

Avocado production and breeding in Mexico

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SYNOPSIS

The avocado was already known in Mexico 12 000 years ago, and it is at present the leading avocado producer in the world; in 1985 the estimated production was 401 000 tons from a harvested area of 57 000 hectares. The avocado culture as a commercial activity is practised in 16 states; four of them produce significant amounts of avocado (Michoacan, Sinaloa, Puebla and Mexico). Of these four states Puebla has a limiting factor (shallow soils) and Sinaloa produces West Indian type avocados; only Michoacan and the state of Mexico have wide land resources and are known as the 'Avocado Belt of the Mexican Republic'. It has 1 347 000 hectares, similar in soil, quality and climate, The Scientific and Technological Research Center of Avocado in the State of Mexico (CICTAMEX) is carrying out a programme to produce new cultivars including intermediate and dwarf trees. These studies date back to 1953. In the first phase Colinmex, Colin V-101 and especially Colin V-33 were used and 21 of these trees have outstanding characteristics of quality and production. Selection of somatic dwarf mutants is also being done. At present three Fuerte and two Rincon dwarf mutants have been selected. (Of the selection of drawling rootstocks used up to the present, more than 20 dwarf trees have been selected from Colin V-33 seedlings.)

PRODUCTION

The avocado was already known in Mexico 12 000 years ago according to findings in caves of Tehuacan Valley, Puebla and since then has become part of the Mexican diet. This fruit is important to the country because of the high consumption by the people and its well-known high nutritive value. From the economic point of view it plays an important role in the Mexican agricultural sector.

Mexico is the leading producer of avocado in the world; in 1985 the estimated production was 401 000 tons from a harvested area of 57 000 ha. In the fifties, avocado orchards of cultivars like Fuerte were established; this increased the national avocado production (Figure 1). In the beginning of the seventies, orchards of Hass were established, and this has become the leading cultivar in Mexico. Between 1970 and 1980 the avocado production has doubled (Figure 2) and has now stabilised.

In the Mexican Republic, avocado culture as a commercial activity is practised in 16 states; four of them produce significant amounts of fruit from different cultivars such as

Hass, Fuerte, Bacon and others. These fruits have a good price on the market. Of these four states, Puebla has a limiting factor because of its shallow soils (Altixco, Puebla) and the incidence of pests and diseases (*Phytophthora cinnamomi* Rands), Sinaloa produces a great amount of West Indian type sold at a low price on the market; only Michoacan and the State of Mexico have wide land resources that are available and potentially adequate for avocado. These two states form part of the 'Avocado Belt of the Mexican Republic' which has an estimated area of 637 km by 21 km, with an area of 1 347 000 ha similar in the soil quality and climate. This belt has altitudes ranging from 1 500, 1 800 and 2 000 m and lies between the latitudes 18° 30' and 20° North (Figure 3).

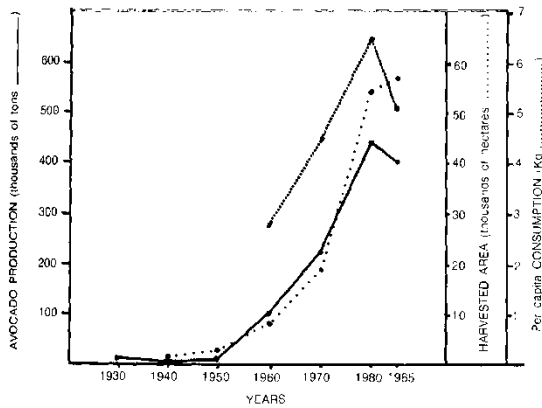


Fig 1 Evolution of avocado production in Mexico from 1930 to 1985.

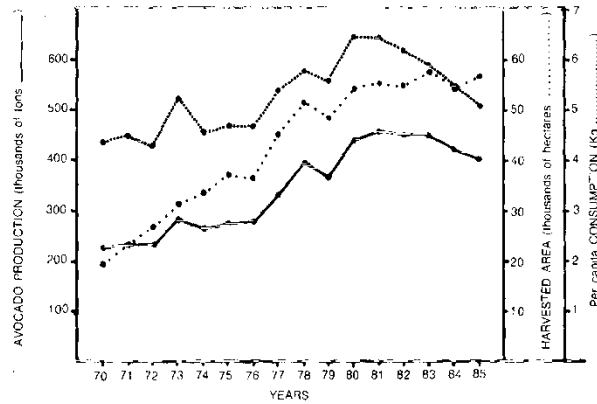


Fig 2 Avocado production in Mexico from 1970 to 1985.



Fig 3 Localisation of the 'Avocado Belt of the Mexican Republic'.

BREEDING

Several studies have been carried out in Mexico for the selection of rootstocks which tolerate salinity (Salazar *et al*, 1982), high-lime induced chlorosis (Lopez *et al*, 1985), drought (Macias, 1981) and the disease caused by *Phytophthora cinnamomi* Rands (Galindo, 1984, pers com). Work has also been done on the selection of 'criollo'-type seedlings of the Mexican race (Mosqueda, 1983).

The Scientific and Technological Research Center of Avocado in the State of Mexico (CICTAMEX) carries out studies to solve the main problems of production and marketing of avocado. Another aim of this breeding programme is to obtain dwarf trees and trees with intermediate vigour with the idea of having more intensive plantings. Cultivation studies at this research centre date from 1953, when plots of Fuerte seedlings were established in Ixtapan de la Sal, State of Mexico. From these plots Colinmex and Colin V-101 suggest a variety of tree of intermediate vigour, and Colin V-33, a dwarf tree with a high heritability ($h^2 = 0,7$) (Barrientos & Sanchez, 1982) were selected (Figure 4). These trees were later planted in Coatepec Harinas, State of Mexico, where this research centre is located.

After this, seedlings of Hass, Fuerte, Boyce, Colin V-101 and especially of Colin V-33 were established. From the latter, we have selected more outstanding trees than from Hass, Fuerte and Boyce seedlings. We are now establishing seedlings of these selections using a recurring selection scheme that includes the recombination of selections to obtain new cultivars.

Eighty six trees have been selected out of more than 3 765 seedlings; to date 21 of these trees have outstanding characteristics of quality and production (Figures 5 and 6). Table 1 shows the harvesting season of some of these selections.

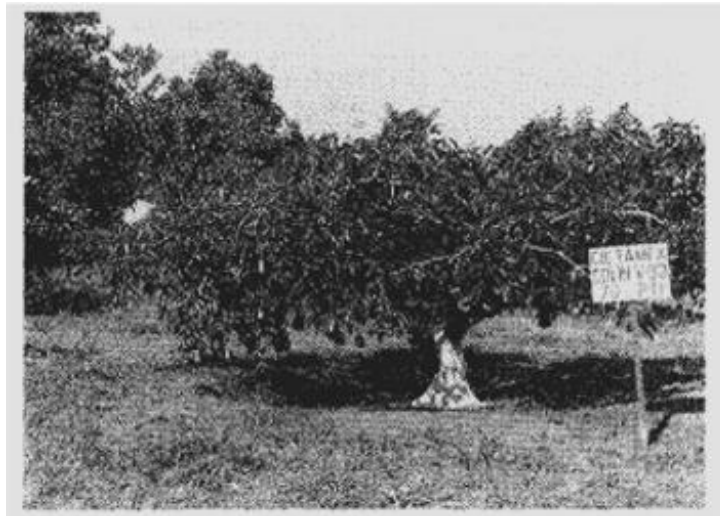


Figure 4 A 16-year-old Colin V-33 dwarf avocado tree.

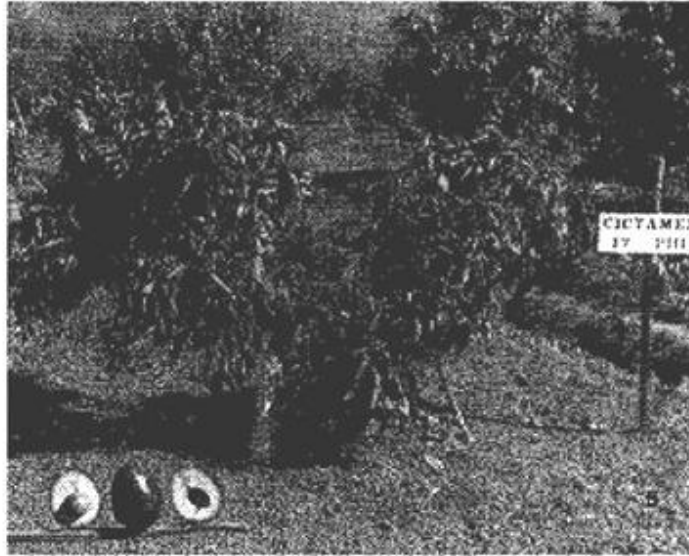


Figure 5 Two-year-old grafted tree of Colin V-33 seedling selection CICTAMEX 137 PLS

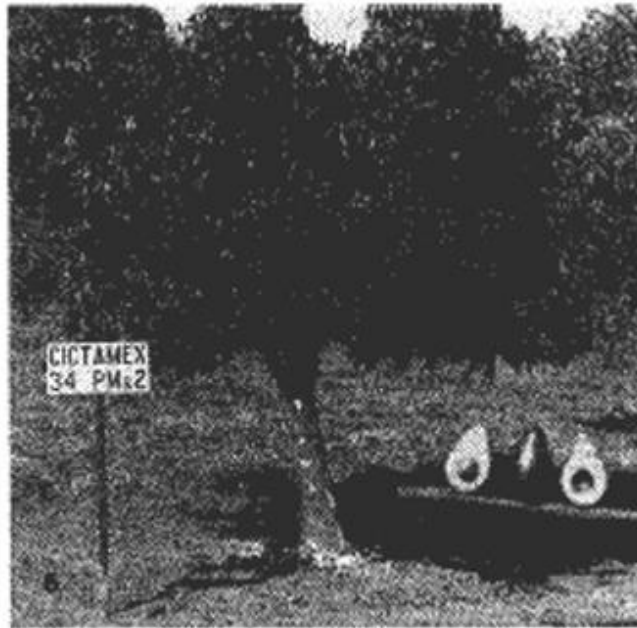


Fig 6 Three-year-old graft 33 seedling selection CICTAMEX 148 PLS.

TABLE 2 Growth characteristics of some dwarf avocado mutants.

Origin	Dwarf Mutant	Age (Years)	Trunk Circumference (cm)	Canopy Diameter (m)	Scion Height (m)
Fuerte	160 PF1	11	29	1,45	1,29
Fuerte	119 PPaA	16	28	2,35	1,27
Fuerte	96 PJ	16	57	3,35	2,05
Rincon	13 PJ111	11	45	2,45	0,75
Rincon	121 PJIII	11	57	4,10	2,25

Besides the selection of seedling trees, some somatic dwarf mutants were selected. To date we have selected three Fuerte mutants (Figure 7) and two Rincon mutants. These trees show a clear lack of apical dominance and a tendency to lateral growth.

To obtain natural hybridisation among cultivars or selections, multiple top-grafting is done on shoots of previously cut-back trees. The number of grafts per tree varies from two to nine different cultivars or selections, to generate populations in which we can continue practising recurring selection.

Studies are also carried out on the selection of dwarfing rootstock. Colin V33 when used as an interstock, reduces the height of Fuerte scions by 43 per cent. For this purpose the selection is done on open-pollinated seedlings of Colin V-33. Up to now we have identified more than 20 dwarf trees. In some of these trees we have carried out studies on the bark/xylem relationship and we have found that dwarf trees have more bark area (22,7 per cent) than tall trees where this proportion is only 12,9 per cent (Lopez & Barrientos, 1987).

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