

CONCLUSION

We have sufficiently indicated the gravity of the problem and the methods of tackling them. The best of grasses, legumes and fodder trees should be grown in all agricultural research stations and in the fields of enterprising ryots so that the public may come to know about their usefulness. Free supply of seeds will be an inducement for the ryots to take up the cultivation of these fodders. Utilisation of the available material to the maximum extent and the avoiding of the loss by wastage should be other concerted measures. One more possibility to find enough fodder is by the elimination of the unproductive animals; while this is a controversial issue much thought and planning is necessary.

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*Some problems on Banana Breeding*

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The province of Madras has an estimated area of 1,36,455 acres under bananas, with an annual production of 11,33,000 tons of fruits. Added to this the banana has also numerous other virtues, which entitles it to be classed as the most popular fruit crop in this province. It thrives from sea level up to 5,500 feet and is as equally at home in the arid hot plains as in the tropical humid zones. With a capacity to yield a quantity of food per acre excelled by none and of a type valuable to infants, invalids as well as for all normal persons the banana assumes a special importance in the present context of intensified food production. It is, therefore, appropriate that the Government of Madras, in conjunction with the Government of India have decided to establish the All India Banana Research Station in our province, in the Tanjore District.

In a crop like the banana which has enjoyed popular estimation from time immemorial, it is to be expected that there would be a very large number of types and varieties with special adaptation for different soil, climate or cultural conditions. This is exemplified by the good yields of Sirumalai and Virupakshi on the Lower Palnis and of the Red Banana at lower elevations, while the very same varieties form no match in yielding capacity or quality to the Chakkrakeli of the Circars, Vamanakeli of parts of Rayalaseema, or the Rastali in the southern parts of the province. Thus the desirable characteristics which should go to give us the ideal banana, are now dispersed over a large number of varieties, types and

species spread over all the different parts of this province and even outside. The task of combining these characters to produce the ideal banana for each region naturally, therefore, is the aim of the banana breeder.

Thanks to several workers, notably Jacob (12) and Venkataramani (13) we have now a mass of varietal descriptions recorded on the basis of an intensive study in all parts of this province. Since a taxonomic study of any crop forms an essential prerequisite of any hybridisation project, it is essential to establish a comprehensive varietal collection area for a careful study of the varieties and the distinguishing features and outstanding qualities of each type.

The classification of the genus offers considerable difficulties, since the plant does not lend itself for study except in the field, and the getting together all types, varieties and species at one place presents great complexities. According to the classification of Linnaeus, cultivated varieties appear under two distinct species, *Musa sapientum* and *M. paradisiaca*. On the score of longer usage, *M. paradisiaca* may be taken as the most appropriate till more is known of its taxonomy. The arbitrary distinction of banana and plantain is not accepted by any banana taxonomist now though the latter term is curiously enough, still in popular usage in South India.

Genetic and the cytological studies on this crop have been done in Trinidad. The basic chromosome number of banana is 11. The common edible types are triploids and therefore, many of the edible varieties are sterile, due to irregularities in pollen development (4).

For breeding better varieties of banana, the following methods are available:

1. **Simple selection:** Banana, rarely if at all, sets seeds and is usually propagated only by suckers. Consequently, selection of chance seedlings is not feasible. The introduction and trial of new varieties and their acclimatisation are therefore of greater promise, for improvement of the crop. Indeed most of our cultivated varieties, notably the Gros Michael and Vamankeli are only recent introductions, and yet they have large and increasing areas devoted to them in this province now

2. **Selection of natural bud mutations or sports:** It is considered by Fawcett (9) that Gros Michael, the world's most famous variety, was itself a sport, isolated about hundred years ago in Martinique. The other and equally famous Cavendish variety is a sport from Grenada. Although widely distributed, Cheesman (8) doubts whether the Cavendish is every where the same or whether it has not given rise to sub-types or local races. In its agricultural history, the dwarf banana has thrown bud sports, some easily recognisable, others so different as to pass for new varieties. One type differs from the usual Cavendish in being taller, but especially

in shedding all its male flowers with their subtending bracts soon after they have opened, leaving the rachis bare, a feature common to the majority of the banana varieties other than the dwarf. The fact that like all the dwarf bananas it fails to set seed indicates however, that it is a vegetative sport of the dwarf. As some of the leading banana varieties are sports, this search for natural sports should be one of the points to be kept in mind in any breeding work.

3. *Use of certain treatments* like high temperature, radio-active rays, chemicals like colchicine etc., to induce sports or mutants are also fruitful lines open to the banana breeder Walter (10).

The main object of hybridisation is to create a variable population and then to select types with the desired combination of characters. In addition to the taxonomical and cytogenetical study, another important step is the preliminary investigation connected with hybridisation with the object of selecting varieties and species to serve as potent pollen parents to various cultivated varieties and also to work out the most convenient pollination technique under our conditions and the most feasible and expeditious way of germinating seeds and raising hybrid progenies.

In large varietal collections of banana, there are found to be individual desirable characters in many of the varieties. But the recombination of these desirable characters are beset with difficulties. They are :

- (1) The commercial types are sterile and produce no seeds;
- (2) They should be induced to set seed for breeding work ;
- (3) the seed breeding character must be eliminated from the selected type. In other words, starting with a seedless plant, a seeded stage must be passed through to provide material for a combination of characters and the seedless form recovered. Hunter and Leake (11) have stated " within the range of species of *Musa*, all stages are found from forms such as those that supply the bananas of commerce with little or no viable pollen and developing fruit without fertilisation, to forms such as *M. malaccensis* with abundant pollen and free formation of viable seeds. In the extreme cases, the reproductive organs of both sexes are abortive upto 99 per cent and failure to set seed is complete. An initial difficulty therefore, is met with in obtaining a sufficient number of seedling plants to provide material for selection, For this purpose, *M. malaccensis* and *M. Ormati* have been used as pollen parents, but even here the percentage of viable seed is very low. Cheesman found that *M. malaccensis* is a diploid and Gros Michael a triploid. This latest interpretation is likely to change the existing classification of the genus and has a direct bearing on the problem of raising a seedless form ".

Cheesman (7) concludes the principles of banana breeding as follows: "It is reasonable to conclude that a new seedling of commercial usefulness may be diploid, triploid or tetraploid, but is most likely by analogy with existing varieties to be triploid. Viewed in this light, breeding from edible varieties, including Gros Michael, resolves itself into the production of tetraploids which may either prove directly useful or serve as breeding stock in place of their less fertile triploid parents. Breeding from fertile species resolves itself into the production of new polyploids, which again may be directly useful or indirectly valuable as material for further crosses. Triploids, in short, may be produced by synthesis from diploids or by reduction from tetraploids".

At Trinidad, breeding was undertaken mainly to get a type which is resistant to the "Panama" disease. Work was mainly done on Gros Michael with *M. malaccensis* which is immune to "Panama", as the male parent. "By cross pollination, 49 perfect seeds were secured, of which 17 germinated and 5 seedlings only survived. Of the hybrid seedlings one produced fair-sized fruits of good flavour. This was resistant to "Panama" and was named I. C. I. It had some commercial disadvantages and when propagated by suckers it occasionally set seeds. Further attempts to improve I. C. I. were made by back-crossing to the parents. Gros Michael and I. C. I. proved to be cross sterile and the latter showed a double complement of Gros Michael chromosomes and achievement of practical results by back-crossing was found uncertain". (4).

Coming to our work in India, breeding need not be undertaken for any specific aspect as resistance to any particular disease as in Trinidad. We have a large number of varieties with one or more good and favourable characters in each. We should try to evolve varieties with a combination of these desirable qualities.

We can indicate some of the varieties which may usefully be crossed to get better types in South India :-

1. Poovan and Vamanakeli to get big bunches of 300 fruits or more and the keeping quality of Poovan and the size and sweet fruits of Mauritius, with dwarf plants.

2. Rastali and Chakkrakeli, to combine the good fruit size of Rastali and the sweetness and strong pedicels of Chakkrakeli.

3. Sirumalai or Mala Vazhai with Kapurbale, in order to get the size of fruits of the latter with its adaptability, to different regions, with the sweetness, high flavour and the keeping quality of the former.

4. Mauritius with Nendran for obtaining short plants like Mauritius to withstand high winds, with fruits of Nendran, and with more numerous fruits per bunch.

5. Nendran and Mouthan to get hardy plants of the Monthan type with fruits of Nendran quality.

The other items of work as the selection of the best suckers for planting, growth habits and yield of the different varieties, the search for mutants and other aspects on the improvement of banana, like optimum methods of propagation, culture, harvest, packing, transport and utilisation etc., will have to be studied along with the breeding work. It is possible to imagine a day when we will have bunches of the size and number of hands of Poovan with about 300 fruits in each bunch, with individual fruits of the size and keeping quality of Nendran, with the taste and pedicel strength of Chakkrakeli and the strong plants of the size of Mauritius.

**Summary:** South India being one of the leading banana producing regions in India, it is desirable to have a banana breeding station in this part of the country:

2. It is seen that we have a large number of choice varieties of banana and the production of new varieties with combination of desirable characters would enable us to become the main centre of banana production in India.

3. As there are no specific criteria to distinguish the different varieties, taxonomical work should be taken up early. For this purpose a comprehensive varietal collection area should be established first.

4. Search for natural mutants and the work on inducing mutations artificially should be pursued side by side with the work on breeding.

5. The preliminary work of a series of pollination studies with the object of selecting varieties and species to serve as potent pollen parents to other cultivated varieties and to find out the best technique of pollination is as important as any other work in breeding.

6. The difficulty experienced in hybridisation work on banana as shown in Trinidad has been stressed. It is seen that the work though promising is not an easy one. The main point is that we have to start with a seedless plant, induce seeds by crossing with a seeded variety and then finally work to eliminate the seed. Still, with the varieties that we have in South India, we may hope to get good results in our breeding work.

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## Manurial Experiments on Rice

### *III. Application of green manures in combination with Phosphates\**

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To maintain the food supply for an ever increasing population every endeavour for conserving the essential elements of soil fertility will have to be made, more so, in these days of acute food shortage. The productive power of soils is steadily reduced when successive crops are grown and no adequate manuring is made. Organic matter is the sheet anchor of soil

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