.</td>
<td>B. D. Sharma</td>
<td>Parts of Meghalaya</td>
<td>23.9.87 to 29.9.87</td>
<td>08</td>
<td>Collected Bamboo species only.</td>
</tr>
<tr>
<td>5.</td>
<td>D. K. Hore</td>
<td>Assam plains and Mikir Hills</td>
<td>14.10.87 to 25.10.87</td>
<td>206</td>
<td>Multicrop exploration including Jute &amp; Cotton.</td>
</tr>
<tr>
<td>6.</td>
<td>D. K. Hore</td>
<td>Parts of Assam and Arunachal Pradesh</td>
<td>9.11.87 to 18.11.87</td>
<td>41</td>
<td>Wild <em>Arylosia</em> sp. and other crops.</td>
</tr>
<tr>
<td>7.</td>
<td>B. D. Sharma</td>
<td>Arunachal Pradesh</td>
<td>20.11.87 to 02.12.87</td>
<td>235</td>
<td>Paddy and other multicrops.</td>
</tr>
<tr>
<td>8.</td>
<td>D. K. Hore</td>
<td>Parts of Meghalaya and NC Hills</td>
<td>09.12.87 to 15.12.87</td>
<td>80</td>
<td>Spices and members of Zingiberaceae.</td>
</tr>
</tbody>
</table>

**Collaborative programme with other ICAR Research Institutes.**

**Programmes scheduled with ICRISAT, Hyderabad but the concerned scientist(s) did not participate.**
teeta' (*Coptis teeta*) a good number of young plants with root stock were collected for introduction and maintenance under Shillong conditions. Apart from this, 26 collections of other crops were also made which are listed below:

Paddy (upland and lowland)-6; maize-2; buckwheat-1; mustard-1; cotton-1; millet-2; pumpkin-1; *Amomum*-1; *Ficus*-1; *Orchids*-4; *Amorphophallus*-1; *Musa*-1; *Primula*-1; wild *Piper*-1 and wild bamboo-1

**Highlights/Comments**—Dibang valley district of Arunachal Pradesh is very rich in several plant genetic resources. Among them *Musa, Saccharum, Amorphophallus, Fragaria*, *Begonia* grow very well between 600 to 1200 m altitude. In temperate condition (between 2000 m to 2600 m) *Orchids*, species of *Primula, Rhododendron* and *Vaccinium* are frequently seen.

(c) **Oilseed-brassicae germplasm collection from Assam plains**

The areas covered during this tour included various parts of Nogaon district, Hamren subdivision of Karbi Anglong district (Assam) and the Garo Hills of Meghalaya. Majority of collections were made from plain valley areas. Potential variability in oilseed brassicae still exists in Nogaon district of Assam and Garo Hills of Meghalaya which mature between 70-90 days. Most of the varieties were brown seeded while yellow seeded types were very few. In all, 45 accessions of oilseed Brassicae and 295 multicrop diversity were collected. Cropwise collections are listed below:

Mustard (brown seeded) —43; mustard (yellow seeded) —2; paddy-118; maize-13; *sorghum*-3; *bajra*-1; amaranth-2; foxtail millet-4; *Digitaria*-1; finger-millet-6; ricebean-4; pigeonpea-3; lentil-7; blackgram-2; soybean-1; greengram-1; sesame-16; *Perilla*-1; pumpkin-8; pea-4; chillies-16; ladiesfinger-2; cowpea-7; *Cucumis*-11; beans-8; *brinjal*-19; *Luffa*-5; bottlegourd-7; *taro*-6; ginger-1; turmeric-1; *Dioscorea*-1; coriander-2; *KalaJira*-1; onion-1; cotton-2; mesta-3; *Colocasia*-3; *Clitoria*-2; *Cissus*-1 and *Bauhinia*-1.

(d) **Collection of bamboo species from certain pockets of East Khasi Hills**

The tour was undertaken in association with the Scientist from ICAR Research Complex for NEH Region, Basar Centre to collect different bamboo species occurring only in certain pockets in East Khasi Hills of Meghalaya. Eight different species were collected six of which were identified. These are: *Dendrocalamus hookerii, Stylosachyum capitatum, Arundinaria manii, Bambusa nutans, B. pallida* and *B. tulda*. All this material was handed over to the concerned scientist of Basar Centre.

(e) **Collection of jute, cotton and other crops from Assam plains and Mikir Hills**

To collect the variability especially in jute and cotton, the programme was collaborated with CICR, Sirsa and JARI, Barrackpore. The area covered ranged
between 200 m to 750 m altitude and collections were made from farmers' fields, homestead areas and farmers' stock. Germplasm of jute was collected from Brahmaputra valleys especially from Nalbari, Barpeta, Dhubri, Goalpara, Darrang, Tezpur, and Nagaon Districts of Assam. The annual and perennial cottons were collected mainly from homestead areas in Assam plains.

In all 21 collections of jute and 35 collections of cotton were made in addition to 150 collections of other crops. These include: paddy (upland + lowland)-83; amaranth-4; black pepper-1; pigeonpea-2; wild okra-1; Pachyrhiza-1; ricebean-2; niger-2; medicinal plants-2; mustard-13; leafy brassicae-1; sesame-8; maize-9; sorghum-1; Eri-1; cucurbits-2; Luffa-2; Cucumis-1; bottlegourd-1; bittergourd-1; chillies-4; Linum-1; millet-1; Coriandrum-3; brinjal-1; spinach-1 and Elaegocarpus-1.

Comments

(i) Intensive survey and collection for paddy (lowland) germplasm is necessary especially in the districts of Goalpara, Dhubri, Barpeta and Nalbari districts of Assam.

(ii) Large-scale introduction of Cinnamomum zeylanicum may be fruitful in the district of Darrang, Assam where a few plants were seen to grow luxuriantly,

(iii) Clinogyne dichotoma, a potential wasteland plant which serves as a substitute of cane for preparation of mats etc. in some pockets of Goalpara district of Assam needs collection and evaluation of germplasm.

(iv) N. C. Hills district is very rich in bamboo resources.

(f) Wild Atylosia collection from lower Assam and subtropical ranges of Arunachal Pradesh

This exploration was undertaken to collect wild Atylosia spp. particularly A. elongata Benth, which is considered as a close relative of cultivated Cajanus cajan. The mission was not successful and it is thought that the species is on the verge of extinction. However, another species of Atylosia (A. barbata) was collected from the Kuklun reserve forest (200 m altitude) of Kokrajhar district of Assam. The habitat of this species was in open, tall grasslands of the interior forest. The plant remains always in entwining situation. An attempt was also made to search, A. elongata in the districts of lower Subansiri and West Siang of Arunachal Pradesh between 1200-1700 m altitude.

Besides the species of Atylosia, wild species of Piper, Citrullus, Colocasia and Musa were collected. Among the cultivated crops, germplasm of millets-1, coix-1, paddy-9, Colocasia-2, maize-2, leafy Brassicae-1, soybean-4, ricebean-2,
cucumber-1, *Abelmoschus*-1, tobacco-1, *Dolichos*-1, chillies-2, pumpkin-2 was also collected. Thus a total of 41 accessions were collected in this trip.

**Comments**

(i) Pure communities of wild *Musa* growing luxuriently between 500 to 1000 m in Kimin-Ziro road and Likabali-Basar road were observed.

(ii) *Livistoma speciosa* Kurz is another useful and economic plant resource of this belt which grows only at lower elevations (300 to 500 m).

(g) Rice germplasm collection from certain pockets of Arunachal Pradesh

This was a collaborative collection programme in association with the scientists from CRRI, Cuttack, CTCRI, Bhubaneswar; NBPGR, Simla and IIHR, Bangalore. Lower ranges of lower Subansiri, West Siang and East Siang districts of Arunachal Pradesh were explored to collect the diversity in paddy, *Citrus*, banana and tuber crops.

In all, 235 collections were made and details are as follows: paddy (upland + lowland)-55, *taro*-5; black pepper-1; ricebean-1; frenchbean-1; fingermillet-1; *Teosinte*-1; cotton-1; *Olaf*-1; *Okra*-2; *Perilla*-1. Remaining 159 collections (paddy-75, tuber crops-37; *Citrus*-15 and banana-32 by CRRI, CTCRI, NBPGR and IIHR respectively) were collected by collaborating scientists from different institutions.

**Comments**

(i) Intensive collection of paddy (upland + lowland) in different districts of Arunachal Pradesh is necessary.

(ii) Lower Subansiri and West Siang districts are rich in wild banana while wild *Citrus* was found in Dorje area of West Siang district.

(h) Collection of *Piper* and members of Zingiberaceae from East Khasi Hills, Jaintia Hills and North Cachar Hills

Species of *Piper* normally grow at lower elevations while the members of Zingiberaceae grow at different altitudes as per their preference. Eighty collections were made which included:

*Piper* (wild + cultivated)-5; *Curcuma* (cultivated)-13; *Zingiber* (wild + cultivated)-15, *Saccharum* (wild)-1; millets (*Pennisetum & Coix*)-2; *Allium*-2, *Sorghum*-1, *Colocasia*-6, chillies-2; cotton-1; paddy-10; maize-2; sweet potato-2; *Vigna*-2; *Dolichos*-2; coriander-1; mustard (yellow) —1; *Sesamum*-4; *Spondias*-1; *Abelmoschus*-1; *Benincasa*-1; *Cucumis*-1; *Cucurbita*-1; *Hodgsonia*-1 and orchid-1.

**Comments**

(i) Naturally occurring bamboo forest in NC Hills to be conserved and should not be allowed any kind of destruction.
(ii) Intensive survey and collection of paddy germplasm is necessary in NC Hills district.

(iii) *Cinnamomum, Areca* and *Thyselaena* are the common economic plants of lower elevation of East Khasi Hills, bordering Bangladesh.

(i) Sorghum collection from Mizoram, NC Hills and parts of Mikir Hills

In this trip parts of Mikir (Diphu subdivision), North Cachar and Lushai Hills were explored in order to collect the available crop diversity with special reference to sorghum. The region is quite hilly which ranges from 800 m to 1900 m altitude and receives heavy precipitation between May to September.

Though sorghum is being grown in the NE region as a minor crop for popping or brewing purposes, it has shown remarkable adaptability and genetic diversity for grain colour, grain size, head size and shape. Eighty-three collections were made from 15 sites. The cropwise details are as follows:

- Sorghum-19; paddy (upland + lowland)-18; maize-14; foxtail millet-1; finger millet-1; rice bean-5; cow pea-2; black gram-1; mustard-2; sesame-2; *taro*-3; yam-1; pumpkin-2; *sem*-1; *Citrus*-1; *Ziziphus*-1; turmeric-1; ginger-2; chillies-3; wild black pepper-1 and orchid-1.

Comments

(i) Thorough exploration is necessary in Cachar and NC Hills districts for sorghum and paddy.

(ii) Cultivation of orange, pineapple, ginger and turmeric is very popular among the farmers of NC Hills district.

B. Germplasm Evaluation and Maintenance

(a) Maize (*Zea mays*)

(i) Preliminary evaluation of selected genotypes for grain yield: The experiment was conducted by planting 30 varieties at two sowing dates at an interval of 30 days. The statistical analysis revealed non-significant differences in grain yield for all the genotypes studied on both sowing dates (5th March & 6th April). However, genotypes B-2, B-9, and C-1761 outyielded the best check (Local white).

(ii) Initial evaluation of germplasm: Accessions totalling 502 alongwith local control varieties were planted in observational rows for evaluation and maintenance. Three to five cobs were sibmated in each accession to maintain purity. Promising accessions were: K—2460, —2506, —3060, DKH—24, —21, B-1, —63, —92, —119, —44, —120, —35, —25, —65, —62, —31, C-1552, —1667, —1535, —1795, —1537, —1792, —1618, —1794, —1681, —1704, —1542, —1776, —1551, —1581, —1512, —1790, —1565, —1625, —1997—1679. BDJ-1-1-1014 and BDJ-1-492.

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Out of these K-2460, B-1, -31, C-1794, -1795, -1542, -1581, -1790, and -1625 are worth special attention.

(iii) *Screening of germplasm against *\textit{T}ulcicUf/1* \textit{Jeaf blight}: Maize germplasm maintained at this station was again screened this year against leaf blight caused by \textit{Helminthosporium turcicum}. Incidence of disease this year was comparatively low. Out of a total of 355 genotypes scored for the disease, 3 genotypes (NH-6/9, NH-6/11 and BDJ/NKG-268) were found to be resistant, 35 showed moderate degree of resistance and the rest either had low degree of resistance or were susceptible. The first two resistant accessions were collected from Nagaland and the last one from Himachal Pradesh. Accessions BD-160, -173, and -165 had repeated their resistance behaviour, however, their degree of resistance was slightly lower this year.

(b) *Paddy* \textit{(Oryza spp.)})*

(i) \textit{Preliminary evaluation of selected upland paddy genotypes for grain yield}: Thirty upland germplasm selections were sown in a randomised block design with two replications. The genotypes had a very diverse origin and hence exhibited wide morphological variations. The promising genotypes were: BD-20, DKH-56, NKG-1007, -1009, 1005 and -1047, which outyielded the control varieties Nogba and Manipuri Local by a margin of 10-20 per cent.

(ii) \textit{Germplasm evaluation and maintenance} : Ninety germplasm accessions of upland paddy were sown in two-row plots for maintenance and preliminary evaluation. Out of these, 24 genotypes were badly damaged by insect-pests or other pathogens and did not produce any seed. Promising types were: BD-7/19, NKG-1020, -1057, BD-12, -38, -55, -57, -140 and DKH-92.

(iii) \textit{Maintenance and yield evaluation of lowland paddy}: A total of 470 accessions of lowland paddy were transplanted under submerged water conditions for maintenance and evaluation for grain yield. Promising ones which outyielded control varieties Nogba and Manipuri Local were: NH-6-72, -6-16, -6-23, -6/49, -6/52, -6/20, -6/13, -6/5, BD-16, -49, -4, -44, -93, -105, -21, NKG-1166, -1168, -164, -1076, -1188, BDJ-1/575, -1254; -1/866, -629, -1/718, C-1054, C-2100/A, -1912, -1911, BDS-6175, and DKH-10. These gave grain yield of 60 to 80 g per plant and were comparatively tolerant to various diseases and insect pests.

(iv) \textit{Evaluation of scented rice germplasm for grain yield}: Out of 80 accessions sown in the nursery, only 66 survived and were transplanted in two replica-
tions for maintenance and evaluation. Promising among these were: P—493, —478, —23, —522, —476, —526, and —475.

(v) *Entomological screening of germplasm collections of lowland paddy*: Out of 550 germplasm collections, 378 accessions were screened against leaf roller (*Onaphalocrocis medialis*) insect of rice. The number of leaves rolled up to maturity stage of the crop were recorded. The number ranged between 0-52 leaf rolls per plant. Accessions showing less than 5 per cent leaf rolls per plant were: NKG—211, —1177, C—2018, —1987, —1942, —1691, MMH-6/5, —6/3, —6/7, —6/9, —6/12, —6/13, —6/16, —6/17, —6/18, —6/19, BD-103, —136, —142, —150, DKH-3, —8, —43, —54, and 62.

Bird (sparrow) damage was also recorded on the maturity stage. Grain loss of 3.04 per cent was recorded in 11.9 per cent of the total collections. Rat damage was recorded in 2.64 per cent collections with 0.66 per cent loss of grain yield in the standing crop under field conditions.

(c) *Ricebean (Vigna umbellata)*

(i) *Preliminary yield evaluation trial*: Twenty genotypes were evaluated for the second year in succession with a local control. Promising genotypes among these were: CRRS-2, RB—4, —40 and —49, which outyielded local control variety by a margin ranging from 122 per cent to 149 per cent.

(ii) *Initial yield evaluation trial*: Another trial with 24 genotypes from the local germplasm collection was laid out in randomised block design. The promising genotypes identified were: A—1156, CXN-26-30, IC—16798, —16800, —19350, —73143 and EC-12436.

(iii) *Co-ordinated yield trial (Shimla material)*: A set of nine varieties received from the NBPGR Regional Station, Shimla, were evaluated in a randomised block design with three replications. CXN-16 P-1 and CXN-Pa-3 were identified as high yielding collections with a potential of producing 23-24 quintals of grain/hectare.

(iv) *Germplasm maintenance*: Two hundred sixty-two collections of ricebean were planted for maintenance at this station. All the entries exhibited very vigorous growth.

(d) *Frenchbean (Phaseolus vulgaris)*

(i) *Screening against beanfly*: A total of 155 germplasm collections and 36 varieties were screened against natural incidence of beanfly (*Ophiomyia phaseoli*).
Seedling mortality, tunnel length and number of pupae were found to be correlated with plant height of young plants. Minimum plant mortality was recorded in BD—13, —17, —52, —4, —54, —11, —9, —12 and —18 in that order.

(e) Soybean (Glycine max)

(i) Preliminary yield trial: Twenty-five varieties of soybean were evaluated in RBD with three replications. Promising varieties for grain yield in order of their merit were, PK-73-203, NH-6/2, PK-73-84, PK-74-261 and BD-1 which out-yielded Ankur (Mizoram) used as control. NH-6/2 and PK-74-261 possessed bold grains. NH-6/9', PK-71-21 and 74-261 were early in maturity whereas NH-6/14 and —6/11 were very late, requiring about 145 days to mature.

(f) Taro (Colocasia esculenta)

Sixty-five collections were grown for preliminary evaluation for different descriptors. Promising genotypes, producing about twenty times corm yield than the initial seed weight were: BD—17, —7, MMH-6/2, BD—22, —7/115, —7/112, DKH-37, NH—6/9, —6/2, —6/4, BDT-6/5 and BDS-85.

(g) Ginger (Zingiber officinale)

Out of 45 genotypes planted for evaluation and maintenance, only 26 survived. Worth mentioning among these are: BD—9, —7-108, DKH—33, NH—6/1, —6/2 and —6/4.

(h) Turmeric (Curcuma spp.)

Forty-two collections were evaluated and maintained at the station. Accessions giving more than ten times rhizome yield were: BD-23, DKH—21, —27, KDH—20 and —22.

(i) Sweet potato (Ipomoea batatas)

Thirty-eight sweet potato accessions were planted in observational rows. Some of these gave very impressive tuber yield, which was twenty times that of initial seed weight. These are: NH—6/3, —6/1, BD—9. —18, —22, DKH—52 and —43.

(j) Potato (Solanum tuberosum)

Twenty-three collections were planted for initial multiplication and observation. Genotypes producing ten times more tuber yield were: DKH-45, BD—57 and —30.

(k) Minor millets

The collections of minor millets included pearlmillet, fingermillet, Digitaria, foxtailmillet and job's tear.
Amongst these worth mentioning accessions were: DKH-3 and NH-6/4 of pearl millet; DKH-10 of finger millet, DKH-1 of *Digitaria*, DKH-5 of finger millet, and BD-2 of jobs tear. Some of these had very interesting characters. In pearl millet, for instance the spike had deep blue purple colour and leaves were erect and broad.

(I) Chillies (*Capsicum annuum*)

Thirty-one accessions of chillies were grown in Shillong. Promising from yield point of view were: BD--77, --135, --214, --247, and --139. BD-214 was a very heavy bearer.

C. Germplasm distribution

Six hundred twenty-three samples of various crops were supplied to different ICAR Institutions, agricultural universities and ICRISAT.

**Research Projects (Project Leader; Associates)**

1. Evaluation and maintenance of germplasm of different horti-agricultural crops (B. D. Sharma; D. K. Hore).

2. Exploration and germplasm collection of agri-horticultural crops in North-Eastern India (D. K. Hore; B. D. Sharma).

3. Research Management (B. D. Sharma; D. K. Hore).
A. Plant Exploration and Collection

During 1987, five explorations were undertaken, of which three were multi-crop explorations for agricultural crops and two were crop specific for fruit crops. Details are given in Table 1.

(a) Multicrop exploration in Kulu and Mandi districts of Himachal Pradesh

The exploration was undertaken in collaboration with H.P. Agricultural University, Palampur for the collection of wheat and barley from Palampur and Baijnath areas of Mandi and from Garsa and Parvati valley of Kulu. Forty sites located between 800 m to more than 3000 m altitude were covered and 273 collections of different crops were made. Good variability was collected with respect to rice, wheat, barley, grain amaranth and maize. In rice 22 local types (mostly rain-fed) viz. Rehadi, Jhin Jhin, Joulia, Jattu, Phulpatash, Jawas, Chowartu, Dewal, Kaladhan, Seyartu, Kalmundu, Peladhan, Ramjuwana, Kasatu, Jaldra, Jalpara and local Basmati were collected. In wheat, 20 local types known by distinct names viz. Chhiti Kankoo, Dhar Mod, Lalpuri, Shiruin, Tarmost, Mandalun, Mundal Kankoo, and Badakanak were collected from Banjar, Sainj, Soja, Garsa and Parvati valleys. In maize variability existed with regard to cob size, seed size and colour. Some collections from Banjar in maize had very thin central axis and bold seeds. In barley both hulled and hulless types having dark bluish seeds were collected. In amaranth, A. caudatus, A. hypochondriacus, and in buckwheat Fagopyrum esculentum, F. tataricum, F. tataricum var. gangri and F. cymosum (a wild buckwheat) were collected.

(b) Collection of mango germplasm from Orissa

Unlike other states where commercial mango cultivars have replaced local types, Orissa still grows local mangoes over large areas. Coastal and hilly districts viz. Cuttack, Puri, Ganjam, Kalahandi and Koraput were explored in collaboration with Dr. S. Rajan of Central Institute of Horticulture for Northern Plains, Lucknow. In all, twenty old collections (samples collected last year but could not establish) and forty-one new accessions of mango were collected. Very good phenotypic variability in fruit characteristics was observed. Collections Agna—Kosha, Sunhari Udyan Sundari, Lahsun, Kachhaswadi, Dahipatti, and Lunagudi have potential to become commercial cultivars. A wild population of native material
Table 1: Plant exploration and collection tours undertaken by Regional Station, Shimla

<table>
<thead>
<tr>
<th>Trip No.</th>
<th>Collector</th>
<th>Area explored</th>
<th>Period</th>
<th>Diversity collected</th>
<th>Total collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>B. D. Joshi</td>
<td>Kullu &amp; Mandi districts (H. P.), Garra, Soja, Parvati valley, Banjar, Sainj, Sarsai</td>
<td>10.5.87 to 25.5.87</td>
<td>Wheat, barley, rice, amaranth, buckwheat, Frenchbean, ured, cucumber, maize, millets, mustard, garlic and others</td>
<td>273</td>
</tr>
<tr>
<td>2.</td>
<td>N. K. Gautam</td>
<td>Kinnaur district (H. P.)</td>
<td>3.6.87 to 21.6.87</td>
<td>Maize, paddy, khira, Panicum, peas, lentil, barley, wheat, buckwheat, Brassica spp.</td>
<td>114</td>
</tr>
<tr>
<td>3.</td>
<td>N. K. Gautam</td>
<td>Una district (H. P.)</td>
<td>21.9.87 to 9.10.87</td>
<td>Chillies, cucurbits, maize, paddy, wheat,</td>
<td>138</td>
</tr>
<tr>
<td>4.</td>
<td>D. S. Rathore</td>
<td>Coastal and hilly regions of Orissa</td>
<td>8.5.87 to 28.5.87</td>
<td>Mango, germplasm local seedlings with potential of becoming commercial cultivars and wild types.</td>
<td>41</td>
</tr>
<tr>
<td>5.</td>
<td>D. S. Rathore</td>
<td>Lower ranges of Arunachal Pradesh</td>
<td>16.11.87 to 5.12.87</td>
<td>(a) Landraces &amp; wild germplasm of banana particularly BB group. (b) Landraces &amp; wild germplasm of Citrus spp.</td>
<td>31</td>
</tr>
</tbody>
</table>

Total = 618
called Thurri or Ghurudi was found in large areas comprising of many districts, which may be an useful rootstock as it may be drought resistant.

(c) Collection of banana and citrus germplasm in Arunachal Pradesh

Northeastern Hill Region is very rich in banana and citrus germplasm, being a part of the centre of genetic diversity of these crops. Lower ranges of Arunachal Pradesh i.e. Lower Subansiri, West Siang and East Siang districts were explored in collaboration with Dr. P. K. Agarwal of IIHR, Bangalore for the collection of banana and citrus genetic resources.

Solid stands of wild banana were commonly observed along the roads and in the woods mostly belonging to bulbisiana (BB) group, but not much variability was observed because of vegetative propagation. However, it may provide a source of resistance against drought and cold. Thirty-one collections comprising of wild types, landraces and some commercial cultivars of the region were collected.

Citrus plants were found in small populations or a few plants in woods or in orchards. Genetic erosion is taking place at a very fast pace. Wild types resembling pumelo, orange, lemon and limes were collected which included Rebab, Tahí, Tanyum, Sohniag Riang, Pinchi-Tashing, Pinchipunia, Sinking-Tasing, Sipa-egra etc. In all, 21 collections were made which were sent to IIHR, Bangalore for conservation and evaluation.

(d) Multicrop exploration in Una district of Himachal

During this exploration 138 samples of various crops viz. maize (36), paddy (19), okra (7), cucurbitaceous vegetables (26), legumes (13) and others (34) were collected mostly from farmers' fields. Mixed cropping of paddy and maize was observed in pockets. No improved types were observed in vegetables as farmers grow their own local types only in their kitchen gardens. Dwarf type of okra, local tinda (Citullus vulgaris var. fistulosus) and a wild cucurbitaceous fruit known as Chhibber were good collections. A maize collection included “30 cm” long cobs.

(e) Multicrop exploration in Kinnaur district

Good variability was collected in crops like wheat, barley, maize, Allium spp. etc. Awnless wheat and hulless barley were interesting collections. Naked barley was collected from higher altitudes. In Panicum, variation was observed with regard to grain size, colour and seed coat thickness. Vegetable cultivation is limited therefore, local germplasm of cucumber, Ghia, kaddu etc. was obtained. Buckwheat was found to be a major crop during Kharif.
B. Germplasm Evaluation

(a) Grain legumes

(i) Frenchbean (*Phaseolus vulgaris*): Eight hundred forty-one collections including 349 new arrivals, were grown during Kharif, 1987. New accessions were evaluated for 26 agro-morphological traits. Good variability was observed in plant height, number of branches, leaves/plant, clusters/plant, pods/plant, pod length, seeds/pod, days to flower, days to maturity, 100 seed weight and yield/plant. BDJ-124 (20 g) and BDJ-219 (19.6 g) were found promising in respect of yield/plant while BDJ-1-269 was a dwarf type.

Two hundred thirteen elite lines with regard to yield were grown at Shimla, Bhowali, Ranichauri, Srinagar, Shillong, Hisar, Kanpur and Varanasi. At Shimla station PLB-124 and P-550-11 were very good seed yielders.

Two trials, one with 13 promising vegetable types and the other with 10 seed types, were conducted along with PLB-10-1, PLB-14-1, Premier, Jwala and Hans as controls. Highest green pod yield of 113.95 q/ha was recorded in EC-57080 followed by —108101 (108.60 q/ha) and —43036 (101.65 q/ha) as compared to 82.17 q/ha in Premier. In case of seed type, control PLB 14-1 outyielded all the selections by giving 11.55 q/ha seed yield.

One hundred ninety-nine old collections were grown for rejuvenation and seed increase.

(ii) Soybean (*Glycine max*): One thousand eighty-six accessions were grown in single observational rows. Data were recorded on 21 different economic characters. IC-18756 gave highest yield/line (143.94 g) followed by EC-96404 (119.94 g). Piso-41 was found to mature early (87 days), while EC—26738, —13202 and —37114 were dwarf types having plant height of 20 cm, 22 cm and 23 cm respectively and IC-13005 bore maximum number of pods/plant (252).

(iii) Ricebean (*Vigna umbellata*): Three hundred thirteen accessions were evaluated for 13 agro-economic characters. IC-7471-2 was found dwarf with plant height of 30.33 cm, while accession ARB-88/114 had highest number of pods/plant (89) and also gave maximum seed yield/line (148.35 g). EC-90453 and —182228 were the early types maturing in 120 and 121 days respectively.

(iv) Lentil (*Lens culinaris*): One hundred eighty-nine accessions were sown in Rabi, 1986 and observations on 13 economic characters were recorded in 1987. Lentil-39 (20 cm) and Lentil-50 (20.8 cm) were observed to be dwarf types. Highest number of pods/plant were observed in Lentil-188 (170) followed by —175 (163). ISP-85-86 was early flowering (85 days) and early maturing (162 days), while Lentil-150 gave highest seed yield/line (41.84 g).
In a replicated yield trial with 11 promising accessions, highest plot yield was obtained in RB-53 (110 g). Accession CXM18P2 was early maturing (115 days), while RB-56 was dwarf type with plant height of 54 cm.

(v) Adzukibean (*Phaseolus angularis*): A replicated yield trial with 12 promising lines was conducted in RBD. EC-120460 gave highest plot yield of 98.93 g followed by --108080 (85.32 g) and HPU-51 (74.43 g). EC-15257 was the earliest to mature (86 days), while --89957 was shortest in height (19.13 cm).

(b) Minor Millets

(i) Foxtail millet (*Setaria italica*): A replicated yield trial with 11 promising accessions was conducted in RBD (plot size 1 x 1.1 m) and observations were recorded on 13 economic characters. Kasol-3-92 gave highest seed yield of 42.34 g followed by JSe-720 (32.55 g). JSe-25 and IC-16339 matured in 107 days. Mannikaran-2 and JSe-138 A lines were identified as dwarf type with plant height of 99.72 cm and 106.26 cm respectively.

(ii) Finger millet (*Eleusine coracana*): A replicated grain trial of 11 accessions conducted at the station revealed that Kandaghat Local and Dumair Local were dwarf types with plant height of 82.66 cm and 83.40 cm respectively. IC-18007 and IE-37 remained at par for grain yield (86.19 g and 86.16 g respectively). Accessions IC-142501, DumairtocaJ and IE-168 matured in 138 to 139 days.

c. Pseudo-cereals

(i) *Amaranthus* spp.: Nine hundred forty-nine accessions of grain amaranth were grown in one row observational plots. These included 210 accessions for second year evaluation and 236 new arrivals which were evaluated for 40 agromorphological characters. Good variability was observed with regard to plant height, leaf size, days to flower and maturity, spikelet number, grain colour and size, 1000 seed weight and seed yield.

One hundred twenty-nine accessions identified earlier as promising in yield and earliness, were grown at Shimla and Bhowali along with Annapurna and VL-21 as control. Four accessions gave higher seed yield than Annapurna (87 g) and VL-21 (80 g). Highest seed yield was recorded in IC-38065 (150 g) followed by --38664 (120 g), --18374 and --38064 (115 g).

A coordinated trial with 11 elite lines (8 from Shimla and 3 from VPKAS, Almora) was conducted at eight locations viz. Almora, Bhowali, Ranichauri, Sri nagar, Shillong, Shimla, Bajaura and Sangla. At Shimla, Annapurna outyielded all the entries by giving 39.62 q/ha seed yield followed by IC-38269 with 39.27 q/ha. Yield potential was not affected much due to drought during 1987.
Five hundred three accessions were grown for rejuvenation after four years of storage. Very good germination was observed and in some cases it was as high as 90 per cent.

(ii) **Buckwheat** (*Fagopyrum* spp.): One hundred seventy-two accessions including 38 new arrivals for second year evaluation and 20 new arrivals for first year evaluation, were grown in single observational rows and evaluated for 24 descriptors. BDJ-3174 was identified as dwarf type (plant height 70.5 cm).

A multilocation coordinated trial of 12 varieties including 10 elite selections from this station and two entries from VPKAS, Almora was conducted at 8 locations i.e. Shimla, Bhowali, Shillong, Almora, Ranichauri, Srinagar, Bajaura and Sangla. Under Shimla conditions IC-13145 outyielded all entries by giving 19.13 q/ha seed yield followed by —13376 (18.26 q/ha) and —13141 (17.46 q/ha).

**Buckwheat Catalogue**: A monograph on buckwheat has been prepared wherein 405 germplasm collections have been classified into five *Fagopyrum* species. It contains information on origin and distribution, uses, botany, cytotaxonomy, breeding, genetics, cultural practices, research needs, exploration and collection, conservation, characterisation and evaluation, descriptors and descriptor states, germplasm distribution and bibliography. A catalogue was also prepared based on two years data on 30 agro-morphological characters.

(iii) **Chenopodium** spp.: Twenty-one arrivals including 14 exotics were grown in single observational rows and were evaluated for 10 characters. BDJ-432 gave highest seed yield of 5 g followed by BDJ-480 (4 g). None of the exotics yielded better than the indigenous collections. A severe leaf spot disease was observed in most of the collections, however, EC—201678, —180010, —180011 and —180012 were free.

(d) **Others**

(i). **Brassica** spp.: Three accessions were sown during *Rabi*, 1986 and data were recorded in 1987 for 12 important traits. NKG-159 and BDJ-86-82 lines were identified as dwarf type having 32.03 cm and 41 cm plant height respectively. Highest number of siliqua/plant (371) were observed in NKG-305, however, BDJ-471 gave highest seed yield/line (91.24 g). BDJ/NKG-436 and BDJ/NKG-488 were early maturing (146 days).

(ii) **Cuphea**: A trial with seven exotic lines was repeated using randomised block design in three replications at 8 locations. EC-133503 outyielded all others by giving 5.66 q/ha seed yield followed by —133501 (5.26 q/ha) and —133506 (5.20 q/ha). Seed shattering is a major constraint for high seed yield. The plant is very hardy and suitable for rainfed areas as an oil seed crop. Weedy tendency was also observed in the plant.
C. Germplasm Evaluation—Horticultural Crops

(a) Pome fruits

(i) Apple (Malus spp.): Out of 250 accessions under conservation, only 100 fruited. Fruiting accessions were evaluated for 20 descriptors. Accessions Stark Red Rome, EC-38681 and Mallies Delicious did not fruit while Vistabelle, Chepenest, Bonza Princess, Noble and State Fair commenced fruiting. Twenty-seven accessions were planted in field genebank for conservation and 28 were multiplied.

(ii) Pear (Pyrus spp.): Assessment of the fruited accessions was done for 22 descriptors. Flemish Beauty (very sweet) and Keiffer yielded 16 kg and 9 kg/plant respectively. Cultivars Doyenne-Du-Comice, Beralutsa, Magness, Star Krimson, Shinsui and Le Conte did not bear any fruit.

(b) Stone fruits

(i) Apricot (Prunus spp.): Preliminary evaluation of the fruited accessions revealed cultivar Royal to be the most promising yielding 25 kg/plant. Cultivar Shakarpara did not fruit which might be due to its high chilling requirement which is not met under Shimla conditions.

(ii) Sweet cherry (Prunus avium): This fruit does not perform well under Shimla conditions. Only two cultivars i.e. Emperor Francis and Valdinirskaya fruited which were harvested in May. Total soluble solids in the fruits were 19.5 and 14.5 per cent respectively.

(iii) Peach (Prunus persica): Fruiting in general was poor because of old age of plants. Stark Earliglo, Candor, Kanto-5, Sure Crop, Helford, Halberta Giant, July Elberta, Wight, Boyce and S-37 did not fruit. Eleven fruiting accessions were evaluated for 20 descriptors. Burbank, July Elberta were high yielding cultivars with 10.5 kg and 10.0 kg yield/plant respectively.

(iv). Plum (Prunus salicina): Cultivars Green Gage, Wilson, Wape and Krassavica did not fruit this year. Other 10 cultivars were evaluated for 10 characters. Methley and Kanto-5 were high yielders and gave 10.5 kg and 11.0 kg/plant yield.

(c) Nut fruits

(i) Walnut (Juglans spp.): Twenty-five accessions fruited this year and were evaluated for 20 characters. Cultivar Ogden gave the highest yield of 4.20 kg/plant but is hardshelled. Tutle-16 and Tutle-31 have very good fruit quality with semi-hard shell. J. nigra (EC-26860) has very hard fruits but the wood is very good for furniture.

(ii) Pecan (Carya spp.): It is an excellent fruit for mid and lower hills
but nonavailability of a suitable propagation method is a constraint in its popularisation. Lower yields were because of heavy bird damage at the time of nut maturity. Cultivar Desirable was promising.

(d) Soft fruits

(i) Strawberry (Fragaria spp.): Fruiting was poor and some accessions suffered badly due to drought. Twenty-two accessions were evaluated. TSS ranged from 7.5 per cent (Shasta) to 12 per cent (Royal Round).

(e) Miscellaneous

(i) Chinese gooseberry (Actinidia chinensis): Forty-six plants were planted for gap filling in the varietal trial planted at the University of Horticulture and Forestry, Solan. At the station, fruiting started in all the cultivars but was poor except in Allison which bore heavily.

(ii) Chinese jujube (Ziziphus jujube): The root stock was found producing good quality fruits. Physico-chemical analysis of the fruits was carried out and was compared with cultivar Ta-Yan-Jhao. Both had good quality fruits. Root stock fruits were smaller in size but richer in all the chemical constituents.

(iii) Feijoa sellowiana: Flowering started on 8th May and continued for about a month. Fruit yield of 4.2 kg/plant was recorded with a mean fruit weight of 15.6 g. The total soluble solids were 14.0 per cent.

(iv) Olive (Olea europaea): Three accessions out of the six received from Portugal could establish. Cultivar Sihestris Bros started flowering and fruiting.

(v) Tree tomato (Cyphomandra betacea): It performs well at lower hills both in western and eastern Himalayas. Yield of 9.5 kg/plant was obtained. Physico-chemical analysis of the fruit was also carried out.

(f) Ornamentals

(i) Gladiolus: Plant growth including spike length and development of corms and cormlets was adversely affected due to drought. Four new accessions viz. Silver Horn, Littlest Fawn, Heady Wine and Western Mist were included in the trial.

D. Germplasm Multiplication

During the year, 100 accessions of Amaranthus spp., 100 of Frenchbean, 160 exotic collections of poppy, and 10 accessions of Fagopyrum spp. were sent to the Headquarters for long-term storage. In addition, 525 samples of agricultural crops and 93 samples of horticultural crops collected through explorations, were also sent to the Headquarters for long-term conservation.
Table 2: List of plant genetic resources maintained at NBPGR, Regional Station, Shimla, during 1987-88

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Total collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PULSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaseolus vulgaris</td>
<td>French bean</td>
<td>2000</td>
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<tr>
<td>Phaseolus angularis</td>
<td>Adzuki bean</td>
<td>70</td>
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<tr>
<td>Vigna unguiculata</td>
<td>Rice bean</td>
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<tr>
<td>Vigna mungo</td>
<td>Urad</td>
<td>175</td>
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<tr>
<td>Vigna radiata</td>
<td>Mung</td>
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<tr>
<td>Glycine max</td>
<td>Soybean</td>
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<td>Macrotyloma uniflorum</td>
<td>Horsegram</td>
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<tr>
<td>Pisum sativum</td>
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<tr>
<td>Lens culinaris</td>
<td>Lentil</td>
<td>530</td>
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<tr>
<td><strong>MINOR MILLETS</strong></td>
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<tr>
<td>Panicum miliaceum</td>
<td>Proso millet</td>
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<td>Panicum sumatrense</td>
<td>Little millet</td>
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<td>Eleusine coracana</td>
<td>Finger millet</td>
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<td>Setaria italica</td>
<td>Foxtail millet</td>
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<td>Paspalum scrobiculatum</td>
<td>Kodo millet</td>
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<tr>
<td>Echinochloa spp.</td>
<td>Barnyard millet</td>
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<tr>
<td><strong>PSEUDO CEREALS</strong></td>
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<tr>
<td>Amaranthus spp.</td>
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<td>Fagopyrum spp.</td>
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<td><strong>GRASSES</strong></td>
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<tr>
<td>Dactylis glomerata</td>
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<tr>
<td>Festuca spp.</td>
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<td>Setaria spp.</td>
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<td>Bromus spp.</td>
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<td>Phleum spp.</td>
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<td>Panicum spp.</td>
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<td><strong>FODDER LEGUMES</strong></td>
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<td><strong>OIL SEEDS</strong></td>
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<tr>
<td>Brassica spp.</td>
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Total collection: 2000
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One hundred fifty-six accessions of different fodder grasses like species of Festuca, Lolium, Dactylis, Agrostis, Bromus, Paspalum and Panicum were maintained for distribution. In case of fodder legumes, 105 collections of *Medicago* and 22 of *Trifolium* were also maintained.
E. Germplasm Distribution

A total of 8,715 samples comprising of pseudo-cereals (1114), grain legumes (3736), minormillets (2085), oilseeds (49), fruit plants (1646) and ornamentals (85) were supplied to various farmers/scientists in the country.

List of genetic resources being maintained at the Shimla Regional Station is given in Table 2.

Research Projects (Project Leader; Associates)


A. Exploration and Collection

The scientists of the station carried out 15 collection missions which included multicrop, crop specific and collaborative explorations. Details of germplasm collections made in different crops are discussed below.

(a) Joint exploration and collection with CTCRI, Trivandrum for tuber crops in Southern districts of Karnataka

In this trip districts covered included Mysore, Madikeri, Hassan, Bangalore, Kolar and Tumkur. Diversity in tuber crops was less due to their limited cultivation. In Madikeri district occurrence of *Dioscorea alata* was sporadic but wild *Cassia* forms were abundant and a few apparently rare collections were made. Chitamani area in Kolar district appeared to be a centre of sweet potato cultivation and from there two distinct types could be obtained. In the case of Cassava five distinct types were collected. These are introductions from neighbouring Kerala state either by the farmers or by the department. Several wild species of *Dioscorea* were also collected. Eight different cultivars of Banana, of which one collection namely RAJABALE is a rare type and is used both as vegetable and table fruit, formed part of the collection.

Besides tuber crops, collections in other crops were also made. *Ragi* had abundant variability. Forty six collections including three distinct landraces of old and newly released types were collected. Other collections included 27 landraces of paddy, 23 drought resistant *Sorghums* and 13 chillies. A total of 398 collections belonging to 86 cultivated crops and wild relatives were made.

(b) Crop specific mission for *Piper* spp. from South Canara district

Forest ranges of Hebri and Karkal of Coondapur forest division, Agumbe of Chickmangalur and Subramanya of Mangalore were surveyed for collection of *Piper* spp. and other spices. A total of 132 collections belonging to 45 species (mainly wild) could be made. Three distinct types of wild *Piper nigrum* having large ovate, ovate-elliptic and elliptic leaves were distinguished. The leaf length varied from 10.2 to 19.0 cm and width from 5.2 to 9.6 cm. Spike length varied from 5.2 to 9.3 cm. The collections included a commonly cultivated variety with large, ovate leaves and very long thick spikes bearing medium to large fruits in clusters. Collections of *Piper betle*, *P. attenuation*, *P. longum*, *P. hapnium*, *P. trichostachyon*, *P. hymenophyllum*, *Garcinia* spp. and *Cinnamomum* spp. were also made. Four
species of *Garcinia* and over 10 identified local cultivars of *Piper nigrum* were collected from district agricultural farm, Taliparamba, Cannore.

The survey indicated the wide spread occurrence of *P. nigrum, P. attenuatum* in South Canara forests. High elevation types of *P. attenuatum* were noticed near Agumba. *Hymenophyllum* spp. were rare. Wild *P. betle* could not be found.

(c) **Joint exploration and collection mission for Groundnut in Tamil Nadu and parts of Kerala (Palghat) with ICRISAT**

Due to extreme drought groundnut cropping was severely curtailed. However, old cultivars were seen in few pockets of the state. A total of 122 groundnut collections were made which included old cultivars, new TMV series and also old Pollachi cultivars. Variability in the collections was moderate. Erect bunch, spreading bunch and spreading types were collected. Pod length varied from 1.98 to 4.20 cm and pod thickness from 0.85 to 1.46 cm. Seed number per pod varied from 1 to 3 and seed colour from tan to red and mottled. The pods were unbeaked to moderately beaked.

The crop was found to be rainfed all over but short duration varieties were grown under irrigated areas and the cultivation was done even above 1000 m elevation in Yercaud hill in Tamil Nadu. Long duration spreading types are preferred in certain areas where the farmers get a premium price for the produce. Spreading bunch type was seen in Guidatum area in North Arcot. Duplicate set of the collection was supplied to Akola station of NBPGR for evaluation. One set of 110 collections have been sent to Directorate of Oil Seeds Research.

(d) **Jackfruit collection with IIHR in parts of Kerala, Tamil Nadu and Karnataka**

A total of 85 jackfruit collections were made and on the basis of 15 different fruit characters these were classified into *Varikka* (62), *Kooza* (20), *Navarikka/Pazam varikka* (3). *Varikka* fruits are characterised by hard flakes and non detachable peduncle when ripe; *Koozoa’s* are soft and mushy when ripe and peduncle is detachable when fully ripe. In *Navarikka*, peduncle is not detachable but flakes are softer than *Varikka*. A type known as *Rudrakshachakka* or *Thamarachakka* consisting of both *Kooza* and *Varikka* forms was also collected and it was characterised by spherical shape and widely spaced spines. Wynad plateau in Westernghats of Kerala showed maximum diversity. From Wynad forests (Manantody) a wild type was collected, which is ‘Kooza’ with very thin, relatively less sweet flakes of pale yellow colour. Wild forms were collected from two other localities also. All the wild types collected were *Kooza* as confirmed by the tribals of the region.

Ten varieties of Banana from the Horticulture Research Station, Chethali were also obtained during this trip.
Variability in Jack fruit (longitudinal sections) collected from Kerala
Variability in pearl millet collected from Tamil Nadu
A joint exploration and collection mission for *Oryza* species from Kerala with IRRI, Philippines

The coastal mid-land and mountaineous areas of Kerala have abundant variability in wild and weedy relatives of *Oryza*. It has been reported that *Oryza granulata*, *O. officinalis*, *O. malampuzhansis* occur in forest areas and *O. rufipogon* and *O. sativa* var. *spontanea* in coastal and mid-land areas. During November 1987, a joint exploration trip of NBPG and IRRI was undertaken. A total of 75 collections comprising *O. officinalis*, *O. granulata*, *O. rufipogon*, *O. nivara* and *O. spontanea* were made.

Collections of *Coleus parviflorus*, *Dioscorea alata* and other crops were also made.

Joint exploration and collection trip with ICRISAT for pearl millet in Karnataka

During this trip undertaken in October-November, 1987 great variability in pearl millet and its wild relatives was assembled. One hundred seventy-six collections of pearl millet and six of its wild relatives were made. Besides, 42 collections exhibiting good variability in cultivated sorghum and its wild relatives such as *S. purpureo serratum* were also made. In pearl millet, spike length varied from 2.1 to 60.0 cm and spike thickness from 0.8 to 3.2 cm. Variation within the population in a sampling site was also noticed which suggested a possibility of ongoing segregation of natural hybrids. Variation in presence of bristles varied from very smooth to very hairy type.

In the case of sorghum, spike length varied from 5.5-24.0 cm and thickness from 3.1-7 cm. Very loose to very compact heads were noticed. Severe drought during the year in the state had affected all the crops.

Joint exploration and collection mission to Tamil Nadu for Pearl millet and other minor millets with ICRISAT

Another exploration and collection mission to Tamil Nadu along with ICRISAT was carried out during December, 1987. Much variability in pearl millet (283 collections) and sorghum (37) was collected from Tamil Nadu. In some areas of Peryar district, introgression between the crop (pearl millet) and its wild relatives such as *Cenchrus* sp. or *Pennisetum cenchroides* has been suspected. Some primitive forms of pearl millet resembling the wild have been collected from central Tamil Nadu. The other collections included 46 minor millets, 8 oilseeds and 15 pulses. About a dozen rare landraces of paddy were also collected.

Multicrop exploration and collection trip to parts of Tamil Nadu

A total of 163 collections comprising 75 different plant species were made from Salem, North Arcot and Tanjore districts of Tamil Nadu. This comprised
mainly of 94 collections of crop plants and their relatives and 69 collections of medicinal plants. Collections included landraces of paddy, pearl millet, sorghum, and finger millet. Variability in floral characters was noticed and collected in Catharanthus roseus.

(i) Crop specific collection for medicinal plants in North Malabar region of Kerala

The trip was conducted with a view to assemble variability in cultivated and naturally occurring medicinal plants from parts of Trichur, Malappuram, Calicut and Palghat. In Atteppady tribal areas collection of many wild medicinal plants could be made from Ghat road sides. Rare pockets of Vetiver cultivation in Ponnani and Chemmanur areas were also noticed. Collection of Catharanthus roseus and Hemidesmus indicus included much variability. In the case of Vetiver, collections obtained from red sandy soils at higher elevation seemed to be distinct from those occurring in coastal areas like Ponnani. In all 76 collections belonging to 49 different species were made.

(j) Collection mission to various forests and Vetiver growing areas in Kerala

A total of six one day local trips were conducted. The places visited included a private cashew plantation at Vellanikkara, Wadakkanchery forest range comprising the catchment areas in Machchad hills 20 km North East of Trichur, Peechi range 12 km east of Trichur, Walayar range in Palghat district and the coastal areas of Ponnani.

A unique large variable population of variants of more than two different species of Amorphophallus occur in a protected private cashew plantation in Vellanikkara. Some of the species that have been encountered are yet to be identified.

Specimens of rare species of Curcuma which was first encountered in the forest undergrowth in Machchad hills and later on in Peechi and Walayar range have been sent to Kew, UK for identification. Two distinct types of Rauwolfia were also obtained. Quite good variability in Hemidesmus indicus was assembled. Dioscorea bulophylla was collected from Peechi range. A total of 216 collections belonging to over 100 species could be assembled.

B. Germplasm Evaluation and Maintenance

(a) Paddy (Oryza sativa)

Germplasm evaluation and maintenance of paddy was carried out in the fields of the Instructional Farm, K. A. U., Mannuthy. A total of 2272 collections which comprised of 1360 collections from the Gene Bank at IRRI, Philippines and 912 from NBPGR and its Regional Stations were sown in June, 1987. Twentyone plant characters including tolerance to gall midge were studied. During the second season beginning in October, 932 collections which comprised of the station's collec-
tions from the southern region and those received from NBPGOR and its regional station till 1986 were raised. Nineteen plant characters were recorded in 771 collections which produced population. Thus, 2130 collections were maintained and evaluated. Characters of the panicles remain to be studied in the laboratory. A severe incidence of gall midge during the first season helped in identification of 72 collections which were either free or mildly infested. *O. officinalis* from Kerala appeared to be free of the pest.

(b) **Greater yam (*Dioscorea alata*)**

One hundred fifty-one collections of *D. alata* planted at 1 x 1 m spacing (5 plants per collection) in pits were maintained and observed for various plant characters. No. 186 yielding 43.7 t/ha was followed by No. 84 yielding 40 t/ha and No. 160 yielding 38.2 t/ha were superior to other collections in yield. All were from morphotype 13 and female with oblong cylindrical tubers.

Twentyfive collections regarded as promising earlier were again tried at spacing as given above. No. 171 yielding 24.9 t/ha was superior to others. No. 270 (23.8 t/ha) was another promising collection.

Fifteen morphotypes were identified on the basis of leaf length, width, petiole length, length of basal lobes of leaf, distance between lobes, tuber length and tuber thickness.

NBPGR 134, a collection of *D. alata*, was found to be best yielding 4.98 kg/plant in the sandy soil tracts as reported by the Regional Agricultural Research Station, K. A. U., Kumarakam, Kerala.

(c) **Lesser yam (*Dioscorea esculenta*)**

Fifty-one collections in *D. esculenta* were planted on raised bed at 50 cm x 1 m spacing, 5 plants per collection. Collections No. 7, 48, 49, 73, 78 and 86 yielding above 5 kg per plot were regarded as promising; collections 7 and 48 were best for eating purpose. No. 71 yielding 5.44 kg per plot, No. 21 yielding 5.27 kg/plot and No. 49 yielding 5.45 kg/plot were superior to others. No. 71 was found to be higher yielding last year also.

(d) **Chinese potato (*Coleus parviflorus*)**

Fortytwo collections (5 morphotypes) in *Coleus* were sown on seed beds and branches were clipped and planted at 30 x 30 cm. Yields were poor due to failure of rains immediately after transplanting of clips. No. 28-A yielding 32.9 g/plant, No. 31 yielding 31.5 g/plant and No. 26 yielding 30.8 g/plant were better than others. No. 28-A had large size tubers. No. 29 and No. 30 were tolerant to root-knot nematode (*Meloidogyne sp.*) both at the time of harvest under natural conditions and on inoculation in pots.
(e) Elephant foot yam (*Amorphophallus campanulatus*)

Sixtyone collections have been maintained.

(f) Cassava (*Manihot esculenta*)

Initial evaluation of 60 collections of Cassava collected in 1986 indicated that No. 176 and 162 yielding 1.65 kg/plant and 1.6 kg/plant respectively were promising.

(g) Other tubers

Five collections of *Alocasia macrorhiza*, 10 of *Maranta arundinacea*, 2 of *Canna edulis* (purple and green) and 40 of *Xanthosoma sagittifolium* are being maintained. A stoloniferous *X. sagittifolium* type which bear flowers was collected from Trichur.

(h) Ginger (*Zingiber officinale*)

Out of 88 collections harvested in 1986, only 46 could be maintained. Others succumbed to soft rot which has been a severe problem affecting ginger.

(i) Turmeric (*Curcuma longa*)

Six hundred and thirtysix collections of *Curcuma* spp. were sown in polybags after harvest and irrigated so as to prevent loss of germplasm by drying in laboratory storage. Seedlings (4-5 months old) were planted at 50 x 100 cm on raised beds. Fortyfour morphotypes comprising several species were identified. Seventeen morphotypes were forms of *Curcuma longa* and *C. aromatic*.* Among these, morphotype-3 (Alleppy) was the most promising in respect of yield, taste and colour. No. 16 and 17 of *C. aromatic* and No. 7 were also high yielding. No. 623 and No. 258 of morphotype-3 (Alleppy) yielded 9-10 t/ha and No. 174 (M-16) and No. 417 (M-17) yielding 12.7 t/ha and 8.3 t/ha respectively may be regarded as promising. Morphotype-3 comprising 327 collections showed much variability for yield (15-500 g per plant) and selection within is likely to result in identification of superior genotypes.

(j) Banana (*Musa sapientum*)

Seventy collections have been maintained.

(k) Mango (*Mangifera indica*)

Twenty collections have been maintained.

(l) Jackfruit (*Artocarpus heterophyllus*)

Eightyfour collections have been maintained. Seedling characters viz., height, number of leaves, leaf shape, leaf length and leaf width of 68 new collections were found to be of no help in distinguishing soft flaked (*kooza*) forms from the much
preferred hard flaked (Varikka) forms. Being cross fertilised, a grower is unable to
know whether a plant is Varikka or Kooza till ripening of fruit which is a major
disadvantage in growing this perennial tree fruit.

In order to find out how long the extracted seeds of Jackfruit would remain
viable, a preliminary experiment with seeds of a "Kooza" fruit was undertaken.
Results indicate that seeds with flake should not be collected and kept as there was
no germination from the beginning to the end of two weeks. Seeds without flake,
pericarp and testa gave 90 per cent germination (fresh), 60 per cent (1 week old)
and 65 per cent (2 weeks old). The experiment will be repeated in greater detail
next year.

(m) Wild relatives of the following crop plants were also maintained

(i) Oryza spp.: O. granulata, O. officinalis (2 forms), O. nivara, O. rufipogon
    complex (65) from Kerala, O. glaberrima (2 forms), O. glumaepetala, O. brachy-
    yantha, O. alata, O. grandiglumis. O. nivara, O. owntata, O. ridleyi, O. longistam-
    inata and O. grandiglumis

(ii) Colocasia esculenta: Several collections of wild stoloniferous and wild
    non-stoloniferous colocasia.

(iii) Dioscorea: Fourteen distinct species are being maintained. It is inter-
    esting that the colour of the flesh is white/dirty white, yellow or pink in wild types
    while in cultivated it is either white/dirty white or pink but not yellow.

(iv) Zingiber: Zingiber zerumpet, Z. cassumnnar, Z. macrostychyum, Z. rose-
    um and an unidentified collection.

(v) Piper: P. nigrum, P. longum, P. hymenophyllum, P. trichostichyum,
    P. attenuatum, P. halmnium.

(vi) Legumes: Vigna radiata var. sublebata, V. wightii, Teramnus labialis,
    Stylosanthes mucronata, Alysicarpus monilifer, A. rugosus, Atylosia scarabaeoides,
    Calapagchium echinoides, Centrosema pubscens, Cliitoria ternatea and Indigofera spp.

C. Leaf Morphology and Epidermal Studies in Dioscorea spp.

Studies were carried out on 18 collections of 14 Dioscorea species with re-

Among all epidermal characters statistically analysed for variance, only dor-

sal epidermal cell length was not significant; others such as number of dorsal,
ventral epidermal cells, length, breadth, and number of stomata and dorsal cell
breadth were all highly significant (at 1 per cent level). Stomatal index, ventral
cell length and breadth were significant at 5 per cent level. Thus, significant inter-
specific variation on the basis of these epidermal characters exists.
D. The Station has been Identified as a Duplicate Centre for Maintenance and Evaluation of the Following Crops

(a) **Blackgram** (*Vigna mungo*)

Three hundred and eight collections of blackgram were sown in 3 m rows at 50 cm spacing, 1–3 rows per variety. IC—45688, —45641, —45648, —65773, TN 87/84/5, 88/84/4 and 30/83/4 were identified as promising lines on yield basis.

(b) **Cowpea** (*Vigna unguiculata*)

Fortyeight selections were grown at 50 × 25 cm spacing in 3 m single rows. In grain type No. 831, 687 and 825 yielded 301–328 pods/plot as compared to Pavizom (control) which yielded only 254 pods per plot. No. 328 was superior in respect of pod weight and grain weight which was 203 g and 107 g/plot respectively. Among vegetable type, no selection was superior to control Kuruthola in respect of pod number per plot. However, No. 452 B1, 504 B1, which had long vegetable pods were superior to others, yielding 107 and 88 pods per plot respectively.

In a replicated trial with 91 varieties of cowpea (identified earlier as promising). No. 88/82-13, and IC-44738 yielding 485 and 445 pods per plot respectively were superior to all the controls. These two varieties were superior in respect of pod yield also which was 1736 kg/ha and 2073 kg/ha respectively. In grain type IC-44738 yielded 886 kg/ha, IC-44719 yielded 713 kg/ha and No. 59/82/13 yielded 666 kg/ha. In dual purpose type, No. 7/83-26 yielding 1245 kg/ha pods and 650 kg/ha grain and IC—45431 yielding 793 kg/ha pods and 633 kg/ha grain were superior.

(c) **Horsegram** (*Macrotyloma uniflorum*)

Five hundred and nineteen collections of horsegram were sown on 30th September in residual moisture of monsoon. Eleven collections yielded more than the control.

(d) **Ricebean** (*Vigna umbellata*)

Two hundred and sixty six collections of ricebean were sown for maintenance in 2 m rows spaced at 50 cm. A total of 146 collection have been maintained. In a trial of 14 ricebean varieties in 3 replications at spacing of 30 cm × 2 m, RB—40 yielding 339 kg/ha, RB—17 yielding 28 kg/ha, RB—25 and —40 yielding 272 kg/ha were better than others.

(e) **Redgram** (*Cajanus cajan*)

Tweegtigh collections of redgram were grown for evaluation. V—1235, —1859, —1881, —1890 and —1899 were identified as promising collections.

(f) **Okra** (*Abelmoschus esculentus*)

Fiftyfive collections and 31 selections were maintained.
(g) **Cucurbits**

One hundred ninety collections of bittergourd, six of bottlegourd, three of ridgegourd and one of smoothgourd were maintained.

(h) **Wingedbean** (*Psophocarpus tetragonolobus*)

Four hundred and six collections of wingedbean, which comprised 183 original collections and 223 selections within, were sown on raised beds at 50 cm between plants and 1 m between rows, 5 plants per collection. The collections were observed for all pod characters at the time of maturity and 20 collections yielding 60-80 pods per plant may be considered promising.

The following other vegetable crops were also grown: *Canavalia ensiformis*, *C. gladiata*, *C. virosa* (98), *Pachyrhizus erosus* (7), *Styloclorium deeringianum* (6) and *Phaseolus lunatus* (8).

(i) **Chillies** (*Capsicum annuum*)

Promising collections in Chillies were multiplied with a view to generate material for selection. Collection No. 132-84-20 (Tamil Nadu), No. 58-82-3 (Kerala), BDJ-11-369 (Shimla), IC-46015 (Kerala), C-1818 and C-1655 (NBPGR, New Delhi), No. 119-82-4 (Kerala), No. 56-82-34 (Kerala), 112-82-2 (Kerala), 132-84-26 (Tamil Nadu), (*Capsicum annuum*) and No. 54-81-14 (Kerala), (*Capsicum frutescens*) had been found promising in earlier years. Seventeen promising selections amongst above yielding between 40-78 g per plant of dry fruits have been identified during the year. No. 54-81-14 (Kerala) a collection in *C. frutescens* yielding 15 g dried fruits/plant has already been accepted for multilocation trial of the Kerala Agricultural University on the basis of its performance.

(j) **Sorghum** (*Sorghum bicolor*)

Two thousand collections in Sorghum were grown in rows spaced 75 cm × 15 cm for evaluation of their photosensitivity. A total of 1957 collections survived and of these 156 did not flower under local conditions. They remained stunted and died before flowering. Flowering in others ranged for 49 days to 201 days and the height of plant varied from 15 cm to 715 cm. The crop was also observed by Scientists of ICRISAT, Hyderabad.

(k) **Ragi** (*Eleusine coracana*)

Twenty varieties of *ragi* were grown in thrice replicated trial spaced at 30 cm between 3 m rows, 4 rows per variety. Data were taken on 18 characters. No. 3 yielding 708 kg/ha and No. 164 yielding 496 kg/ha were better than others. In general the crop was poor.

Three hundred and ninetynine collections were also maintained. The collections were observed for 18 descriptors with the view to prepare a catalogue for the
second year. Eight collections yielding between 1003-1529 kg/ha may be regarded as promising. The local control yielded 600 kg/ha.

The following other millets were also maintained: *Panicum miliaceum* (20) and *Paspalum scrobiculatum* (13).

E. Plant Introduction

(a) New introductions

(i) Seeds of *Copaifora langsdorffii* (EC-196556) introduced from Brazil and received here on 20-1-87 has established.

(ii) Seeds of *Solanum muricatum* (EC-194214) introduced from Lima, Peru was sown but did not germinate.

(iii) 38 selected varieties of paddy and wild species of *Oryza* viz. *O. glumaepetala*, *O. brachyantha*, *O. alta*, *O. glaberrima*, *O. grandiglumis*, *O. nivara*, *O. punctata*, *O. ridleyi* and *O. longistaminata* were introduced from Philippines by Sri K. C. Velayudhan. In addition, one species each of Winged-bean, *Bauhinia* sp., *Capsicum frutescens*, *Glycine Momordica charantia*, *Amaranthus* sp. were also introduced.

The Gene Bank at IRRI supplied 1360 accessions of rice. One batch consisting of 838 accessions failed to germinate.

(b) Old introduction

(i) *Acrocomia sclerocarpa* (EC-170497) and *Jatropha curcas* (EC-170498) introduced from Brazil are growing satisfactorily. *Anona glabra* (EC-168324) introduced from Brazil on 7-2-1985 bore a single fruit which was small and deformed although it was sweet and fragrant.

Maracuja (Passion fruit, EC-165003) which has been reported as a promising introduction in this region in 1986 continued to perform well. The seedlings have been planted out in the open for comparison with *P. edulis* (local).

The following introductions made earlier are healthy but have not yet flowered:


F. Seed Supply

A total of 1502 lines were supplied to different research institutions during the year.
G. Organisation of Herbarium

Work was initiated to organise the existing herbarium collections by mounting, poisoning, labelling and placing them in species, genus covers and then arranging them familywise in alphabetical order. The personal herbarium sheets (200) collected by V. A. Amalraj during 1971-73 from W. Bengal and Tamil Nadu are also being incorporated (after remounting) in this herbarium. Five hundred sheets have been mounted and 300 more sheets are ready for mounting.

Research Projects (Project Leader; Associates)

1. Exploration and collection of indigenous crops and their relatives in the Southern Region (K. C. Velayudhan; V. K. Muralidharan, V. A. Amalraj).


4. Genetic resources programme for selected medicinal and aromatic plants of southern region (V. A. Amalraj; K. C. Velayudhan).
GENERAL INFORMATION

A. National Policy Planning and Review Committee on Plant Genetic Resources:

Chairman

Dr. N. S. Randhawa, Director General, ICAR, Krishi Bhawan, New Delhi.

Members

Dr. D. N. Srivastava, Former Deputy Director General (CS), ICAR, Krishi Bhawan, New Delhi.

Dr. R. L. Rajak, Plant Protection Adviser to the Govt. of India, Room No. 409, 'B' Wing, Shastri Bhawan, New Delhi.

Dr. T. R. Subramanian, Director, Indian Institute of Horticultural Research, 255, Upper Palace Orchards, Bangalore (Karnataka).

Dr. A. M. Michael, Director, Indian Agricultural Research Institute, New Delhi.

Dr. A. Appa Rao, Vice-Chancellor, Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad (A. P.).

Sh. T. N. Seshan, Secretary to the Govt. of India, Deptt. of Environment, Forest & Wildlife, Bikaner House, Shahjahan Road, New Delhi.

Dr. A. B. Joshi, 10-Aboli Apartments, 102-103 Erandwana, Law College Road, Pune, Maharashtra.

Dr. P. V. Sane, Director, National Botanical Research Institute, Lucknow (U. P.) (Representative of Council of Scientific and Industrial Research, New Delhi).

Dr. N. Sen, Joint Adviser, Council of Scientific and Industrial Research, New Delhi (Representative of CSIR, New Delhi).

Dr. Shankar Lal, Assistant Director General (FC), ICAR, Krishi Bhawan, New Delhi.

Convenor

Director, National Bureau of Plant Genetic Resources (IARI Campus), New Delhi.
Sub-Committee of the National Policy Planning and Review Committee

Chairman

Dr. A. B. Joshi, 10—Aboli Apartments, 102-103 Erandwana, Law College Road, Pune.

Members

Dr. R. L. Rajak, Plant Protection Adviser to the Govt. of India, Room No. 409, ‘B’ Wing, Shastri Bhawan, New Delhi.

Dr. P. V. Sane, Director, National Botanical Research Institute, Lucknow.

Dr. M. P. Nayar, Director, Botanical Survey of India, Calcutta.

President, Forest Research Institute, Dehradun.

Member-Secretary

Director, National Bureau of Plant Genetic Resources, New Delhi.

B. Institute Management Committee

Chairman

Dr. R. S. Paroda, Director, National Bureau of Plant Genetic Resources, New Delhi (upto 1-11-87).

Members

Director of Agriculture, Govt. of Haryana, Agricultural Department, Chandigarh (Haryana).

Development Commissioner, Delhi Administration, Khyber Pass, Delhi.

Dr. E. A. Siddique, Head, Division of Genetics, Indian Agricultural Research Institute, New Delhi.

Shri Jagan Nath Mishra, Ex-Member of Parliament, Village & P. O.—Sudai, Rataull Via—Gogardiha, Distt.—Madhubani, Bihar.

Shri Ram Kishan Gupta, Ex-Member of Parliament, C-31, Tara Apartments, Kalkaji Extension, Delhi.

Sh. H. P. Chamola, Accounts Officer, NBPGR, New Delhi.

Dr. K. P. S. Chandel, Sr. Scientist S-3, NBPGR, New Delhi.

Dr. V. K. Mathur, Sr. Scientist S-3, NBPGR, New Delhi.

Dr. B. R. Verma, Scientist S-2, NBPGR, New Delhi.

Dr. S. Mandal, Scientist S-2, NBPGR, New Delhi.

Dr. Amar Singh, Senior Scientist S-3, (NSP), ICAR, Krishi Bhawan, New Delhi.
Member-Secretary
Sh. M. R. Wadhwa, Sr. Admn. Officer, NBPGR, New Delhi.

C. Institute Joint Staff Council
Official Side

Chairman
Dr. R. S. Paroda, Director, NBPGR, New Delhi. (upto 1.11.87).

Members
Dr. V. K. Mathur, Sr. Scientist S-3, NBPGR, New Delhi.
Sh. M. Kazim, Scientist S-2, NBPGR, New Delhi.
Sh. M. R. Wadhwa, Sr. Admn. Officer, NBPGR, New Delhi.
Sh. H. P. Chamola, Accounts Officer, NBPGR, New Delhi.
Mrs. Manju Lata Kapur, Scientist S-1, NBPGR, New Delhi.

Member-Secretary
Dr. M. L. Maheshwari, Sr. Scientist S-4, NBPGR, New Delhi.

Staff Side

Secretary
Sh. Daulat Ram Chauhan, S. S. Gr. II, NBPGR, New Delhi.

Members
Sh. Jitendra Mohan, T-4, NBPGR, New Delhi.
Sh. D. D. Sharma, Assistant, NBPGR, New Delhi.
Sh. Naval Kishore, Sr. Clerk, NBPGR, New Delhi.

D. Institute Grievance Cell
Official Side

Chairman
Dr. K. L. Sethi, Sr. Scientist S-3, NBPGR, New Delhi.

Members
Sh. M. R. Wadhwa, Sr. Admn. Officer, NBPGR, New Delhi.
Sh. H. P. Chamola, Accounts Officer, NBPGR, New Delhi.
E. Staff Reservations

(a) Total number of employees and the number of Scheduled Castes and Scheduled Tribes among them as on 31-12-1987 were as follows:

<table>
<thead>
<tr>
<th>Class</th>
<th>Nature of Post</th>
<th>Total No. of employees</th>
<th>No. of Scheduled Caste employees</th>
<th>No. of Scheduled Tribe employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Permanent</td>
<td>62</td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td>Temporary</td>
<td>36</td>
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<td></td>
</tr>
<tr>
<td>Class II</td>
<td>Permanent</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class III</td>
<td>Permanent</td>
<td>31</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td>102</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>Class IV</td>
<td>Permanent</td>
<td>36</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td>116</td>
<td>18</td>
<td>5</td>
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</table>

(b) Number of reserved vacancies in different grades filled by members of Scheduled Castes and Scheduled Tribes during 1987:

<table>
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<tr>
<th>Class</th>
<th>Total number of vacancies filled</th>
<th>Number of Scheduled Caste vacancies filled</th>
<th>Number of Scheduled Tribe vacancies filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>Class II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class III</td>
<td>10</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Class IV</td>
<td>2</td>
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</tr>
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</table>
F. Financial Expenditure

A total expenditure of Rs. 89.22 lakhs (non-plan) and Rs. 84.50 lakhs (plan) was incurred by the Bureau during 1987-88. Besides this, an expenditure of Rs. 103.95 lakhs was also incurred out of the grant received from the Department of Biotechnology (Table 1)

Table 1. Budget estimates and expenditure incurred during 1987-88

<table>
<thead>
<tr>
<th></th>
<th>Budget estimates Rs. (in lakhs)</th>
<th>Revised estimates Rs. (in lakhs)</th>
<th>DBT Rs. (in lakhs)</th>
<th>Expenditure Rs. (in lakhs)</th>
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<tbody>
<tr>
<td></td>
<td>Non-Plan</td>
<td>Plan</td>
<td>Non-Plan</td>
<td>Plan</td>
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<tr>
<td>Establishment Charges</td>
<td>71.40</td>
<td>15.00</td>
<td>76.29</td>
<td>15.30</td>
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<tr>
<td>Equipment</td>
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<td>15.00</td>
<td>—</td>
<td>15.00</td>
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<tr>
<td>Works</td>
<td>—</td>
<td>33.50</td>
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<td>33.20</td>
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<tr>
<td>Contingencies</td>
<td>15.00</td>
<td>15.00</td>
<td>11.63</td>
<td>20.15</td>
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<tr>
<td>T. A.</td>
<td>1.40</td>
<td>1.50</td>
<td>1.25</td>
<td>1.35</td>
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<tr>
<td>Leave Salary &amp; Pension Contributions</td>
<td>0.05</td>
<td>—</td>
<td>0.08</td>
<td>—</td>
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<tr>
<td>Total</td>
<td>87.85</td>
<td>80.00</td>
<td>89.25</td>
<td>85.00</td>
</tr>
</tbody>
</table>
G. Personnel

(a) Retirements

1. Dr. A. K. Lambat, S-4 (Plant Pathology) took voluntary retirement after 20 years of qualifying service from ICAR/NBPGR with effect from 28-2-1987.

2. Dr. K. L. Sethi, S-3 (Plant Breeding)—Retired on superannuation from ICAR/NBPGR's service with effect from 31-8-1987.

(b) Transfers

1. Sh. D. B. Parakh, S-1 (Plant Pathology)—Joined on 1-7-1987 in Plant Quarantine Division, NBPGR, New Delhi on transfer from SBI, Regional Station, Karnal.

2. Dr. J. P. Singh, S-1 (Plant Breeding)—Joined on 16-2-1987 in Germplasm Evaluation Division, NBPGR, New Delhi on transfer from CICR, Nagpur (MS).

3. Dr. S. R. Bhat, S-1 (Genetics and Cytogenetics)—Joined on 2-6-1987 in NFPTCR, New Delhi on transfer from IISR, Lucknow.

4. Shri V. K. Pandita, S-1 (Horticulture)—Joined on 25-11-1987 at Exploration Base Centre, Srinagar, on transfer from Satellite Centre, Amravati.


6. Shri Birbal Singh, Jr. Clerk—Joined on 21-4-1987 in Germplasm Exchange Division on transfer from IARI Regional Station, Pusa, Bihar.

7. Shri Mange Lal, S. S. Gr-I—Joined on 15-4-1987 at Regional Station, Jodhpur on transfer from Central Sheep and Wool Research Institute, Avikanagar.

(c) Promotions

<table>
<thead>
<tr>
<th>Name</th>
<th>Promoted as</th>
<th>Date of promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. R. S. Paroda</td>
<td>Deputy Director General (CS), ICAR,</td>
<td>2-11-87</td>
</tr>
<tr>
<td></td>
<td>Krishi Bhawan, New Delhi.</td>
<td></td>
</tr>
<tr>
<td>Shri Harbir Singh</td>
<td>Assistant Admn. Officer</td>
<td>2-11-87</td>
</tr>
<tr>
<td>Shri R. P. Dhasmana</td>
<td>Superintendent</td>
<td>31-10-87</td>
</tr>
<tr>
<td>Shri B. D. Gaur</td>
<td>Superintendent</td>
<td>2-11-87</td>
</tr>
<tr>
<td>Shri A. G. Meshram</td>
<td>Superintendent</td>
<td>31-10-87</td>
</tr>
<tr>
<td>Ms. R. S. Lathadevdas</td>
<td>Stenographer (NFPTCR)</td>
<td>28-2-87</td>
</tr>
<tr>
<td>Shri Subhas Chander</td>
<td>Assistant (NFPTCR)</td>
<td>27-10-87</td>
</tr>
<tr>
<td>Shri Geetam Kumar</td>
<td>Assistant</td>
<td>28-10-87</td>
</tr>
<tr>
<td>Shri P. Venugopalan</td>
<td>Assistant, Regional</td>
<td>16-11-87</td>
</tr>
<tr>
<td></td>
<td>Station, Trichur</td>
<td></td>
</tr>
<tr>
<td>Shri Mohar Singh</td>
<td>Assistant</td>
<td>31-10-87</td>
</tr>
<tr>
<td>Shri M. L. Malik</td>
<td>Assistant</td>
<td>3-11-87</td>
</tr>
<tr>
<td>Ms. Rita Rani</td>
<td>T-4 (Artist)</td>
<td>1-7-87</td>
</tr>
<tr>
<td>Shri V. K. Pant</td>
<td>T-4, Regional Station, Bhowali</td>
<td>1-7-87</td>
</tr>
<tr>
<td>Shri Anand Singh Rana</td>
<td>T-4, Regional Station, Bhowali</td>
<td>1-7-87</td>
</tr>
<tr>
<td>Shri G. L. Arya</td>
<td>T-4, Regional Station, Bhowali</td>
<td>1-7-87</td>
</tr>
<tr>
<td>Mrs. Vinay Sharma</td>
<td>Senior Clerk</td>
<td>31-10-87</td>
</tr>
<tr>
<td>Mrs. Kuljit Kaur</td>
<td>Senior Clerk</td>
<td>31-10-87</td>
</tr>
</tbody>
</table>
(d) New appointments

Scientific Cadre

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name</th>
<th>Grade</th>
<th>Discipline</th>
<th>Place</th>
<th>Date of joining</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dr. Bhag Mal</td>
<td>S-3</td>
<td>Economic Botany</td>
<td>New Delhi</td>
<td>2-2-87</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Project Co-ordinator, Under-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>utilized &amp; Underexploited Plants)</td>
<td></td>
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<tr>
<td>2.</td>
<td>Ms. Kamala</td>
<td>S-1</td>
<td>Economic Botany</td>
<td>Hyderabad</td>
<td>20-1-87</td>
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<tr>
<td></td>
<td>Venkateswaran</td>
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<tr>
<td>4.</td>
<td>Ms. Suman Lakhan</td>
<td>S-1</td>
<td>Genetics &amp; Cytogenetics</td>
<td>New Delhi</td>
<td>24-3-87</td>
</tr>
<tr>
<td></td>
<td>Pal</td>
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<tr>
<td>5.</td>
<td>Shri K. V. Bhat</td>
<td>S-1</td>
<td>Plant Breeding</td>
<td>New Delhi</td>
<td>27-3-87</td>
</tr>
<tr>
<td>6.</td>
<td>Shri Ghanshyam</td>
<td>S-1</td>
<td>Horticulture</td>
<td>Shillong</td>
<td>21-12-87</td>
</tr>
<tr>
<td></td>
<td>Pandey</td>
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Technical/Administrative/Supporting Cadre

<table>
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<th>Name</th>
<th>Category</th>
<th>Place</th>
<th>Date of joining</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Shri Girdhar Gopal</td>
<td>S. S. Gr.-I</td>
<td>Shimla</td>
<td>28-3-87</td>
</tr>
<tr>
<td>2.</td>
<td>Miss Jasvinder Kaur</td>
<td>Steno</td>
<td>New Delhi</td>
<td>3-4-87</td>
</tr>
<tr>
<td>3.</td>
<td>Shri Ranbir Singh</td>
<td>T-II-3</td>
<td>New Delhi</td>
<td>12-6-87</td>
</tr>
<tr>
<td>4.</td>
<td>Shri Mahabir Singh Yadav</td>
<td>Hindi Typist</td>
<td>New Delhi</td>
<td>29-6-87</td>
</tr>
<tr>
<td>5.</td>
<td>Shri Puran Chand</td>
<td>T-1</td>
<td>New Delhi</td>
<td>11-11-87</td>
</tr>
<tr>
<td>6.</td>
<td>Shri Surender Kumar</td>
<td>Jr. Clerk</td>
<td>New Delhi</td>
<td>11-11-87</td>
</tr>
</tbody>
</table>

(e) Staff-Scientific

(i) Headquarters

Dr. R. S. Paroda, Director; Plant Breeding (upto 1-11-87).

Division of Germplasm Exchange

Dr. B. P. Singh (Head), S-3; Eco. Botany
Shri Basant Kumar, S-2; Eco. Botany
Shri M. Kazim, S-2; Eco. Botany
Dr. Ranbir Singh, S-2; Eco. Botany
Shri Deep Chand, S-1; Eco. Botany
Mrs. Pratibha Brahmi, S-1; Eco. Botany
Division of Germplasm Conservation

Shri P. P. Khanna (Scientist-in Charge), S-2; Eco. Botany
Dr. R. K. Saxena, S-2; Eco. Botany
Mrs. Kusha Verma, S-2; Eco. Botany
Miss N. K. Chowdhary, S-2; Agril. Statistics
Shri S. K. Jain, S-1; Seed Technology
Dr. (Mrs) Neeta Singh, S-1; Pl. Physiology

Division of Plant Exploration and Collection

Dr. R. K. Arora (Head; Offg. Director from 2-11-87) S-4; Eco. Botany
Dr. M. N. Koppar, S-2; Eco. Botany
Shri S. Mauria, S-2; Eco. Botany
Shri Umesh Chandra, S-1; Eco. Botany
Miss Anjula Pandey, S-1; Eco. Botany

Division of Germplasm Evaluation

Shri T. A. Thomas (Head), S-4; Eco. Botany
Dr. K. L. Sethi, S-3; PI. Breeding
Dr. S. K. Mithal, S-3; Eco. Botany
Dr. Bhag Singh S-3; Eco. Botany
Dr. B. S. Dabas, S-2; Eco. Botany
Dr. S. K. Pareek, S-2; Agronomy
Shri Ranbir Singh, S-2; Eco. Botany
Shri B. M. Singh, S-2; Eco. Botany
Dr. P. N. Mathur, S-2; PI. Breeding
Shri R. L. Sapra, S-1; Agril. Statistics
Shri D. Pandey, S-1; Horticulture
Dr. I. S. Bisht, S-1; PI. Pathology
Dr. B. S. Phogat, S-1; Agronomy
Mrs. Shashi Bhalla, S-1; Entomology
Mrs. Ranjana Nagpal, S-1; Agril. Statistics
Dr. I. P. Singh, S-1; Pl. Breeding

Chemistry Unit

Dr. M. L. Maheshwari, S-4; Agril. Chemistry
Dr. M. A. Kidwai, S-2; Agril. Chemistry
Dr. S. Mandal, S-2; Biochemistry
Dr. V. K. Srivastava, S-2; Agril. Chemistry

Division of Plant Quarantine

Shri Ram Nath (Head), S-3; Pl. Pathology
Dr. A. K. Lambat, S-4; Pl. Pathology (up to 28.2.1987)
Dr. A. Majumdar, S-2; Pl. Pathology
Dr. P. C. Agarwal, S-2; Pl. Pathology
Shri R. K. Khetarpal, S-2; Pl. Pathology
Dr. Shamsher Singh, S-1; Pl. Pathology
Mrs. Usha Dev, S-1; Pl. Pathology
Dr. D. B. Parakh, S-1; Pl. Pathology
Dr. V. K. Mathur, S-3; Nematology
Dr. Arjun Lal, S-2; Nematology
Dr. Rajan, S-1; Nematology
Miss Nandini Gokte, S-1; Nematology
Dr. B. R. Verma, S-2; Entomology
Dr. Beche Lal, S-1; Entomology
Mrs. Manju Lata Kapur, S-1; Entomology

**Plant Tissue Culture Repository**

Dr. K. P. S. Chandel (Scientist-in-Charge), S-3; Eco. Botany
Miss E. Roshini Nayar, S-2; Eco. Botany
Dr. (Mrs.) Rekha Chaudhary, S-1; Eco. Botany
Shri S. M. Balachandran, S-1; Eco. Botany
Dr. (Miss.) Ruchira Pandey, S-1; Eco. Botany
Dr. (Mrs.) Neelam Sharma, S-1; Eco. Botany
Miss Suman Lakhan Pal, S-1; Genetics & Cytogenetics
Shri K. V. Bhat, S-1; Pl. Breeding
Dr. S. R. Bhat, S-1; Genetics & Cytogenetics

**All India Coordinated Projects**

Dr. R. Gupta (Project Co-ordinator, Medicinal and Aromatic Plants), S-5; Eco. Botany
Dr. Veena Gupta, S-1; Eco. Botany
Dr. Bhag Mal (Project Co-ordinator, Under-utilised & Under-exploited Plants) S-3; Eco. Botany
Mrs. Vandana Joshi, S-1; Eco. Botany

(ii) **Regional Stations/Base Centres**

**Akola**

Shri D. P. Patel (Officer-in-Charge), S-2; Eco. Botany
Shri T. R. Loknathan, S-1; Pl. Breeding
Shri Satyanarayana Rao Sarvanam, S-1; Pl. Physiology

**Amravati**

Shri T. G. Kawalker, S-1; Eco. Botany
Bhowali

Shri K. C. Pant (Officer-in-Charge), S-3; Eco. Botany
Shri P. C. Joshi, S-3; Pl. Pathology
Shri K. C. Muneem, S-1; Pl. Pathology
Shri Kuldeep Singh Negi, S-1; Eco. Botany

Cuttack

Shri Nilamani Dikshit, S-1; Eco. Botany

Hyderabad

Dr. K. S. Varaprasad (Officer-in-Charge), S-2; Nematology
Dr. R. D. V. J. Prasada Rao, S-2; Plant Pathology
Dr. S. K. Chakrabarty, S-1; Plant Pathology
Shri P. L. Premi, S-1; Entomology
Miss Kamala Venkateswaran, S-1; Eco. Botany
Shri Someswara Rao, S-1; Eco. Botany

Jodhpur

Shri D. P. Chopra (Officer-in-Charge), S-3; Eco. Botany
Dr. D. C. Bhandari, S-2; Eco. Botany
Mrs. Neelam Bhatnagar, S-1; Eco. Botany
Shri S. K. Verma, S-1; Horticulture

Shillong

Dr. B. D. Sharma (Officer-in-Charge), S-2; Pl. Breeding
Dr. D. K. Hore, S-2; Eco. Botany
Shri Ghanshyam Pandey, S-1; Horticulture

Shimla

Dr. B. D. Joshi (Officer-in-Charge), S-3; Eco. Botany
Dr. D. S. Rathore, S-2; Horticulture
Shri Narinder Kumar Gautam, S-1; Eco. Botany
Shri R. K. Tyagi, S-1; Eco. Botany
Shri Rakesh Srivastava, S-1; Horticulture

Srinagar

Shri V. K. Pandita, S-1; Horticulture

Trichur

Shri V. K. Muralidharan (Officer-in-Charge), S-3; Eco. Botany
Shri K. C. Velayudhan, S-2; Eco. Botany
Shri V. A. Amalraj, S-2; Eco. Botany

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(f) Technical (T-II-3 and above)

T-5
Shri Rameshwar Prasad (Sr. Tech. Asstt.)

T-4
Shri Abhay Sharma (Photographer)
Shri A. M. Siddiqui (Librarian)
Shri Bankey Lal (Tech. Asstt.)
Shri B. D. Dahiya (Foreman)
Mrs. Indra Rani Madnani (Tech. Asstt.)
Shri R. K. Kale (Tech. Asstt.)
Shri Rajiv Mathur (Tech. Asstt.)
Shri Janak Lal Poddar (Tech. Asstt.)
Shri Charan Singh (Tech. Asstt.)
Mrs. Rita Rani (Artist)
Shri V. K. Pant (Tech. Asstt.)
Shri Anand Singh Rana (Tech. Asstt.)
Shri G. L. Arya (Tech. Asstt.)

T-II-3
Shri B. C. Bachhawandia (Tech. Asstt.)
Shri G. P. Agham (Tech. Asstt.)
Shri J. K. Ingle (Tech. Asstt.)
Dr. (Mrs.) Manju Upreti (Tech. Asstt.)
Mrs. M. Pushp Lata (Tech. Asstt.)
Miss Poonam Suneja (Tech. Asstt.)
Shri Babu Abraham (Tech. Asstt.)
Shri B. P. Singh (Tech. Asstt.)
Shri R. Asokan Nair (Tech. Asstt.)
Shri Satya Pal Singh (Seed. Ex. Asstt.)
Shri Daya Shankar (Tech. Asstt.)
Miss Sheela Kumari (Hindi Translator)
Shri Ranbir Singh (Tech. Asstt.)

(g) Administrative (Assistants and above)
Shri M. R. Wadhwa

Evaluation Division

Photo Section, Headquarters
Library, Headquarters
Germplasm Exchange Division
Conservation Division
Plant Quarantine Division
Evaluation Division
Regional Station, Akola
Plant Quarantine Division
Library, Headquarters
Plant Quarantine Division
Headquarters
Regional Station, Bhowali
Regional Station, Bhowali
Regional Station, Bhowali
Regional Station, Jodhpur
Satellite Centre, Amravati
Regional Station, Akola
Conservation Division
Plant Quarantine Division
Evaluation Division
Regional Station, Hyderabad
Regional Station, Shimla
Regional Station, Trichur
Germplasm Exchange Division
Regional Station, Hyderabad
Library, Headquarters
Plant Quarantine Division
Sr. Administrative Officer, H. Q.
Administrative Officer

Accounts Officer, H. Q.

Asstt. Administrative Officer, H. Q.

Office Superintendents, H. Q.

Assistants, H. Q.

Assistant, Regional Station, Shimla

Assistant, Regional Station, Trichur

### H. Staff of Bureau Working for Doctorate

<table>
<thead>
<tr>
<th>Name</th>
<th>Guide</th>
<th>Institution</th>
<th>Problem</th>
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<tr>
<td>1. Km. E. Roshini Nayar</td>
<td>Dr. K. M. M. Dakshini</td>
<td>Delhi University, Delhi</td>
<td>Studies on some grass taxa</td>
</tr>
<tr>
<td>2. Sh. R. K. Khetarpal</td>
<td>Dr. Y. Maury</td>
<td>Institute Nationale, de la Recherche, Station de Pathologie, Versailles, France.</td>
<td>Studies on pea seed-borne mosaic virus</td>
</tr>
</tbody>
</table>

### I. Staff Membership in Committees/panels/Boards etc.

Dr. R. S. Paroda, Director

Member of the prestigious Global Genetic Resources Committee constituted by the Board of Agriculture, National Research Council, USA.

President, Indian Society of Plant Genetic Resources.

President, Indian Society of Desert Technology


Chief Editor, Guar Research Annals, Published by the Guar Research and Development Association, HAU, Hissar.

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Member, National Man and the Biosphere Committee, Department of Environment, New Delhi.

Member, ICAR Scientific Panel for Plant Breeding, ICAR, New Delhi.

Member, Board of Studies of Agriculture of Meerut University, Meerut, U. P. and of the Birsa Agricultural University, Kanke, Ranchi, Bihar.

Member-Secretary, ICAR Regional Committee No. IV. (upto 1-11-87)

Member, Environmental Appraisal Committee for River Valley and Hydro-Electric Projects, Ministry of Environment and Forests, New Delhi.

Member, Committee to Scrutinise the Proposals of International Cooperation dealing with oil seed production and exchange of technology, on processing and post harvest technology, Department of Agriculture and Cooperation, New Delhi.

Member, ICAR Committee on Breeder’s Seed Production and Seed Sciences.

Member, ICAR Standing Committee on Field Plot machinery.

Member, Scientific Panel on Fruits, Plantation Crops, Medicinal and Aromatic Plants, ICAR, New Delhi.

Member, Quinquennial Review Team, "All India Coordinated Research Project on Medicinal and Aromatic Plants." ICAR, New Delhi.

Member Secretary of Task Force on National Research Centre (M & AP), ICAR, New Delhi.

Member, National Committee for Asia and Pacific Information Network on Medicinal and Aromatic Plants, CSIR (PID), New Delhi.

Member, Governing Body of Central Council of Research in Ayurveda and Siddhah, Ministry of Health and Family Welfare, GOI, New Delhi.
Dr. R. K. Arora,
Sr. Scientist

Member, Inter-agency Sub-group on Standardisation and Quality Control of Traditional Remedies/Natural Products, ICMR, New Delhi.

Member, Standing Committee on Development of Medicinal Plants, Ministry of Health and Family Welfare. Also member of a sub-committee to examine legal aspects on movement of medicinal plants and crude drugs in the country.

Member, Technical Committee to examine matters related to manufacture of Poppy straw concentrate, Deptt. of Revenue, Ministry of Finance, GOI, New Delhi.

Member, Natural and Synthetic Material Committee (PCDC-18) and Chairman, Sub-committee (PC-DC 18 : 6) to bring out a document on “Good Agronomic Practices” (GAP) on Aromatic Plants grown in India under Bureau of Indian Standards (BIS), Delhi.

Member, Advisory Committee and Editorial Board of Medicinal and Aromatic Plants Abstract Service (MAPA), CSIR (PID), New Delhi.


Member, NABARD Committee on Financing Schemes for Development of Medicinal Plants, Bombay.

Member, Advisory Committee, Dabar Research Foundation, Delhi.

Member, Executive Committee of Indian Drugs Manufacturing Association for organising an International Seminar on “Industrial Utilization of Medicinal Plants” under Deptt. of Chemicals and Petrochemicals in Union Govt., Delhi.

Member, International Commission of Ethnobotany, Canada.

Member, Editorial Committee, Indian Journal of Genetics & Plant Breeding.
Dr. K. P. S. Chandel, Sr. Scientist
Executive Secretary of the Executive Committee of National Facility for Plant Tissue Culture Repository.

Dr. M. L. Maheshwari, Sr. Scientist
Member, Technical Committee on Development of Essential Oils of Essential Oil Association of India, Kanpur.
Member, BIS/Natural & Synthetic Materials Sectional Committee, PCDC-18, New Delhi.
Member, Editorial Board, Indian Perfumer.

Shri P. P. Khanna, Scientist (S-2)
Member, DARE Committee on Simplification of Procedures for Issue of Customs Duty Exemption Certificates for use by ICAR Institutes.

J. Participation in Seminars/Workshops/Symposia/Training Programmes etc.

—Dr. K. P. S. Chandel, Headquarters, delivered lecture in the 10th Integrated Seed Improvement Training Course held at NSC from January 8 to March 4.

—Shri T. A. Thomas, Headquarters, attended the Workshop on All India Coordinated Vegetable Improvement Project held at NDUAT, Faizabad from January 13 to 16.


—Dr. D. C. Bhandari, Regional Station, Jodhpur, participated and presented a paper at the International Symposium organised by the Indian Society of Soil Science held at CSSRI, Karnal from February 16 to 20.

—Ms. Ranjna Nagpal, Headquarters, attended the Training Programme on Agricultural Information Management at the Society for Information Sciences, New Delhi from February 16 to 20.

—Dr. R. S. Paroda, Director, delivered the keynote address on Plant Genetic Resources Activities in India at the Symposium organised by the Crop Improvement Society of India held at PAU, Ludhiana from February 22 to 23.

—Dr. D. S. Rathore, Regional Station, Shimla, participated in the Specialised Training Programme on Nutrient Management of Fruit Crops and Flowering Plants organised by the Executive Director, Fertilizer Corporation of India at Lodhi Hotel from March 19 to 20.
—Dr. M. L. Maheshwari, Headquarters, attended the 30th Annual Convention of the Essential Oil Association of India and the Seminar on Utilisation of Essential Oils and Flowers and Fragrance at Madurai from March 21 to 22. He also presented a paper.

—Dr. R. K. Arora, Headquarters, presented a paper on Life Support Species of the Indian Temperate region at CSC International Workshop on Maintenance and Evaluation of Life Support Species in Asia and Pacific Region held at NBPG from April 4 to 7.

—Dr. Bhag Mal, Headquarters, attended the 13th Annual Workshop of All India Coordinated Research Project on Forage Crops held at Himachal Pradesh Agricultural University, Palampur from April 13 to 15.

—Dr. R. S. Paroda, Director, attended the NAARM Management Committee Meeting held at Hyderabad on April 16.

—Dr. B. R. Verma, Headquarters, delivered a lecture during the 18th Vegetable Seed Improvement Training Course at NSC, New Delhi on April 14.

—Dr. Bhag Singh, Headquarters, attended the 30th Annual Maize Workshop held at APAU, Rajendra Nagar, Hyderabad from April 17 to 20.

—Dr. D. P. Patel, Shri T. R. Loknathan and Shri S. S. Rao, Regional Station, Akola attended the workshop on Kharif oil seeds at PKV, Akola from April 22 to 27.

—Shri V. K. Muralidharan, Regional Station, Trichur attended the Rice Workshop at Rajendra Agricultural University, Patna from April 24 to 28.

—Dr. R. S. Paroda, Director and Dr. R. K. Arora, Headquarters attended a seminar on Objectives and Perspective of the Botanical Survey of India held at the BSI, Calcutta from May 2 to 3. Dr. Paroda also chaired Session II on Exploration, Monitoring and Conservation.

—Dr. R. S. Paroda, Director, delivered a lecture on Plant Genetic Resources—an International Perspective, at ICRISAT, Patancheru, Hyderabad on May 22.

—Shri R. L. Sapra, Headquarters, participated and presented a paper in the National Symposium on Electronic Data Processing and Computerised Information System in Agricultural Research held at IASRI, New Delhi from May 25 to 26.

—Dr. R. S. Paroda, Director, delivered a lecture on National Activities in Plant Genetic Resources and its Management at IVRI, Izatnagar on June 6.

—Dr. D. S. Rathore, Regional Station, Shimla, attended the Workshop on Temperate Horticulture in North West Hill Region with particular reference to Apple, organised by the Ministry of Agriculture, Government of India, from June 18 to 20 at Shimla. He also delivered a lecture.
—Shri D. P. Chopra, Regional Station, Jodhpur, attended the Guar Group Meeting held at Agricultural Research Station, Durgapura, Jaipur on July 3.

—Shri T. A. Thomas, Headquarters, Dr. D. P. Patel, Regional Station, Akola, Dr. B. D. Joshi, Regional Station, Shimla, Shri D. P. Chopra, Dr. D. C. Bhandari, Mrs. Neelam Bhatnagar and Shri S. K. Verma, Regional Station, Jodhpur, attended the Fourth Annual Workshop of All India Coordinated Project on Under-utilised and Under-exploited Plants held at CAZRI, Jodhpur from July 6 to 8. They also presented papers.

—Dr. K. S. Varaprasad and Dr. R. D. V. J. Prasada Rao, Regional Station, Hyderabad, delivered a series of lectures in the training programmes organised by CPPTI, Hyderabad from July to December.

—Dr. B. P. Singh, Headquarters, attended the 31st Annual Rabi Oilseeds Workshop on Rapeseed, Mustard, Safflower and Linseed held at Narendra Dev University of Agriculture and Technology, Faizabad from August 17 to 19.

—Dr. D. S. Rathore, Regional Station, Shimla, attended the National Workshop-cum-Seminar on Temperate Fruit Production held at Dr. Y. S. Parmar University of Horticulture and Forestry, Regional Fruit Research Station, Mashobra, Shimla on August 18 and delivered a lecture.

—Dr. M. N. Koppar, Headquarters, attended the Wheat Workshop held at Jaipur from August 22 to 26 and also presented a paper.

—Dr. K. P. S. Chandel and Dr. B. R. Verma, Headquarters, delivered lectures in the 49th Seed Improvement Training Course at NSC, Beej Bhavan, Pusa, New Delhi during August-September.

—Dr. R. S. Paroda, Director, attended International Symposium on Sugarcane Varietal Improvement—Present Status and Future Thrusts at Tamil Nadu Agricultural University from September 3 to 7. He was the co-chairman of Technical Session III on Sugarcane Genetic Resources and Their Utilisation.

—Dr. B. R. Verma, Shri Devendra Pandey, Headquarters, Mrs. Neelam Bhatnagar and Shri S. K. Verma, Regional Station, Jodhpur, attended the IVth National Workshop on Arid Zone Fruit Research held from September 16 to 19 at Agriculture College and Research Institute, Tamil Nadu Agricultural University, Madurai. Dr. B. R. Verma and Shri S. K. Verma also presented papers.

—Dr. A. Majumdar, Headquarters and Dr. K. S. Varaprasad, Regional Station, Hyderabad, attended National Symposium on the Role of Scientific Research and its Management in accelerating Socio-economic Transformation held at IARI, New Delhi from September 19 to 20.
Dr. R. S. Paroda, Director, participated in Sixth meeting of the Technical Committee on Agriculture of SAARC organised by ICAR from October 5 to 7.

Dr. B. D. Sharma, Regional Station, Shillong, attended the Symposium on Himalayan Horticulture in the context of Defence Supplies held at Defence Research Laboratory, Tezpur from October 28 to 30 and presented a paper.

Dr. R. Gupta, Dr. M. L. Maheshwari, Dr. S. K. Pareek, Dr. V. K. Srivastava, Shri B. M. Singh and Dr. Veena Gupta, Headquarters, attended the 7th All India Workshop on Medicinal and Aromatic Plants held at Sukhadia University, Rajasthan College of Agriculture, Udaipur from November 2 to 5.

Dr. A. Majumdar, Headquarters, attended a seminar on Testing, Analysing and Control of equipments, organised by SICO at New Delhi from November 3 to 4.

Dr. Bhagmal, Headquarters, attended National Rangeland Symposium held at IGFRI, Jhansi on November 9 to 12 and presented a paper.

Dr. R. Gupta, Headquarters, attended Silver Jubilee Celebrations and the Seminar on Captain Srinivas Murthy Drug Research Institute for Ayurveda and Siddha at Madras from November 13 to 14.

Dr. R. Gupta, Headquarters, participated in National Symposium on Recent Advancement on Abnormal Growth in Plants at Department of Botany, University of Rajasthan, Jaipur from November 16 to 19.

Mrs. Shashi Bhalla, Headquarters, attended International Workshop on Sorghum Stem Borer held at ICRISAT, Hyderabad from November 17 to 20.

Shri Ram Nath, Dr. V. K. Mathur, Dr. A. Majumdar, Dr. P. C. Agarwal and Mrs. Usha Dev, Headquarters, delivered a series of lectures and held practicals for the trainees during the training course on Seed Pathology at the Division of Seed Technology, IARI, New Delhi under Indo-Danish Project on Seed-Borne Diseases from November 17 to December 31.

Ms. Ranjna Nagpal and Miss N. K. Chowdhary, Headquarters, attended National Symposium On Statistical Ecology held at Indian Agricultural Statistics Research Institute, New Delhi from November 19 to 21.

Dr. K. S. Varaprasad and Dr. S. K. Chakarbarty, Regional Station, Hyderabad and Dr. A. Majumdar and Shri S. M. Balachandran, Headquarters, attended an International Seminar on Agricultural Research Management Systems organised by NAARM, Hyderabad from December 8 to 10.
—Mrs. Neelam Bhatnagar, Regional Station, Jodhpur, attended the International Symposium on Tropical Ecology held at Banaras Hindu University, Varanasi from December 11 to 16 and presented a paper.

—Shri R. L. Sapra, Headquarters, attended a Mini-Workshop on Data Processing and Application in ICAR Coordinated Projects organised jointly by IRRI and ICAR at Ashoka Hotel, New Delhi from December 14 to 16.

—Dr. B. D. Sharma, Regional Station, Shillong, participated in the 1st Meeting of ICAR Regional Committee No. III held at Aizwal, Mizoram from December 21 to 22 and presented a paper.

—Dr. R. K. Arora and Dr. B. P. Singh, Headquarters, attended the Review meeting of the Micro-mission I on Oilseeds, held at NRL, IARI, New Delhi from December 23 to 24. A joint paper along with Shri T. A. Thomas was also presented by Dr. Arora.

K. Deputations Abroad

—Dr. B. S. Dabas, Headquarters, attended the Short Course No. III on Evaluation and Utilisation of Plant Genetic Resources at Birmingham, UK from January 12 to March 20.

—Dr. P. N. Mathur, Headquarters left for a 12 months’ training course on Tree Breeding and Tree Genetic Resources at University of Oxford, UK from January 18, 1987 to January 17, 1988.

—Shri K. C. Velayudhan, Regional Station, Trichur, attended a training course on GEU at IRRI, Manila from February 9 to May 22.

—Dr. B. D. Joshi, Regional Station, Shimla, attended an International Workshop on Mountain Agriculture and Crop Genetic Resources organised by IDRC, Canada at Kathmandu, Nepal from February 16 to 19. He also presented the country status paper.

—Dr. R. S. Paroda, Director, attended a meeting of the Sub-committee on Plant Genetic Resources, constituted by the National Research Council at Washington, USA from March 9 to 11. Dr. Paroda also attended the second meeting of the Working Group of the Commission on Plant Genetic Resources in Rome, Italy from March 16 to 20.

—Shri Ram Nath, Headquarters, attended the International Workshop on Rice Seed Health from March 16 to 31 at IRRI, Philippines and got acquainted with the seed processing and exchange procedures.

—Dr. K. P. S. Chandel, Headquarters, visited centres of excellence engaged in Tissue Culture in USA, UK and Canada from April 7 to May 6.

—Shri Umesh Chandra, Headquarters, visited ICARDA, Syria from May 18 to 26 to see various research programmes at the Centre.
—Dr. S. Mandal, Headquarters, left for the study and analysis of Nutritional and Industrial Quality of Maize and Wheat at CIMMYT, Mexico from June 2 to July 31.

—Dr. R. K. Arora, Headquarters, attended the ICARDA International Workshop on Genetic Resources of Cold Season Pasture, Forage and Food Legumes for Semi-arid Temperate Environments at Cairo, Egypt from June 19 to 24.

—Dr. B. P. Singh, Headquarters, visited the International Rice Research Institute, Philippines to get acquainted with the procedures related to Seed Exchange and Plant Quarantine of Rice Germplasm and other activities/facilities from July 13 to 24.

—Dr. S. K. Mithal, Headquarters, attended a six weeks training course on Germplasm Development and Exchange at CIMMYT, Mexico from August 22 to October 5.

—Shri K. C. Pant, Regional Station, Bhowali, participated in the Maize Germplasm Programme at CIMMYT, Mexico from September 7 to November 16.

—Shri Ranbir Singh, Headquarters, left for a one-year training course on Conservation and Utilisation of Plant Genetic Resources at the University of Birmingham, UK on September 16.

—Dr. Bhag Mal attended the International Symposium on New Crops for Food and Industry held at Southampton University, U.K. from September 22 to 25.

—Dr. R. S. Paroda, Director, attended the International Rice Research Conference held in China from September 23 to 26.

—Dr. B. S. Dabas, Headquarters, participated in a two months’ IBPGR Collection Programme for wild and forage Sorghum germplasm from Sudan, Kenya and Ethiopia from October 9 to December 8.

—Dr. M. N. Koppar and Shri Basant Kumar, Headquarters, visited USSR on a study tour for Plant Exploration, Characterisation and Storage of germplasm of agri-horticultural crops from November 10 to December 15 under the Indo-USSR Programme.

L. NBPG Library

The library which subscribes currently to about 80 Indian and foreign journals and periodicals (besides about 100 newsletters/bulletins etc. received on complimentary basis) continued to add to its present holdings of books, journals and other published technical literature relevant to the needs of the Bureau’s scientists. The number of titles acquired and accessioned during the period under report was 520. The library procured extra reprints of 8 scientific papers authored by the
Bureau’s scientists and published in scientific journals, for distribution on requisitions from scientists in India and abroad, and also obtained 91 Reports from different organizations and agencies.

The library committee (Chairman: Dr. R. Gupta; Members: Dr. M. L. Maheshwari, Sh. B. M. Singh, Dr. (Smt.) Rekha Chaudhary, Mrs. Usha Dev and Sh. A. M. Siddiqui) met periodically for considering and finalizing proposals and recommendations received for the purchase of books and other scientific literature. Sh. Janak Lal Poddar, T-4 and Miss Sheela Kumari T-II-3 assisted in maintenance and day to day work of the library.

M. Publications

(a) Papers published


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(b) Catalogues and Plant Introduction Reporters


(c) Books/Monographs

(d) Miscellaneous Publications


Brochure, NBPGR, Plant Quarantine Regional Station, Hyderabad, 16 pp.

Brochure, Regional Station, Trichur.


N. Honours

Dr. R.S. Paroda was awarded the Federation of Indian Chambers of Commerce and Industry (FICCI) award for research in science and technology for 1987. He was given this award for establishing the genetic architecture of yield and related attributes including quality traits in wheat, barley and number of forage crops.

Dr. R.S. Paroda also won the prestigious Rafi Ahmed Kidwai Memorial Prize for Agricultural Research for the biennium 1982-83 for his outstanding contribution in the field of Plant Breeding and Genetics.

Uttam Chand Memorial Medal was awarded by Essential Oil Association of India to Dr. M.L. Maheshwari, Dr. V.K. Srivastava, Dr. K.L. Sethi and Dr. R. Gupta for the best research paper entitled "Natural Variability in Physico-Chemical Constants and Odour Value of Vetiver Collections from Bharatpur, published in
This work will be helpful in the development of essential oil industry in India.

Shri K.C. Velayudhan has been awarded the ‘Harbhajan Singh’ award for excellence in Exploration and Collection of Genetic Resources of Crop Plants by the Indian Society of Genetics and Plant Breeding.

O. Field Days

With a view to show the breeders/user scientists in the country the germplasm variability in various crops under field conditions, so that they can select germplasm material of their choice, the Bureau organised several field days at its experimental farm, Issapur, New Delhi and at Regional Stations. About 50 wheat breeders and scientists from different institutes were also invited to visit the Post-entry Quarantine Isolation Nursery at NBPGR headquarters for selecting wheat and barley germplasm and the breeding materials received from CIMMYT (Mexico), ICARDA (Syria) and USA. During 1987, field days were organised in the following crops: leafy vegetables, oil seed crops, maize, pearl millet and Sorghum at Issapur Farm, New Delhi; mung bean field day at Amravati Satellite Centre and pigeon pea, oilseeds and minor millets field days at Regional Station, Akola.

P. Research programmes/group meetings/discussions convened

—Expert consultation on Use of Tissue Culture in Plant Quarantine for Exchange of Germplasm and Planting Material, co-sponsored by FAO (RAPA) and ICAR through NBPGR at New Delhi from February 26 to March 2.

—National Symposium on Plant Genetic Resources organised at New Delhi from March 3 to 6 to mark the completion of a decade of NBPGR.

—International Workshop on Maintenance and Evaluation of Life Support Species in Asia and the Pacific Region, organised jointly by the Commonwealth Science Council, London, UK and ICAR at NBPGR, New Delhi from April 4 to 7.

—Meeting of the SAARC Countries on Plant Exploration and Related Activities at NBPGR, New Delhi from May 26 to 28.

—Group Discussion on Rice Germplasm, organised jointly by NBPGR and the Directorate of Rice Research, Hyderabad at New Delhi from July 23 to 24.

—Orientation Course on Germplasm Collection, Evaluation and Conservation of Jute and Allied Fibres, organised in collaboration with International Jute Organisation at New Delhi from September 19 to 23.
—Workshop on Plant Genetic Resources of South and South-east Asia organised by ICAR/NBPGR and IBPGR at New Delhi from November 23 to 25; a Memorandum of Understanding (MOU) for long-term collaboration between ICAR and IBPGR was also signed.

—First Meeting of the Sub-committee of the National Policy Planning and Review Committee on Plant Genetic Resources for effective coordination in collection and conservation of plant genetic resources at NBPGR, New Delhi on November 21.

Q. Distinguished Visitors

Headquarters

Dr. V. S. Bhat, Director, Publications Unit, ICAR on January 2.

Dr. B. S. Rana, Head, IARI Regional Station, Rajendranagar, Hyderabad on January 2.

Dr. K. L. Chadha, Horticulture Commissioner, Krishi Bhavan, New Delhi on January 3.

Dr. A. Ahmed, Vice Chancellor, S. K. Univ. of Agriculture and Technology, J & K on January 6.

Dr. J. P. Satavastava, Leader, Cereal Improvement Programme, ICARDA on January 9.

Dr. K. W. Riley, Programme Coordinator, IDRC, New Delhi on January 12.

Mr. R. S. Lugani, Principal, Delhi Public School, R. K. Puram, New Delhi on January 15.

Dr. Richard N. Blue, Dy. Director, USAID, New Delhi on January 16.

Dr. J. R. Sharma, Head, Department of Plant Breeding, CIMAP, Lucknow on January 21.

Dr. R. D. Jackson, Director, FERRO, New Delhi on January 31.


Dr. H. K. Jain, Deputy Director General, ISNAR, The Hague, Netherlands on February 3.

Dr. Michael Tiner, Seed Technology, Edinburgh School of Agriculture on February 3.

Dr. Ranbir Singh, Ex. Vice Chancellor, M. L. Sukhadia University, Udaipur on February 6.

Dr. E. N. Seme, National Gene Bank, Nairobi, Kenya on February 10.

Dr. A. Abou-Zeid, German Agricultural Team, National Gene Bank Project, Nairobi, Kenya on February 10.
Shri Ram Niwas Mirdha, Hon'ble Union Minister of Textiles in Plant Quarantine Laboratory

Dr. M. V. Rao, Special D.G., ICAR, addressing the scientists after a field day at Issapur farm
Dr. Duane Acker, Director, Food & Agriculture, USAID (extreme left) and Dr. O. G. Bentley, Asstt. Secretary of Agriculture for Science & Education, USDA (extreme right) visiting Conservation Lab

Dr. Arjun Lal (Winner of ICAR Badminton Singles Championship) receiving prize from Dr. V. Rajagopalan, V.C., TNAU, Coimbatore
Dr. R. O. Hampton, USDA, Agricultural Research Service, Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon on February 12.

Dr. Eric H. Roberts, Department of Agriculture, University of Reading, UK on February 16.

Dr. John Hanson, Minister of Cultural Affairs and Dr. David Sanderson, British Council Division, British High Commission on February 20.

Dr. G. M. Reddy, Dean, College of Basic Sciences, Osmania University, Hyderabad on February 24.

Dr. A. F. Mascarenhas, National Chemical Laboratory, Pune on February 18.

Dr. P. V. Sane, Director, NBRI, Lucknow on March 3.

Dr. M. P. Nayar, Director and Dr. K. Thothathri, Joint Director, Botanical Survey of India, Calcutta on March 24.

Dr. Carl Pray, Associate Professor, Rutgers University, New Jersey, USA on March 24.

Dr. Herb Lingham, USAID/Directorate of Agriculture and Resources Management on March 24.

Dr. H. J. Dubin, Regional Pathologist/Breeder, CIMMYT, Kathmandu, Nepal on March 27.

Dr. Robert G. M. Intol and Dr. Elisabeth Gordonwene, PBI, Castle Hill, University of Sydney on March 28.

Dr. Roger W. Smith, ODA, Eland House, Stag Place, London on April 1.

Dr. G.S. Dhillon, Hon'ble Union Agriculture Minister, Dr. N. S. Randhawa, DG, ICAR and Dr. M. V. Rao, Special Secretary, DARE on April 3.

Dr. D. H. Van Slatten, Leader, Field Program, IBPGR, Rome, Italy on April 8.

Dr. J. P. Tandon, Project Director (Wheat), IARI on April 14.

Dr. Alan App, Director, Agriculture Sciences, Rockefeller Foundation, New York, USA on May 6.

Dr. P. Ray, Director, DARE, Krishi Bhawan, New Delhi on May 6.

Dr. M. P. Bharati, Coordinator, Grain Legumes Improvement Programme, Nepal on May 6.

Dr. R. M. Acharya, Deputy Director General (Animal Sciences), ICAR, New Delhi on May 8.

Shri S. P. Malhotra, Director and Dr. J. C. Kalla, Head, Division of Agricultural Economics and Statistics, CAZRI, Jodhpur on June 19.

Dr. C. Parsad, Deputy Director General, Agriculture Extension, ICAR, New Delhi on June 19.
Dr. M. S. Joshi, Project Co-ordinator, FAO Seed Project, Khartoum, Sudan on July 10.

Dr. Sadaaki Kondo, Researcher (Seed Preservation), Department of Genetic Resources, National Institute of Agro-biological Resources, Dr. H. Ikehashi Team Leader and Mrs. Shoii Nishikawa, Training Officer, Training Affairs Division, Tsukuba International Centre, Japan International Cooperation Agency (JICA) on July 21.

Dr. M. Kasem Ali, Senior Officer, International Jute Organisation, Dhaka, Bangladesh on July 30.

Dr. T. R. Subramanian, Director, IISR, Bangalore on August 11.

Dr. A. K. Percival, Curator for Cotton Germplasm, USDA, ARS, SPA, Texas on August 19.

Dr. David Sanderson, First Secretary (Natural Resources), British Council Division British High Commission on August 22.

Dr. J. B. Chowdhury, Professor of Genetics, HAU, Hisar on September 8.

Dr. Duncan Vaughan, Associate Geneticist, International Rice Germplasm Centre, IRRI, Philippines on September 15.

Dr. V. K. Sharma, Dean, Veterinary College, HAU, Hisar on September 18.

Shri Ram Niwas Mirdha, Hon'ble Union Minister of Textiles accompanied by Dr. N. S. Randhawa, Director General, ICAR on September 19.

Dr. A. S. Rana, Chief Technical Adviser, Prof. (Dr.) Pak Sok Ju, Director General, Dr. Kim Myong Sin, Vice Director, Mr. Choi Kang Ryong, Chief Engineer, Mr. Cho Yong Dok and Dr. Kang Jong Nam, Academy of Agricultural Sciences, Pyong Yang, Korea on September 26.

Dr. Mohmad Sayed Balal, Director, Rice Research Section, Agricultural Research Centre, Giza, Egypt on September 29.

Dr. M. R. Thakur, Vice Chancellor and Dr. T. R. Chadha, Director Research, Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (HP) on October 7.

Dr. Kar Ling J. Tao, Genetic Resources Officer, IBPGR, FAO, Rome, Italy on October 9.

Dr. D. P. Motiramani, ex. Vice-Chancellor, Assam Agricultural University and Consultant to ICAR on World Bank Projects, New Delhi on October 13.

Dr. Hoan Dinh Phu, State Commission for S and T., Dr. Nguten Huu Thuoc, Biology Institute and Mr. Nguyenminh Tri, Vietnamese Embassy, New Delhi on October 19.

Dr. R. L. Paliwal, Associate Director, Maize Programme, CIMMYT, Mexico on November 16.
Dr. Peter Benedict, Director of Planning for Asia/Near East, USAID, Washington, on November 17.

Chinese Delegation lead by Mr. Xiao Zhouxin along with Mr. Chen Rukai, Mrs. Si Enpu and Mr. Linhuogen, Dr. L. C. Alexander, Liaison Scientist from Sugarcane Breeding Institute, Coimbatore, under the Science and Technology Exchange Programme between India and China for study in the field of Dryland Breeding and Germplasm of Sugarcane on November 18.

Dr. M. H. J. P. Fernando, Deputy Director of Agricultural Research, Central Agricultural Research Institute, Gannoruwa, Peradeniya, Sri Lanka on December 3.

Dr. O. G. Bentley, Assistant Secretary of Agriculture for Science and Education, USDA and Dr. Duane Acker, Director of Food and Agriculture, U.S. Agency for International Development on December 8.

Dr. L. Bogorad, Department of Cell and Developmental Biology, Harvard University, Cambridge and Dr. R. H. Burris, Department of Biochemistry, University of Wisconsin on December 16.

Shri S. S. Dawra, Secretary, ICAR, Krishi Bhavan New Delhi on December 18.

Dr. V. K. Tehebotav, Pushkin Research Institute of Agricultural Microbiology, Dr. I. V. Kazakov, Sr. Scientist, Horticulture Research Institute, Moscow and Dr. N. E. Saveliev, Head, Genetics Laboratory, Michunsk, USSR on December 19.

Regional Stations

Akola

Dr. H. Kehashi, Dr. S. Kondo and Shri S. Nishikawa, Japan International Cooperation Agency, Tokyo, Japan on 25 July.

Dr. P. K. Vaidya, Sorghum Breeder, ICRISAT, Hyderabad on 23 September.

Dr. V. N. Shukla, Dean, Faculty of Agriculture, PKV, Akola on 13 October.

Prof. A. P. Ekbote, Head, Department of Botany, PKV, Akola on 13 October.

Bhowali

Sh. C. M. Jaiswal, ADA, Shatdal Distt (MP) on 23 March.

Sh. M. M Srivastava, PS to Minister of State, Agriculture, New Delhi on 27 May.

Dr. A. Seetharam, Project Coordinator (Minor Millets), GKVVK Campus, Bangalore on 9 September.

Dr. D. V. S. Tyagi, Associate Prof./Millet Breeder, GBPUA & T, Pant Nagar, Nainital.
Cuttack
Dr. N. S. Randhawa, Director General and Dr. M. V. Rao, Special Director General, ICAR, New Delhi on 12 December.

Hyderabad
Dr. B. K. Verma alongwith the group of 11 ICRISAT trainees of Seventh International Training Course on Legume Pathology representing India, Malaysia, Philippines, Tunisia, Morocco, Sri Lanka and Pakistan on 27 January.
Dr. C. Kempanna, DDG (CS), ICAR, New Delhi on 18 April.
Dr. John Pino, Washington, DC., Dr. Mark A. Smith USAID, New Delhi, Dr. Quentin Jones, USDA/ARS, Beltsville, Maryland, USA on 23 May.
Dr. M. V. Rao, the then Special Secretary (DARE) and presently Special Director General ICAR, Krishi Bhawan, New Delhi on 17 June.
Dr. G. M. Reddy, Professor, Osmania University, Hyderabad on 1 September.
Dr. Anand, Senior Manager, Hindustan Lever Ltd. on 1 September.
Dr. Shankar Lal, ADG, ICAR, New Delhi on 1 September.
Mr. J. L. Kachecheba, Plant Quarantine TPRI, Arusha, Tanzania on 2 September.
Dr. D. V. Seshu, International Rice Research Institute, Manila, Philippines on 7 September.
Dr. V. T. Prakash, Municipal Chairman, Rajendra Nagar on 22 September.
Mr. R. S. Raman, Former Project Director, DRR, Madurai, Tamil Nadu on 20 November.
Dr. E. A. Siddique, Project Director, DRR, Hyderabad on 30 November.

Jodhpur
Dr. Lex Thomson, CSIRO, Australia in February.
Dr. K. P. S. Pundir, Chickpea breeder, ICRISAT, Hyderabad in February.
Dr. D. Sanderson from U. K. in September.
Dr. Mark A. Smith of USAID, New Delhi in November.

Shillong
Dr. N. S. Randhawa, Director General, ICAR, New Delhi in May.
Professor M. H. Hazarika, Head, Deptt. of Genetics and Plant Breeding, AAU, Jorhat alongwith Summer Institute participants on 2 July.

Shri O. Lyngdon, Hon’ble Minister of Education, Govt. of Meghalaya, Shillong on 25 September.

Hon’ble Union Agriculture Minister, Shri G. S. Dhillon on 18 October.

Dr. Manmohan Singh, Deputy Chairman, Planning Commission, Govt. of India in June.

Shimla

Dr. J. S. Kanwar, DDG, ICRISAT, Hyderabad on 8 May.

Dr. Nand Puri, Director (Research), PAU, Ludhiana on 8 May.

Dr. G. L. Kaul, ADG (Hort.), ICAR, New Delhi on 8 May

Dr. Quentin Jones, Dr. J. I. Gahan and Dr. M. A. Smith, USAID on 1 June.

Dr. K. L. Kabu, Professor of Horticulture, SKUAST, Srinagar on 19 June.

Dr. D. Astley, National Vegetable Research Station, Wellesbourne, UK on 9-10 September.

Dr. R. P Awasthi, Professor and Head (Pomology), Dr. Y. S. Parmar University of Horticulture and Forestry, Solan on 2 December.

Dr. I. V. Kazakov, Sr. Scientist, Horticulture Research Institute, Moscow, Dr. N. E. Saveliev, Head, Genetics Laboratory, Michunsk, and Dr. Tetebovat, Pushkin Research Institute of Agricultural Microbiology, USSR on 19 December.

Dr. K. K. Jindal, Chief Scientist, Dr. Y. S. Parmar Univ. of Horticulture and Forestry, Mashobra on 22 December.

Trichur

Dr. S. Edison, Proj. Coordinator Spices, N. R. C. S., Calicut on 19 February.

Dr. D. Astley, N. V. R. S., Wellesbourne, UK on 28 March.

Smt. M. S. Jagada Ganapathy, Asstt. Proj. Officer, British High Commission on 28 August,

Dr. E. G. Zailas, Vice Chancellor, KAU on 11 December.
# Annexure-I: Meteorological data for various regional stations and Headquarters from January to December, 1987

(Temperature in °C, Rainfall in mm)

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<td></td>
<td>Min. Temp.</td>
<td>22.7</td>
<td>22.4</td>
<td>22.2</td>
<td>25.3</td>
<td>24.7</td>
<td>23.7</td>
<td>23.5</td>
<td>23.9</td>
<td>29.9</td>
<td>23.9</td>
<td>22.8</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>Rainfall</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>13.3</td>
<td>95.0</td>
<td>837.7</td>
<td>336.5</td>
<td>388.4</td>
<td>174.0</td>
<td>280.4</td>
<td>224.4</td>
<td>64.6</td>
</tr>
</tbody>
</table>
"राष्ट्रीय पालप आनुबंधिक संसाधन ब्यूरो की वर्ष 1987 की उपलब्धियाँ"

राष्ट्रीय पालप आनुबंधिक संसाधन ब्यूरो, नई दिल्ली की स्थापना एक राष्ट्रीय संगठन के रूप में भारतीय कृषि अनुसंधान परिषद के प्रशासनिक नियमनांक के अन्तर्गत 1976 में हुई थी। वह संस्थान पालप आनुबंधिक संसाधनों से संबंधित राष्ट्रीय गतिविधियों के संचालन तथा समन्वय के प्रति उत्तरदायी है। ब्यूरो कृषि-बागवानी फसलों तथा बन सामग्री को देश में तथा अन्य देशों के बीच प्रभावशाली दंग से विनम्रता हेतु सरकारी मान्य संगठन है।

उद्देश्य

- राष्ट्रीय पालप आनुबंधिक संसाधन ब्यूरो, मुख्यतः एक सेवा संगठन है तथा निम्न उद्देश्यों की पूर्ति में सेवारत है।

- समाचार विदेशी संगठनों से प्रभावी संबंधों के माध्यम से पालप आनुबंधिक संसाधनों के प्रवेशान तथा विनम्रता का कार्य;

- विनम्रता की जाने वाली सामग्री में विभिन्न कीटों, कृषियों तथा रोगों का पता लगाने हेतु बीज तथा पालप सामग्री की जांच;

- समस्त संगठनों आवश्यकताओं को ध्यान में रखते हुए संक्रमित तथा प्रसिद्ध सामग्री का उपचार करके स्वस्थ बीज तथा पेड़ सामग्री वैज्ञानिकों को उपलब्ध कराना;

- अन्वेषण करना, विशेष रूप से देशी वनस्पतियों का संग्रह करना तथा अन्य संसाधनों के साथ अन्वेषण संबंधी गतिविधियों का समन्वय करना;

- उपलब्ध जननतंत्र का मूल्यांकन तथा उनके गुणों का निर्धारण करना, तथा इस प्रकार की गतिविधियों में अन्य फसल संसाधनों तथा परियोजना समन्वयकों के साथ समन्वय करना, तथा उपलब्ध आनुबंधिक संसाधनों की प्रविधियाँ तथा सूचियाँ तैयार करने में सहायता प्रदान करना;

- राष्ट्रीय जीन बैंक तथा राष्ट्रीय उत्तरक कल्चर भण्डार को मध्यवर्ती तथा दीर्घवर्ती भण्डारण हेतु जननतंत्र संग्रहों का संरक्षण;

- औषधि उद्योग में प्रयुक्त होने वाले चुनींदा औषधीय तथा संगंधीय जिन्तों में फसल सुधार व अनुसंधान करना तथा समन्वित केंद्रों में औषधीय तथा संगंधीय पौधों पर अधिक भारतीय समन्वित अनुसंधान परियोजना के अंतर्गत अनुसंधान कार्य की देख रेख/निर्धारण करना;
- व्यूरो तथा अन्य अनुसंधान संगठन द्वारा पादप आनुवंशिक संसाधनों पर उपलब्ध सूचना की पुनः प्राप्त हेतु ऑफिस का प्रलेखन;
- अपेक्षाकृत कम प्रयुक्त की गई फस्लों में सुधार हेतु अनुसंधान कार्य तथा घटक केंद्रों में अविलं सावधान समीक्षित अनुसंधान परियोजना के अंतर्गत अनुसंधान कार्य की देख रेख तथा समन्वय करना;
- अविलं भारतीय समीक्षित अनुसंधान परियोजना के माध्यम से राष्ट्रीय स्तर पर चार की फसल पर अनुसंधान कार्य का संचालन तथा समन्वय करना;
- पादप आनुवंशिक संसाधनों तथा उनमें समन्वित विषयों के क्षेत्र में प्रशिक्षण प्रदान करना।

संगठनात्मक ढाँचा

मुख्यालय

राष्ट्रीय पादप आनुवंशिक संसाधन व्यूरो का मुख्यालय पुणा परिसर, नई दिल्ली में स्थित है। व्यूरो के पांच निदेशक विभागों के कार्य पूर्ण रूप से निवेशक की देख रेख में समप्त होते हैं: (1) पादप अनुवंशिक तथा संग्रह विभाग, (2) जननद्रव्य मूल्यांकन विभाग, (3) जननद्रव्य बिनियमन विभाग, (4) पादप संग्राहक विभाग, (5) जननद्रव्य संरक्षण विभाग। प्रत्येक विभाग के कार्य का संचालन विभागाध्यक्ष द्वारा किया जाता है। इनके अतिरिक्त पादप उच्च कल्चर मण्डल विभाग भी है जिसकी स्थापना 1986 में की गई। व्यूरो का परिचय फार्म 40 है की रूप में व्यूरो से 45 किमी की दूरी पर ईसापुर गांव में स्थित है। फार्म के अतिरिक्त, व्यूरो के मुख्यालय के निकट ही लगभग 4 हैकेट भूभाग उपलब्ध है। इसका प्रयोग प्राविधि पशुचालन संग्राहक नसरी के रूप में विदेशी बीज तथा पादप सामग्री की उगाने हेतु किया जाता है।

व्यूरो के मुख्यालय पर तीन समन्वयकर्ताओं के कार्यालय भी स्थित हैं—औषधीय तथा संग्राहक औषधीय पौधों पर अविलं भारतीय समीक्षित अनुसंधान परियोजनानुसार; अपेक्षाकृत आयुर्वेदिक व कम प्रयुक्त की गई फस्लों तथा चार समवेती समीक्षित अनुसंधान परियोजनायाम।

क्षेत्रीय केन्द्र/अनुवेषण आधार केन्द्र

व्यूरो के अंतर्गत छ: क्षेत्रीय केन्द्र हैं, जिनमें से प्रत्येक का संचालन एक वरिष्ठ वैज्ञानिक की देख रेख में होता है। ये केन्द्र देश के विभिन्न क्षेत्रों जलवायु के अनुसार उन्हें रखनेवाले भूभागों में स्थित हैं। अमरावती में अकोला केन्द्र का उपकेन्द्र भी है। इन सभी क्षेत्रीय केन्द्रों का चयन विभिन्न विभागों के जननद्रव्यों की जलवायु की आवश्यकता आधार पर किया जाता है, जहाँ संग्रह फसलों में मूल्यांकन भी किया जाता है। क्षेत्रीय केन्द्रों के बैज्ञानिक पादप अनुवेषण तथा संग्रह का कार्य भी करते हैं। हैदराबाद के क्षेत्रीय केन्द्र में पादप संग्राहक तथा अनुवेषण का कार्य होता है। इसके अतिरिक्त कठिन तथा श्रीलंका में तने पादप अनुवेषण आधार केन्द्र स्थापित किये गये हैं जहाँ पादप संग्रहों का मूल्यांकन भी किया जाता है।
राष्ट्रीय नीति नियोजन समिति

महानिदेशक, भारतीय कृषि अनुसंधान परिषद की अध्यक्षता में इस समिति की स्थापना 1986 में की गयी थी। इसके अन्तर्गत एक उप-समिति का गठन 20 एक्ट बी.ए. जोशी की अध्यक्षता में किया गया जिसके छः सदस्य हैं। इस उप-समिति की एक बैठक नवम्बर 1987 में हुई जिसमें यह सुझाव दिया गया कि पादप आनुवंशिक संसाधन सम्बन्धी कार्यों में लगे विभिन्न संस्थाओं (राज. प.ए. 30 सं. ब्यू.रो, भारतीय वनस्पतिक सर्वेक्षण, भार. बन अनुसंधान परिषदु, राज. वनस्पति अनुसंधान संस्थान तथा यादव निर्देशालय) के बीच अधिक तालमेल से कार्य हो। यह भी तय किया गया कि जिन पादप जननवयों की कमी है अथवा जिनका अस्तित्व खतरे में है उनका संग्रह अविलम्ब किया जाये।

विभागीय गतिविधियाँ

जननवय्य मूल्यांकन विभाग

विभाग के वैज्ञानिकों द्वारा ईसापूर्व फार्म पर विभिन्न प्रकार की लगभग 75 फसलों के 15,000 से भी अधिक प्रजातियों का वर्गाकल्प मूल्यांकन किया गया जिसके रूपांतरण का प्रलेखन किया गया। विभिन्न प्रजातियों में 600 से भी अधिक प्रजातियंगत संस्थाओं का पता लगाया गया जिनमें कुछ रोग तथा कठोर रोधित संग्रह भी शामिल है। इसके अतिरिक्त कई औषधीय तथा संग्रहीय प्रजातियों में नया परीक्षण किया गया। उत्तम किस्मों के बीजों से संवर्धन किया गया तथा विभिन्न मांग-कार्यों को अनेक प्रजातियों के जननवयों की आपूर्ति की।

विभाग द्वारा अन्तर्राष्ट्रीय अनुसंधान संस्थान, हैदराबाद के समन्वय से ज्ञात (4,430 संस्थाओं), बाजार (2000 संस्थाओं), अर्थ (350 संस्थाओं), निवास (1200 संस्थाओं), का संयुक्त मूल्यांकन किया गया तथा बेहतर नमूनों का पता लगाया गया।

पादप अन्वेषण विभाग

वर्ष 1987 में फसलों पर आधारित संस्थाओं तथा फसल समन्वित परियोजनाओं के अंतर्गत 44 नया तथा प्रारंभिकताओं के आधार पर कुल 44 अन्वेषण किए गये। इनमें से 15 अन्वेषण बहुसंस्करित तथा 29 अन्वेषण फसल मूलक थे। हिमालय के निचले पर्वतीय क्षेत्रों, महाराष्ट्र के तटीय क्षेत्रों, विहार तथा मध्यप्रदेश के आदिवासी इलाकों, तमिलनाडु तथा केरल से कृषि-बागवानी की विभिन्न प्रजातियों के लगभग 5000 संग्रह एकजुट किये गये। ज्यादा तथा अन्य फसलों के संग्रह हेतु एक अन्वेषण अन्तर्राष्ट्रीय पादप आनुवंशिक संसाधन मण्डल के सहयोग द्वारा पूर्वी अफ्रीका में किया गया।

जननवय्य विनिमय विभाग

इस विभाग के माध्यम से ब्यूरो ने 51 देशों से स्वभावित फसलों के बागवानी तथा अन्य पेड़ पौधों के 52,642 नमूने आयात किये। अन्तरराष्ट्रीय संस्थाओं जैसे शुष्क क्षेत्रों में कृषि अनुसंधान हेतु
अन्तरराष्ट्रीय केन्द्र, अलप्पो, सीयरिया, अन्तरराष्ट्रीय चावल अनुसंधान संस्थान, मनीला, फिलिपाइन
tथा अन्तरराष्ट्रीय मस्तक व गेहूं सुधार केन्द्र, मैकिन्सको से बड़ी मात्रा में गेहूं, धान, जूर तथा मस्तक
के संग्रह भी प्राप्त हुए जिनमें प्रजनन तथा परीक्षण सामग्री शामिल हैं। इन पादप संग्रहों में मुख्य
प्रभावियां इस प्रकार हैं—चावल के शुष्क क्षेत्रों में अधिक उपज देने वाली तथा रोग-प्रतिरोधक
किस्में, सरसों वर्गीय फसलों की कीट प्रतिरोधक किस्में, सूरजमुखी की अधिक तेल वाली किस्में,
सुंसफली की शीत-प्रतिरोधक किस्में, चावल की विषाणु प्रतिरोधक किस्में, कठौनीय फसलों की
कीट (फलमक्खी) प्रतिरोधक किस्में तथा चुकन्तर की ज्वलन रोग प्रतिरोधक किस्में। विभाग
d्वारा 2,378 नमूने 61 देशों को निर्यात भी किये गये।

पावप संग्रोध विभाग

संग्रोध परीक्षण के लिए कुल 83,945 नमूने प्राप्त हुए। इनमें से 1251 नमूने कीटों तथा
कुटियों से प्रस्त पाये गये; 1325 नमूने पादप जड़कृयाओं से प्रसिद्ध पाये गये तथा 385 नमूने
रोग प्रस्त पाये गये। इसके अतिरिक्त 326 नमूने में 26 प्रकार के खरपतवार बीज पाये गये।
परीक्षण के दौरान कुछ ऐसे कीट, कुभ तथा रोगानुक्रमण अवरोधित किये गये जो अभी तक हमारे
dेश में नहीं पाये जाते। कीट अथवा रोग रोकने के लिए विभिन्न उपचार अपनाये गये तथा
99 प्रतिशत से अधिक नमूने को उपचार के बाद मांगकारियों को उपलब्ध कराया गया।

पीढ़ी नाशी दवाओं से उपचारित बीजों को संग्रोध नसिमी में उगाया गया।

फसल की
अवधि के दौरान नियमित परीक्षण किये गये तथा स्वस्थ पीड़ों से प्राप्त बीज को मांगकारियों को
भेज दिया गया।

निर्यात के लिए विभिन्न फसलों के 2,977 नमूने प्राप्त हुये जिन्हें आवश्यक परीक्षण के बाद
“स्वस्थता प्रमाण पत्र” देकर जारी किया गया।

कीट व्यापारियों, सूतकृयाओं तथा बीमारियों पर उपलब्ध विश्व-साहित्य का संकलन किया

गया। लोकिया, टमाटर तथा गेहूं में कृषि-प्रतिरोधक संग्रहों का पता लगाया गया।

जनजन्म यंत्र विभाग

वर्ष 1987 में विभिन्न फसलों के लगभग 25,100 पादप जनजन्म यंत्र श्रेणी, मध्यम/दीर्घांगित
भण्डारण हेतु राष्ट्रीय जीव बैंक में बनाने तथा देश में विकसित की
गई। परीक्षण की नई किस्म, विभिन्न पादप अन्य्यास तथा सूतकृयाओं द्वारा आवश्यक गई बेहतर किस्में
भी शामिल हैं। इस समय कुल मिलाकर 72,000 नमूने जीव बैंक में सौजन्य है।

पावप उत्तर कलेक्सर भण्डार

प्याज, लहसुन, रतालू, अदरक, हल्दी, सर्पगंधा, नीबू आदि के उत्तर कलेक्सर विकसित
करने में आश्रयात्मक सफलता प्राप्त की। कठोर आवरण वाले बीजों, जैसे काकेबाजा, चाय,
लोहा, तनरे, कोफी तथा कपड़े को प्रशीतन भण्डार में परीक्षण के लिए रखा गया है। जूरा
tथा ज्वार के परागकर्मों को दीर्घांगित में संरक्षण हेतु परीक्षण के लिये रखा गया है।
विकासात्मक पत्रिपुस्तिकाः

मुख्यालय:

विशेषतः अधिकांशिक भण्डारण हेतु आवश्यक चार प्रशीतन भण्डारों (मॉड्यूल) के ऊपर छत का निर्माण किया गया तथा उनको नियांचित करने के लिए आवश्यक सामग्री जुटायी गयी। दो लाखीयी भण्डारों का नीतिकरण कराया गया। एक शीघ्र तथा एक वातानुकूलित पादप जननद्वय संग्रहालय का निर्माण चालू किया गया। पौध संग्रहों नस्तरी एक “ट्रूबेल” का निर्माण कराया गया। ईसापुर फार्म की समतल करवाया गया तथा पानी के भण्डारण हेतु एक पत्तके जलाशय का निर्माण करवाया गया। ईसापुर में ही आवश्यक फार्म प्रयोगशाला एवं कार्यालय के भवन का निर्माण-कार्य पूर्ण किया गया।

क्षेत्रीय केन्द्र:

अकोला में एक पौध घर, भूवासी में एक पम्प घर तथा तीन भण्डार घरों, कटक में परकोट के निर्माण, हैदराबाद में परकोट के निर्माण, जोधपुर में दो कमरों का निर्माण, शिमला में एक फार्म शैल तथा एक मध्यमाध्यम भण्डारण का कार्य पूरा किया गया। प्रयोगशालाओं में आवश्यक सामान उपलब्ध करवाया गया।

साहित्य प्रकाशन

बुधों द्वारा इस वर्ष प्रकाशित मुख्य प्रकाशन इस प्रकार हैं— वार्षिक रपट-1986, पृ.० सं 267, अनुसंधान संक्षिप्त रपट-1986, पृ.० सं 32, रात पात आं सं ३० बुधों, समाचार पत्र, जनवरी तथा जुलाई, 1986, प्रत्येक पृ.० सं १२, रात पात आं सं ३० बुधों का एक दशक-1987, १७० पृष्ठ तथा संग्रहों महत्त्व के पौधवाणशाख क्रम। उपरोक्त प्रकाशन (सभी अंग्रेजी में) निदेशक, रात पात आं सं ३० बुधों, नई दिल्ली-११००१२ से प्राप्त किये जा सकते हैं।

फसल दिवसों का आयोजन

बुधों द्वारा ईसापुर फार्म, नई दिल्ली तथा क्षेत्रीय केन्द्रों पर रबी तथा खरीफ में विभिन्न फसलों पर पादप आनुरंगी विचार दिवसों का आयोजन किया गया। इन दिवसों में प्रजनकों/ प्रोक्टर वैज्ञानिक को अपनी आवश्यकतानुसार जननद्वय सामग्री का चुनाव किया। गेहूँ तथा जी के जननद्वयों के चयन में विभिन्न संस्थाओं के ५० प्रजनकों/वैज्ञानिकों ने भाग लिया। इसके अतिरिक्त मक्का, बाजरा, अरहर, झार, पत्तों बाली संभिज्यां, तथा तिलहन फसलों पर फसल दिवसों का आयोजन ईसापुर फार्म पर, मूंग पर अमरावती में, अरहर, छोटे-अनाज तथा तिलहन फसलों पर अकोला में फसल दिवसों का आयोजन किया गया।

क्षेत्रीय केन्द्र

अकोला: केन्द्र के वैज्ञानिकों ने विभिन्न कृषि तथा बागवानी फसलों के संग्रह हेतु दो बहु-फसलीय अन्वेषणों के दौरान महाराष्ट्र, कर्नाटक तथा आनन्द प्रदेश से कुल ५०३ नमूने इकट्ठे किये। तिल (९१), मूंग (१०९), उड़द (५२), न्यार (२०), भिन्नी (२२), प्याज (१५), अरहर (९) तथा छोटे अनाज (६६) के नमूनों में बहुत विविधता पाई गई।
विभिन्न फसलों के कुल 26,500 संग्रहों, जिनमें बजरों (7,294), तिलों (9,223), छोटे-मोटे अनाज (8804), सब्जियों (1400) तथा अन्य फसलों (926) के संग्रह शामिल हैं, यहा को जलवायु में बुवाई के बाद महत्वपूर्ण गुणों के लिये उनका मूल्यांकन किया गया तथा हर फसल में बेहतर संग्रहों का पता लगाया गया। उपज तथा अन्य गुणों के आधार पर मुख्य फसलों के बेहतर संग्रह इस प्रकार हैं: अर्हर (आई नीदेशन 73959, -73911, -73901, -73891, तथा -73883); चना (आई नीदेशन 23483, -16176 तथा पी-एल 80 के २०१-१४१); खार (पी-आर जूनी-२५८, -७५); सोयाबीन (ई मैशन 30205, -6103, -104873, -174131); मूर्गाफली (ज्वाइटी-१, ई मैशन 20954, -100717, -21133); अलसी (ई मैशन 41495 तथा आई नीदेशन -53260); तिल (२-७३, -१०, पी-०८, सी-८); बाजरा (आई नीदेशन 13712, -13730, -13571); फ्रेंचबीन (पी-एल २०० तीर-१०१, ई मैशन 37670, -116179); प्याज़ (पी-एल १२४/३, ५९/८, ४७/२); लहसुन (आई नीदेशन ४८३७३, -४९३८१); अन्तर्राष्ट्रीय फसल अनुसंधान संस्थान, हैदराबाद द्वारा प्रयुक्त की जाने वाली फसलों क्रमशः मूर्गाफली, ज्वार, बाजरा तथा अर्हर का संयुक्त मूल्यांकन भी किया गया।

इस केंद्र द्वारा बेहतर संग्रहों के कुल 1756 नमूने 36 विभिन्न संस्थानों तथा किसानों को मांग के अनुसार भेजे गये।

अमरावति: इस केंद्र पर मूंग (2196 संग्रहों), शकरकंद (275 संग्रहों), पपिता (19 संग्रहों), बंगुर (75 संग्रहों), मोठ (170 संग्रहों), प्याज (549 संग्रहों), उड़द (111 संग्रहों), लोहिया (422 संग्रहों), लहसुन (677 संग्रहों) तथा कई अन्य फसलों में संग्रह किया गया। विभिन्न फसलों के बेहतर संग्रह इस प्रकार हैं:— मूंग (पी-एल 80 एम० -311, -683, -747, -992, -646, -272, -245, -345, -507 तथा आई नीदेशन -10498-१); शकरकंद (पूरा लाल, पूरा सफेद); पपिता (ई मैशन 26495, रहत गांव); मोठ (अंग्रेजी नीदेशन 80 एम० और-15); उड़द (आई नीदेशन 53070) तथा लोहिया (आई नीदेशन -22042). भिन्न (संबंधित 2) तथा खार (पुश्कर) के बीजों का संयुक्त मूल्यांकन भी किया गया। विभिन्न फसलों के बीज तथा पौध जैविक एवं फिकस दोनों को वितरित किये गये।

भुवाली: उत्तर प्रदेश की कमाऊं तथा गड़वाल पहाड़ियों में तीन अन्वेषणों के दौरान कुल 683 नमूने एकत्रित किए गए। धान के 220 संग्रहों तथा मक्का के 92 संग्रहों में अच्छी विभिन्न रोगों गई। मक्का की कई जंगली प्रजातियों तथा पांडा द्वारा मेकिको से भी लाई गई। इन क्षेत्रों से जंगली प्रजातियों, जौंधिया तथा संग्रहीत रोगों के बेहतर संग्रह गई।

इस केंद्र पर विभिन्न फसलों के लगभग 8,300 संग्रहों का मूल्यांकन किया गया। धान के कुल संग्रहों (सी-0७८, -१०९, -१३४, -१३५, -३३४, -११४०, -१२३६) में पती धब्बा रोगों (पाकिस्तानी कोरा, हेल्मिंग्सॉप्शियर) के प्रति रोधिता पाई गई। मक्का की जल्दी पक वाली संग्रहों (सी-१०४) तथा हेल्मिंग्सॉप्शियर टर्सीक के प्रति रोधित संग्रह (सी-१६, -१९, -३५, ६३, -७७, ८१) का पता लगाया गया। नमूने के संग्रह (एन० सी-६०६६८) में तीनों प्रकार के चूनी फ्लूकी रोगों के प्रति रोधिता पाई गई।
कक्ष : अन्वेषण आधार केन्द्र, कक्ष द्वारा उद्धीत राज्य के कोरपस, फूलबनी, मयूरबंध, संबलपुर, कलाहरिणी, गंगासागर इत्यादी के साथ तथा अन्य फसलों के कुल 469 नमूने एकत्रित किए गए। धान की जंगली प्रजातियों का मुख्य रूप से अन्वेषण किया गया। धान के 259 संप्रेक्षणों का विभिन्न गुणों के लिए मुख्य रूप से पैदाकार्य के आधार पर छोटे-20, -15, -78, संग्रहों को बेहतर पाया गया। विभिन्न फसलों के 304 संप्रेक्षण वैश्विक विभिन्न भागों के भर्ती इंस्ट्र्यूक्ट इंस्ट्र्यूक्ट इंस्ट्र्यूक्ट इंस्ट्र्यूक्ट इंस्ट्र्यूक्ट 437, 469, नई दलितों को बेहतर पाया गया।

हैदराबाद : वर्ष 1987 के दौरान कुल 71,041 नमूनों के संग्रह जाँच हेतु प्राप्त हुए जिनमें 52,918 नमूने वाजा-6,223, झार-20,081, अरहर-4,389, चना-9,354, मूंगफली-11,677, चावल-224, छोटे अनाज-955 तथा अन्य-15) आयात किए गये तथा 18,123 नमूने अन्य देशों की निर्यात किये गये। निर्यात की गई सामग्री के आयात केन्द्र द्वारा "स्वतंत्रता प्राप्त पत्र" जारी किये गये। आयातित बीजों की जांच के दौरान बागान (9 नमूने), अरहर (3 नमूने) तथा झार (180 नमूने), विभिन्न क्षेतों तथा पौधे व्याख्यानों से प्राप्त पाये गये। आयातित बीजों के स्वतंत्र नमूने ही सामग्रियों को बेहतर पाये गये।

केन्द्र के वैज्ञानिकों द्वारा अर्ध-शुष्क तथा उष्ण परिस्थितियों में बाध्यता हेतु अन्तरराष्ट्रीय प्रश्न अनुसंधान संयुक्त, हैदराबाद की विशेषता परचार संग्रह नर्सी में फसल निरीक्षण संग्रही 47 दौरे किए गये। निरीक्षण के बाद उत्पाद की रोगान्त क्षेत्रों को उद्धार कर नव्वू हो दिया गया। मूंगफली में पत्ती निरीक्षण का पता लगाया गया तथा बीज द्वारा फैलने वाले इस रोग का आरोग्य प्रदेश, कार्य तथा गुजरात में सर्वेक्षण किया गया। दो बहु-फसलीय अन्वेषण किये गये तथा विभिन्न फसलों के कुल 335 नमूने एकत्रित किये गये।

जोधपुर : केन्द्र के वैज्ञानिकों ने राजस्थान तथा गुजरात प्रदेशों में सात अन्वेषण किये तथा कुल 553 नमूनों का संग्रह किया। विभिन्न फसलों के संग्रहों में व्यापक विविधता पाई गई तथा गेहूँ, तिल, जू, गधार, झार, संग्रही, मक्खी के बेहतर नमूने बागानी तथा सुखाग्रस्त क्षेत्रों से एकत्रित किये गये। लगातार सुखाग्रस्त पड़ने के कारण विभिन्न फसलों में संग्रहों की संख्या बहुत कम रही। मूंगफली (1500 संग्रहों), तिल (1705 संग्रहों), अरण्य (120 संग्रहों), तथा शुष्क श्रेणी फसलों के संग्रहों (बेर, बेल, अनाज, सर्दी, बेर, अनाज, फालसा) का मुख्य अन्वेषण किया गया, परन्तु अनाजालू बुखार तथा तुलसी के कारण अधिकांश फसलों में फूल/बीज नहीं बने।

प्राकृतिक शारीरिकता का अनुसंधान करने की 155 ओलिपों को माना गया, गधार, मोटा, गुवाहाटी, बेर, मूंग, सिरच, अनाज, फालसा, तुलसी, गेहूँ, जू, खेजरी, संग्रही, भिष्करी, करेला, आदि के बीज तथा पौधे सामग्री की आपूर्ति की गई।

शिलांग : वर्ष 1987 के दौरान असम, मेघालय, मिजोरम तथा अरुणाचल प्रदेशों में व्यापक पौध जननदण्ड संग्रह हेतु 9 अन्वेषण किए गए तथा कुल मिलाकर 1137 नमूने एकत्रित किए। चावल, तिलहन, बांस, पटास, कपास, केला, नींबू-वार्गीय फलों, तथा बीज अन्वेषण के संग्रहों में व्यापक विविधता मिली। मक्खी की 30 किस्मों का पैदावार के लिए मुख्य अन्वेषण किया गया तथा बी-2, -9 तथा सी-1761 को अन्य के मुकाबले बेहतर पाया गया। मक्खी के 355
संग्रहों पर पत्ता लगवाने रोग का प्रभाव आंका गया तथा तीन रोग रोधक संग्रहों का पता लगाया गया। कुल 623 संग्रहों की मानकताओं को आपूर्ति की गई।

शिष्याल : केंद्र के वैज्ञानिकों ने अन्य संस्थाओं के वैज्ञानिकों के साथ मिलकर पांच अन्वेषणों के तहत कुल 618 संग्रह एक्षेत्र किये। हिमालय प्रदेश के कुलू तथा बैली जिलों से एक्षेत्र चालू, भगलार, जौ, चौलाई, उड़ड तथा व्यापकता के संग्रहों में व्यापक विविधता पाई गई। इसी प्रकार उड़डा के तदोग्य तथा पर्वतीय क्षेत्रों (कटक, पूरी, गंजाम, कलाहण्डी, कोरापुट) से आय की कई अच्छी किस्मों का संग्रह किया गया। अरुणाचल प्रदेश से एक्षेत्र चालू के संग्रहों में भी व्यापक विविधता पाई गई।

बुधवार के पश्चात विभिन्न फलों के संग्रहों का मूल्यांकन किया गया तथा कुछ फलों में बेहतर संग्रह इस प्रकार रहे: प्रेमचन्द (पी० २०० ५००-०००, ५००-५५०-११), सोमसूर (आई० ५०००-१८७५६, इ० ५०००-६६४०४); सुख (सुख-१५०, आई० ५०००-५३), चौलाई (आई० ५०००-३८०६५, -३८५६४, -१८३७४, -३८०६४, अनुपुर्ण), ग्रामीण पौधों (सेब, आइ, प्लाम, अकलोट, पाकान आदि) का फील्ड जीत बैंक में मूल्यांकन किया गया।

केंद्र के विभिन्न फलों के ९२० संग्रह दीर्घविध भंडारण हेतु नई विलाल मुख्यालय भेजे गये तथा ८,७१५ नमूने अनूसंधानकर्ताओं, किस्मों तथा विवरण एजेंसियों को आवश्यकतानुसार वितरित किये।

ब्रिचूर : दक्षिण भारत के कन्नटक, तमिलनाडू तथा केरल प्रान्तों में कुल १५ अन्वेषण किये गये और विभिन्न फलों में व्यापक विविधता को एक्षेत्र किया गया। रतलाल, अरविंद, हल्दी, कसाबा, कटहल, अनानास में व्यापक विविधता पाई गई। कालीमिंच की जंगली प्रजातियों में पत्तियों की लम्बाई में व्यापक विविधता पाई गई। मूल्यांकन के बाद आया है इन फस्फों में व्यापक अनेक गुणों से नई किस्मों का विकास हो सकता।

अन्तर्राष्ट्रीय चालार, अनुसंधान संस्थान, फिलिपाइन्स के सहयोग से चालार की दुर्लभ जंगली प्रजातियों का अन्वेषण भी किया गया। तमिलनाडू राष्ट्र से मूल्यांकन के १६१ नमूने एक्षेत्र किये गये। कटहल के विभिन्न समुदायों (कुषा, नवरिका, गुड़गुड़ राजक) के कुल ९१ संग्रह एक्षेत्र किये गये।

विभिन्न फस्फों में उपलब्ध संग्रहों (चालार-२२२१; बड़ा रतलू-१५१; सुसंगतियाँ-५१; चीनी आलू-४२; हल्दी-६१; कसाबा-६०; अदरक-८८; हल्दी-६३६; केला-७०; आई-२०; कटहल-८४; उड़ड-३०८; नीच-१५३; ज्यार-२०००; राष्ट्रीय जंगल और जंगली जीवन के क्षेत्र में उपयोग हेतु मूल्यांकन किया गया तथा बेहतर संग्रह का पता लगाया गया।

केंद्र के विभिन्न फस्फों के १५०२ नमूने मांगकर्ताओं को भेजे गये।