SORGHUM AND MILLETS GENETIC RESOURCES AT ICRISAT

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The Genetic Resources Unit of ICRISAT was established in 1979 to collect, conserve, evaluate, catalogue, utilize and distribute germplasm of the Institute's mandate crops, i.e. sorghum, pearl millet, pigeonpea, chickpea and groundnut. ICRISAT also maintains germplasm of certain minor millets in accordance with the recommendations of the IBPGR. The current status of sorghum and millet germplasm is described below.

SORGHUM GERMPLASM

Collection and Assembly

The sorghum germplasm assembly work at ICRISAT is currently developing at an accelerated pace. A special effort is being made to fill in the missing gaps of the world collection from other genebanks. In addition to the existing world collection, 9,486 new accessions have been assembled from 68 countries by organizing collection expeditions in priority areas and by correspondence with other genebanks. As of September 1981 the total sorghum germplasm collection at ICRISAT numbered 21,264 accessions. Besides these, 774 accessions - recently assembled from 14 countries - were under plant quarantine and with their release the total collection at ICRISAT will increase to 22,038. Among these accessions, 167 belong to 10 taxa of wild sorghums. (see Table 1).

Future collections will cover Angola, Benin, Burundi, Congo, Egypt, Ethiopia*, Gambia, Ghana*, India, Indonesia, Ivory Coast, Libya, Mali*, Mozambique*, northern Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, Togo, Uganda and Zimbabwe. Some rare types of sorghum germplasm have

Table 1. Sorghum germplasm at ICRISAT (September 1981)

Country	Total No. of accessions
AFRICA	
Angola	29
Benin	4
Botswana	190
Cameroun	1,835
Central African Republic	39
Chad	138
Egypt	22
Ethiopia	4,113
Gambia	1
Ghana	64
Ivory Coast	1
Kenya	761
Lesotho	7
Madagascar	1
Malawi	370
Mali	111
Morocco	3
Namibia	1
Niger	408
Nigeria	1,173
Senegal	230
Sierra Leone	3
Somalia	125
South Africa	659
Sudan	2,255
Swaziland	19
Tanzania	133
Uganda	612
Upper Volta	216
Zaire	24
Zambia	210
Zimbabwe	186

* Collected in 1981-82

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Table 1. Sorghum germplasm at ICRISAT (September 1981) (cont'd)

Country	Total No. of accessions
ASIA	
Afghanistan	6
Bangladesh	9
Burma	8
China	68
India	4,027
Indonesia	32
Iran	7
Iraq	4
Israel	22
Japan	111
Lebanon	179
Nepal	8
Pakistan	29
Philippines	5
Saudi Arabia	1
South Korea	2
Sri Lanka	25
Syria	4
Taiwan	13
Thailand	5
Turkey	51
Yemen AR	27
Yemen PDR	1
USSR	69
EUROPE	
Belgium	1
Cyprus	1
France	5
Greece	1
Hungary	22
Italy	8
Portugal	6
UK	1
AMERICAS	
Argentina	16
Cuba	3
El Salvador	1
Guatemala	6
Honduras	1
Mexico	234

Table 1. Sorghum germplasm at ICRISAT (September 1981) (cont'd)

Country	Total No. of accessions
Nicaragua	1
Spain	3
Uruguay	1
USA	1,867
Venezuela	1
West Indies	3
AUSTRALIA	
Australia	28
New Guinea	1
UNKNOWN	397
Total:	21,264

been reported to exist in Venezuela and the surrounding areas, where collection possibilities will be explored.

Conservation and Maintenance

All collections were maintained by selfing about 20 representative heads in each line. Seed harvested from the selfed heads is mixed and a bulk of about 500 g is preserved in bottles under cold storage. One to two kg samples are maintained for named cultivars and genetic stocks where seed demand is higher. Cytoplasmic male steriles are maintained by hand pollination with their counterpart B lines. The entire sorghum germplasm is now being conserved in the medium-term (4°C and 40% RH) cold storage.

Evaluation

Over 16,500 accessions have been evaluated for important morpho-agronomic descriptors. The Sorghum Descriptors booklet (1980), published in collaboration with the IBPGR, will promote a more systematic

and uniform system of evaluation around the world, which will, in turn, enhance a common language and better understanding among sorghum scientists. Screening sorghum germplasm for insect, disease, Striga and drought resistance, and grain quality is being carried out in collaboration with other disciplines at ICRISAT headquarters in India. Details of the accessions screened are given below.

Screened for	No. of accessions	No. of promising lines
Insect resistance	7,874	323
Disease resistance	7,429	64
Striga resistance (Lab. screening)	15,504	641
Drought resistance	1,075	133

A large number of germplasm lines are being screened for grain moulds, downy mildew, leaf diseases, shoot fly and stem borer resistances by the Sorghum Pathology and Entomology Units.

Basic Collection

A basic collection consisting of about 1,000 accessions was selected from the world collection stratified taxonomically, geographically based on their ecological adaptation at the Patancheru location. At present this is being used by the sorghum scientists to work with in their improvement programme.

Regional Evaluation

Evaluation of sorghum germplasm in the rainy season (kharif) at Patancheru cannot provide complete information because most tropical germplasm accessions are photoperiod sensitive. For this reason much importance is placed on future evaluation of germplasm at or close to its original habitat. This project could be started at carefully selected regional centres in collaboration with national programmes.

Documentation and Publication

Data tabulated for 7,114 IS numbers were computerized at IS/GR, Colorado, USA using the EXIR programme for easy retrieval. The same data were transferred to ICRISAT's computer via magnetic tape and a computer print-out was brought out in the form of a catalogue. The data is being up-dated on the ICRISAT computer for all accessions and for the additional descriptors.

Distribution

The supply of seed material to sorghum improvement scientists around the world is one of the major responsibilities of ICRISAT and so far 117,231 samples have been distributed from the ICRISAT genebank.

Introgression and Conversion

For an effective and easy flow of tropical germplasm into various sorghum improvement programmes around the world, an introgression and conversion project has been initiated. At present ICRISAT is in the process of converting zera-zera landraces from Sudan and Ethiopia. These landraces are highly valued for their superior agronomic characters but are of restricted utility because of their photoperiod sensitivity and plant height.

PEARL MILLET GERMPLASM

Collection and Assembly

The pearl millet genetic resources maintained at ICRISAT comprise 14,340 cultivated, 633 intermediate weedy types and 35 accessions of 18 wild species and 6 possible interspecific hybrids. In addition, 170 accessions recently collected from Mozambique and Ghana have not yet been released from quarantine. The gaps in the world collection assembled in India by the Rockefeller Foundation will be filled with the incomplete set of IP lines recently obtained from ICARDA, Syria. Most of the accessions from West Africa were collected by ORSTOM and in East Africa by IBPGR/ICRISAT and those from Asia were collected

by ICRISAT or donated by various millet scientists in India.

Future collection programmes are being planned for different priority areas covering Angola, Benin, Burma, Chad, Burundi, Egypt, Ethiopia, Gambia, Ghana*, India, Ivory Coast, Mali*, Mozambique*, Pakistan, Rwanda, Sierra Leone, Uganda, Upper Volta, Zaire and Zimbabwe.

Conservation and Maintenance

Until their recent transfer to medium-term cold storage (4°C and 40% RH), all accessions had previously been maintained in a viable condition in temporary cool room conditions. A maximum quantity of 500 g is stored for each accession in air-tight plastic bottles after treating with insecticide and fungicide. Rejuvenation is done in the post-rainy season as and when the seed quantity reaches a critical level of viability. During the first seed increase the "cluster bagging method" is used to reconstitute the original population and maintain genetic diversity. Selfed seeds are also maintained for distribution.

Evaluation

Evaluation is necessary for effective utilization of the germplasm and is carried out during the rainy season, the main growing season for pearl millet. Each accession is grown in four rows of 4 m length at a spacing of 75 x 12 cm. All the accessions, except for the most recent collections from Tanzania, Malawi and Uttar Pradesh, have been evaluated for important agronomical characters. The IBPGR/ICRISAT sub-committee on descriptors of pearl millet published a list of descriptors in 1978 which is being used for evaluation.

Realizing the need to evaluate the germplasm at or near the place of collection, a multi-locational evaluation project of selected pearl millet germplasm was initiated at Patancheru, Bhavanisagar, Hissar, Ludhiana and Jaipur in India; Bobo-Dioulasso and Kamboinse in Upper Volta and Maradi in Niger. A set of 343 diverse accessions was planted in three replications using the triple lattice design. This work is continuing.

In general, the accessions from India differ greatly from those of Africa. The Indian material flowers early, produces many tillers with small heads and small but several grains per spike. The African material is very tall, flowers very late, produces very few tillers with thick stems with long, loose spikes and bold grain. Some of the West African material flowers only during short days.

There is a tremendous diversity in the material collected. Days to flowering 34 to 135, tillers 1 to 40, plant height 30 to 400 cm, spike length 5 to 160 cm and 1,000 grain weight 2.84 to 12.86 g. Seed colour varies from ivory to purple black, seed shape oval to globular. The endosperm texture varies from completely starchy to corneous.

Working Collection

After preliminary evaluation of the available collection, accessions were carefully identified and stratified by geographical distribution and general variability. So far, 581 accessions have been selected which represent the general variability of the ICRISAT world collection. It consists of accessions from Botswana (10), Cameroun (46), Central African Republic (23), Ghana (1), India (75), Malawi (6), Mali (84), Niger (184), Nigeria (24), Senegal (61), Sudan (8), Uganda (1), Upper Volta (5), USSR (3), Zambia (5) and unknown sources (45).

Documentation

The evaluation data are documented for computerization and those being maintained will be used in the retrieval system.

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* Collected in 1981-82

Distribution and Utilization

The germplasm is extensively utilized by millet scientists, not only at ICRISAT but also elsewhere. ICRISAT pathologists continuously screen germplasm for resistance against downy mildew, ergot, smut and rust. Some potentially useful lines have already been identified by ICRISAT scientists. Millet workers in India liberally use the germplasm. The photosensitive lines from West Africa were used directly for fodder purposes. Up to the present time 11,456 samples have been despatched to millet workers in India and 7,847 samples to scientists elsewhere.

Table 2. Pearl millet germplasm at ICRISAT (September 1981)

Country	Total No. of accessions
AFRICA	
Botswana	45
Cameroun	171
Central African Republic	58
Chad	62
Gambia	17
Ghana	157
Kenya	47
Malawi	223
Mali	527
Mauritania	1
Mozambique	14
Niger	1,032
Nigeria	399
Senegal	304
Somalia	3
South Africa	16
Sudan	168
Tanzania	136
Uganda	48
Upper Volta	28
Zambia	25
Zimbabwe	52
Unknown	11
ASIA	
India	10,656*
Lebanon	71
Pakistan	5
USSR	12
AMERICAS	
USA	48
AUSTRALIA	4
Total:	14,340

Table 2. Pearl millet germplasm at ICRISAT (September 1981) (cont'd)

*includes 7,086 accessions donated by millet scientists in India

MINOR MILLETS COLLECTION

The minor millets world collection, assembled by the Rockefeller Foundation in the sixties, had been kept at room temperature at Rajendranagar for about eight years before the material was transferred to ICRISAT. Out of 3,428 accessions covering six minor millets received by ICRISAT in 1976, only 1,475 were viable and these were consequently rejuvenated.

At its second meeting of 9-12 January 1978, the IBPGR Advisory Committee on Sorghum and Millets recommended that ICRISAT accept responsibility for maintenance of the germplasm collection on hand and improve it by obtaining additional material of the six specific minor millets listed below. The Governing Board of ICRISAT accepted and approved the minor millets germplasm assembly, conservation and distribution, at the ICRISAT Center and from then on ICRISAT intensified its minor millets germplasm assembly. At present the total number of minor millet accessions maintained at ICRISAT is over 4,039, as listed overleaf.

Eleusine coracana (Finger millet)	1,241
Setaria italica (Foxtail millet)	1,160
Panicum miliaceum (Proso millet)	715
Panicum sumatrense (Little millet)	243
Echinochloa crusgalli (Barnyard millet)	380
Paspalum scrobiculatum (Kodo millet)	300
	4,039

Evaluation and Seed Distribution

A preliminary evaluation of the existing minor millets collection is in progress.

So far, 9,185 samples have been distributed to scientists in India and 4,738 samples to scientists abroad.

Future trends of development

As seen from the above-mentioned activities, requests for minor millets germplasm from India and internationally, are steadily increasing, thus demanding a larger and ready supply of material. The cost of maintenance of the viability and distribution of material is also gradually increasing. In view of the importance of minor millets in semi-arid tropic countries and in the light of the IBPGR's request, ICRISAT will continue its genetic resources activities with minor millets.

RESUME

L'ICRISAT est chargé des recherches sur le sorgho et le millet à l'échelle mondiale. L'article donne un tableau général de l'état des collections et une récapitulation des recherches en cours.

RESUMEN

El ICRISAT tiene el cometido de ocuparse del sorgo y el mijo a nivel mundial. El artículo presenta un resumen general del estado de la recolección y de la labor en curso.

NEW IBPGR PUBLICATIONS

Directory of Germplasm Collections, No. 4. Vegetables by J. Toll & D.H. van Sloten. IBPGR, Rome. 1982. 187 pp.

This directory provides the most up-to-date information concerning germplasm collections for nine categories of vegetables: *Abelmoschus*, *Allium* spp., *Amaranthus*, *Capsicum* spp., Cruciferae, Cucurbitaceae, *Lycopersicon*, *Solanum* and other vegetables. An index is included for easy reference.

This publication is available from the Secretariat at headquarters upon request.