1.4

Germplasm Collection, Conservation and Utilization Activities of the Office de la Recherche Scientifique et Technique d'Outre-Mer (ORSTOM)

A. CHARRIER and S. HAMON

The Office de la Recherche Scientifique et Technique d'Outre-Mer (ORSTOM) began its activities in the field of genetic resources during the 1960s with studies on *Panicum* (Combes, 1975; Pernès, 1975). During the past 10 years new studies have been carried out on rice, okra, coffee, cereals, and root and tuber crops. Funding for ORSTOM collecting missions has come from many sources, including the International Board for Plant Genetic Resources (IBPGR), the European Economic Community (EEC) and the French Ministry for Research and Cooperation. From the outset, our goal has been to understand genepool organization, including cultivated and wild species. The study of gene flow and ecological and genetic barriers are fundamental for plant improvement.

Over the past decade we have added isoenzymatic variability to morphological evaluation (Second and Trouslot, 1980). The new biochemical markers now available will certainly increase our understanding of evolution. Microcomputer and multivariate analysis provide a good tool for managing and using a large amount of data. Special attention is also paid to controlled crosses in intra- and interspecific situations.

We present here an overview of the collecting missions carried out during the past decade.

OKRA

ORSTOM's program on okra, *Abelmoschus* species, was sponsored by IBPGR. Following the basic work carried out by Siemonsma (1982) in Côte d'Ivoire, a worldwide survey of okra genetic resources was conducted (Charrier 1984), as a result of which numerous okra samples were sent to us from different parts of the world. In association with IBPGR, we sent a mission

to collect only okra in Togo and Benin (Hamon and Charrier, 1983). Great variability was found and an ecological partition of the main cultivated types was made. Another collection was undertaken in Guinea (Hamon et al., 1986). Outside Africa, a collecting mission was recently carried out in Thailand (Hamon et al., 1987). The total number of samples is now nearly 2,000 (*see* Tables 1 and 2).

TABLE 1 **Global collection of okra, *Abelmoschus* species**

	A. esculentus	*A. caillei*	*A. moschatus*	*A. manihot*
West Africa	873	673	17	
East Africa	251	1[1]		
America	8			
Asia	113		35	36
Europe	129			
Total	1,374	673	52	36

1 Spontaneous hybrid with *A. esculentus*

TABLE 2 **ORSTOM/IBPGR collecting missions of okra, *Abelmoschus* species**

	A. esculentus	*A. caillei*	*A. moschatus*	*A. manihot*
Benin	213	64	12	
Guinea	97	94		
Niger	31			
Togo	206	165	6	
Thailand	6		35	36
Total	547	323	53	36

Our results show that two species, partly sympatric, are cultivated in West Africa. One is a previously undescribed species, *A. caillei* (Stevels, 1988), which is endemic and probably native to West Africa. The two species exhibit differences in ecological affinities; they are mainly autogamous and their hybrids are strongly sterile. They coexist but without significant gene exchange (Hamon, 1988). For both species, there is greater morphological diversity in West Africa than elsewhere. Unlike some other species, there is no correlation between enzymatic and morphologic variability. For the cultivated species, easily recognizable by their isozymic patterns (Hamon and Yapo, 1985), global polymorphism is limited because of its particular speciation process and high polyploidy status. In contrast, wild species collected in Thailand have a higher level of isoenzymatic polymorphism.

We have considerably improved crossing techniques in our laboratory and are now able to predict the rate of hybrids in intraspecific as well as interspecific crosses. We have also observed that the reproductive potential varies within cultivated species such as *A. esculentus*. Useful genes can be transferred through hybridization.

The basic collection is located in Côte d'Ivoire. Duplicate samples (100 g, 30 g) are sent to the US National Seed Storage Laboratory in Fort Collins and to ORSTOM headquarters in France, repsectively. Our data evaluation also allows us to distribute a package of 180 samples (20 g) containing a high level of diversity, which, in our opinion, is a good way to start a breeding program (Hamon and van Sloten, 1989).

Unfortunately, 'economically minor crops' are often not considered in international programs and scant attention is paid to them.

COFFEE

To increase the diversity of the existing coffee collection, the Food and Agriculture Organization of the United Nations (FAO) and various French organizations have intensified their efforts over the past 25 years to collect wild coffee trees. Initially, emphasis was given to *Coffea arabica* because of its economic importance and to *C. canephora*, *C. congensis* and *C. eugenioides*, presumed to be the progenitors of *C. arabica*. Since 1978, ORSTOM's most important collecting missions in the African forests were made in Cameroon (Anthony et al., 1985), Congo and Guinea (*see* Table 3).

TABLE 3 **Coffee surveys since 1978**

	Number of species collected	Number of genotypes
Before 1978	13	4,850
Cameroon	6	1,375
Congo	5	1,080
Guinea	5	269
Tanzania	3	820
Total	15+	3,544

The African coffee species are kept in living collections at Divo, Man, in Côte d'Ivoire. Over 15 species are represented by hundreds of genotypes collected from natural populations (Anthony and Mercier, 1987).

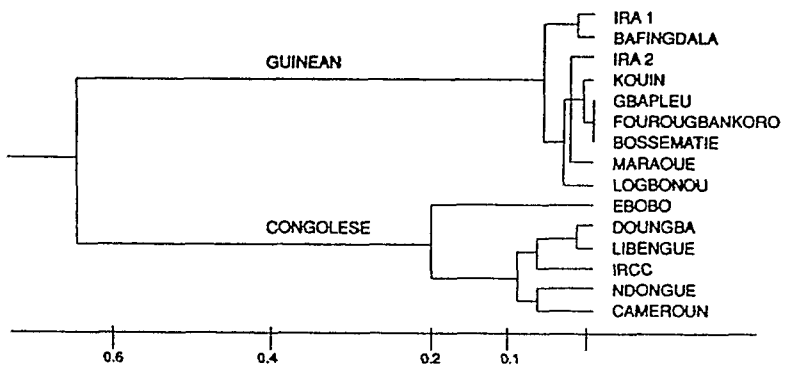
Botanists and geneticists have used numerous methods to describe the variability in wild coffee populations, including morphological and agronomic observations, enzymatic variability, and genetic analysis with progenies of controlled crosses within and between species. Some of the major achievements are outlined here.

Previously, the lack of caffeine was known only in those coffee species growing naturally on the islands of Madagascar, Comoros, Mauritius and Bourbon and belonging to the section *Mascarocoffea*. Coffee species collected in Kenya by Berthaud et al. (1980) and evaluated by Hamon et al. (1984) show that a new species, *C. pseudozanguebariae*, produces caffeine-free seeds.

Natural populations of *C. canephora* were collected in Côte d'Ivoire, Cameroon, Central African Republic, Congo and Guinea. Observations on morphological characteristics and

floral biology indicate a clear geographical differentiation into two groups — West Africa (Guinean) and Central Africa (Congolese). This was confirmed by electrophoretic analysis (Berthaud, 1986). Each group shows a specific combination of alleles (*see* Figure 1). Hybrid vigor and productivity have been observed in the progenies obtained by crossing these two groups.

FIGURE 1 **Genetic organization of *Coffea canephora* species based on Nei's genetic distance (the dendogram was drawn up using genetic distances between populations distributed over the distribution area)**



The great variability which exists in natural populations of *C. arabica* is clearly demonstrated by a hierarchical variance of morphological characters. A new source of useful genes for resistance to leaf rust, *Hemileia vastatrix*, and coffee berry disease, *Colletotrichum coffeanum*, was found.

The large number of taxa in East Africa (Bridson, 1982) and Madagascar correspond to allopatric populations with distinct morphological characters but without strongly developed genetic barriers.

The genetic evaluation of *Coffea* species should be continued, but special attention should be paid to the duplication of collections using *in vitro* culture techniques and long-term preservation, such as cryopreservation (*see* Chapter 5.1).

RICE

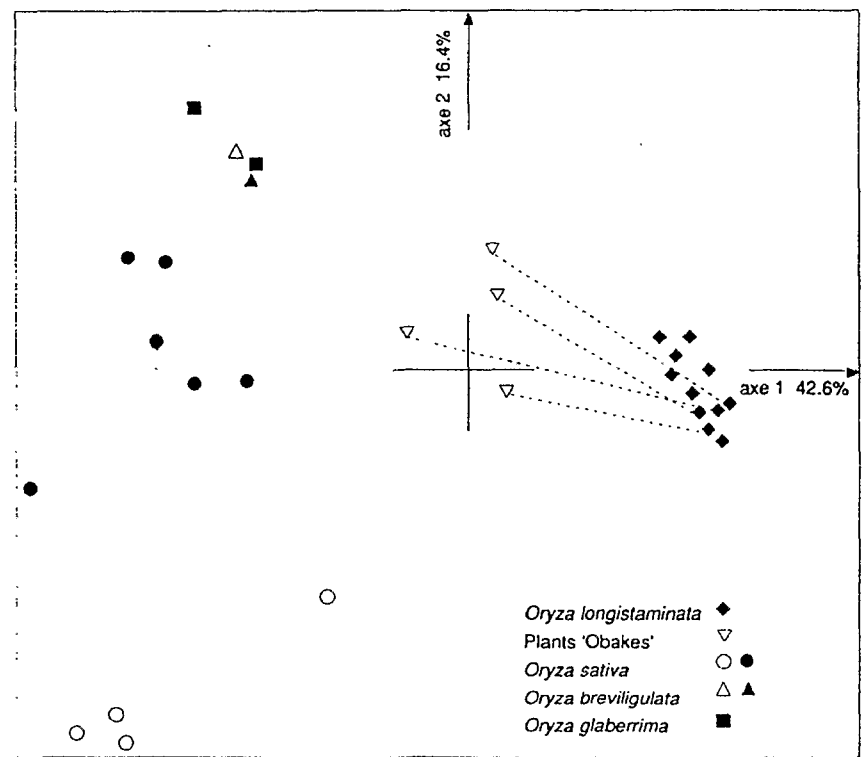
ORSTOM's geographical survey of rice genetic resources in Africa has now been completed. Collecting missions were undertaken in West Africa (Guinea) (Bezancon et al., 1984), East and Southern Africa (Tanzania, Zambia, Zimbabwe) and Madagascar (De Kochko, 1985). The ORSTOM collection consists of four main species, two cultivated and two wild: *Oryza sativa*, the worldwide cultivated species; *O. glaberrima*, the African endemic; *O. breviligulata* (*barthii*), the wild progenitor of *O. glaberrima*; and *O. longistaminata*, the perennial allogamous wild species (*see* Table 4).

TABLE 4 **Rice (*Oryza* species) collecting missions**

	O. sativa	*O. glaberrima*	*O. breviligulata*	*O. longistaminata*	*Others*
Before 1978	1,375	549	305	120	25
Guinea Bissau	134	47	2	11	
Guinea Conakry	573	172	7	18	
Madagascar	661			2	
Tanzania	53	3	6	12	11
Zambia, Malawi					
Botswana	20		4	10	
Total	1,441	222	19	53	11

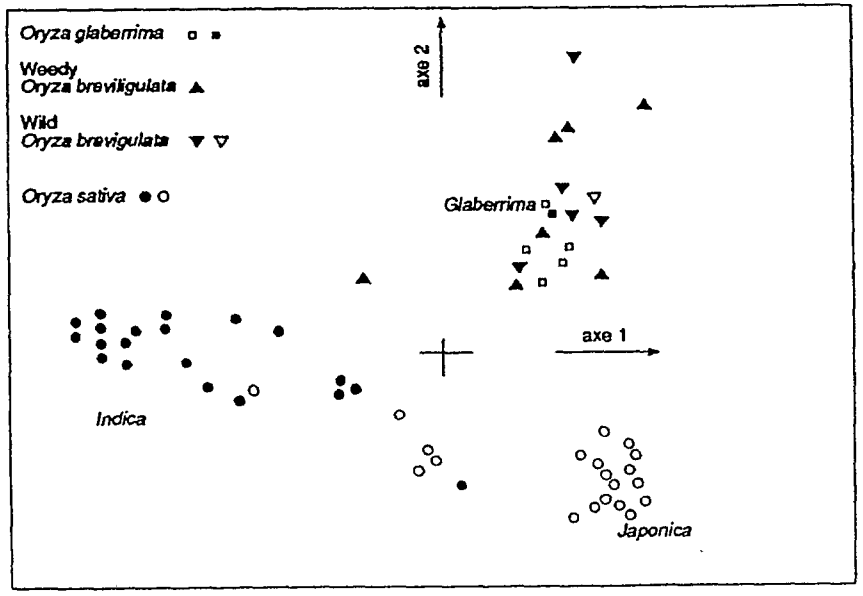
Mainly using isoenzymatic electrophoresis, we have shown that the diversity of *O. sativa* in Asia is also found in Africa. However, in Africa new polymorphism exists (De Kochko, 1987) and introgression with *O. longistaminata* (Ghesquière 1988) is not rare (*see* Figure 2).

FIGURE 2 **Genetic diversity of rice**



Regarding the two types of *O. sativa* (*japonica, indica*) (Second, 1984), we have shown that even if some intermediate forms exist, they can be easily recognized by using electrophoretic patterns. We have also shown that the *O. glaberrima-O. breviligulata* complex is isolated (*see* Figure 3). These two groups exhibit variable levels of intercrossing but, using electrophoresis, we are able to find atypical varieties which have a high level of compatibility with any other genitors. Nevertheless, a good correlation exists between ecological constraints, the two *indica-japonica* groups (*indica*, irrigated, phenol+, *japonica*, upland, phenol-) and the phenol reaction (De Kochko, 1987).

FIGURE 3 **Genetic diversity of cultivated rice**



Breeding and improving rice directly with *O. glaberrima* will be difficult, for several reasons. As shown by Bezancon et al. (1977), the variability of *O. glaberrima* is included completely in the spectrum defined by its progenitor, *O. breviligulata*. By itself, yield production is low. It is likley to be useful only in hybridization with *O. sativa*.

The use of *O. longistaminata* merits special attention. In spite of its strong sterility barrier, the gene flow has been thoroughly analyzed (Ghesquière, 1985, 1988). The use of this species as a tool for introducing new variability in upland rice, as shown by Causse (1989), must be considered.

In conclusion, none of the above discoveries would have been possible if we had not had access to collected material. ORSTOM has tested the evolutionary hypotheses now validated by the use of chloroplastic DNA (Dally, 1988).

MILLETS, SORGHUM AND *DIGITARIA* SPECIES

During the past 10 years pearl millet, *Pennisetum* species, sorghum and *Digitaria* species have been collected in the Sahelian region (*see* Tables 5 and 6).

TABLE 5 ***Pennisetum*** **collecting missions**

	Cultivated	Wild	Intermediate
Before 1978	2,151	91	347
Burkina Faso	211	13	
Benin	137	1	10
Mali/Niger	574	124	
Mauritania		40	
Senegal		9	
Total	922	187	10

TABLE 6 **Sorghum and** ***Digitaria*** **collecting missions**

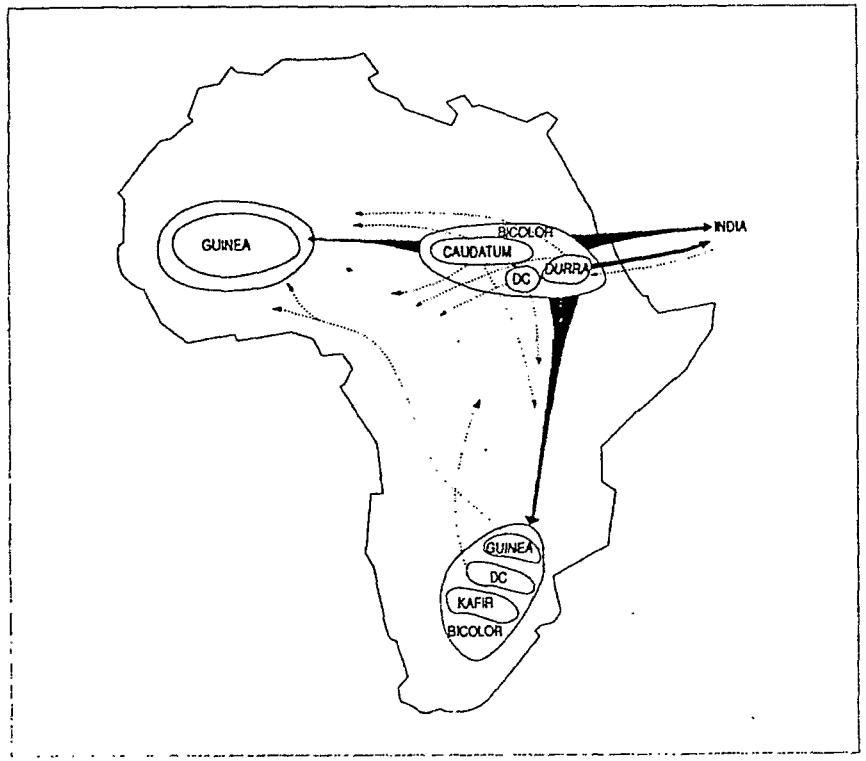
	Sorghum		*Digitaria*
	Cultivated	Wild	
Before 1978	1,305	12	61
Benin	512	11	12
Burkina Faso	390		21
Mali	1,146		139
Total	2,048	11	172

Over 3,000 samples of pearl millet were collected (Clément, 1985) and their diversity evaluated (Tostain and Marchais, 1989). Wild samples collected recently in Mauritania, Mali and Niger (Tostain et al., 1986) were evaluated using morphological, agronomic and electrophoretic analysis (Marchais and Tostain, 1988). From the results it appears that the genetic structure is composed of two main groups, the Mauritanian and the Niger families; the former is characterized by greater plant height, later flowering and specific electrophoretic patterns (Marchais and Tostain 1988). A strong correlation within each family exists between types associated with pasture or field crop, the former exhibiting lower vigor and enzymatic diversity in its progenies (Marchais and Tostain, 1988). A surprising observation is the lower level of enzymatic polymorphism found in wild species than in the cultivated forms.

The results of morphological evaluation of sorghum (Ollitrault, 1987) fit well with Harlan and de Wet's evolution hypothesis, but not so well with the electrophoretical data. A study which was carried out using 24 loci shows that the genetic structure is correlated with three geographic poles (East, West and Southern Africa), within which population diversity is high

(30%) and seems to be maintained by migrating processes, allogamic reproduction and heterosis (*see* Figure 4). This knowledge will be useful in breeding and in improving sorghum yield.

FIGURE 4 **Domestication of *Sorghum bicolor***



ROOTS AND TUBERS

Yams and cassava are studied in close cooperation with the genetic laboratory of Abidjan University, Côte d'Ivoire.

The main purpose of ORSTOM's work on yam, *Dioscorea* species, is to assemble a virus-free collection. Virus diseases not only reduce yield but also lead to a loss of genetic material. The genetic structure of the *D. cayenensis-rotundata* complex is now better known (*see* Chapter 3.2) and we can propose a better rationalization of the composition of collections. Sanitation and indexing using *in vitro* culture and the enzyme-linked immuno-sorbent assay (ELISA) test are now in progress (Malaurie and Thouvenel, pers. comm.). We are also

developing all the techniques which permit micropropagation, such as somato-embryogenesis and meristem culture. We will soon be able to distribute a truly representative collection, miniaturized and disease-free, throughout the world for breeding purposes.

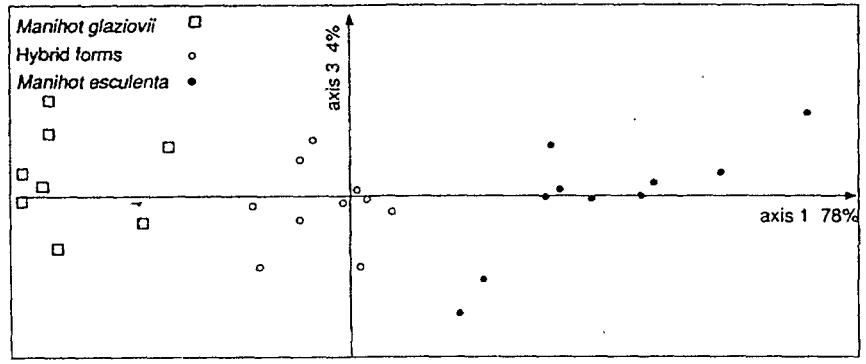
ORSTOM's work on cassava, *Manihotis* species, is connected with the international Cassava Network. Although cassava is not indigenous to Africa, African farmers maintain a great diversity of cultivars well adapted to local diseases and selected according to food preferences (Charrier and Lefèvre, 1988).

We now have a field collection of 356 clones of *M. esculenta* and 109 wild types of *M. glaziovii* or hybrids. Morphological analysis of such material, often misshapen as a result of virus diseases, is difficult (Zoudjihekpon, 1986). A technique using starch gel electrophoresis was adapted by Zoudjihekpon and Touré (1983), and four systems were revealed. Currently, 10 systems are available (Lefèvre, 1988a, 1988b), and thus we are now able to identify a variety by its pattern and to control or eliminate duplicates in a collection.

In the field we observed that *M. glaziovii* exhibits good resistance to disease. Lefèvre (1988a) has shown that in Côte d'Ivoire, and probably throughout West Africa, different levels of backcross between *M. esculenta* and *M. glaziovii* can be found. In many interspecific combinations female fertility exists and spontaneous intercrosses are relatively frequent (*see* Figure 5).

Future work will be aimed at producing virus-free material and intraspecific crosses using *M. esculenta*. Virus-resistant plants must be obtained, using *M. glaziovii*, but we need also to consider obtaining transgenic plants.

FIGURE 5 **Natural hybrids between *Manihot esculenta* and *Manihot glaziovii***



CONCLUSION

ORSTOM's aim is not to produce improved varieties but to test hypotheses and to give guidelines to breeders. Most of our samples are duplicated and, in accordance with our mandate, are transferred to international institutes, such as the International Institute of Tropical Agriculture (IITA), the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), the International Rice Research Institue (IRRI) and the West Africa Rice

Development Association (WARDA). When possible, and where the necessary facilities exist, we also send samples to national organizations, such as the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD).

In collaboration with IBPGR in Côte d'Ivoire and Niger and with the Agence de Cooperation Culturelle et Technique (ACCT) in Tunisia, we try to transmit our philosophy, results and techniques to African students attending short courses. The building of a new ORSTOM center in the Agropolis complex at Montpellier, France, will be of great help for this purpose.

During the past 10 years ORSTOM has carried out a number of original studies on the evolutionary process, plant population polymorphism and genetic barriers, using the material that has been collected. In the next decade more emphasis will be placed on genetic evaluation and conservation. Molecular biology will certainly produce new tools which are easier to use and manage in developing countries. Nevertheless, the greatest problem is still the cost of conservation and rejuvenation. Detailed consideration needs to be given to the miniaturization of the size occupied by each genotype, the selection of materials for conservation and long-term conservation procedures.

References

Anthony, F., and Mercier, J. P. 1987. *Les ressources génétiques des caféiers africains: La base de données sur les collections de Côte d'Ivoire*. ASIC, 12° Colloque, Montreux, France.

Anthony, F., Couturon, E., and de Namur, C. 1985. *Les caféiers sauvages du Cameroun: Résultats d'une mission de prospection effectuée par l'ORSTOM en 1983*. ASIC, Lomé, Togo.

Berthaud, J. 1984. Gene flow and population structure in *Coffea canephora* populations in Africa. In Jacquard, P., Heim, G, and Antonowics, J. (eds.) *Genetic Differentiation and Dispersal in Plants*. Springer Verlag, Berlin and Heidelberg, Germany.

Berthaud, J. 1986. Les ressources génétiques pour l'amélioration des caféiers africains diploides: Evaluation de la richesse génétiques des populations sylvestres et de ses mécanismes organisateurs: Conséquences pour l'application. Travaux et Documents 183. ORSTOM, Paris, France.

Berthaud, J., Anthony, F., and Lourd, M. 1983. Les caféiers sauvages de Tanzanie: Résultats d'une mission de prospection effectuée du 5 Mars au 11 avril 1982. *Café Cacao Thé* 27: 245-258.

Berthaud, J., Guillaumet, J. L., Le Pierres, D., and Lourd, M. 1980. Les caféiers sauvages du Kenya: Prospection et mise en culture. *Café Cacao Thé* 24: 101-112.

Bezancon, G., Bozza, J., Koffi, G., and Second, G. 1977. Diversité génétique d'*O. glaberrima* et d'*O. breviligulata* en observation directe et par électrophorèse d'enzymes. In *Réunion sur les espèces africaines de riz*. IRAT-ORSTOM, Paris, France.

Bezancon, G., De Kochko, A., and Koffi, G. 1984. Cultivated and wild species of rice collected in Guinea. *Plant Genetic Resources Newsletter* 57: 43-46.

Bridson, D. 1982. Studies in *Coffea* and *Psilanthus* section for Part 2 of Flora of East Africa: *Rubiaceae*. *Kew Bulletin* 36(4): 817-59.

Causse, M. 1989. Evolution de la diversité d'une population artificielle d'hybrides entre l'espèce de riz sauvage *Oryza longistaminata* et le riz cultivé *O. sativa*. Thèse de Doctorat, l'Université de Paris IX.

Charrier, A. 1984. Genetic resources of the genus *Abelmoschus*. 84/194. IBPGR, Rome, Italy.

Charrier, A., and Lefèvre, F. 1988. La diversité génétique du manioc: Son origine, son évaluation et son utilisation. *Colloques et séminaires ORSTOM, Yamoussoukro, 1987*.

Clément, J.C. 1985. Les mils pénicillaires de l'Afrique de l'Ouest: Prospections et collects. 85/15. IBPGR, Rome, Italy.

Combes, D. 1975. Polymorphisme et modes de reproduction dans la section des *Maximae* du genre *Panicum* (graminées) en Afrique. Mémoires No 77. ORSTOM, Paris; France.

Dally, A.M. 1988. Polymorphisme des longeurs des fragments de restriction de l'ADN chloroplastique dans la section *Eu-oryza*du genre *Oryza* et implications phyllogénétiques. Etudes et thèses. ORSTOM, Paris, France.

De Kochko, A. 1985. Collecting rice in the Lake Alaotra region in Madagascar. *Plant Genetic Resources Newsletter* 63: 6-7.

De Kochko, A. 1987. Isozymic variability of traditional rice *Oryza sativa* L. in Africa. *Theor. Appl. Genet.* 73: 675-82.

Ghesquiere, A. 1985. Evolution of *Oryza longistaminata*. *Proceedings of International Rice Genetics Symposium*. IRRI, Los Baños, Philippines.

Ghesquiere, A. 1988. Diversité génétique de l'espèce sauvage de riz, *Oryza longistaminata* et dynamique des flux géniques au sein du groupe *sativa* en Afrique. Thèse de Doctorat en Sciences. L'Université de Paris IX, France.

Hamon, S. 1988. Organisation génétique du genre *Abelmoschus* (Gombo): Co-évolution de deux espèces cutivées de gombo en Afrique de l'Ouest (*A. esculentus* et *A. caillei*). Travaux et Documents Microfichés 46. ORSTOM, Paris, France.

Hamon, S., and Charrier, A. 1983. Large variation of okra collected in Benin and Togo. *Plant Genetic Resources Newsletter* 56: 52-58.

Hamon, S., and van Sloten, D. 1987. Characterization and evaluation of okra. In Frankel, O. H., and Brown, A. D. H. (eds.) *The Use of Crop Genetic Resources Collections*. Cambridge University Press, Cambridge, UK.

Hamon, S., and Yapo, A. 1985. Perturbation induced within the genus *Abelmoschus* by the discovery of a second edible okra species in West Africa. *Acta Horticulturae* 182: 133–143.

Hamon, S., Anthony, F., and Le Pierres, D. 1984. La variabilité génétique des caféiers spontanés de la section *Mozambicoffea* (A. Chev). I. Précisions sur deux formes affines *Coffea pseudozanguebariae* (Bridson) et *C.* spp. (A. Bridson) *Adansonia* 2: 207-23.

Hamon, S., Chomchalow, N., Chantaraprasong, C., and Chomchalow, S. 1987. Collecting *Abelmoschus* germplasm in Thailand. *IBPGR/ASEAN Newsletter* 11 (2): 2-6.

Hamon, S., Clément, J. C., Leblanc, J. M., and De Kochko, A. 1986. The cultivated okra in West Africa: Inquiries given by collecting missions in Guinea. *Plant Genetic Resources Newsletter* 65: 34-37.

Lefèvre, F. 1988a. Contribution à l'étude des ressources génétiques africaines du manioc (*Manihot*) spp. en une de leur utilisation en sélection. Thèses de Doctorat en Sciences. L'Université de Paris IX, France.

Lefèvre, F. 1988b. Considérations sur la diversité génétique du manioc en Afrique d'après les premiers résultats d'une analyse enzymatique. *Séminaire international sur la mosaique Africaine du manioc et son controle, Yamoussoukro, Côte d'Ivoire (ORSTOM)*.

Marchais, L., and Tostain, S. 1988. Premières investigations sur la diversité des mils pénicillaires sauvages de l'Ouest africain. In Attere, F., Ng, N. Q., Perrino, P., and Zedan, H. (eds.) *Plant Genetic Resources of Africa*. (vol. 1). IBPGR/UNEP/IITA (in press).

Ollitrault, P. 1987. Evaluation génétique des sorghos cultivés (*Sorghum bicolor*) par l'analyse conjointe des diversités enzymatique et morphologique. Thèses de Doctorat en Sciences. L'Université de Paris, France.

Pernes, J. 1975. Organisation évolutive d'un groupe agamique: La section de *Maximae* du genre *Panicum* (Graminées). Mémoires 75. ORSTOM, Paris, France.

Second, G. 1984. Relations évolutives chez le genre *Oryza* et processus de domestication des riz. Etudes e Thèses. ORSTOM, Paris, France.

Second, G., and Trouslot, P. 1980. Electrophorèse du riz (*Oryza* spp.). Travaux et Documents 120. ORSTOM, Paris, France.

Siemonsma, J. S. 1982. Morphological and cytogenetical indications for the existence of a natural amphiploïd of *Abelmoschus esculentus* (L.) Moench and *A. manihot* (L.) Medikus. *Euphytica* 31(1): 241-52.
Stevels, J. M. C. 1988. Une nouvelle combinaison dans *Abelmoschus* Medik. (*Malvaceae*) un gombo d'Afrique de l'Ouest et Cenrale. *Adansonia* 2: 137-44.
Tostain, S., and Marchais, L. 1989. Enzyme diversity in pearl millet (*Pennisetum glaucum*). 2. Africa and India. *Theor. Appl. Genet.* 77(5): 634-40.
Tostain, S., Hamon, S., Bernus, E., Marchais, L., and Ingram, G. B. 1986. Collection of wild millets in Burkina Faso and Niger. *Plant Genetic Resources Newsletter* 68: 11–15.
Tostain, S., Riandey, M. F., and Marchais, L. 1987. Enzyme diversity in pearl millet (*Pennisetum glaucum*). 1. West Africa. *Theor. Appl. Genet.* 7: 188-93.
Zoundjihekpon, J. 1986. Etude de la variabilité morphophysiologique et enzymatique de cultivars de *Manihot esculenta*. Thèse. L'Université d'Abidjan, Côte d'Ivoire.
Zoundjihekpon, J., and Touré, B. 1983. Utilisation de la technique d'électrophorèse chez le manioc cultivé en champ et *in vitro*. *Annales de l'Université d'Abidjan (Série C)* 19: 213-20.

1.5

Plant Genetic Resources Activities of the Food and Agriculture Organization of the United Nations (FAO)

N. M. ANISHETTY and J. T. ESQUINAS-ALCAZAR

The Food and Agriculture Organization of the United Nations (FAO) has for many years been concerned about the consequence of the loss of genetic variability of crops. It past, current and planned activities in this field are outlined here.

HISTORICAL BACKGROUND

In 1947 and 1948 an FAO subcommittee on plant and animal stocks considered setting up a clearing house for information on germplasm, cooperation in plant exploration, the recording of collections and the removal of artificial barriers to the interchange of stocks. The major accomplishment during the early years was the publication of world catalogues on the genetic stocks of rice, wheat, barley and grain legumes (FAO, 1950a, 1950b, 1958, 1959) and the provision of assistance in the exchange of germplasm.

During the 1950s and early 1960s FAO collaborated with and/or provided logistic and other support to several plant exploration and collecting missions, including: the Australian pasture species collection in the Mediterranean region; the Swedish collection of *Brassica*, *Beta*, *Sinapsis* and grasses in Italy, Greece, Turkey and Yugoslavia; and the Japanese collection of wheat and its wild relatives in the Mediterranean and Middle East and wild rice in the Sahel and East Africa. In addition, FAO field officers made extensive collections of wild and primitive forms of various crops for use in the breeding programs of the countries to which they were assigned and for distribution to specialists in other countries (Whyte and Julén, 1963). Unfortunately, a large part of these collections was lost because no germplasm preservation strategy had been established.

Over the years FAO has developed a seed exchange program in response to a continuous stream of enquiries for samples of seed and other propagating material for use by breeders