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

[z]Expressed 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.

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

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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, particularly 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 Tecomán, 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) was used to study root systems of mango and tamarind trees. A 45° angle section of the root system was excavated and fibrous roots separated from soil. Fibrous roots were extracted from 20 cm soil layers up to an 80 (mango) or 100 cm depth (tamarind). Six samples, 85 cm apart, were taken to determine horizontal fibrous root distribution. Mango fibrous root were weighed fresh, whereas dry weights were measured for tamarind roots.

Tree height and canopy diameters were also determined in both experiments. Soil samples were taken at all depths to obtain information on chemical and physical soil characteristics.

Statistical analysis. A randomized complete block design was used in both experiments. Fresh or dry weights of fibrous roots were analyzed as a split plot treatment. Means were separated using Duncan's multiple range test at the 5% level.

Results and Discussion

Mango. Mean fibrous root density of the 3 mango cultivars was not statistically different (Fig. 1). 'Haden' trees were greater in height and canopy volume than 'Kent' and 'Diplomatico'.

Vertical root distribution. The density of fibrous roots of 'Haden' was not significantly different at various depths. However, root density was numerically lower at a 60-80 cm soil depth. These results agree with those of a previous study in Venezuela (2, 3). Fibrous root density of 'Diplomatico' decreased with soil depth, and the highest root density was observed at 0-20 and 20-40 cm soil depths. 'Kent' had the highest root density at a 0-20 cm soil depth as previously reported (5, 11).

All cultivars had more than 60% of the fibrous root system at the 0-40 cm depth. This trend was perhaps influenced by the higher organic matter content and finer texture of this soil layer than that of the 40-80 cm soil layer (Table 1). The influence of soil characteristics on root distribution of mango trees has been previously studied (3, 5, 11). Mountounet et al. (12) also found a higher root density at the 0-40 cm soil depth. They recommended that soil temperature and moisture measurements be made at 40-cm soil depths.

Horizontal fibrous root distribution. The greatest fibrous root density for 'Haden' occurred at 90-175 and 175-260 cm from the trunk. 'Diplomatico' root density was greatest at 90-175 cm from the trunk. 'Kent' root density was greatest at 90-175, 175-260 and 345-430 cm from the trunk (Fig. 2). 'Kent' root density was different from that shown by other

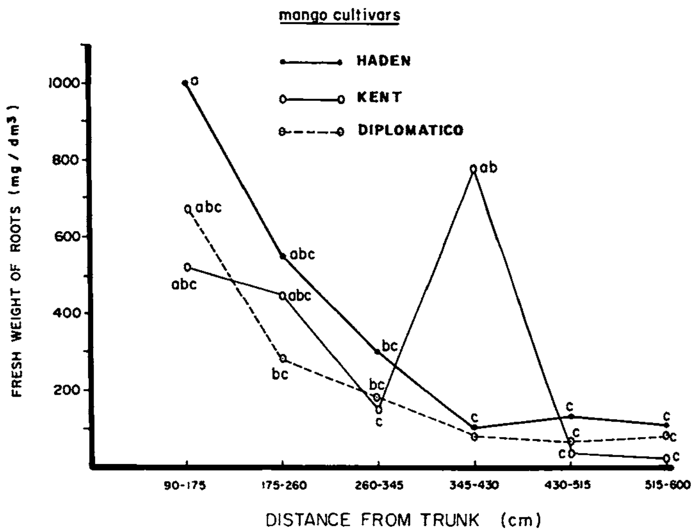


Fig. 2. Horizontal fibrous root distribution of 3 mango cultivars growing on sandy soil, Tecomán, Colima, México.

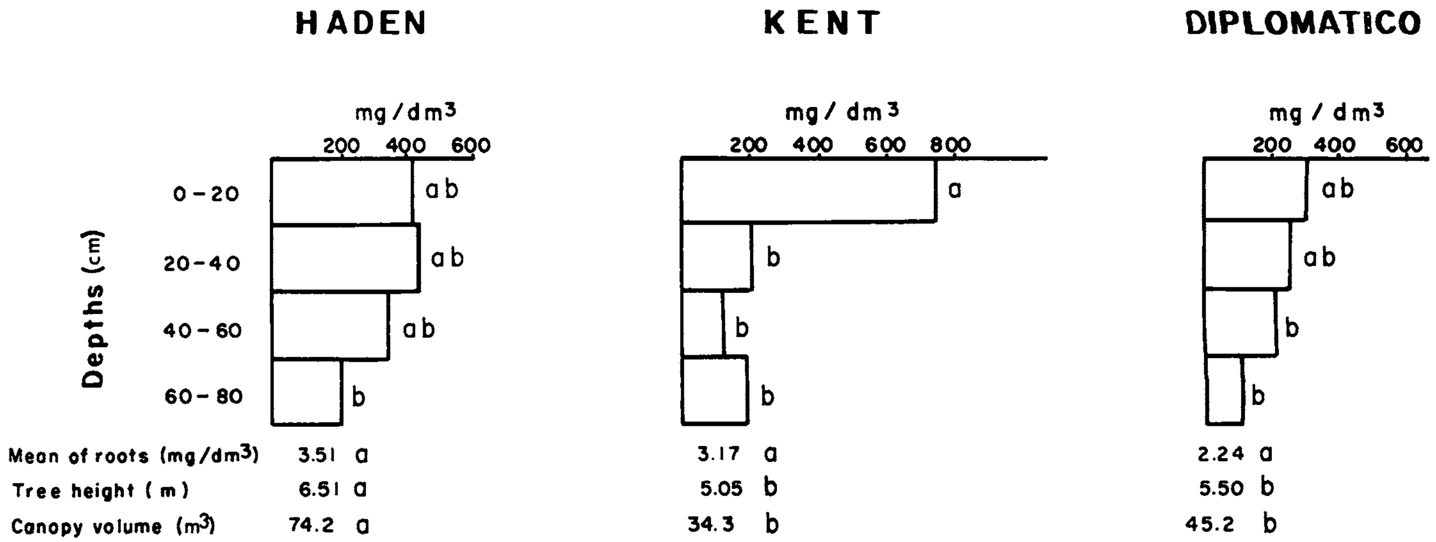


Fig. 1. Vertical fibrous root distribution, tree height and canopy volume of 3 mango cultivars growing on sandy soil. Tecomán, Colima, México.

Table 1. Soil characteristics of the mango orchard, Tecomán, Colima, México.

Depth (cm)	Sand (%)	Clay (%)	Silt (%)	Texture	Org. matter (%)	Ca (ppm)	K (ppm)	Mg (ppm)	P (ppm)	pH
0-20	84.26	3.66	12.06	Loamy-sand	0.45	3.13	Rich	1.6	Medium	7.2
20-40	82.9	4.33	12.73	Loamy-sand	0.45	2.86	Rich	1.6	Medium	7.5
40-60	90.35	3.00	6.64	Sand	0.18	4.4	Low	1.6	Low	7.8
60-80	92.36	1.00	6.64	Sand	0.31	1.2	Low	0.6	Medium	8.0

Table 2. Soil characteristics of the tamarind orchards, Tecomán, Colima, Mexico.

Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Org. matter (%)	N (%)	P (ppm)	Ca (ppm)	Mg (ppm)	pH	Compactation (kg/cm³)
					Sandy loam Soil					
0-20	73	15	12	0.70	0.072	6.5	6829	288	8.3	7
0-40	75	17	8	0.20	0.057	3.1	7142	321	8.2	20
0-60	78	15	7	0.13	0.038	3.1	6866	214	8.1	18
0-80	79	15	6	0.16	0.042	2.8	6267	213	7.8	19
0-100	90	5	5	0.20	0.038	2.6	5174	144	7.6	19
					Loam Soil					
0-20	44	32	24	2.1	0.165	8.6	52718	371	8.1	31
0-40	45	25	30	2.2	0.139	8.8	47925	383	8.1	38
0-60	47	30	23	1.6	0.113	8.4	46819	408	8.2	46
0-80	52	30	18	1.1	0.090	8.3	50668	358	8.0	41
0-100	52	27	21	0.8	0.075	4.5	67883	362	8.1	19

mango cultivars, especially at the 345-430 cm distance. A study of 'Kent' trees established on clay-loam soil showed the highest fibrous root at 175 cm from the trunk (11). The unusually high root density at 345-430 cm in the present study cannot be explained.

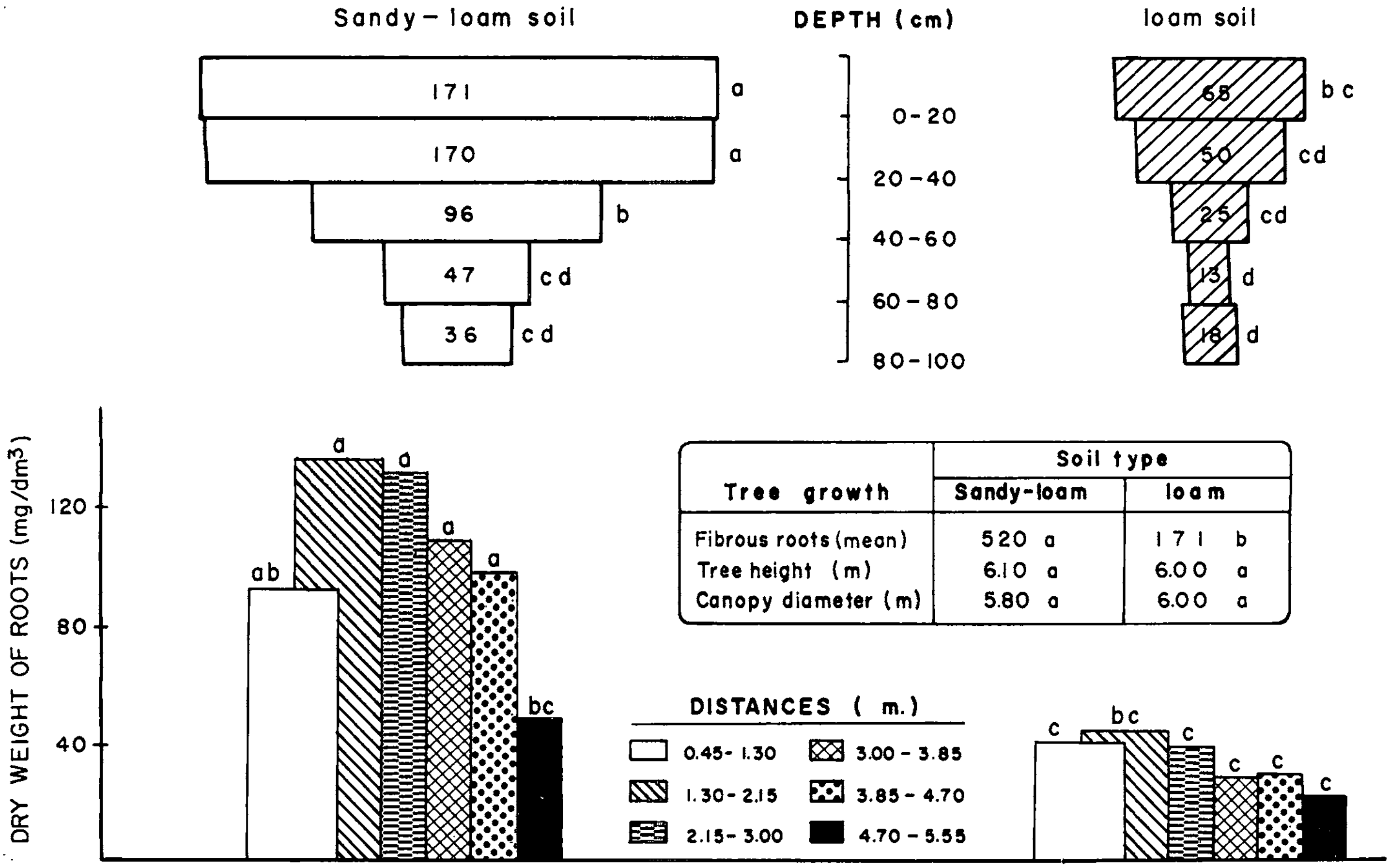
Tamarind. A higher fibrous root density was observed on sandy loam than on loam soil, although canopy diameter of the trees on both soil types was similar (Fig. 3).

Vertical root distribution. Fibrous root density in sandy-loam was highest at the 0-20 and 20-40 cm depths. In loam soil root density was statistically identical at the 0-20, 20-40 and 40-60 cm soil depths.

The highest percentage of fibrous root was observed at 0-40 cm soil depth, which supports previous reports on mature tamarind trees (7) and in trees of mixed ages (4). Root density was higher overall in sandy loam than in loam soil at all depths except at 60-80 and 80-100 cm.

It appears that the greater soil compaction (Table 2) restricts fibrous root growth in loam soil more than in sandy-loam soil (6, 9). Furthermore, fibrous roots have to explore a greater volume of soil under poor soil fertility conditions than rich soils. Roots growing in rich soil may shorten and increase in diameter, and their growth may be irregular, as shown in Fig. 4.

Horizontal root distribution. The horizontal fibrous root distribution patterns in both soil types was similar, but root density was higher at all distances from the trunk in the sandy loam soil, as compared to loam soil (Fig. 3). It appears that root distribution of tamarind trees is a genetic characteristic, since horizontal roots showed similar dis-



Tree growth	Soil type: Sandy-loam	Soil type: loam
Fibrous roots (mean)	520 a	171 b
Tree height (m)	6.10 a	6.00 a
Canopy diameter (m)	5.80 a	6.00 a

Fig. 3. Vertical (above) and horizontal (below) fibrous root distribution of tamarind trees growing on 2 soil types. Dry weight of roots mg/dm³ of soil. Tecomán, Colima, México.

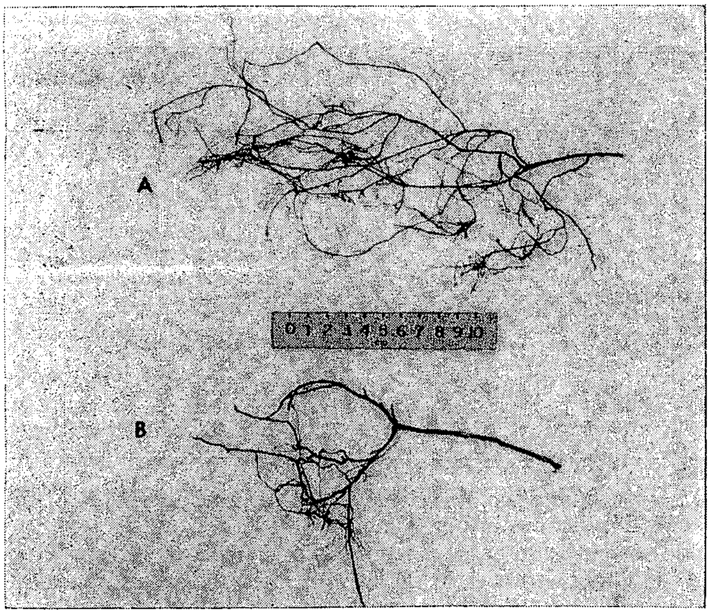


Fig. 4. Fibrous roots of tamarind trees growing on sandy-loam soil (A) and loam soil (B). Tecomán, Colima, México.

tribution in both soil types. There were no statistically significant differences in horizontal fibrous root densities in loam or sandy loam soils.

Results observed here seem to confirm that tamarind trees can be grown in any soil type along the central Pacific coast of México (7), because canopy volume was similar in trees on both soil types, although root density was different.

Conclusions

1. Canopy volume was greater in 'Haden' than in 'Kent' and 'Diplomatico' mango trees, but root density was similar for all cultivars.
2. Mango cultivars showed a tendency to develop highest fibrous root density at a 0-40 cm soil depth. Root density at 40-80 cm was greatest in 'Haden' trees.
3. 'Haden' trees had the highest root density at 90-175 and 175-260 cm from the trunk, while root densities of 'Diplomatico' trees were highest at 90-175, 175-260 and 345-430 cm from the trunk.
4. Greater root density occurred in sandy-loam than in loam soil for tamarind trees but tree size in both soil types was similar.
5. Fibrous root density of tamarinds grown in sandy-loam soil was greater than in loam soil at most soil depths and distances from the trunk, but vertical and horizontal root distribution patterns were similar on both soil types.

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THREE FACES OF INTERCROPPING IN DADE COUNTY, FLORIDA

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Abstract. **Intercropping is the practice of growing 2 or more crops simultaneously in the same field. It has long been used by traditional farmers in the subtropics and tropics as a means of increasing productivity per unit area, guaranteeing at least some yield even under adverse weather conditions, and of providing greater dietary diversity. High land costs in Dade County, Florida, have encouraged practices which increase early returns on capital invested in land and equipment. Three types of intercropping systems with edible horticultural products are currently being used by local growers: 1) tree crops with tree crops, 2) tree crops with vegetables and 3) vegetables with vegetables. Most cultural operations are performed with machinery typical for the main crops involved, supplemented by hand labor as needed; harvesting is done by hand.**

Examples will include specific crops as well as temporal and spatial arrangements for different systems.

Intercropping, or the growing of 2 or more crops simultaneously on the same land, is a practice which has been used by "traditional" or subsistence farmers around the world for many thousands of years. Some basic premises regarding intercropping were recognized at the American Society of Agronomy Special Symposium on Multiple