

INTERVARIETAL HYBRIDIZATION IN MANGO (*Mangifera indica* L.): TECHNIQUES, MAIN RESULTS AND THEIR LIMITATIONS

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INTRODUCTION

Mango breeding studies began in the 17th century in India by using selection of seedlings from opened cross then, propagation of these seedlings through inarching propagation technique. Since that period until recently, several breeding programs have shown exciting results and hundred varieties have been released in different countries. Although more difficult to apply, the hand cross or hand pollination allows a better control of progenitors and progenies facilitating the heritance studies. The low success in obtaining the hybrid progenies, the need for large areas for seedlings evaluation, the long juvenile period extending the selection and the release of varieties are discouraging aspects of the mango breeding. Therefore, the development of new or techniques to improve the artificial and opened crosses as well as the handling of the population of hybrid progenies are highly desired. This paper has the objective to present and discuss the steps of some mango breeding techniques and their limitations.

MATERIAL AND METHODS

This study has been carried out since 1983 in the Experimental field of Embrapa Cerrados, Brasília, Federal District of Brazil. The introduction of 78 varieties from different countries or regions was the genetic base for the selection of progenitors to be used as parental groups. A phenotypic selection is used to establish these parental groups by using the following characteristics: high yield, dwarf tendency, fruit quality and resistance to pest and diseases. The breeding program has 5 phases:

- Phase 1 - Introduction, Evaluation and Selection of Cultivars;
- Phase 2 - Intervarietal Hybridization;
- Phase 3 - First Selection and Field Evaluation of Progenies;
- Phase 4 - Field Evaluation of Progeny in Different Regions;
- Phase 5 - Fruit Market Evaluation and Cultivar Release.

The hand pollination technique described by Mukherjee et al. (1961) was improved in order to increase hybrid population. The perforating bag, the maintenance of male flowers under different shade conditions, the spray of fungicide, the ratio of one anther to 3 pistils, the labelling of panicles and bagging of the new hybrid fruits were some of the improvement (Pinto, 1993). The progenitors established in the field in a latin square design is also an important open pollination technique being tested. The floral induction of top-worked cultivars, which show different period of flowering, allows synchronous pollination. The technique of caging top-worked cultivars with insect pollinators has been a very important open pollination process (Figure 1). Seedlings are controlled by using an alpha-numerical or only a numerical code. This code is formed by Institution's name (contracted form), a control number of the progenitor in the field and the date of the cross. The high dense progeny population (4 m x 2 m) and precocious evaluation of seedlings have been used, and molecular marker studies have started recently. The selected material is cloned and tested in the same environment at the beginning and in different environment later on. Top-working technique is used to increase the number of available propagules from selected progenies.



Figure 1 - Caging top-worked cultivars with insect pollinators may facilitate reproduction, being an important open pollination technique.

INTRODUCTION AND SELECTION OF CULTIVARS - Sixteen mango cultivars (Table 1) have been frequently selected out of 78 cultivars of the elite collection to establish the parental groups in the last ten years. Indian cultivars Malika and Amrapali present dwarf trees and very sweet fruits. Floridian cultivars Tommy Atkins, Winter, Van Dyke and Palmer with good yield and colored fruit were selected as progenitors. South African cultivars Heidi, Joa and Neldica were introduced (Table 1) and should be used in the future.

Table 1- List of the main progenitors used in the breeding program.

Cultivar Name	Description of the Main Characteristics
Amrapali	Dwarf, 150 g fruit, yellow peel, excellent pulp quality, rich in vitamin A.
Haden	Vigorous, 510 g fruit, red peel, excellent pulp quality, suscept. to anthracnose.
Heidi	Vigorous, 540 g fruit, red yellowish peel, good pulp quality, regular bearing.
Irwin	Moderately vigorous, 340 g fruit, red bright peel, good pulp quality.
Joa	Moderately vigorous, approx. 300 g fruit, dark red fruit, good quality pulp.
Keitt	Vigorous, 850 g fruit, greenish-yellow peel, good pulp quality, late harvest.
Maçã	Dwarf, 146 g fruit, yellow peel, regular pulp quality, irregular bearing.
Malika	Dwarf, 330 g fruit, yellow-apricot peel, excellent pulp quality for processing.
Neldica	Moderately vigorous, 459 g fruit, red yellowish peel, regular bearing.
Nam Doc Mai	Vigorous, 600 g fruit, yellow peel, good-excellent pulp quality.
Palmer	Moderately vigorous, 620 g fruit, dark-red peel, excel. taste, semi-late harvest.
Rosa	Moderately vigorous, 370 g fruit, pink peel with terpenin, good pulp quality.
Tommy Atkins	Vigorous and productive tree, 550 g fruit, red bright peel, fair pulp quality only.
Ubá	Vigorous, 120 g fruit, yellow peel, excellent pulp quality for processing.
Van Dyke	Vigorous, 350 g fruit, red-yellowish peel, excellent pulp quality.
Winter	Semi-dwarf, 320 g fruit, red-yellowish peel, excellent pulp quality.

INTERVARIETAL HYBRIDIZATION - The improvement of Mukherjee's technique, increased the pollination success in 4.53%. Although the caging of top-worked cultivars is a time consuming and an expensive technique, the number of pollinated flowers is uncomparably higher than that obtained by using hand pollination. The caging technique and floral induction is also possible to establish the polycross method, since allows a synchronous flowering of the top-worked cultivars. The tagging and bagging fruit procedures (Figure 2) give 100% of crossing insurance, allowing the breeder to know the right generation obtained.



Figure 2 - The tagging and bagging fruit procedures give 100% of crossing insurance, allowing the breeder to know the right generation.

MANAGEMENT OF HYBRID POPULATION - The high dense planting and precocious selection cut, approximately, two years of the time to release a mango cultivar. The selection intensity starts with 10 to 5% during the first years of evaluation and decreases to 5-2% before cultivar release. A complete control of the seedlings in the field occurs with an alpha-numerical code. Top-working method (Pinto, 1987) has increased the supply of propagules to new nurserymen. The commercial fantasy name for the new cultivar when short, facilitates its marketing and commercialization. Nowadays, a Marketing Plan is highly requested and important to use during cultivar development or, before its release.

RELEASED CULTIVARS AND PROMISING HYBRID SELECTIONS - Out of 2088 hybrid progenies established in the field, 209 seedlings were selected, preliminarily, in the first year of selection. Out of these 209 seedlings, 42 hybrid progenies were selected as promising materials and 4 of them were already released:

- **ALFA** - Hybrid cultivar from the cross between 'Malika' and 'Van Dyke', semi-dwarf and high yield plant, regular bearing, fruit with 435 g of weight, pink/red peel, firm and medium fiber pulp with good quality (Brix 16%, acidity 0,23%, Brix/Acidity ratio 70), resistant to oidium and moderately resistance to anthracnose, without malformation problem or pulp soft-nose (Figure 3).

RESULTS AND DISCUSSION

- **BETA** - Hybrid from the cross between 'Amrapali' and 'Winter', moderately vigorous, high yield plant, irregular bearing, fruit with 310 g of weight, yellow peel, firm and low fiber pulp with excellent quality for fresh consumption and processing (Brix 24.8%, acidity of 0.16% and ratio Brix/acidity 155), moderately resistant to anthracnose and oidium, without problem of flower malformation.

- **ROXA** - Hybrid from the cross between 'Amrapali' and 'Tommy Atkins', moderately vigorous and medium yield, regular bearing, fruit with 287 g of weight, purple reddish, very firm and fiberless pulp with excellent quality (Brix 19%, acidity 0.12%, ratio Brix/acidity 158), susceptible to cochineals, low resistance to anthracnose and oidium and with problem of flower malformation.

- **LITA** - Hybrid cultivar from the cross 'Amrapali' and 'Tommy Atkins', vigorous and high yield plant, regular bearing, fruit with 414 g, very firm and low fiber pulp with excellent quality (Brix 18-20%, acidity 0.20%, ratio Brix/acidity 90-100), moderately resistant to anthracnose and oidium, with low presence of flower malformation.

Other hybrid progenies are still being evaluated and have shown excellent characteristics, such as CPAC 144/86, CPAC 23/93, CPAC 165/93 (Figure 4), CPAC 263/93, CPAC 256/94 and CPAC 394/94.

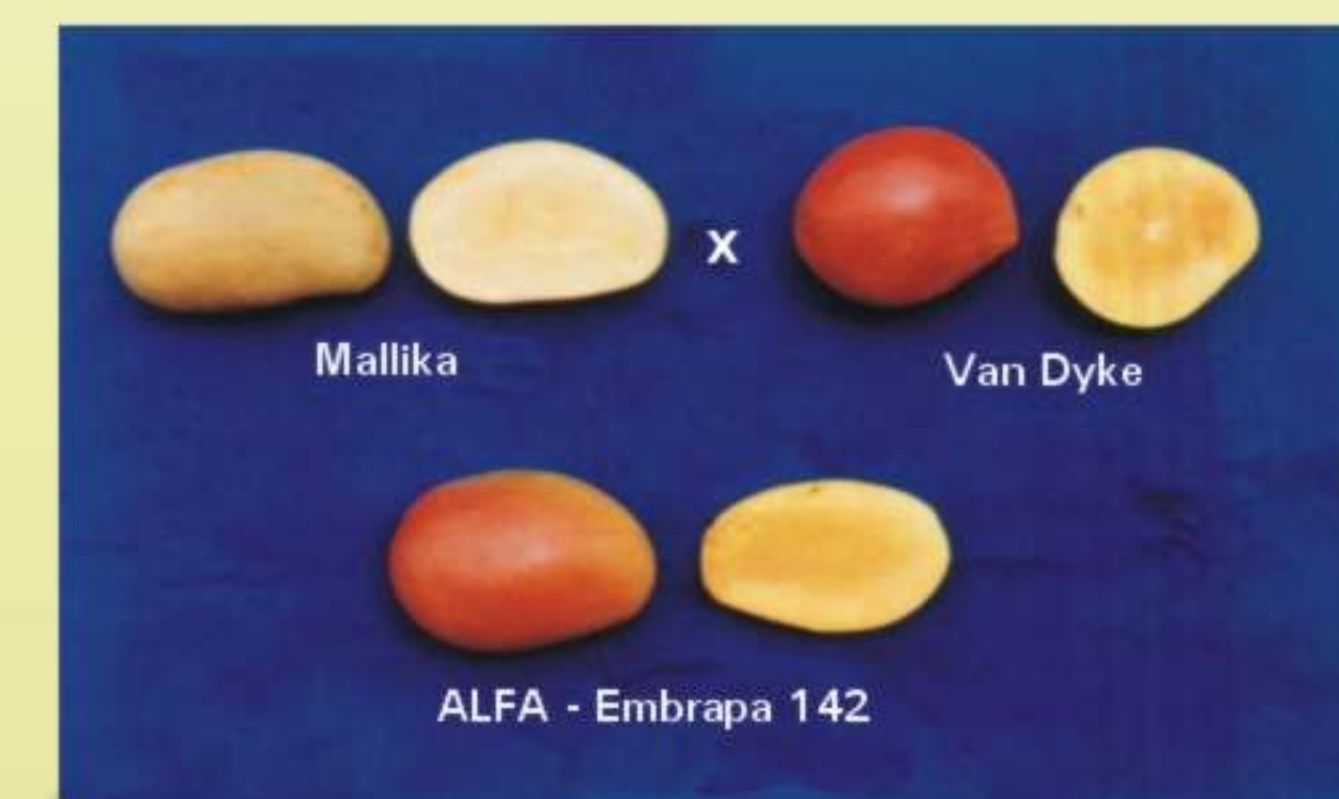


Figure 3 - ALFA is a semi-dwarf hybrid, regular bearing, resistant to oidium, pink/red color fruit.



Figure 4 - The outstanding hybrid selections CPAC 165/93 has red yellowish peel, firm, gold yellow and very sweet pulp.

CONCLUSIONS

It can be concluded that significant results were obtained with the improvement of techniques of mango hybridization program in Central Region of Brazil. However, there is not a good technique when used alone, since the most adequate may be expensive to be applied, while that inexpensive one may present inefficient application and poor results. Therefore, a conjunction or join improved techniques, after elimination of previous mistakes, should be used to increase success of hybrid population and to release a high quality cultivar.

REFERENCES

- Mukherjee, S.K.; Majumder, P.K. & Chatterjee, S.S. An improved technique of mango hybridization. Indian J. Hort. 18:302-304, 1961.
- Pinto, A. C. de Q. Sobrenxertia e reforma da mangueira. Revista Globo Rural, p. 25-29. December 1987.
- Pinto, A. C. de Q. & Byrne, D.H. Mango hybridization studies in tropical savannah (Cerrados) of Brazil Central Region. Acta Horticulturae 341, p. 98-106. 1993.