POTENTIAL AND CONSTRAINTS OF USING WILD *MUSA*

Bananas (*Musa* spp.) have a number of pests and diseases co-evolved owing to long periods of evolution. Among the insect pests, banana rhizome weevil (*Cosmopolites sordidus*) and pseudostem borer (*Odoiporus longicollis*) and nematodes (*Radopholus similis, Pratylenchus coffeae, Meloidogyne incognita, Helicotylenchus multicinctus*) are causes of concern. Among the diseases, Fusarium wilt (*Fusarium oxysporum f.sp cubense*), Sigatoka leaf spot (*Mycosphaerella musicola, Musa fijiensis*) are the major constraints. Recently, a new leaf spot disease has been identified in India, *Mycosphaerella eumusa,* that causes considerable damage to many commercial clones in India. Among viral diseases, Banana Bunchy Top Virus (BBTV), Banana Streak Virus (BSV), Banana Bract Mosaic Virus (BBMV) and Cucumber Mosaic Virus (CMV) are devastating in many regions. BSV has become more important since it integrates with the host genome and limits the way of developing new varieties through conventional breeding.

Figure 46. Raw banana fibre dyed different colours

Banana is a recalcitrant crop for improvement owing to its parthenocarpy, non-seeded nature, and male and/or female sterility. Also, the triploid nature of the best clones severely limits their use as parents. For any crop improvement programme, availability of desired gene sources in cultivated or wild forms is the prerequisite. In bananas, most of the desired resistant gene sources are harboured by the wild species, especially *Musa acuminata* subspecies and *Musa balbisiana*.

Figure 47. Primitive cultivar with breeding potential

One of the subspecies, *Musa acuminata* spp. *burmannicoides* (wild) that originated from India is the major gene source conferring resistance to Sigatoka leaf spot diseases. This is the only wild type extensively used in all breeding programmes and it is under the shadow of threat of breakdown of resistance. A vigorous search for alternate sources for Sigatoka resistance is necessary and much attention is being paid to Indian collections. *Musa acuminata* spp. *burmannica*, originating from western Ghats of Karnataka and Kerala is also a potential source exhibiting resistance to leaf spot diseases. Among primitive diploid clones, Kalmatti and Sembatti, ecotypes of cv. Matti (AA) have proven to be the better resistance source in breeding programmes. Other primitive varieties like Hatidat, Kanaibansi, and Anaikomban have exhibited partial resistance to leaf spot incidence fertility when pollinated, enabling them to set seeds under controlled pollination and yet they remain parthenocarpic under unpollinated conditions. Sannachenkadali (AA) is another diploid *acuminata* cultivar, found in the southern tips of Tamil Nadu and Kerala, that has been an excellent source of resistant genes against Sigatoka leaf spot, Fusarium wilt and nematodes. Being a diploid red cultivar, it has good potential for improving the commercial Red Bananas (AAA) against Fusarium wilt and Sigatoka leaf spot diseases.

Figure 48. Unknown leaf spot disease on wild *Musa* spp. in their natural habitat

Wild *Musa balbisiana*, a collective group of many 'wild types' with no specific subspecies status, has proven to be an excellent source of resistance to various biotic and abiotic stresses. *Musa balbisiana* types are immune to Fusarium wilt, leaf spot diseases like Sigatoka (*Mycosphaerella musicola, Musa fijiensis, Musa eumusae*), Cordana and Septoria leaf spot, rust and bacterial diseases like head rot (*Erwinia* spp.). They are also very tolerant to pseudostem weevil (*Odoiporus longicollis*) and rhizome weevil (*Cosmopolites sordidus Germar*). Apart from having resistance to biotic stresses, *Musa balbisiana* is highly tolerant to severe drought, cold and poor soil conditions.

Outweighing these advantages of *Musa balbisiana* is the problem of BSV which has integrated with the host B-genome. The limited number of *balbisiana* accessions maintained in most genebanks and all tested B-derived hybrids, i.e. *acuminata-balbisiana*, natural hybrids, have their genome contaminated with integrated BSV. Some of the human-induced hybrids developed in breeding programmes have expressed symptoms of BSV. This situation has forced some of the banana breeding programmes like that of CIRAD, France to temporarily halt using *Musa balbisiana* as a parent.

It is hoped that the search for more *Musa balbisiana* types in the areas of its origin and natural diversity might reveal individuals free of integrated BSV.

Figure 49. Banana Streak Virus (BSV)

Asia offers many unexplored areas where a search might reveal truly wild *balbisiana.* More systematic research on the B-genome and on accessions with B-containing genomes (AB, AAB, ABB, ABB) is needed. India, which is the major centre of origin and diversity of these natural hybrids, has much to offer the international community with its diversity in pure *balbisiana* and bispecific clones (Figures 47 to 49). Indian banana scientists are optimistic about locating and revitalizing banana breeding programmes with the inclusion of BSV-free *Musa balbisiana.*

CONCLUSIONS AND RECOMMENDATIONS

Bananas have been an important and integral part of Indian floral heritage with their great diversity and long periods of domestication. As the major centre of origin of interspecific AB hybrids, the Indian subcontinent has contributed enormously to the global wide genetic base of *Musa*.

In northeastern India, western Ghats, eastern Ghats and in Andaman and Nicobar Islands, some wild *Musa* species still exist. Some species, however, are already extinct, and they have been extirpated from most of India that was once in forest.

Apart from *Musa acuminata* and *Musa balbisiana*, the progenitors of present day bananas, a number of peripheral species, which have contributed to the total diversity are also known to occur. Though explorations and reports have revealed the occurrence of many more new species, natural hybrids and mutants, the geographical locations, unfavourable terrains, delicate political situations, insurgency problems, poor transportation facilities and wild animals, have made natural *Musa* habitats highly inaccessible. A systematic exploration, and developing good *ex situ* collections is the priority together with their conservation. The prevailing agricultural production system, Jhum cultivation, has depleted the fauna and floral treasury through incessant ecosystem destruction and subsequent genetic erosion. *Musa acuminata* spp. *burmannicoides* has been lost, but it is probable that many more valuable gene sources have been lost. The Government, Indian Council of Agricultural Research (ICAR) and other NGOs are supporting various *in situ* and *ex situ* conservation programmes. However, for a crop like banana, *ex situ* conservation in specific locations is not easy and needs more commitment.

Some *Musa* genetic resources are conserved in field gene banks at several sites in India. Most collections have serious virus problems. Conservation efforts or national parks should be established where wild *Musa* still occurs. Evaluation of the wild species for their suitability for direct uses like fibre source, food source and medicinal application, etc. and indirect uses like resistant gene sources for biotic and abiotic traits in the breeding programmes would be useful; however, exploitation for fibre, etc. should be evaluated against the potential of perpetuation of the wild species.

The indigenous knowledge of wild *Musa* is a treasure, but little information is available on this aspect. Though efforts are underway to collect and collate the information, the methodology or exact procedure for its meaningful utility is still lacking. A lot of medicinal uses were mentioned in earlier Indian medical epics and other documents, but there is a void on their protocols. Involvement of local NGOs, local doctors and tribal doctors in collating the information on indigenous technical knowledge forms the basis for the understanding of some of the courses and effects directly related to the loss of genetic diversity in Musa and other species, for the future management of genetic resources for achieving sustainable agriculture and assuring tribal livelihoods (Annex 3).

The tribes are aware of the ruinous effects of Jhum cultivation. Jhumming, being their way of living, needs a paradigm shift and this subject needs sensitive handling. ICAR has evolved a three-tier hill-farming package combining forestry, horticulture, tree farming, and terraced cultivation. Jhum farming needs to be refined and reduced to ensure better land management. The thrust should be on educating the Jhum farmers on alternate methods of cultivation.

Selected *Musa* wild species have been exploited for specific purposes like roofing, medicines, fibre extraction, handcraft preparation and medicinal applications, etc. The suitability of different varieties for a wide array of uses needs to be balanced with germplasm survival and alternative methods of livelihood. Developing wild *Musa* for their direct uses is expected to add to the holistic process of bringing in ecostability. From the breeders point of view, however, *Musa* species offer ample scope for their utilization in banana improvement programmes.

The only constraint in using *Musa balbisiana* is the integration of BSV in its genome. The search for wild types free from BSV, development of protocols to eliminate BSV at genomic level and exploiting the possibilities of using wild types carrying only dead sequences of BSV are expected to bring an improvement in *Musa* breeding strategies.