COMUNICACIONES

Collecting wild cassavas, *Manihot* spp in Brazil*

Resumo. O autor viajou durante 17 semanas (15 de Fevereiro a 29 de Março, 4 de Julho a 12 de Agosto de 1980. 1º de Fevereiro a 12 de Março de 1981) por nove estados Brasileiros de duas áreas: Nordeste Brasileiro em Estados do Rio Grande do Norte, Ceará, Piaui, Maranhão, Pernambuco, Paraíba e Bahía; Centroeste Brasileiro: estados de Goiás e Mato Grosso do Sul Sementes e/ou estacas foram coletadas e plantadas numa coleção viva.

Numero total de 726 introduções são agora numa coleção viva na Universidade de Brasilia. São: *M. caerulescencs, M. glaziovii, M. dichotoma, M. pseudoglaziovii, M. epruinosa, M. heptaphylla, M. pohlii, M. grahamii, M. zenhtneri, M. reptans. M.* sp (undertermined). 6 (Seize) mil sementes das seguintes espécies são mantidas para que sejam plantadas na próxima estação. São *M. tripartita, M. gracilis, M. falcata, M. fruticulosa, M. longeperiolata, M. oligantha, M. pentaphylla, M. alutacea, M. pruinosa, M. paviaefolia, M. salicifolia, M. purpurea-costata, M. attenuata* e *M. tomentosa.*

A distribuição geográfica destas espécies esta relatada. Avaliação destas instroduções em relação a resistência a Xanthomonas manihotis, Coelosternus manihoti, *e capacidade de formação de raizes esta apresentado. Sementes deste material são disponível aos melhoristas de IITA e CIAT.*

There is evidence that Northeastern Brazil and the states of Goias and Mato Grosso are the main centers of diversity in the genus *Manihot* (1). These sites were found to contain about 50 wild species. A collecting trip in Northeastern Brazil was carried out by this author in 1975. The material collected in that trip proved extremely valuable to plant breeders. For example, plants of *M. glaziovii* that grow in IITA and those which came from that material, showed a high level of resistance to the mealy bug, a very dangerous insect in West Africa. Moreover, crosses between these plants and cassava cultivars were highly fertile. These results were the principal stimulus for the expedition as it showed the need for more exploration in these areas to obtain a broader spectrum of germplasm to be used in plant breeding programs. In addition to this objective, many natural habitats are suffering continuous destruction and a number of wild species are on the verge of extinction (1, 2).

Therefore, saving these genotypes and maintaining them in a living collection was another stimulus for this work.

Materials and methods

To determine localities of wild *Manihot* species, the following procedures were followed:

1. Localities of wild *Manihot* species in Northeastern Brazil, Goias, and Mato Grosso were extracted from the monograph of Rogers & Appan (4).

2. A visit was made to the herbarium of the Universidade Federal do Ceará where a major collection of *Manihot* is deposited. They were studied, and localities of species were determined.

3. Cooperation was obtained from the Brazilian Corporation for Extension and Rural Assistance (Empresa Brasileira de Assistência Técnica e Extensão Rural – EMATER). The chief of the exten-

* Supported by a grant from the International Development Research Centre (IDRC), Ottawa, Canada, and the National Council for Research Development (Conselho Nacional de Desenvolvimento Cientifico e Tecnológico (CNPq), Brasília, Brazil

sion services for cassava contacted his agents in approximately 500 counties and requested that farmers be asked to supply the localities of *Manihot* spp. known to grow wild on their farms and called "Maniçoba". Several agents were very helpful and supplied information, assistance in the field and guided me to the actual localities.

4. Rainfall distribution in Northeastern Brazil was studied. Species adapted to drought regions were determined by comparing their natural habitats with rainfall distribution.

5. Seeds of the collected species were germinated using 26/38 C for 18/8 hours to break dormancy, then planted in a nursery. After 2 months, the seedlings were transplanted to the plots for the collection. Ability to form tubers was examined at this stage.

6. Four months after transplantation, the growing plants were infected artificially by *Xanthomonas manihotis* according to Takatsu and Lozano (5). The infections were applied to 3 plants of each species.

7. Observation of susceptibility of the growing plants to infection by *Coelosternus manihoti* was documented. For this purpose, 50 stems of each species were investigated.

Results and discussion

The help received from EMATER, Empresa Brasileira de Assistência Técnica e Extensão Rural (Brazilian Corporation for Technical Assistance and Rural Extension), was extremely valuable and serves as an example for what can be called a national campaign for saving wild cassavas threatened by extinction. The areas covered and routes followed are shown in Figures 1 and 2. The results of these collecting activities are presented in Tables 1 and 2 including the species collected, the areas of collection and the number of living plants of seeds in storage. A total of 6750 acessions of wild *Manihot* species true seed and cuttings were collected from about 60 sites (Table 1, 2). The sampling was performed on a population basis. Each seed collection was gathered from different plants of the local population taken at random.

The travel dates correlated with the maturation period of the fruit which is normally subsequent to the rainfall in different parts of Brazil. February to March is the most suitable time for collection from the littoral and adjacent areas in Northeastern

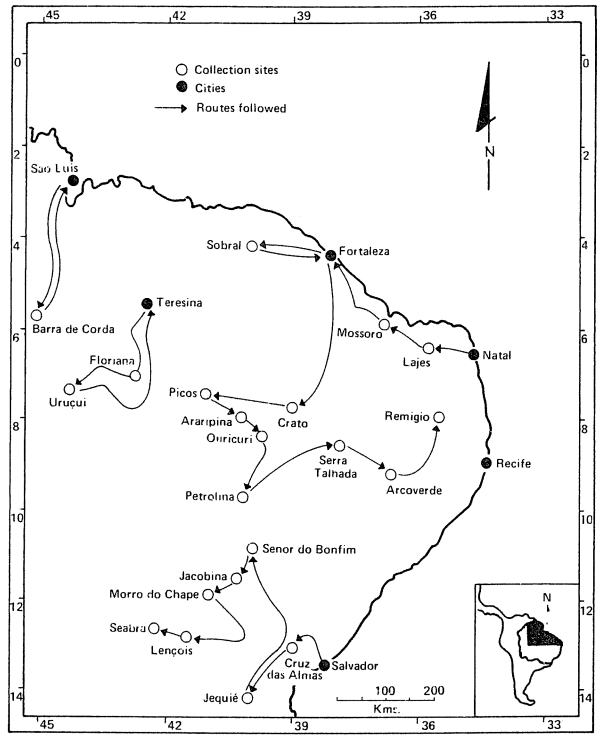

Fig. 1. Route and regions of collection in Northeast Brazil.

Brazil. These areas are known as the "zona de mata" and "zona de agreste" respectively. July to August is the suitable time for collection from the savana regions known as the "catingae." In Goias and Mato Grosso do Sul, the most suitable time is also February to March.

The geographical distribution of *M. pseudoglaziovii* was seen to be restricted to the littoral areas with rainfall precipitation ranging from 1000 – 1400 mm (Figure 3). However, material of this species was collected from microregions with a very low precipitation of only 500 mm per year, such as the region of Remigio, the state of Paraiba. It seems that this species has developed certain biotypes adapted to drought conditions. These biotypes can be used in breeding programs as sources of resistance to drought.

Occurence of *Manihot glaziovii* was restricted to dry regions such as Crato and Sobral with rainfall precipitation of 600 – 700 mm per year. This species can also be used as another source of drought tolerance. Another species, *M. caerulescence*, was also collected from dry regions, Picos and Petrolina (500 – 600 mm per year). Geographic distribution of this species had been studied earlier by the author (3). This new data confirms the previous results of its

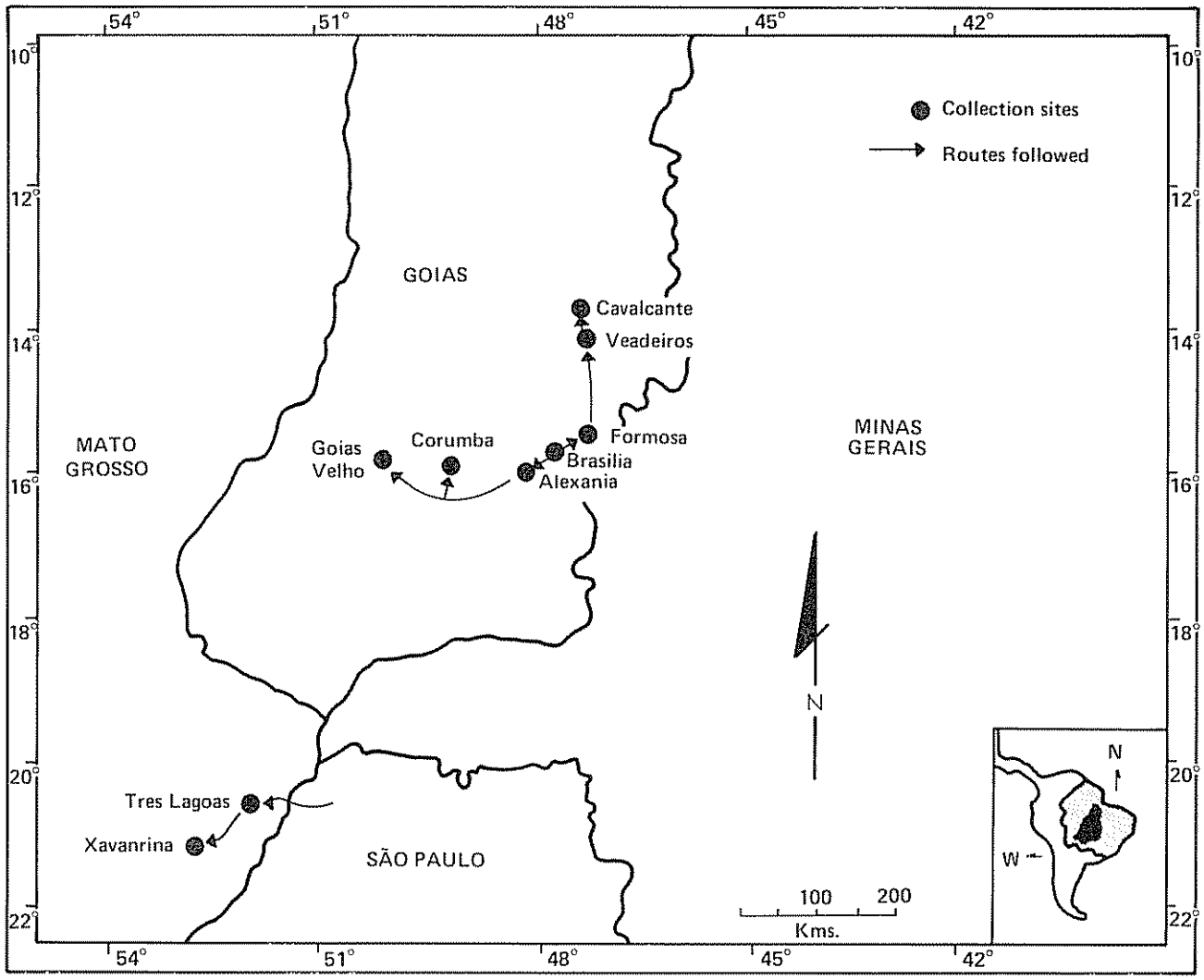

Fig. 2 Route and regions of collection in West-Central Brazil

large distribution covering vast areas with large range of precipitation.

Manihot attenuata, *M. purpurea-costata*, *M. aluta-cea* and *M. peltata* were collected from the Veadeiros-Cavalcanti region in the state of Goias. The first two species are endemic to this region as they have not been reported to occur in any other. Probably this is due to the dramatic heterogeneity of the topography of this region with a high plateau of 1600 m elevation. Probably this has provided the isolation of fragmented populations that made possible evolution of these two species. *Manihot attenuata* may provide a considerable source for tolerance to cool temperature in breeding programs because it grows at elevations of about 1600 – 1700 m.

Preliminary evaluation of the living plants at the Estação Biológica, Universidade de Brasília (Table 3) showed, that *M. pseudoglaziovii* is highly resistant to *Xanthomonas manihotis*. Probably this resistance had been acquired because it grows naturally in humid regions and the littoral areas where natural selection may have worked to bring out these types. The same thing can be said for *M. reptans* which also grows in similar conditions in Central Brazil.

The only species found to form tubers was *M. caerulescens*. As shown by the author earlier (3), this

Table 1. *Manihot* species collected as seeds, locality of collection and number of living plants at the Estaçao Biológica, Universidade de Brasília.

Species	Locality of collection	Nº of living plants in cultivation
M. caerulescens	Picos, Floriano, Urucui (PI), Petrolina, Araripina (PE), Morro de Chapeu (BA) Tres Lagoas (MS)	261
M. glaziovii	Sobral, Crato (CE)	145
M. dichotoma	Serra talhada, Ouricuri (PE)	26
M. pseudoglaziovii	Natal, Lajes, Mossoro (RN), Campina Grande, Remigio (PB)	72
M. epruinosa	Barra de Corda (MA)	16
M. heptaphylla	Seabra, Senhor de Bonfim (BA)	21
M. pohlii	Jequie (BA)	7
M. spp.	Jacobina (BA)	7
Natural hybrid	Cruz das Almas (BA)	6
M. reptans	Alexania (GO)	86
M. zenhrneri	Goiânia (GO)	71
M. grahamii	Sta Helena (GO)	8

species had suffered frequent natural hybridization with cultivated cassava resulting in the production of various biotypes. Probably this explains the acquiring ability for tuber formation.

Manihot pohlii collected from Jequie is a promising source for producing natural rubber under "cerrado" conditions. Wild plants growing in this region had been utilized by local farmers for the production of natural rubber.

This is the first report of possible economic utilization of this plant for this pupose. Moreover, it proved easy propagation by cuttings in our living collection. This fact would make it a good candidate for breeding programs to improve rubber productivity.

Many parts of Northeastern Brazil have not yet been visited. There is an urgent need for the systematic collection of *Manihot* germplasm from these

Table 2. *Manihot* species collected as seeds, locality of collection and the number of seeds now in the seed bank at the Departamento de Engenharia Agronônica, Universidade de Brasília.

Species	Locality of Collection	Nº of seeds
M. reptans	Coromba, Goiás Velho, Alexania Formosa, Veadeiros (GO)	711
M. zenhtneri	Goiania (GO)	322
M. salicifolia	Xavantina (MS)	110
M. purpurea-costata	Veadeiros (GO)	205
M. stricta	Xavantina (MS)	180
M. attenuata	Veadeiros (GO)	132
M. gracilis	Luziania (GO)	561
M. falcata	Alexania (GO)	282
M. fruriculosa	Alexania (GO)	410
M. oongeperiolata	Brasília (GO)	475
M. oligantha	Cristalina (GO)	223
M. pentaphylla	Goiás Velho (GO)	396
M. alutacea	Goiás Velho (GO)	341
M. pruinosa	Goiás Velho (GO)	24
M. paviaefolia	Coromba de Goiás (GO)	533
M. tomentosa	Formosa (GO)	341
M. tripartita	Goiania (GO)	615

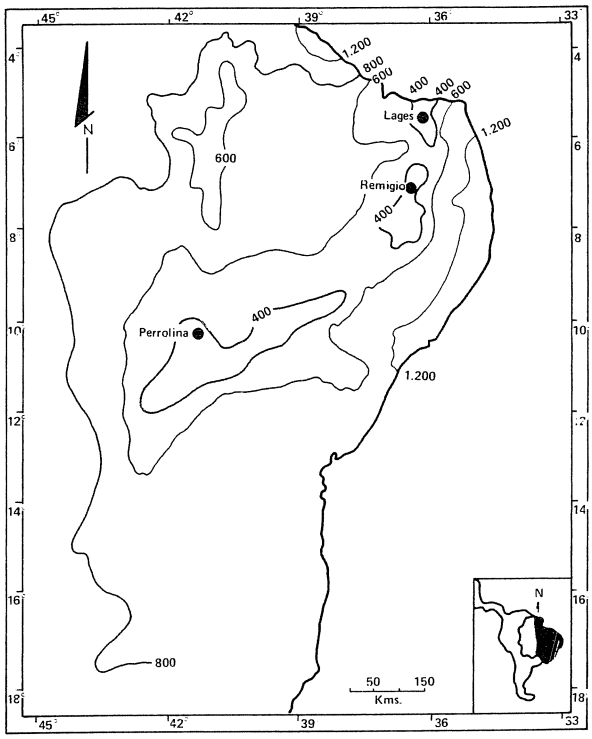

Fig. 3. Average annual rainfall distribution in Northeast Brazil.

regions. Natural hybrids should receive more attention in collection work because of their assumed easy crossability with cassava and their large charge of genetic variability. A new approach to collection should be the collaboration of researchers with extension agents in the area through suitable arrangements with central extension administration.

Summary

The author has travelled for 17 weeks (February 15 – March 29, July 4 – August 12, 1980; February 1 – March 12, 1981) in nine Brazilian states distributed in two main areas: Northeastern Brazil in the states of Rio Grande do Norte, Ceará Piaui, Maranhão, Pernambuco, Paraiba and Bahia, and Wester-Central Brazil in the states of Goias and Mato Grosso do Sul. Seeds and/or cuttings were collected and planted in a living collection.

A total of about 726 introductions are now being grown at the Universidade de Brasília. They are: *M. caerulescens, M. glaziovii, M. dichotoma, M. pseudoglaziovii, M. epruinosa, M. heptaphylla, M. pohlii, M. grahamii, M. zenhtneri, M. reptans, M.* sp. (undetermined), and a natural hybrid. Six thousand seeds of the following species are being maintained until planting in next season: *Manihot tripartita, M. gracilis, M. falcata, M. fruticulosa, M. longeperiolata, M. oligantha, M. pentaphylla, M. alutacea, M. pruinosa, M. paviaefolia, M. stricta, M. salicifolia, M. purpurea-costata, M. attenuata* and *M. tomentosa.*

The geographical distribution of these species is reported.

Evaluation of the introductions in relation to resistance to *Xanthomonas manihoti* and *Coelo-*

Table 3. Evaluation of some of the collected species grown in the living collections at the Estação Biológica Universidade de Brasília.

Species	Description
M. caerulescens	Susceptible to *Xanthomonas manihotis* and *Coelosternus manihoti,* collected from regions with 600 mm rainfall per year; rubber producer.
M. pseudoglaziovii	Highly resistant to *Xanthomonas manihotis.* Susceptible to *Coelosternus manihotis* (Figure 5) some collections from regions with precipitation as low as 500 mm per year.
M. glaziovii	Susceptible to *Xanthomonas manihotis,* very susceptible to *Coelosternus manihoti* (Figure 6). From dry regions with 700 mm of precipitation per year; rubber producer.
M. pohlii	Highly resistant to *Coelosternus manihoti.* Easily propagated by cuttings; excellent rubber producer in Cerrado habitats.
M. reptans	Highly resitant to *Xanthomonas manihotis* and *Coelosternus manihoti.*
M. zenhtneri	Susceptible to *Xanthomonas manihotis* and *Coelosternus manihoti.*
M. grahamii	Highly resistant to *Coelosternus manihoti.*

sernus manihotii as well as the capacity to form rubber is presented here. Seeds of these materials have been made available to breeders of IITA and CIAT.

Acknowledgments

I like to extend my gratitude to IDRC, Ottawa, and the CNPq, Brasilia, for their financial support, to Drs. Barry Nestel, formerly of IDRC and Roberto Meirelles de Miranda of UnB for their encouragement, Eng. Agro. Jairo Ribeiro da Silva, Director for cassava extension, EMATER, for his valuable help with *Xanthomonas* inoculations.

July 5, 1981

NAGIB M. A. NASSAR*

* Departamento de Agronômica Universidade de Brasilia 70.910 – Brasilia, D. F. BRASIL.

Literature cited

1. NASSAR, NAGIB. M. A. Conservation of the genetic resources of cassava (*Manihot esculenta*): Determination of wild species localities with emphasis on probable origin. Economic Botany 32(3):311-320. 1978.

2. NASSAR, NAGIB, M. A. A study of the collection and maintenance of the germplasm of wild cassavas, *Manihot* spp. Turrialba 29:221-224. 1979.

3. NASSAR, NAGIB. M. A. Three brazilian *Manihot* species with tolerance to stress conditions. Canadian Journal of Plant Science. 59:553-555. 1979.

4. ROGERS, D. J. and APPAN, S.G. Flora Neotropica. Monograph No. 13, *Manihot, Mahinotoides (Euphorbiacea)*, Hafner Press, New York p. 272. 1973.

5. TAKATSU, A. and LUZANO, J. C. Translocación del agente causal del amplo bacterial de la yuca (*Manihot esculenta* Crantz) en los tejidos de hospedero. Fitopatologia 10(1):13-22. 1975.

Fewer beetle pests on beans and cowpeas interplanted with banana in Costa Rica

Resumen. Se estudió la densidad de los escarabajos *Diabrotica balteata* y *Cerotoma ruficornis rogersi* en monocultivo de frijol común y de frijol de costa (caupí) así como en el cultivo asociado de estas dos especies con banano. El trabajo se realizó en Costa Rica, haciendo el muestreo de campo con la ayuda de una red. La población en Costa Rica, fue aproximadamente tres veces más alta en los monocultivos que en los cultivos asociados, lo que quizá permita explicar las diferencias en rendimiento obtenidas cuando se intercalan leguminosas en el trópico

Beans and cowpeas are frequently interplanted with other crops throughout the subtropics and tropics. What are the advantages of growing the crops in polycultures? Although much speculation has focused on the possibility that there are fewer insect pests on these crops when interplanted, there has been little empirical work. Studies in annual cropping systems in the netropics have shown that there are fewer beetle pests on bean when interplanted with corn (1) or with corn and squash (2). This communication demonstrates that there are significantly fewer bettles (*Diabrotica balteata* and *Cerotoma ruficornis rogersi*) on beans and cowpeas when interplanted with banana. Both *D. balteata* and *C. ruficornis* are important pests throughout Central America. The adults eat the leaves and flowers of the plants and transmit viral diseases. The larvae eat the roots.

Material and methods

The beetles were sampled from bean and cowpea plants in three monocultures of bean (*Phaseolus vulgaris;* CATIE-1), three monocultures of cowpea (*Vigna unguiculata*; V-44), three polycultures of bean-banana, and three polycultures of cowpea-banana. In each case, one monoculture was planted immediately adjacent to a comparable polyculture so that there were three pairs of bean monoculture/bean-banana polyculture, and three pairs of cowpea monoculture/cowpea-polyculture. Each plot was 10 m x 10 m. Beans and cowpeas were planted at the same density in all plots. The work was conducted in July, 1976, at the Tropical Agriculture Research and Training Center at Turrialba, Costa Rica.

The beetles were sampled with a standard sweep net 38 cm in diameter when the beans and cowpeas were approximately six weeks old and about 35 cm in height. It is at this stage of plant growth that there is the highest number of beetles per plant. The banana was approximately 3 m in height and provided considerable shade, yet the bean and cowpea plants