and fruited. Scions from mature trees that have been reverted to a "juvenile-like" condition by severe pruning also graft more readily than scions from mature trees.

These experiments were conducted to determine if seedling terminals from young nursery stocks used as interstocks would permit the use of mature and "juvenile-like" scions for topworking mamey sapote.

### Materials and Methods

Three large grafted trees were cut back below the graft to stumps at a height of approximately 1 m in June, 1982. The trunks were painted with white latex paint to prevent sunscald. Sprouts from the stump were permitted to grow until they obtained a size suitable for grafting.

A modified veneer graft with a shallow cut on both the stock and scion was used (3, 4, 5). Scionwood was selected from terminal shoots that were relatively short without fully expanded leaves. If the wood is too hard or too gelatinous, it is not suitable for graftwood. Scions were collected and used the same day and not stored overnight.

On 25 March 1983, 45 sprouts were grafted with seedling tops and wrapped with polyethylene tape. When the seedlings had sprouted and obtained a stem diameter of 2 to 3 cm, they were grafted with the mature and "juvenile-like" scions of 'No. 2' and 'Magana' on 8 August 1983. Ten replications of each treatment were used for a total of 40 grafts.

### Results and Discussion

Young seedling terminals used as interstocks were evaluated on 8 May and had a 92% graft take (Table 1). The second set of grafts using mature and "juvenile-like" scions were evaluated on 13 September 1983. The surviving grafts had sprouted and were growing vigorously. The "juvenile-like" scions had 100% success for 'No. 2' and 80% success for 'Magana' with an overall average of 90%. The mature scions had 80% graft take for both 'No. 2' and 'Magana'.

Table 1. Juvenile interstocks for topworking mamey sapote.

| Date | Stage[z] | Cultivar | Gfts[y] | Take (%) |
|---|---|---|---|---|
| Mar | Seedling | — | 45 | 92 |
| Aug | "juv" | 'No. 2' | 10 | 100 |
| | "juv" | 'Magana' | 10 | 80 |
| | Mature | 'No. 2' | 10 | 80 |
| | Mature | 'Magana' | 10 | 80 |

[z]"juv" ("juvenile-like").
[y]gfts (number of grafts per scion maturity).

Juvenile interstocks using terminals from young seedling plants as scions are the best material to use as interstock for topworking mamey sapote. Both mature and "juvenile-like" scions can be grafted successfully on juvenile interstocks even during August, when graft take is usually poorest.

### Literature Cited


1. Campbell, C. W. and S. P. Lara. 1982. Mamey sapote cultivars in Florida. Proc. Fla. State Hort. Soc. 95:114-115.
2. Nelson, R. O. 1957. Suggested methods for top-working lychee trees. Proc. Fla. Lychee Growers Assoc. 5:15.
3. Ogden, M. A. H. 1984. Factors affecting the graft union of mamey sapote (*Cloocarpum sapota* (Jacq) Merr.). Ph.D. dissertation, Univ. Florida, Gainesville.
4. Ogden, M. A. H. and C. W. Campbell. 1981. Grafting annonas in southern Florida. Proc. Fla. State Hort. Soc. 94:133-136.
5. Ogden, M. A. H., C. W. Campbell, and S. P. Lara. 1982. Grafting techniques for the mamey sapote (*Colocarpum sapota* (Jacq.) Merr.) under Florida conditions. Proc. Trop. Reg. Amer. Soc. Hort. Sci. 26: (in press).


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# INCIDENCE OF "SOFT-NOSE" ON MANGOES IN THE CANARY ISLANDS


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*Abstract.* **In the last 5 yr, an internal breakdown of mango fruit—described as "soft-nose" in Florida—has appeared in most mango plantings in the Canary Islands. This paper discusses the influence of harvesting at the green-ripe stage and date of harvesting on the incidence of affected fruits, as well as cultivar sensitivity. The main conclusions are: a) harvesting at the green-ripe stage considerably reduces the incidence of "soft-nose"; b) no clear difference in "soft-nose" incidence seems to be connected with the harvesting date; c) the incidence of "soft-nose" varies among cultivars, some (especially 'Kent' and 'Ameeri') being very sensitive.**


Although the mango (*Mangifera indica* L.) was probably introduced into the Canary Islands at the end of the 18th Century (5), it is at present a minor fruit crop in the Islands. The relatively low water and soil requirements of this species as compared with bananas—the main crop of the Islands—and the excellent market possibilities (4) are the main causes of the great interest for the development of this crop in the Archipelago.

The mango, like many other tropical fruits, exhibits several problems in its adaptation to the subtropical climate of the Islands, the main one being the production of many small, embryo-aborted fruits (4). Over the past 5 yr, there has been an incidence on most locations in the Islands and on most cultivars, of an internal breakdown of the fruit with symptoms apparently identical to those described by Young in Florida (9). Several pathological analyses have been conducted at the INIA's (Instituto Nacional de Investigaciones Agrarias) Regional Centers in the Canary Islands and the Levant region of Mainland Spain (CRIDA-11 and CRIDA-07, respectively)—but to date no pathogenic cause has been detected. Although this agrees with the observations in Florida by Young and Miner (10), more analyses should be carried out before stating a definite negative assessment, as other researchers claim breakdown of the fruit is also induced by bacterial injections (2).

In 1982 several preliminary trials were made, both at the CRIDA-11 and on other farms, using different concentra-

tions of boron, calcium and nitrogen. Similar studies were performed by others (7, 8, 10). No statistically significant differences were found among treatments (6).

One possible way of reducing the problem appears to be harvesting the fruit at the green-ripe stage, although differences among cultivars also seem to exist (9). A survey was conducted in 1983 on an heterogenous sample of cultivars to study the influence of harvest stage and date of harvesting on the incidence of soft-nose.

## Materials and Methods

The survey was carried out at the INIA research station located at Güimar, on the south east side of the island of Tenerife (altitude 120 m). A total of 623 fruits belonging to 36 cultivars were observed August through December, 217 fruits being harvested at the green-ripe stage (just before color changes at the apical end) and 406 at ripe stage (after color change, but before softening). All fruits were evaluated at maturity and classified as follows: 0 = without symptoms; 1 = slight decomposition of base of petiole, without affecting flesh; 2 = same but slightly affecting flesh near the seed; 3 = 1/3 flesh affected; 4 = 2/3 flesh affected; and 5 = complete decomposition of fruit. Percentage of healthy fruit (ranking 0) and edible fruit (ranking 0, 1, 2) was recorded. Before making any statistical analysis the data were transformed using the arc sin transformations, and analyzed in accordance with the following variance analysis model:

$$xij = \mu + Hi + Ej(i)$$

where $\mu$ = general mean effect
H = Harvesting stage effect
E = Error term

The data were also grouped by months of harvesting (85 fruit in August, 96 in September, 132 in October, 257 in November and 53 in December) and analyzed in accordance with the following variance analysis model:

$$xij = \mu + Di + Ej(i)$$

where D = dates of harvesting

## Results and Discussion

*Influence of harvesting stage on the incidence of soft-nose.* There were highly significant statistical differences between both harvesting stages (Table 1). The high percentage of edible fruits (95.7%) when harvesting at green-ripe stage almost doubled the percent at the full stage (54.2%). The difference was even greater for healthy fruits. Since the survey was carried out on an heterogenous sample of cultivars, we can conclude that to avoid soft-nose early picking is imperative. This agrees with previous studies by others (9, 10). With this practice of harvesting green-ripe mangoes some problems of color development may occur. Fortunately there are commercial methods involving the use of ethylene which solve these problems (1, 3).

Table 1. Influence of harvesting stage on the incidence of mango soft-nose.

| Harvest stage | Fruit without soft-nose (ranking 0) (%) | Acceptable fruit (ranking 0, 1, 2) (%) |
|---|---|---|
| Green-ripe | 36.8 | 95.7 |
| Ripe | 5.6 | 54.2 |
| | **z | **z |

zMeans within columns differ significantly at the 1% level.

Table 2. Influence of harvesting date on the grade of incidence of mango soft-nose.

| Date of harvest | Fruit without soft-nose (ranking 0) (%) | Acceptable fruit (ranking 0, 1, 2) (%) |
|---|---|---|
| August | 38.3 | 75.2 |
| September | 18.4 | 65.9 |
| October | 14.5 | 82.3 |
| November | 8.5 | 67.5 |
| December | 12.1 | 86.2 |

Table 3. Incidence of soft-nose of various mango cultivars.

| Cultivar | Green ripe harvesting | | | Full ripe harvesting | | |
|---|---|---|---|---|---|---|
| | No. fruits sampled | Healthy (%) (ranking 0) | Edible (%) (ranking 0, 1, 2) | No. fruits sampled | Healthy (%) (ranking 0) | Edible (%) (ranking 0, 1, 2) |
| Adams | — | — | — | 22 | 0.0 | 13.6 |
| Ah Pingh | 8 | 87.5 | 100.0 | 8 | 62.5 | 100.0 |
| Ameeri | 5 | 40.0 | 100.0 | 5 | 0.0 | 0.0 |
| Anderson | 5 | 80.0 | 100.0 | — | — | — |
| Big Yellow | — | — | — | 14 | 0.0 | 21.4 |
| Cogshall | — | — | — | 8 | 12.5 | 62.5 |
| Eldon | — | — | — | 21 | 0.0 | 19.0 |
| Extrema | — | — | — | 9 | 0.0 | 33.3 |
| Fascell | 4 | 50.0 | 100.0 | — | — | — |
| Gouveia | 10 | 70.0 | 100.0 | 12 | 0.0 | 75.0 |
| Haden | — | — | — | 11 | 9.1 | 63.6 |
| Harders | — | — | — | 5 | 0.0 | 20.0 |
| Kent | 5 | 40.0 | 60.0 | 8 | 0.0 | 0.0 |
| Lippens | 14 | 35.7 | 85.7 | 31 | 9.7 | 41.9 |
| Osteen | 13 | 46.2 | 84.6 | 4 | 50.0 | 50.0 |
| Peach | — | — | — | 9 | 11.1 | 88.9 |
| Pirie | — | — | — | 15 | 0.0 | 13.3 |
| Rubi | — | — | — | 34 | 5.9 | 64.7 |
| Sensation | 56 | 44.6 | 94.6 | 89 | 16.9 | 61.8 |
| Smith | 20 | 25.0 | 95.0 | 10 | 10.0 | 40.0 |
| Tolbert | 39 | 56.4 | 92.3 | 22 | 31.8 | 54.6 |
| Tommy Atkins | 9 | 44.4 | 88.9 | 12 | 0.0 | 13.3 |
| Valencia Pride | — | — | — | 5 | 20.0 | 75.0 |
| Van Dyke | 4 | 100.0 | 100.0 | 21 | 14.3 | 47.9 |
| Zill | — | — | — | 4 | 50.0 | 50.0 |
| Other cultivarsz | 25 | 30.4 | 87.0 | 27 | 25.0 | 56.3 |

zIncludes all cultivars where less than 4 fruits were sampled.

*Influence of harvesting date on the incidence of soft-nose.* Mangoes are harvested in the Canary Islands over a period of several months from August to December. This allows testing of the possible effect of climatic conditions of a particular year on the incidence of soft-nose. No statistically significant differences existed between months nor was there a clear trend (Table 2). These findings agree with those of Young (9) who found soft-nose occurred in all seasons in Florida.

*Differences between cultivars on the grade of incidence of soft-nose.* All cultivars except 'Kent' appear to have similar numbers of edible fruits when harvested at green-ripe stage (Table 3). Results, however, are very different for the full ripe harvesting where 'Eldon', 'Adams', 'Pirie', 'Tommy Atkins', 'Big Yellow', 'Harders', and especially 'Kent' and 'Ameeri' seem to be extremely sensitive. These results are similar to those found in Florida (9, 10). It is, however, surprising that 'Sensation' is not in this category, since many growers in the Canary Islands as well as in Florida have reported serious losses for this cultivar. Cultivars like 'Estrema' or 'Peach' are also sensitive in contrast to observations made in Florida (9, 10) where only Indian cultivars or their first and second generations were reported as being sensitive. From observing both harvests it appears that 'Ah Pingh' is less sensitive than the other cultivars. Further studies are needed at different locations to provide more information as to differences among cultivars in relation to the incidence of soft-nose.

## Conclusions

1. Green-ripe harvesting is imperative to reduce incidence of soft-nose of mangoes in the Canary Islands.
2. The incidence of soft-nose seems to be similar throughout the harvesting season.
3. 'Kent' and 'Ameeri' seem to be very sensitive to soft-nose.
4. Other cultivars besides those of Indian origin are also affected by soft-nose.

## Literature Cited


1. Barmore, C. R. and E. F. Mitchell. 1975. Ethylene preripening of mangoes prior to shipment. Proc. Fla. State Hort. Soc. 88:469-476.
2. Díaz Polanco, C., M. Figueroa, and O. Aponte. 1971. Una bacteriosis de la pulpa del mango, causada por *Xanthomonas* sp. Agron. Trop. 21(1):17-27.
3. Fuchs, Y., G. Zauberman, U. Yanko, and S. Homsky. 1975. Ripening of mango fruits with ethylene. Trop. Sci. 17:211-216.
4. Galán Saúco, V., and J. García Samarín. 1979. Pasado, presente y futuro del mango en Canarias. Ministry Agr., Spain, Cuadernos INIA No. 9.
5. Galán Saúco, V. 1983. Objetivos y tecnicas de producción del mango. Proc. XIII Congreso N.O.R.C.O.F.E.L. (in press.).
6. Galán Saúco, V., D. Fernández Galván, and C. Rodríguez Pastor. 1984. El mango (*Mangifera indica* L.) como alternativa a la platanera en Canarias. In: CRIDA-11—INIA (ed.). Memoria del Centro Regional de Investigación y Desarrollo Agrario de Canarias 1972-1982. CRIDA-11—INIA, La Laguna, Tenerife, Spain. (in press.)
7. Krishnamurthy, S. 1982. Effect of calcium and boron on the incidence of internal breakdown in Alphonse mango (*Mangifera indica* L.). J. Food Sci. and Tech. (India) 19:80-81.
8. Malo, S. E. and C. W. Campbell. 1978. Studies on mango fruit breakdown in Florida. Proc. Trop. Reg. Amer. Soc. Hort. Sci. 22:1-15.
9. Young, T. W. 1957. Soft-nose, a physiological disorder in mango fruits. Proc. Fla. State Hort. Soc. 70:280.
10. Young, T. W., and J. T. Miner. 1961. Relationship of nitrogen and calcium to soft-nose disorder in mango fruit. Proc. Amer. Soc. Hort. Sci. 78:201-209.


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# 'MANZANILLO-NUNEZ': A NEW MEXICAN MANGO CULTIVAR


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*Abstract.* **'Manzanillo-Nunez' is a promising mango clone which originated as a chance seedling of possible Indian race ancestry in Manzanillo, Colima, Mexico. The tree was first observed in 1972. Observations were made on more than 900 5 to 8-yr-old grafted trees. Flowering occurs between January and April, with harvest between June and July. Trees have shown little or no alternate bearing tendency with yields higher than 300 kg on 8-yr-old plants. Fruit appearance and quality are excellent. Average fruit weight is 660 g and the seed is 6% of total fruit weight. External color is 75% red blush and flesh is almost fiberless, bright yellow, juicy, and has a pleasant aroma and flavor (15°Brix). Fruit retain high quality following 16 days of storage at room temperature with minimum damage by anthracnose. Fresh fruit is currently exported to Japan, competing favorably against other Indian, Indochinese and Philippine cultivars.**


The mango is an important tropical fruit crop in Mexico, where it is cultivated on more than 42,000 ha. There are 2 major producing areas in the country; the state of Veracruz, along the Gulf of Mexico, where 'Manila', a polyembryonic Philippine mango, is extensively cultivated, and the Pacific Coast, where the main cultivars are the Florida introductions 'Haden', 'Tommy Atkins', 'Kent' and 'Keitt'. In contrast to the Gulf area mango cultivation on the Pacific Coast is relatively new, since most orchards are less than 20 yr old (2). As in other mango growing countries, there is constant interest in finding germplasm with desirable tree and fruit characteristics for commercial cultivation. Attainment of cultivars through common hybridization techniques has been inefficient, costly and very slow (3, 4), consequently selection of valuable mango germplasm in Mexico has been mainly through evaluation of introductions from other countries and of native Mexican collections. Several cultivars have originated in Colima and are grown on a local scale, 'Diplomatico' being perhaps the most popular for its early harvest, high yields and compact tree size, while fruit is also of acceptable quality (1). The 'Manila' mango was brought to Colima from Veracruz and hectarage has been rapidly expanding in the last 5 yr; it is expected to become a major cultivar in the near future. 'Manila' is a popular mango mainly due to its early harvest, and is destined, as 'Diplomatico', to the local market as fresh fruit. A more recent selection, 'Manzanillo-Nuñez', has shown many desirable characteristics, particularly in relation to fruit quality, and is gaining interest among local