# Evaluation and Utilization of Introduced *Musa* Germplasm in India

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Banana and plantains (*Musa* spp.) have got an important niche as a major staple food in India as well as other tropical countries. Their cultivation has become a source of livelihood for the marginal and small farmers across the world. In India, banana and plantains lie interwoven with culture and tradition. India boasts of its polyclonal germplasm with more than 20 varieties contributing to commercial cultivation and over 30 serving as choice cultivars (Uma *et al.*, 2002). But almost all varieties are threatened by a wide range of pests and diseases, and constitute the most significant constraint in *Musa* production. Important diseases of *Musa* include leaf spots diseases (Sigatoka complex) caused by species of *Mycosphaerella*, Fusarium wilt (Panama disease) caused by *Fusarium oxysporum* f. sp. *cubense*, bacterial wilts caused by *Erwinia carotovora etc.* Viral diseases like Banana bunchy top, Banana bract mosaic, Banana streak and Cucumber mosaic are economically important. Pests include nematodes (*Radopholus similes, Pratylenchus coffeae, Meloidogyne incognita* are important) and the borers (*Cosmopolites sordidus* and *Odoiporus longicollis*). Breeding for resistant cultivars and integrated pest and disease management are the only options for sustainable and economically viable banana production.

Banana is one of the toughest crops for improvement through breeding, due to inherent sterility. However, genetic improvement of diploids (by crossing and selection) stared in the early 1930s on the principle that with a generally fixed female parental contribution, success of hybrids must depend totally on the positive genetic qualities transmitted by the pollen. Subsequently tetraploid hybrids were developed; Currently efforts are underway to breed new hybrids through classical breeding as well as biotechnological methods and to popularize them among growers. Various national and international breeding programmes like Fundación Hondureña de Investigación Agrícola (FHIA), Honduras, International Institute for Tropical Agriculture (IITA), Nigeria, Centre de Recherches Regionales sur Bananiers et Plantains (CRBP), Cameroon, etc. have resulted in the release of more than 25 superior hybrids.

The International Network for Improvement of Banana and Plantains (INIBAP), Montpellier, France, is instrumental in developing a network for collection, conservation and distribution of germplasm and improved global hybrids. Additionally, an International *Musa* Testing Programme (IMTP) is a collaborative effort in which elite *Musa* varieties produced by breeding programmes, as well as promising germplasm accessions from the INIBAP collection, are evaluated in sites worldwide (Orjeda, 2000). IMTP has been running since 1990 as a partnership between National Agriculture Research Systems, INIBAP and breeding programmes. India is a partner in the IMTP in which many hybrids were evaluated. With the National Research Centre for Banana (NRCB), Trichy, Tamil Nadu, as the nodal center, India has four test centers to undertake trials of evaluation of global hybrids against *Fusarium* wilt, Sigatoka, nematodes, and performance in farmers' fields. This paper briefly describes the status of introduced hybrids and germplasm of *Musa* and their extent of utilization in India.

Exotic banana hybrids and cultivars were obtained from the world collection of banana held at INIBAP Transit Centre (ITC), Leuven, Belgium in the form of proliferating *in vitro* cultures. The cultures were quarantined at National Bureau of Plant Genetic Resources (NBPGR), New Delhi and conserved in its *in Vitro* Genebank. They were subcultured in Murashige and Skoog's (1962) medium with 3% sucrose, 1-3 mg/l $N^6$-benzyladenine, 0.1-0.5mg/l IAA for bulking up. In a phased manner during 1994-2004, several hybrids (Table 1) and cultivars were supplied to the NRCB for field evaluation and trial in the farmers' fields.

During the second phase of IMTP, 21 accessions were screened against Fusarium wilt (*Fusarium oxysporum* race 4) and the results showed that the introductions namely Bluggoe, Burro Cemsa (ITC 1259) and Saba (ITC 1138), despite their greater rating for vascular

**Table 1. Details of some of the promising global hybrids evaluated under the IMTP by NRCB, Trichy**

| INIBAP No. | NBPGR No. | Name of Hybrid | Parentage | Important Traits |
|---|---|---|---|---|
| *Source Institute: International Institute for Tropical Agriculture (IITA), Nigeria* | | | | Sturdy, high yielding with resistance to Black Sigatoka |
| ITC 1296 | EC468354 | **BITA-2** (TMB x 1378) | Pisang Awak cv. Fougamou X *M. balbisiana* 1-63 | |
| ITC 1297 | EC426459 | **BITA-3** (TMB x 5295) | AAB Laknau, cv. Laknau x Tjau lagada | High yielding with resistance to Black Sigatoka, suitable for culinary purpose |
| *Source Institute: Centre de Recherches Regionales sur Bananiers et Plantains (CRBP), Cameroon* | | | | |
| ITC 1344 | EC497313 | CRBP-39 | AAB – Plantain cv. French clair x M53 (4X) | Highly resistant to Black Sigatoka, possess good cooking qualities |
| *Source Institute: Fundación Hondureña de Investigación Agrícola (FHIA), Honduras* | | | | |
| ITC 0504 | EC501358 | FHIA-01 | AAB – Pome cv. Prata Ana X Prata Ana (Dwarf Prata) SH 3142 | Resistant to Black Sigatoka, burrowing nematodes and race 1 and 4 of *Fusarium* wilt; tolerant to drought and cold, fruits have good apple flavour and long green life; suitable for cooking and beer making |
| ITC 0505 | EC501359 | FHIA–02 | AAA – Cavendish cv. Williams x SH 3393 | Fruits are sweet in taste similar to Cavendish bananas but possess a shorter green life. Susceptible to *Fusarium* wilt |
| ITC 0506 | EC501360 | **FHIA–03** | (Gaddatu x BB) x SH 2471- SH 3386 SH 3386 x SH 3320 | Possess good resistance to Black Sigatoka, tolerant to marginal soil fertility and rainfall, performs well at both sea level and high altitudes; resistant to strong winds, drought and tolerant to cold; hybrid is highly suitable for homestead gardens |
| ITC 1264 | EC407587 | **FHIA–17** | Cultivar AAA – Gros Michel Highgate x SH 3362 | Possess good resistance to Black Sigatoka and race 1 of *Fusarium* wilt |
| ITC 1319 | EC467908 | **FHIA–18** | AAB – Pome cv. Prata Ana x SH 3142 | Resistant to Black Sigatoka; fruits are sweet acid in taste with apple flavour |
| ITC 1332 | EC469509 | **FHIA–21** | AAB – Plantain cv. AVP – 67 x SH 3142 | French plantain is resistant to Black Sigatoka and has excellent plantain flavour; twice as productive as False Horn; recommended for home gardens |
| ITC 1265 | EC468351 | **FHIA–23** | cv. AAA – Gros Michel Highgate x SH 3362 | Tolerant to Black Sigatoka and resistant to race 1 of *Fusarium* wilt |
| ITC 1418 | EC467911 | **FHIA–25** | SH 3648 (4X) x SH 3142 (2X) | Dwarf and sturdy with high level of resistance to Black Sigatoka; fruits are easy to peel, fast to cook and possess excellent texture and flavour both boiled and fried and long green life after harvest |

discolouration performed well and yielded good bunches indicating their resistance to Fusarium wilt. Similar screening was done for Sigatoka leaf spot diseases (*Mycosphaerella* spp.) during the third phase of IMTP. Among the nine accessions tested, the exotic hybrids namely TMB 5295-1, FHIA-18, CRBP-39 and FHIA-21 were found to be resistant to Sigatoka leaf spot diseases. When the introductions were screened against the three major nematodes namely *Pratylenchus coffeae, Meloidogyne incognita* and *Helicotylenchus multicinctus,* none were found to be resistant or immune to all the three nematodes. However GCTCV 215 was found to be resistant to *P. coffeae* alone while Pisang Berlin (ITC 0611), Pisang Ceylon (ITC 1441) and FHIA-3 were found to be resistant to *H. multicinctus* alone.

Superior hybrids and clones were evaluated at NRCB, Trichy and the promising ones were identified and distributed for multilocation trials under the All India Coordinated Research Project (AICRP)-Tropical Fruits for commercial cultivation (Anon., 2004). The varieties evaluated are detailed in Table 2.

Out of these varieties, FHIA-01, FHIA-03, FHIA-23 and Saba, which were found to be highly promising, have been taken to farmer's fields for large scale testing under various agro-climatic conditions across the country. The programme on evaluation of global hybrids in the farmers' fields is being partially supported by BAPNET/ INIBAP, France. Under this three major hybrids namely FHIA-01, FHIA-03 and FHIA-23 have been multiplied and supplied by NRCB, Trichy to various farmers. FHIA-01 was widely tested in Maharashtra by a leading tissue culture industry and the fruits were evaluated for post-harvest processing and preparation of puree. FHIA-01 was found to be more suitable for processing with high sugar:acid ratio and low polyphenol oxidation of the pulp, which results in pulp browning. The consumers

**Table 2. Promising exotic hybrids of *Musa* identified by NRCB for multi-location trials for commercial cultivation under the AICRP-Tropical Fruits**

| AICRP Centre | Hybrid No. |
|---|---|
| National Research Centre for Banana, Trichy, Tamil Nadu | FHIA-01, FHIA-03, FHIA-18, FHIA-23, FHIA-21, FHIA-25, CRPB-39, SH-3640 |
| University of Agricultural Sciences, Arabhavi, Dharwad, Karnataka | FHIA-01, FHIA-03, FHIA-17 |
| Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu | FHIA-01, FHIA-03, FHIA-17, FHIA-23 |
| Kerala Agricultural University, Kannara, Kerala | FHIA-17, FHIA-18, FHIA-21, FHIA-25, CRPB-39 |
| Acharya NG Ranga Agricultural University, Kovvur, Andhra Pradesh | FHIA-01, FHIA-03, FHIA-17 |
| Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, West Bengal | FHIA-01, FHIA-03, FHIA-17 |
| Rajendra Agricultural University, Pusa, Bihar | FHIA-01, FHIA-03, FHIA-17, FHIA-23 |

have popularly accepted FHIA-03 as cooking banana, as also the cultivar Saba. FHIA-23 is still being evaluated as a dessert cultivar, as substitute for local Cavendish clones.

In the evaluation trial conducted at NRCB, Trichy to assess the superiority of FHIA-01 over the indigenous hybrids and cultivars belonging to the Pome subgroup namely, H-1 and Pachanadan, FHIA-01 was found to be promising for many traits. Tolerance to wind damage was attributed to plant robustness, high yield, extended green and yellow shelf life, resistance to *Fusarium* and Sigatoka and tolerance to weevils.

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# Status of Introduced *Musa* Germplasm at Banana Research Station, Kannara

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*Musa* germplasm conservation and evaluation activities are in progress under the All India Coordinated Research Project on Tropical Fruits at the Banana Research Station (BRS), Kannara. The work aims to collect and conserve wild and cultivated germplasm, representative of the diversity existing in the *Musa* genepool for evaluation and subsequent use in breeding programme and to make available selected superior material to the farmers of Kerala. The center presently holds a germplasm of 256 accessions in its field genebank comprising indigenous and exotic varieties.

Since 1994, efforts have been made to enrich the germplasm collection through introductions and till 2004, 48 accessions have been received. Exotic germplasm was procured by the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, from the global *Musa* germplasm collection held at International Network for Improvement of Banana and Plantain (INIBAP) at its Transit Centre (ITC) in Leuven, Belgium.

## Materials and Methods

Proliferating *in vitro* cultures of *Musa*, received from INIBAP, were multiplied at NBPGR, New Delhi and periodically supplied to BRS, Kannara during 1994-2004. The 48 accessions comprising 21 germplasm/reference cultivars, 6 wild species and 21 improved hybrids/variants were received in the form of small suckers or proliferating *in vitro* cultures which were regenerated to plantlets at the Center for Plant