

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 'Es-trema' 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 técnicas 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.

Proc. Fla. State Hort. Soc. 97:360-363. 1984.

'MANZANILLO-NUNEZ': A NEW MEXICAN MANGO CULTIVAR

ROBERTO NUNEZ-ELISEA
*Instituto Nacional de Investigaciones Agrícolas,
 Campo Agrícola Experimental Tecomán
 Apartado Postal 88,
 28100 Tecomán Col., México*

Additional index words. *Mangifera indica* L.

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 hectareage 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

mango growers. The purpose of this paper is to describe and compare this new Mexican mango with those presently cultivated in Colima and in other areas.

General Site Description

The state of Colima is situated between 18°41'-19°27' North latitude and 103°30'-104°37' West longitude, on the West Coast of Central Mexico. Favorable ecological conditions in the State allow cultivation of various fruit species, mainly 'Mexican' (or Key) lime [*Citrus aurantifolia* (Christm.) Swingle], coconut palm (*Cocos nucifera* L.), banana (*Musa sp.*), mango (*Mangifera indica* L.) and tamarind (*Tamarindus indica* L.), which are planted on ca. 80,000 ha. Mango ranks fourth in cultivated area, occupying nearly 3,500 ha in 1982. The mango region is located along the Pacific Coast. Orchards are found mainly between 0-100 m above sea level, where mean annual temperature is 26°C and average annual rainfall is nearly 800 mm, 65% of which occurs between July and September. Winters are dry, with relatively cool nights. Mango orchards are generally established on deep and well-drained soils of various textures, which are predominantly sandy; pH ranges from 7.0 to 8.5. These environmental conditions are considered excellent for mango cultivation.

Location and Description of Original Seedling Tree

The mother tree is a seedling of unknown genetic origin located in an orchard near Manzanillo, Colima (Fig. 1). In 1972, when the tree was approximately 8-10-yr-old, it called the attention of Mr. Carlos Nuñez-Escobar because of its heavy load of large fruit. Trees had an upright growth habit and fruit were borne around and inside the canopy. Fruit were very attractive upon ripening, with a juicy, bright yellow pulp. Fiber content was low and the seed small.

Propagation of Original Seedling Tree

Productivity and fruit quality were consistently maintained after 4 yr. Therefore in 1975 the tree was vegetatively propagated for the first time, using native polyembryonic mangos as rootstocks. An initial lot of 30 trees was established in Mr. Nuñez-Escobar's orchard and the clone was named 'Manzanillo-Nuñez'. Since performance of these new grafted trees was also outstanding, another lot of about 900 trees was planted in 1979. Further detailed information was collected from this orchard on tree and fruit characteristics.

Description of Grafted Trees

Orchard management. Trees were planted at 14 x 14 m on a sandy, slightly sloping hillside. Orchard management consisted of chemical disease and pest control, and mechanical weed control. Irrigation was provided during the first 2 yr after transplanting, but only during fruit development at maturity. Bearing trees were fertilized annually following harvest.

Vegetative growth. Grafted trees maintained the upright growth habit observed in the original seedling tree, a habit similar to that of 'Kent' (Table 1). Trees are of medium vigor, between 5-6 m tall, with long and well-distributed branches. Main vegetative flushes occur during fall and spring, as in other local and Florida cultivars grown in the area.

Flower and fruit set. Flower bud formation begins in December, with peak flowering occurring during January and February, and ending in April (Table 1). In contrast to other cultivars in the region, 'Manzanillo-Nuñez' has a tendency to produce a high proportion of mixed panicles (those also containing leaves along the central axis), most of which set fruit. Panicles, both mixed and reproductive,

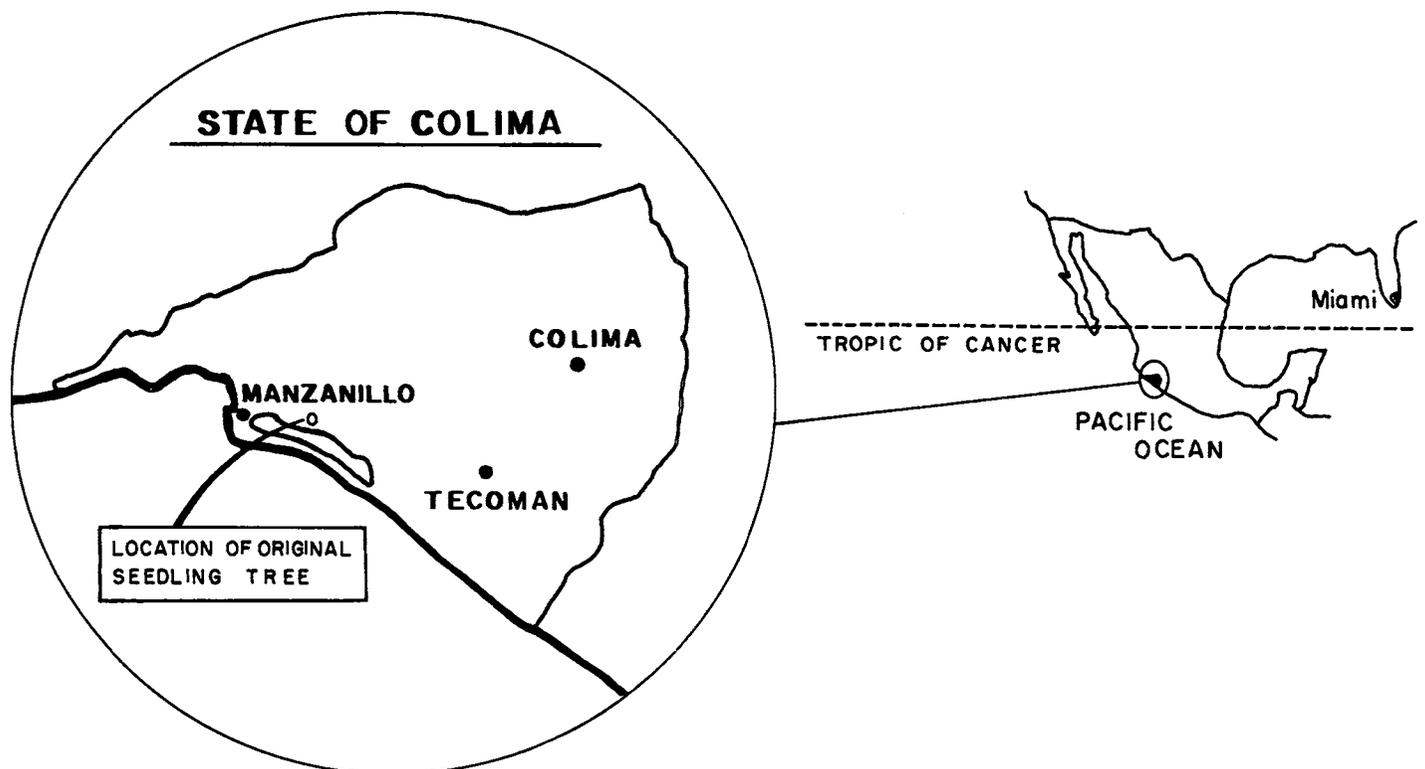


Fig. 1. Geographical origin of the 'Manzanillo-Nuñez' mango in Mexico.

are mainly terminal, well-distributed throughout the canopy and are about 40 cm in length. Mature fruit, which are borne toward the apical portion of the panicle, vary in number from 1-4 per panicle. A distinctive feature in 'Manzanillo-Nuñez' is the presence of fruit at all stages of development, allowing a harvest period of more than 60 days. The bulk of the fruit is collected between June and July and normally some fruit are still available 2-3 weeks after 'Haden' and 'Tommy Atkins' have been harvested (Table 1).

Fruit yield and bearing habit. 'Manzanillo-Nuñez' trees are heavy bearers. Average yield is 200 kg for 5-yr-old trees and more than 300 kg on 8-yr-old ones. However, frequent limb breakage occurs on the most heavily loaded branches. Annual cropping has been regular in contrast to 'Haden', which has shown a strong alternate bearing tendency in Colima (Table 1).

Fruit Characteristics

The 'Manzanillo-Nuñez' mango is a large, plump, attractively colored fruit with a pleasant aroma and flavor. Upon ripening, fruit skin acquires an intense dark red coloration, dominant over a yellowish-orange background. Average fruit and seed dimensions are 12 x 10 x 7.5 cm and 9 x 6 x 2 cm in length, width and thickness, respectively (Fig. 2). Fruit shape is similar to that of 'Kent' (5). Numerous lenticels are present on the skin surface. 'Manzanillo-Nuñez' is larger and contains a proportionately smaller seed (6% of total fruit weight) than other cultivars grown in Colima. The seed is monoembryonic and is covered by a thin and almost fiberless endocarp (Fig. 2). The low fiber content in the fruit is comparable to that of 'Haden' and 'Kent', although the latter's external quality is low (Table 2). External fruit color of 'Manzanillo-Nuñez' is comparable to that of 'Haden' and 'Tommy Atkins', however, the former is smaller with a proportionately larger seed, and the latter has a higher fiber content (Table 2). Percent total soluble solids in ripe fruit is similar to that of 'Haden' and 'Tommy Atkins'. Pulp from 'Manzanillo-Nuñez' fruit is slightly subacid and very palatable.

A characteristic seldom mentioned when describing mango fruit is the amount of latex secreted by the peduncle at harvest. Mango latex is corrosive and damages the fruit surface, and contact with this substance causes skin irritation. 'Manzanillo-Nuñez' fruit secretes a very small amount of latex after harvest, allowing for easier fruit handling.

Fruit of 'Manzanillo-Nuñez' ship and store well (mango fruit is harvested before ripening, when it is still hard). In preliminary trials, June-harvested fruit left uncovered at room temperature for 16 days retained high eating quality. Incidence of anthracnose (*Colletotrichum gloeosporioides* Penz.) was negligible.

Highest fruit quality is achieved during the dry season, since fruit harvested during the rainy season are affected by anthracnose and Mexican fruit fly (*Anastrepha ludens* Loew)

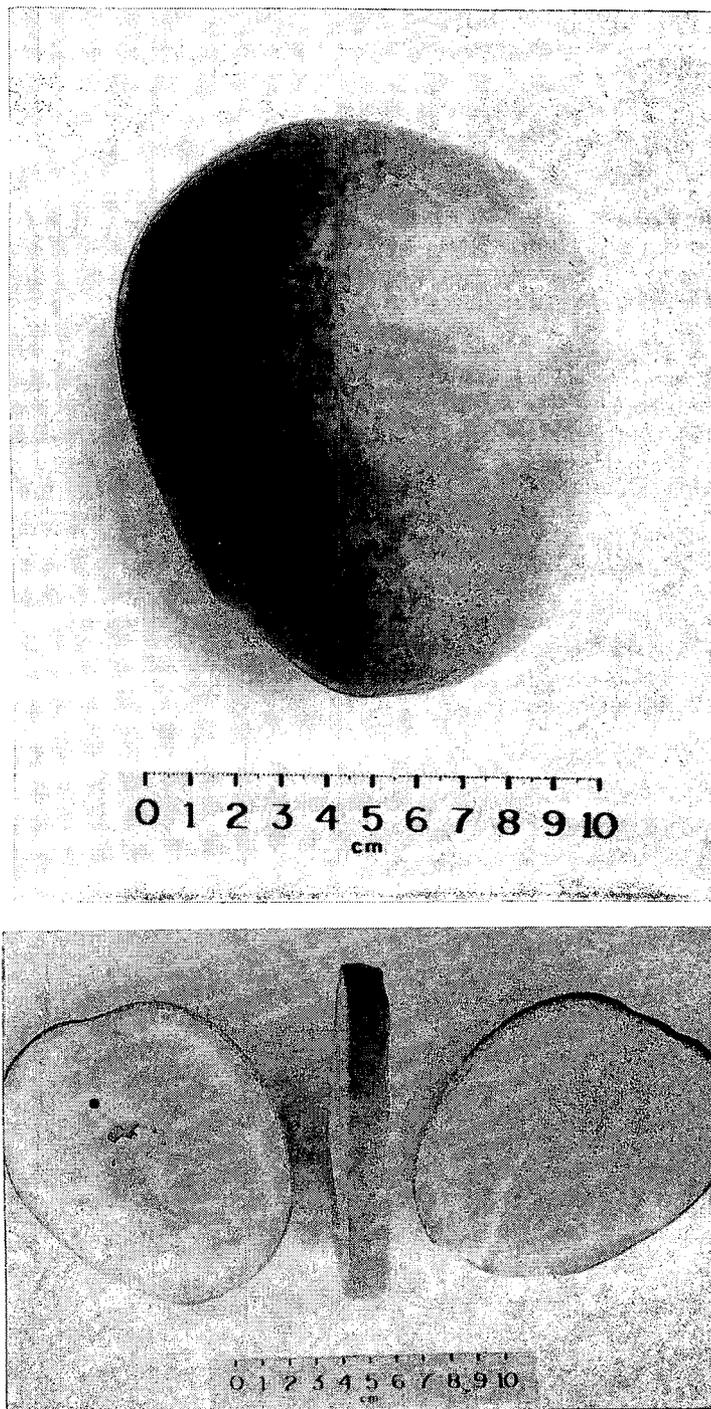


Fig. 2. Whole and sliced 'Manzanillo-Nuñez' mango fruit. Fruit shape and size (above). Longitudinal section of central fruit portion showing thinness of seed (below).

Table 1. Characteristics of mango cultivars grown in Colima, Mexico.

| Cultivar | Growth habit | Flowering season | Main harvest period | Alternate bearing tendency | Productivity | Main defect |
|------------------|--------------|------------------|---------------------|----------------------------|--------------|-----------------------------|
| Manzanillo-Nuñez | Upright | Jan.-Apr. | June-July | None | Very High | Medium late harvest |
| Haden | Spreading | Jan.-Mar. | June-July | Strong | Moderate | Alternate bearer |
| Tommy Atkins | Dense | Jan.-Mar. | June-July | None | Moderate | Physiol. breakdown of fruit |
| Kent | Upright | Feb.-Apr. | July-Aug. | Slight | Low | Late harvest |
| Manzila | Spreading | Dec.-Mar. | May-June | Moderate | Moderate | Poor external quality |
| Diplomático | Compact | Dec.-Mar. | May-June | None | Moderate | Poor internal quality |

Table 2. Fruit characteristics of mango cultivars grown in Colima, Mexico.

| Cultivar | Avg. wt. (g) | Total soluble solids (%) | Seed wt. ^z (%) | Fiber content | Red peel blush (%) |
|------------------|-----------------|-----------------------------|------------------------------|------------------|-----------------------|
| Manzanillo-Nuñez | 660 | 15 | 6 | Low | 75 |
| Haden | 350 | 14 | 11 | Low | 65 |
| Tommy Atkins | 600 | 14 | 9 | Mod. | 80 |
| Kent | 560 | 13 | 9 | Low | 10 |
| Manila | 180 | 15 | 10 | Mod. | 0 |
| Diplomático | 260 | 15 | 13 | High | 50 |

^zExpressed as % of total fruit wt.

(Table 2). Various control measures are being implemented, including early flower induction, in order to regulate the harvest season and avoid unfavorable climatic conditions.

Commercial Prospects

'Manzanillo-Nuñez' is a high quality mango which has excellent potential for export. Approximately 25,000 kg of fresh fruit were air-freighted to Japan between 1982 and 1984. The fruit compares favorably with that from other Indian, Indochinese and Philippine cultivars due to its large size, attractive red blush and high content of tasty and virtually fiberless pulp.

Although actual production of 'Manzanillo-Nuñez' fruit is limited (only an estimated 1500 trees are at the bearing stage), the cultivar is rapidly gaining popularity in other nearby mango growing areas.

Literature Cited

1. Macías-González, J. L., V. M. Medina-Urrutia, and R. Nuñez-Elisea. 1979. Estudio de adaptación de 15 cultivares de mango introducidos a la Costa de Jalisco. Informe Anual del Programa de Frutales Tropicales. Secretaría de Agricultura y Recursos Hidráulicos, Instituto Nacional de Investigaciones Agrícolas, Campo Agrícola Experimental Costa de Jalisco, México.
2. Mosqueda-Vazquez, R. 1983. Logros y aportaciones de la investigación agrícola en el cultivo de frutales tropicales y subtropicales. Publicación Especial No. 97. Secretaría de Agricultura y Recursos Hidráulicos, Instituto Nacional de Investigaciones Agrícolas. México, D. F.
3. Naik, K. C. and M. M. Rao. 1943. Studies on blossom biology and pollination in mangos (*Mangifera indica* L.). Indian J. Hort. 1: 107-119.
4. Singh, L. B. 1960. The mango. World Crops Books. Leonard Hill, London.
5. Young, T. W. and J. W. Sauls. 1979. The mango industry in Florida. Fla. Coop. Exten. Serv., Univ. Florida, Inst. Food Agr. Sci. Bul. 189.

Proc. Fla. State Hort. Soc. 97:363-366. 1984.

FIBROUS ROOT DISTRIBUTION OF MANGO (*MANGIFERA INDICA*, L.) AND TAMARIND (*TAMARINDUS INDICA*, L.) TREES

V. M. MEDINA-URRUTIA

*Instituto Nacional de Investigaciones Agrícolas,
Campo Agrícola Experimental Tecoman,
Apartado Postal No. 88,
28100 Tecoman, Colima, México*

Additional index words. Monolith method, cultural practices.

Abstract. This study was conducted in Tecoman, Colima, Mexico during the summer of 1982. Root systems were studied in two 8-yr-old orchards of seedling tamarind (ST) planted on 2 soil types, and one 9-yr-old mango MG orchard with 3 different cultivars on native rootstocks. Fibrous roots were observed at 6 distances from the trunk and at 5 (ST) and 4 MG soil depths at 20-cm intervals, using the monolith method. Fibrous root density was greatest at a 20-40 cm depth in 'Haden' mango, and between 0-20 cm in 'Kent' and 'Diplomatico'. Root density outside the drip zone was greater in 'Kent' than in 'Haden' or 'Diplomatico'. Fibrous root density of tamarind trees planted on sandy loam soil was greater than that of trees planted in loam soil. Tamarind fibrous root density was greatest at a 0-40 cm soil depth in both soil types and between 2.15-3.0 m from the trunk.

Colima is located on the Central Pacific coast of México. Nearly 3000 ha of mangos (8) and 2160 ha of tamarind (1) are cultivated in the state, although most orchards, par-

Proc. Fla. State Hort. Soc. 97: 1984.

ticularly tamarind, are poorly managed. Annual mean temperature is 26°C and annual rainfall is 800 mm, most of which occurs from June to October. Soil types vary from sand to loam.

Root distribution of mango trees has been studied in Venezuela (1), México (5, 11), and Ivory Coast (12). Results indicated that fibrous root density was highest at a 40 cm soil depth. Similar results were observed in root distribution studies of tamarind (4, 7) and lime (10) trees.

The objective of this study was to measure fibrous root distribution of mango and tamarind under local soil and climatic conditions.

Materials and Methods

Studies were conducted at the Campo Agrícola Experimental in Tecoman, Colima, México during summer, 1982.

Mango experiments. A 10-yr-old mango orchard established on sandy soil was studied. Trees were planted at 10 x 10 m. Florida cultivars Haden and Kent, as well as 'Diplomatico' (a native local selection) all grafted on native polyembryonic rootstocks were studied. Three trees from each cultivar were chosen to study the fibrous root system.

Tamarind experiments. Two 8-yr-old orchards established on 2 different soil types were selected. Trees from both orchards were propagated by seed and were planted at 10 x 10 m. Four trees on sandy-loam-soil and 3 on loam soil were sampled to study fibrous root distribution.

Method of root system study. The monolith method (9)