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Germplasm From SADCC Countries Maintained At ICRISAT Center And Its Implications On National Programs[1]

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Introduction

The area covered by Southern African Development Coordination Conference (SADCC) member countries extend from near the equator to about 30' S latitude and 11'-41' E longitude. The area has a wide range of environmental conditions ;and ecosystems: dry areas in the Kalahari desert in Botswana; tropical rainfall in Angola; coastal climate in Mozambique to continental Zambia; high plateaux in Angola and river basins in Zimbabwe; high altitudes in Lesotho and low elevations in Tanzania. The dominant cereal crop in the region is maize (*Zea mays* L.) followed by sorghum [*Sorghum bicolor* (L.) Moenche], pearl millet *[Pennisetum glaucum* (L.) R.Br.], and finger millet [*Eleusine coracana* (L.) Gaertn.] Among the legumes, groundnut (*Arachis hypogaea* L.) is an important crop followed by chickpea (*Cicer arietinum* L.), and then pigeonpea [*Cajanus cajan* (L.) Millsp.], which is usually grown in backyards.

Germplasm Assembly At ICRISAT Gene Bank

ICRISAT launches collection missions in collaboration with the national programs and international organizations like the International Board for Plant Genetic Resources (IBPGR) and regional organizations like the Southern African Center for Cooperation in Agricultural Research (SACCAR). The main purpose of germplasm collection is to conserve it before it is extinct and make it available at all times for all those who use it. Priority areas of collection are determined in consultation with national, regional, and international organizations. The important factors to consider for launching collection missions are area under cultivation, crop diversity occurring in the region, extent of genetic erosion, official government clearance, collaborating scientists, and logistic support. Collection missions are carried out at harvest time. The germplasm thus collected is shared among the national programs IBPGR, and ICRISAT.

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ICRISAT, in collaboration with IBPGR, SADCC countries, and others, have so far assembled a total of 8236 accessions consisting of 3010 sorghum, 2391 pearl miller, and 824 finger millet (Appa Rao *et al.* 1989), 496 pigeonpea, 1 chickpea, and 1498 groundnut (Tables 1 and 2). It must be emphasized here that such germplasm collections will have great national implications in that the new varieties to be developed involving these germplasm are likely to be well adapted in the original habitat of the germplasm.

Though sorghum is grown in all SADCC countries, it is extensively grown in Tanzania, Mozambique and Zimbabwe. It is an important crop in Botswana, Lesotho, Malawi and Zambia. In much of SADCC, the loose panicle guinea sorghums with their white corneous grain are grown for food. The kafirs, which had originated in southern Africa, usually have red/brown pericarp and are distributed in Zimbabwe, and northern Tanzania mainly for brewing beer. Sorghums with sweet juicy stalks are also chewed like sugarcane. These are called by different names in different languages like Ipka, Misale, etc. The distribution of different landraces and their characteristic features ware described by Prasada Rao and Mengesha (1980a, 1980b), Mushonga and Appa Rao (1986), Appa Rao and Mushonga (1987). Sorghum germplasm from SADCC countries is useful as a source of local adaptation (Andrews *et al.* 1984). Red Swazi, which has very good malting quality, is used in sorghum improvement. Chifumbata, which has excellent grain quality, was used as one of the parents in crossing. Segaolane from Botswana is a good source for heat and drought tolerance, framida for Striga resistance, pests, and sorghum from the highlands of Zimbabwe, Zambia, Lesotho and Swaziland for cold tolerance (Appa Rao *et al.* 1989).

Pearl millet is grown in all SADCC countries except Lesotho and Swaziland. It is an important crop in Zimbabwe, Tanzania, Mozambique, Shire Valley in Malawi, and western Zambia. Pearl millet is used to brew local beer or to prepare fermented or unfermented porridges. It is preferred by farmers as it matures before other crops and when farmers have depleted their food stocks. In general, pearl millet landraces in SADCC countries usually grow very tall, flower late, and produce large but few spikes (Appa Rao *et al.* 1986). Landraces grown in SADCC countries can broadly be grouped into photoperiod-sensitive and insensitive types. Most of the landraces from Tanzania, Mozambique, northern part of Malawi, and Zambia are strongly photoperiod-sensitive (flower in more than 120 days in rainy season) whereas most of the accessions from Botswana, Zimbabwe, and southern Malawi are less photoperiod-sensitive as they flowered in 55-70 days.

Finger millet ranks fourth in area and production and its cultivation is concentrated in the vicinity of Lake Tanganyika, Lake Victoria, and Lake Malawi and Tanzania (Gupta *et al.* 1986). It is preferred for brewing beer as it is reported to have better malting qualities.

ICRISAT has so far launched 16 collection missions and collected 5779 samples of cereals and legumes germplasm from all SADCC countries except Angola (Table 3). Priority areas of collection in the SADCC countries are given in Table 4. All the assembled germplasm is evaluated at ICRISAT Center. Realizing the need for regional evaluation, sorghum and pearl millet germplasm from southern Africa and the diverse working collection maintained at ICRISAT Center were evaluated at different locations in collaboration with SADCC/ICRISAT (Table 5). Sorghum from Zimbabwe, Lesotho, Swaziland, and the Arid Lands Agricultural Development Program (ALAD), Lebanon, were evaluated at Matopos. Finger millet from Zimbabwe was evaluated at Matopos and Panmure

Research Station. Groundnut was evaluated at Chitedze Research Station, Lilongwe, Malawi. The beneficiaries of germplasm collection are the scientists from the national program. All the germplasm assembled at ICRISAT Center is freely accessible to all the scientists throughout the world. So far, ICRISAT has sent 33 648 samples to scientists in the SADCC region (Table 6). Countrywise details on general agroclimatic remarks, germplasm collection and utilization of ICRISAT mandate crops are given below, and their implications on national programs are discussed.

Angola

According to Estavao de Carvalho (1988), sorghum is grown in the sub-plateau zones of Malange Cuanza Sul in Cunene and Huila province mostly in the remote areas where rainfall is very low. It is also reported that local landraces of pearl millet are grown in southern Angola.

Botswana

The major food crops of Botswana are sorghum and maize, along with small amounts of pearl millet, finger millet, bambara groundnut (*Vigna subterranea*), groundnut and cowpea (*Vigna uniquiculata*).

In 1980, ICRISAT launched an expedition in Botswana in collaboration with the Department of Agricultural Research (DAR), and collected 138 samples of sorghum and 47 of pearl millet (Prasada Rao, 1980). Another mission, funded by IBPGR, was organized during April 1985 and collected 17 samples of pearl millet, and several samples of other crops in the Northeast, Tutume, and Kgatleng districts of Botswana (Appa Rao *et al.* 1986).

Sorghum from Botswana is mostly photoperiod-sensitive and is of high value because of its agronomic superiority, early-maturity, good grain quality, and adaptability to low moisture and poor soil conditions (Prasada Rao 1981). Segaolane, which is a durra-kafir, is extensively grown in Botswana and appears to have wide adaptability and good grain quality. Kanye and Marupantse, which have semi-compact ear heads belong to race kafir, produces the maximum head length. No wild and weedy sorghums are noticed except for parasorghum near Sirowe in the central district.

Pearl millet samples collected from Botswana possess spike types which are long, cylindrical, short, loose, conical, or globose with long bristles. Some nonbristled types are also grown. Serere 6A (an introduced composite from Uganda) is becoming popular and replacing the local millet. Pearl millet is usually grown as a sole crop or occasionally mixed with sorghum and groundnut.

Groundnut is usually grown in small patches in sorghum and pearl millet fields. They are mostly eaten as nuts but ground seeds are also used for seasoning meat and vegetables. Only Valencia types (bunch) were collected. The two-seeded, amber colored types were common, but a few red-seeded types were also collected (Mazhani and Appa Rao, 1985). The two distinct types were Nongogulu (late-maturing with relatively large seeds) and Chinongwana (early-maturing with relatively small seeds).

Lesotho

Sorghum is the second most important food crop after maize. Farmers use mostly traditional cultivars that grow over 3 m tall, mature late, and produce loose panicles. Some popular local varieties like David Makanya (red grain) and Tennant white are grown in the mountain foothills. During 1985, SADCC/ICRISAT, in collaboration with the Department of Agricultural Research, collected 130 samples from farmers' fields. When these accessions were evaluated at Mzarabani, Zimbabwe, they grew over 3 m tall and produced large, loose, drooping panicles of guinea-kafir. However, some of them belong to race kafir and they produced more compact heads, with red/brown or white grain, and mostly starchy endosperm. Sorghum germplasm collected from the highlands of Lesotho is reported by farmers to possess cold tolerance.

Malawi

During March/April 1979, IBPGR/ICRISAT, in collaboration with the Ministry of Agriculture and Natural Resources, Malawi, collected 417 samples of sorghum, 277 of pearl millet, and 190 of finger millet (Appa Rao, 1979). In general, the frequency of cultivation and the associated genetic diversity within sorghum and pearl millet decreased from south to north.

Sorghum in Malawi is generally tall, growing to more than 3 m, 5-6 months maturity, and are grown with wide spacing. Farmers commonly grow a mixture of different types that vary a great deal in head type and maturity. Different types of sorghum that were collected in Malawi have different names. They vary in panicle and grain characteristics (Appa Rao 1979).

Sorghum purpureosericum, which has a ring of white hair at the node is widely distributed in Shire Valley, Phalombe plains, Mzimba, and Rumphi. *Sorghum verticilliflorum* is locally called 'Nkhundei' or 'Gugu' and has very loose, stiff branches. The stems are very thick and the leaves are broad. The spikelets have asynchronous maturity and shatter.

Though pearl millet is grown essentially throughout the country, its concentration is in the lower Shire Valley in the southern part of Malawi. It is grown to mature at such time when farmers have depleted their stock of food grains, and sorghum and maize are not yet for harvest.

During March/April 1979, joint IBPGR/ICRISAT collection mission, 260 traditional cultivars of pearl millet, 11 intermediate forms and 6 accessions of wild *Pennisetum* were collected. Most of the cultivated pearl millet samples were obtained from the hot lowlands of the lower Shire Valley, with a few samples from the cool highlands of Mulanje and Mangochi. A mixture of different types that varied in plant height, maturity, and spike characters were observed in farmers' fields. In the south, early types with loose, thin, cylindrical spikes and in the north, late-maturing types producing many tillers with stout spikes having long bristles were found. When the collection was evaluated at ICRISAT Center, Patancheru, considerable variation was observed for days to 50% flowering and plant height, but not for spike and grain characters. During the rainy season, the majority of the accessions flowered early (70 days), grew very tall (250 cm), and produced thin (22 mm), short (22 cm) spikes with small, obovate to elliptical, corneous gray grain (Appa Rao *et al.* 1986). In the postrainy season, most of the accessions flowered a week earlier, accompanied by reduction in plant height. Millet

germplasm from Malawi belongs to the race typhoides and serves as a good source of genes for earliness, tillering, and corneous endosperm.

Pennisetum purpurem (Napier grass) is commonly found on river banks, roadsides, on black fertile soils and stands out among other grasses. The thick strong stems are commonly used for fencing, mat making, etc. *Pennisetum polystachyon*, locally called 'Mchila Wagaru', which means 'dog's tail' is found in Phalombe plains, Mangochi, Balaka, Salima, Euthini, and many other places but not in Shire Valley. It is found at about 1000-1500 m above sea level on sandy soils.

Intermediate forms were found in the cultivated fields along with the millet crop only in Shire Valley. The farmers do not harvest them since they feel that they do not have any seed.

Finger millet is grown extensively in the northern region around Mzimba and Chitipa districts, and a few places in southern Shire Valley. Finger millet is called mawere in the south, kapuku in the central region and lupoko in the northern region. It is grown extensively in the northern region around Mzimba and Chitipa districts. Two distinct types are recognized, based on head characters. The open type has long, thin, ribbon-like fingers that open outwards and is called phazi-la-njobvu meaning elephant's foot in the Shire Valley. The first type in which short fingers fold inwards is called fumbata. The early type which matures in about three months, is called nthanga and is common around Mzimba. It has small, incurved heads and very small seed. The late-maturing form, which takes more than 120 days to mature, produces large heads and bold grain. Finger millet from Malawi grew taller, matured later with profuse tillering and produced longer fingers compared to those from India (Harinarayana *et al.* 1983).

Wild species of *Eleusine* are found throughout the country on waste land, roadsides and cultivated fields. It grows to a height of about 1 m and produces small heads that shatter seed readily. Weedy intermediate forms which appear to be natural crosses between wild and cultivated types are found in farmers' fields.

Mozambique

During April/May 1981, Nampula and Zambezia provinces of Mozambique were explored and collected 42 samples of sorghum, 15 pearl millet, 16 pigeonpea, and 131 groundnut (Ramanatha Rao 1981).

Sorghum is extensively grown in the Niassa, Central Cabo Delgado, Central Manica and Sofala provinces in the sub-plateaux region, and in the Zambezi, Limpopo and Sane basins in the interior lowlands (Freire and Lacomblez 1984). It is mainly intercropped with beans, cassava, and maize. Sorghum landraces grow very tall, mature in 6-8 months and produce pearly-white grains. Several harvests are made during this period, thus providing continuous food supply for the farm family.

Pearl millet is grown in the Zambezi, Limpopo and Sabi river basins and in the central region between Zambezi and Sane rivers, and is one of the major food crops (Ramanatha Rao, 1981). More variation was observed in pearl millet in the Namapa district, where different types of grain, bristles, and head shapes were found. A similar range of variation was observed on the same material grown at ICRISAT Center.

Pigeonpea called 'Fejo Mbwerre' in Mozambique, is grown in backyards almost everywhere (Ramanatha Rao, 1981). Though perennial types are common,

annual types are also found. Pigeonpea is consumed as fresh pods/seeds, and as dal by the Asian population. In groundnut, runner, spreading, bunch, and erect types with very small to very bold kernel types were collected. Cultivars mature in about 150 days, with a range of 3-6 months. Variability for pod shape and size was high.

Swaziland

In May 1985, a collection expedition was organized in Swaziland in collaboration with the Ministry of Agriculture (through SACCAR), and SADCC/ICRISAT, where 96 accessions of sorghum were collected. According to K.E. Prasada Rao's unpublished report, these include a good number of indigenous kafir landraces with wide variation for panicle shape, seed color, and seed size, which were claimed to be bird-resistant by farmers. Usually they grow very tall, flower very late and produce loose panicles. Grains are usually red/brown or white.

Tanzania

Five germplasm collection missions were launched to Tanzania and collected 244 samples of sorghum, 489 pearl millet, 35 finger millet, 234 pigeonpea, and 111 groundnut (Prasada Rao and Mengesha 1981; Ramanatha Rao and Mwenda 1987; and Appa Rao *et al.* 1989).

The majority of the sorghum samples collected belong to the basic races of guinea caudatum, and durra or their intermediate races. Bicolors and half bicolors are very few and kafirs are not seen. The variability in each race and its ecological distribution was discussed by Prasada Rao and Mengesha (1980b).

Morogoro and Iringa are important regions for wild sorghum where *Sorghastrum*, a closely related genus of sorghum with characteristic absence of pedicelled spikelets is abundantly found along the roadside. *Sorghum versicolor* and *Sorghum purpureosericeum*, the two parasorghums with characteristic bearded sheath nodes were found on the roadside from Mikumi to Morogoro and Dar-es-Salaam. In addition, races arundinaceum and verticilliflorum have also been found on the embankment of small streams. Around Mtwara and Mbeya regions, several *Sorghum versicolor, S. purpureosericem*, and *Sorghastrum* sp. were found on borders of sorghum fields.

Pearl millet is mainly distributed in the drier regions of Dodoma, Singida, Shinyanga, and Babati. There is wide variability in the landraces with respect to spike length, width and shape, grain color, shape and size, and bristling characters. Pearl millet is locally called 'Uwele'. A relatively high infestation of ergot was observed throughout the pearl millet collection areas.

In the 1978 and 1979 expeditions, 18 samples of wild *Pennisetums* were collected and most of them are *P. polystachyon, P. purpurem* and P. *mezianum.* Shibras are often found to be extensively grown in a place 33 km north of Manyoni on the Dodom-Singida road.

Finger millet, locally known as 'Ulezi', is distributed in the Singinda, Babati, and Dodoma regions. Arusha and Moshi seem to be more important areas for the collection finger millet in Tanzania. Both topcurved and incurved head types are collected. *Eleusine indica* and *Eleusine multiflora* are the wild types distributed in Tanzania.

Pigeonpeas from Tanzania are the world's most impressive perennial types whose potential is yet to be realized. Around Kilosa, the cultivars are highly branced, late-maturing with bold seeds. Seed color is mostly yellow white. In Ruoma region, Pigeonpea is grown on the borders of cassava fields, which are compact to semi-spreading green types with 5-7-seeded pods. Around Mtwara region, pigeonpea produces moderately bold seeds with a speckled color pattern. In Lindi coastal region, pigeonpea is high pod bearing, moderately perennial with 6-8 seeds per pod. In Arusha region, vegetable and grain types of pigeonpea are grown (Remanandan and Mengesha 1981). Dry grains (unsplit with seed coat intact) are cooked with maize. Pigeonpea is also used for baking local breads. *Rhynchosia aura* was found in Ruoma region.

Zambia

In four collecting expeditions between 1980 and 1984, the IBPGR collected 457 sorghum samples (Attere 1985). Mehra (1982) found both grain/dual purpose, and sweet stalk genotypes of sorghum. Variability was highest in localized areas of the Southern, Western, and Copperbelt provinces. The farmer's field populations of sorghum varied in head size, maturity, grain size, etc. In all provinces, mostly tall, late-maturing bicolor, durra, and guinea and occasionally, caudatum races and broomcorn were found. Often, one or more types occurred as mixtures in the same farmer's field and even hybrids between certain races were observed. Such fields should be re-examined for observing and selecting intermediate forms.

Traditional sorghum cultivars that are tall and late-maturing differ markedly for several characters, including panicle shape, compactness and size, grain shape and size, glume color, plant height, and maturity (Attere 1985). The landraces are often called by a specific local name and their salient features have been reported by Appa Rao (1980). The sweet-stalk types were called 'Nagongo' or 'Misale'. During the 1981-82 season, 143 samples of local germplasm were evaluated at Mount Makulu for plant type, flowering time, yield, and grain characters, and six lines were selected for further study (Rao and Prior 1984).

In pearl millet, bristled types with small, corneous grain are grown in backyards. Cylindrical, compact heads with short bristles are also found. Diversity was greater in the Western province and in localized areas of the Southern province. The populations from Sinazongwe, Monze, Kaoma, and Kalabo districts were more variable than those from other provinces (Mehra 1982). Among wild species, *Pennisetum purpureum* showed greater variation in tiller number, leafiness, and leaf size in the Luapula Province, where variability was greater than in other provinces. Localized areas with increased variability in *Peniisetum pedicellatum* were also noted in the Luapula and Copperbelt provinces (Mehra 1982).

In 1980, ICRISAT collected 107 samples of finger millet mainly from the Northern, Eastern and Central provinces (Appa Rao 1980). During April-June 1981, the Southern, Western, Central, Copperbelt and Luapula provinces were explored and 63 samples were collected (Mehra 1982). During June/July 1982, the Northern, North Western, and Luapula provinces were explored and 40 samples were collected (Attere 1985). Up to 1985, a total of 273 samples of finger millet from Zambia were assembled (Attere 1985). Variability was greatest in the populations from the Luapula and Copperbelt provinces and to a lesser extent also in those from Western province, which differed in maturity,

finger number, grain color and size, etc. Early-maturing types were collected in the Ndola and Samfya districts (Mehra 1982).

Zimbabwe

Most of the sorghum is grown in the communal lands and to a greater or lesser extent in all provinces. It is mostly concentrated in Matabeleland south and Matabeleland north, Mashonaland central and Manicaland, and in the Sebungwe region parallel to Lake Kariba.

Commercial farmers invariably grow high-yielding hybrids. Communal farmers usually grow such varieties as Red Swazi, Feterita, Framida, and other traditional tall, late-maturing landraces. During 1982 and 1985, a total of 858 samples of sorghum were collected from Zimbabwe (Appa Rao *et al.* 1986). Over 500 samples were further collected from Matabeleland and the Midlands provinces by SADCC/ICRISAT and ICRISAT during 1988.

Some 285 samples of sorghum collected in 1982 (Appa Rao and Mengesha 1982) were evaluated during 1985 at Gwebi, Panmure, and Matopos. Morphological variation and distribution of different races and their characteristics were published as a catalog (Appa Rao and Mushonga 1987). Though the race kafir is extensively grown, caudatum, guinea, durra, and bicolor were also found.

ICRISAT and IBPGR, in collaboration with the Department of Research and Specialist Services, collected 63 pearl millet samples during 1982 (Appa Rao and Mengesha 1982), 342 samples during 1985 (Appa Rao et al. 1986)., and 830 during 1988. The 1982 collection was evaluated in 1985 at Gwebi, Panmure, and Matopos and a catalog was published (Appa Rao and Mushonga 1987). Considerable variation was found within single samples for plant height, maturity, spike shape, size, and presence or absence of bristles. Though farmers select large heads for seeds, other types appear because of allogamy. The cultivars grown by farmers are very tall, flower very late, and produce large spikes. Considerable variation was found for several spike characters such as spike size, shape, grain compactness, presence or absence of bristles, etc. Long cylindrical heads with small grains are very common (Appa Rao and Mushonga 1987).

The first archaeological record of finger millet in Zimbabwe was found at Inyanga, dating back to the eighth century A.D. (Summers 1958). It is at present the third most important crop grown in the Mashonaland, Midlands, and Manicaland provinces. IBPGR and ICRISAT collected 286 samples of cultivated finger millet and 6 wild forms during 1982 (Appa Rao and Mengesha 1982).

Finger millets vary in the form and shape of their inflorescence. Farmers recognize these shapes and give them distinct names. All the samples collected were evaluated at Gwebi and Panmure and agronomically elite types were selected for crossing to produce higher-yielding varieties (Appa Rao and Mushonga 1985). Wild and weedy types of finger millets are found throughout the Masvingo province (Appa Rao and Mengesha 1982). These were found at several places growing in cultivated finger millet fields or along bands and roadsides. The weedy forms resemble the cultivated types in several morphological characters and it is difficult to differentiate them until they flower. The wild types have very long, thin digitate fingers with very small seeds, while the weedy forms are intermediate between the wild and the cultivated.

Implications On National Programs

Maintenance and conservation of germplasm at places other than their original habitat offer great advantages of long-term, strategic importance. The major advantages are discussed below. At this point, however, it must be pointed out that regional and international germplasm maintenance and conservation centers are not being suggested as replacement to national centers but rather essential alternate storage points for long-term security and exchange purposes. The major objectives of germplasm collection in relation to maintenance and conservation are:

1. Arrest genetic erosion
2. Characterization and evaluation
3. Diversity studies
4. Maintenance
5. Conservation
6. Documentation
7. Genetic tudies
8. Identity potential
9. Present and future use
10. Distribution/Exchange

All the above-listed objectives can best be achieved if they are carried out by a network of concerted efforts at national, regional, and international levels. This is particularly true when we consider the long-term safety and security of the germplasm. Multidisciplinary and multinational efforts are bound to be more effective and successful in studying and identifying potentials of germplasm in wider agroclimatic conditions. Nations often depend on one another and share and exchange their natural resources. This is specially important in the area of plant germplasm exchange and utilization in crop improvement programs that are carried out within or beyond political boundaries.

The implications of international germplasm collection and conservation with national programs are many. Generally they are advantageous and economical. World collections like the one assembled at ICRISAT Center insure the safety and availability of germplasm from an alternate source. Regional programs like the SADCC/ICRISAT and the regional gene bank being developed in Zambia are extremely important and highly beneficial to national programs in the region. This is extremely crucial if and when national collections cease to exist for one reason or another. Such possibilities are not hypothetical as seen from the number and frequency of requests we have received from different countries for their entire germplasm, which we supplied and will continue to supply in the future. Often it is the source countries that benefit from regional and international germplasm collection, assembly, and conservation. This is because the new cultivars developed anywhere from indigenous or exotic germplasm are most likely to be better adapted in the original habitat of the germplasm.

The unique advantage of world germplasm collections is demonstrated through multilocational germplasm evaluation in close collaboration with national programs. When any national program is prepared to evaluate a large number of its own indigenous germplasm, the gene bank holding the world collection could be tapped as a source of material for not only one country's entire germplasm but also for diverse germplasm accessions collected from different parts of the world with similar agroclimatic conditions such as rainfall, longitudes, latitudes, altitudes, and other environmental factors.

Nowadays, the availability of germplasm is largely taken for granted. In future, however, as more and more landraces become extinct or difficult to

and, national programs will have to rely on their own national gene banks, in situ conservation or other regional and international gene banks. There are great dangers if germplasm is maintained at only one national center. Though it is highly desirable for all nations to maintain in situ conservation, it may not be practical to cover all crops. Therefore, regional and international world collections of germplasm will continue to be of great value to present and future national programs.

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Table 1. Status of cereals germplasm from SADCC countries maintained at ICRISAT Centre.

Crop	Number of samples maintained at ICRISAT Center					
	Sorghum		Pearl Millet		Finger Millet	
	C	W	C	W	C	W
Angola	29	33	0	0	0	0
Botswana	190	1	82	0	0	0
Lesotho	257	1	0	0	0	0
Malawi	443	18	298	9	248	11
Mozambique	42	0	31	0	1	0
Swaziland	201	0	0	0	0	0
Tanzania	437	12	484	28	20	0
Zambia	291	0	95	4	117	0
Zimbabwe	1052	3	1356	4	414	13
Total	2942	68	2346	45	800	24

C = Cultivated
W = Wild

Table 2. Status of legumes germplasm from SADCC countries maintained at ICRISAT Center.

Crop	Number of samples maintained at ICRISAT Center					
	Pigeonpea		Chickpea		Groundnut	
	C	W	C	W	C	W
Angola	0	0	0	0	7	0
Botswana	0	0	0	0	1	0
Lesotho	0	0	0	0	0	0
Malawi	245	0	10	0	148	0
Mozambique	10	0	0	0	158	0
Swaziland	0	0	0	0	8	0
Tanzania	221	0	7	0	392	0
Zambia	20	0	0	0	231	0
Zimbabwe	0	0	0	0	553	0
Total	496	0	17	0	1498	0

C= Cultivated
W= Wild

Table 3. Germplasm collection missions launched by ICRISAT in SADCC region.

Country	Date(s)	Collected material					
		SG	PM	FM	CP	PP	GN
Angola	-	-	-	-	-	-	-
Botswana	1980	138	47	-	-	-	-
	1985	-	17	-	-	-	-
Lesotho	1985	130	-	-	-	-	-
Malawi	1979	417	277	190	-	21	15
	1983	-	-	-	-	230	-
Mozambique	1981	42	15	-	-	16	131
Swaziland	1985	96	-	-	-	-	-
Tanzania	1978	97	63	8	-	-	-
	1979	83	102	-	-	-	-
	1981	56	13	27	-	234	15
	1985	8	12	-	-	-	96
	1987	-	299	-	-	-	-
Zambia	1980	237	25	107	-	21	80
Zimbabwe	1982	125	63	61	-	3	7
	1985	733	342	182	-	-	68
	1988	-	830	-	-	-	-
Total		2162	2105	575	-	525	412

SG = Sorghum, PM = Pearl millet, FM = Finger millet, CP = Chickpea
PP = Pigeonpea, GN = Groundnut

Table 4. Priority for germplasm collection in SADCC countries

Crop	Sorghum	Pearl millet	Finger millet	Pigeonpea	Chickpea	Grour
Angola	1	1	5	5	5	
Botswana	4	4	5	5	5	
Lesotho	4	5	5	5	5	
Malawi	4	4	4	4	1	
Mozambique	1	1	2	2	5	
Swaziland	4	5	5	2	5	
Tanzania	4	4	2	4	2	
Zambia	4	2	4	2	5	
Zimbabwe	4	4	4	2	5	

1 = High priority
2 = Medium priority
3 = Low priority
4 = Recently collected
5 = Needs more information

Table 5. Number of samples of sorghum, pearl millet, finger millet, and groundnut germplasm from ICRISAT Center evaluated in the SADCC region.

Country	Sorghum	Pearl millet	Finger millet	Groundnut
Angola	-	-	-	-
Botswana	-	766	-	-
Lesotho	-	-	-	1
Malawi	-	244	-	4063
Mozambique	-	-	-	48
Swaziland	-	-	-	-
Tanzania	-	857	-	605
Zambia	-	795	-	-
Zimbabwe	1416	4447	132	-
Total	1416	7089	132	4717

Table 6. Germplasm samples supplied to scientists in SADCC region.

Country		SG	PM	FM	CP	PP	GN
Angola	S	-	10	-	10	10	-
	C	-	1	-	1	1	-
Botswana	S	3250	-	-	-	4	45
	C	6	-	-	-	1	1
Lesotho	S	-	-	-	-	-	1
	C	-	-	-	-	-	1
Malawi	S	3271	8	-	100	148	4051
	C	6	2	-	1	6	7
Mozambique	S	378	25	30	10	14	48
	C	2	1	1	1	3	2
Swaziland	S	-	-	-	-	10	12
	C	-	-	-	-	1	2
Tanzania	S	3115	100	-	10	175	605
	C	6	2	-	1	5	3
Zambia	S	51	29	-	70	90	-
	C	1	1	-	2	6	-
Zimbabwe	S	10689	6237	988	10	44	-
	C	24	9	9	1	2	-
Total	S	20754	6409	1018	210	495	4762
	C	45	16	10	7	25	16

SG = Sorghum, PM = Pearl millet, FM = Finger millet, CP = Chickpea, PP = Pigeonpea, GN = Groundnut
S = Number of samples supplied
C = Number of consignments

DISCUSSION

MUCHENA: 1) Patenting of genes worries people in developing countries. What is the impact of this on germplasm collection? 2) What resources are required to maintain a germplasm bank at ICRISAT Centre?

MENGESHA: In general, ICRISAT stands against any company that patents germplasm. Genetic engineered product can be considered for patenting. Since ICRISAT maintains all the genetic stocks of its mandate crops, no company can patent landraces.

PERSAUD: Is the information on the collection been computerized? If so, are they available? What hardware is required to access the data base?

MENGESHA: Yes, the information is fully computerized with the use of IDMRS (ICRISAT Data Management and Retrieval System), and it is available. The computer system is IBM compatible. In the future we are also planning to operate our vast evaluation data with the use of compact discs IBM compatible.