Fruits - vol. 39, n° 3, 1984

The banana breeding programme at the Centro nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), Bahia State, Brazil.

K. SHEPHERD and E.J. ALVES*

LE PROGRAMME D'HYBRIDATION BANANIERE AU CENTRE NATIONAL DE RECHERCHES SUR LE MANIOC ET LES CULTURES FRUITIERES.
(CNPMF) Etat de Bahia, Brésil

K. SHEPHERD et E.J. ALVES.

Fruits, Mars 1984, vol. 39, n° 3, p. 154-157

RESUME - Rappel de la distribution variétale au Brésil, et de l'importance du cultivar 'Prata' (Pome) comme banane douce de grande consommation, alors que la banane 'Maçã', ou les Cavendish sont appréciés dans d'autres régions.
Des efforts sont faits pour rassembler des collections de germplasm, en vue de développer des programmes d'hybridations déjà débutés (CNPMF, Bahia).

INTRODUCTION

Bananas are cultivated in all the Brazilian states, whether equatorial or more or less temperate, and from the coastal belt to the tablelands of the interior. The present production, of more than 4 millions tonnes per annum, is almost all consumed within the country. Exports of fruit of the Cavendish subgroup of cultivars never had great relative significance, although before 1940 more than ten millions of bunches a year were exported from Sao Paulo state (CUNHA, 1948), that is of the order of 250,000 tonnes. In recent years there has been only a small exportation to Uruguay and Argentina.

As in other producing countries, banana cultivation in Brazil is becoming over less profitable because of the diseases and pests already present in the country, and is threatened by others yet more serious. Taking these problems into account, and the low productivity of several preferred cultivars, the Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) decided some years ago to establish a breeding programme for bananas.

* - K. SHEPHERD, Consultant, IICA/EMBRAPA/CNPMF, Caixa postal 007, CEP 44380 - Cruz das Almas - BA.
E.J. ALVES - Eng° Agro., M.Sc., EMBRAPA/CNPMF, Caixa postal 007, CEP 44380 - Cruz das Almas, BA.

A paper presented at the 6th ACORBAT held in Guadeloupe F.W.I. from 16-20th May, 1983.

PRINCIPAL CULTIVARS AND THEIR PROBLEMS

The names of some of the cultivars have synonyms in the diverse regions of Brazil, but the intention here is to use only the commonest ones and equivalents among the types described by SIMMONDS (1966).

In the majority of states the cultivars most appreciated are the dessert bananas of the AAB genomic group ; in the markets of large cities the fruits of these cultivars command a price per dozen as much as 50 % higher than that of the larger fruits of the Cavendish subgroup (AAA). The most favoured is still the 'Maçã' banana ('Silk'), in spite of the Panama disease problem which has almost eliminated its cultivation in the largest consuming states, and which

forces its plantation ever further from the markets. At present the states with significant production are in the Centre-West of the country, such as Goias, and in the North, represented by Rondonia, whence bunches are transported by truck over distances exceeding two thousand kilometres. Even in these states the plantations are ephemeral because of the disease.

The other important cultivar of the AAB group is the 'Prata' or 'Branca' banana ('Pome'), which is found in every state and territory of Brazil, being quite tolerant of the elevated lands of the interior. The centres of greater production are in the South-East and the Nord-East. This cultivar also is susceptible to Panama disease in some situations and it is rather susceptible to yellow Sigatoka.

Mainly in the state of Santa Catarina, in the south of Brazil, 'Prata' is replaced by 'Enxerto' or 'Prata Aña', cultivated on the hill slopes. It is a semi-dwarf cultivar of the same AAB group but, despite the second name and other synonyms, it is not a mutant of 'Prata' ; its international synonymy is not yet certainly known. It has the same disease problems as 'Prata'. Another relatively recent substitute in some places is 'Mysore', which has better disease resistance.

The Cavendish subgroup (AAA) has its greatest production in the coastal belt of the sub-tropical south, occupying a large area mainly in the littoral of Sao Paulo state. The commonest cultivars still are 'Nanicão' (at least very similar to 'Valery') and 'Nanica' ('Dwarf Cavendish'). They have the well-known problems of yellow Sigatoka and of nematodes and borers (*Cosmopolites*), pests which in fact attack all cultivars to a certain degree.

Cooking bananas are not important except in the Amazon basin, where 'Figo' of the ABB group ('Bluggoe') and plantains (ABB) are cultivated as a major carbohydrate source for the people. In this region, still chiefly to the north of the river, there exists a problem with Moko disease (*Pseudomonas*) spread from neighbouring countries (MARTINEZ, 1981).

Black Sigatoka has not yet arrived in Brazil, but the threat of this disease is clearly recognised, with its high potential for economic losses, even disastrous ones.

OBJECTIVES OF THE BREEDING PROGRAMME

The programme ought to be directed to all the principal types of cultivar, at least as far as studying or confirming the behaviour of the relevant crosses in the conditions of Bahia. In this respect, there is already the former experience of workers in Trinidad (CHEESMAN and DODDS, 1942 ; SHEPHERD, 1960 a) to serve as a guide.

However, the priority must be the production of hybrids with flavour and texture similar to those of 'Maçã' or 'Prata', more productive and resistant to the principal diseases and pests.

GERMPLASM FOR BREEDING

Any banana breeding programme of a conventional type needs fertile diploid material. The germplasm available in Brazil up to last year included only two diploid cultivars, 'Ouro' ('Sucrier') and 'Colatina Ouro'. 'Sucrier', as Type 19 in the Trinidad collection, neither had useful pollen nor viable seeds (DODDS, 1943) ; there is no greater hope for 'Ouro'. 'Colatina Ouro', whose identity elsewhere is unknown, also lacks pollen and there are attempts now to find out if it has any female fertility. The first two bunches crossed did not have seeds.

Also there were already, in the germplasm bank at the CNPMF, five forms of diverse subspecies of wild *Musa acuminata*, received some years ago from Jamaica, two accessions of *M. balbisiana* and one of *M. ornata*.

The initial assistance in 1982 came from Tropical Agriculture Research Services (SIATSA) in Honduras, who donated three more forms of *M. acuminata* and seven diploid cultivars of that species, as well as the triploid cultivar 'Highgate' (AAA). The plante arrived in the form of meristem cultures at the Centro Nacional de Recursos Genéticos (CENARGEN) in Brasilia ; they have already been released from post-entry quarantine there and are located in the active germplasm bank at CNPMF.

With the aim of introduction or collection of germplasm, a journey was made to Asia, with visits to India, the Philippines and Papua New Guinea (SHEPHERD and FERREIRA, 1982 a). In India, the Coimbatore collection (BHAKTHAVATSALU and SATHIAMOORTHY, 1979) was replanted and, moreover, was menaced by the Bunchy Top virus. No material was introduced or solicited from this collection. The Philippines have good collections of banana germplasm, both of national cultivars and material proceeding from Malaysia and Thailand (VALMAYOR, 1979 ; VALMAYOR et alii, 1981 a and b). The collections are maintained at Los Baños in Luzon by the Institute of Plant Breeding, and at Davao in Mindanao by the Bureau of Plant Industry. The visit was made to Los Baños and there also were seen a few plants with symptoms of Bunchy Top. Nevertheless, samples were sent to Brazil of 34 accessions, from symptomless plants, almost all of them of diploid material.

The large collection of the Papua New Guinea Biological Foundation is currently maintained by the Department of Primary Industry close to Port Moresby. It is yet insufficiently classified, despite the efforts of visitors (SHEPHERD and FERREIRA, 1982 b). The reference cited includes a classification which remains provisional, from the lack of chromosome counts at that time. Such counts among the 94 accessions consigned to Brazil reveal several errors,

chiefly in the presence of some triploids (AAA group) in the listing for the «AA» group. Further, the existence has been established of diploid hybrids of *M. acuminata* with *M. balbisiana* and *M. schizocarpa*. Certainly this collection is still very interesting for its frequency of diploid cultivars.

On the return journey there was also a stop in Hawaii, whence 12 more accessions were brought. All the new material was put into post-entry quarantine at CENARGEN, where the greater part was transferred immediately to meristem cultures. There seem to exist no phytosanitary problems with the Papua New Guinea germplasm and some plants are now being released to the CNPMF.

METHODS OF BANANA BREEDING

The procedure so far practised in the programmes of the Caribbean islands and in Honduras depends basically on the capacity of various triploid cultivars to produce tetraploid embryos, when the female flowers receive haploid pollen. That is evident is that the tetraploid hybrid is generally of a type resembling its triploid mother, having received most of its genotype from that source.

On the evidence so far published, the production and germination of seeds from triploid mothers are rarely good, and the ploidy levels of the seedlings are variable depending on the mother (CHEESMAN and DODDS, 1942 ; SHEPHERD, 1960 a). Among the main cultivars it seems that the Cavendish subgroup is very sterile. The Plantain subgroup also has no reputation for fertility, although the first pollinated bunch of the 'Terra' cultivar in Bahia contained several good seeds ; these cultivars merit further study. On the other hand the subgroup of 'Gros Michel' (AAA), the 'Maçã' banana (AAB), the subgroup of 'Prata' (AAB) and the variations of 'Figo' ought to yield tetraploid embryos. In this respect there already exist in Brazil two spontaneous tetraploid hybrids, one derived certainly from 'Maçã' and the other from 'Prata'.

Present trials in the CNPMF programme should better illustrate the fertility levels of some cultivars. Up to the end of March 1983 there were already more than 300 bunches pollinated, including approximately 150 of six clones of 'Prata', 60 of 'Prata Anã', 60 of 'Mysore' and 30 of three clones of 'Figo'.

On a large scale, tetraploid hybrid production has been tried previously only in the subgroup of 'Gros Michel' (AAA), and most recently in the shorter-statured variations 'Cocos' and 'Highgate'. Some of the factors are recognised that control the production of seeds in 'Gros Michel' itself, yet this production was very low (SHEPHERD, 1954 et 1960 b). In general there is evidence to suppose that the potential fertility might be considerably greater in several cultivars, the chief problem being the inefficient penetration of pollen tubes into their ovaries (DODDS, 1943 ; SHEPHERD, 1960 a). The stage of flower pollinated and the nutrition of the ovary may both be important.

Further studies are intended on this subject, even to the fertilisation and culture of ovules *in vitro*. In the germination of valuable seeds the method of embryo culture is indispensable, eliminating seed dormancy and perhaps endosperm deficiencies. It achieved great success in Honduras (ROWE and RICHARDSON, 1975) and earlier in Jamaica. Techniques are yet needed to eliminate the style and the apical part of the ovary, in the procurement of fertilisation.

There are other alternatives of the conventional method to consider, being means for the production of triploid plants. For example, it is possible to cross some hybrid tetraploids once again with diploids. Such tetraploids, perhaps mainly of the genomic types AAAA and AABB, could arise from triploid cultivars, or from diploids, after treatment of embryos or somaric meristems with drugs such as colchicine.

Alternatively, diploids can be sought that have the natural capacity to generate spontaneous triploid embryos. Such diploids of the AA type should be rare ; those of AB type offer more hope in triploid production, at least of the AAB group.

As a general rule, new generations of triploid plants ought to present great variability, and the success of the method will depend on the creation and evaluation of multitudes of plants. Another consideration is the rigour to be applied in evaluation. Any new cultivar of the AAA group needs to be of a very high standard, in agronomic and physiological terms, to take the place of the Cavendish subgroup. On the other hand, the present sweet banana cultivars of the AAB group do not have optimal agronomic characteristics, and the severity of evaluation may rest more on physiological qualities, including taste and texture of the ripe fruit.

At all events, the final results of any method will depend on the quality of diploid germplasm used. Presently, there are only the wild forms to provide pollen. They can offer disease resistances, but they have unfavourable genotypes in the sense of their small fruits. Even the AA group cultivars should lack one or another desirable character. In fact good results must await the availability of diploid hybrids selected for their combinations of good qualities. It is from the want of this fundamental phase that any new programme of banana breeding must be long-term.

REFERENCES

BHAKTHAVATSALU (C.M.) and SATHIAMOORTHY (S.).
Banana clonal situation in India.
Fruits, 34 (2), 99-105. 1979.

CHEESMAN (E.E.) and DODDS (K.S.).
Genetical and cytological studies of *Musa*. Certain triploid clones.
J. Genet., 43 (3), 337-357, 1942.

CUNHA (J.F.) da.
Cultura de bananeira.
Rio de Janeiro, Min. Agric.-SIA, 1948, 104 p.

DODDS (K.S.).
Genetical and cytological studies of *Musa*. V.- Certain edible diploids.
J. Genet., 45 (2), 113-138, 1943.

MARTINEZ (J.A.).
O moko da bananeira no Brasil e no mundo.
In : *Moko ou murcha bacteriana da bananeira, Cruz das Almas, EMBRAPA/CNPMF*, 1981, p. 15-18 (CNPMF. Documentos, 6).

ROWE (P.R.) and RICHARDSON (D.L.).
Breeding bananas for disease resistance, fruit quality and yield.
La Lima, SIATSA, 1975, p. 18 (SIATSA, Boletin, 2).

SHEPHERD (K.).
Seed fertility of the Gros Michel banana in Jamaica.
J. Hort. Sci., 29 (1), 1-11, 1954.

SHEPHERD (K.).
Seed fertility of edible bananas.
J. Hort. Sci., 35 (1), 6-20, 1960 a.

SHEPHERD (K.).
Seed fertility of 'Gros Michel' bananas.
Tropical Agriculture, Trinidad, 37 (3), 211-231, 1960 b.

SHEPHERD (K.) and FERREIRA (F.R.).
Relatório de viagem internacional : Italia, India, Filipinas, Nova Guiné, Havai, 1982 a, 10 p.
Unpublished, but presented to IBPGR, Rome, in English translation.

SHEPHERD (K.) and FERREIRA (F.R.).
The Papua New Guinea Biological. Foundation's banana collection at Laloki, Port Moreshy, PNG, 1982 b.
(Report presented to IBPGR, Rome).

SIMMONDS (N.W.).
Bananas.
2. ed. Longmans, London, 1966, 466 p.

VALMAYOR (R.V.).
Status report of banana and plantain germplasm resources in Thailand, Burma and Malaysia,
Rome, IBPGR, 1979.
(Mimeographed report, AGPE:IBPGR/79/18).

VALMAYOR (R.V.), RIVERA (F.N.) and LOMULJO (F.M.).
Philippine banana cultivar names and synonyms.
Los Baños, Inst. of Plant Breeding, Univ. of the Philippines, 1981 a, 16 p.

VALMAYOR (R.V.), RIVERA (F.N.), LOMULJO (F.M.) and PASCUA (O.).
Germplasm collection, maintenance and evaluation for bananas and plantains in South-East Asia.
in : *Annual Report 1980, Los Baños, Inst. of Plant Breeding, Univ. of the Philippines*, 1981 b.