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Height Variability Obtained From a New Dwarf Avocado Tree Population

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Abstract

An analysis of genetic variability has been done in a population of trees obtained from a new dwarf-internode avocado clone. It was found that trees varied considerably in height. A highly significant negative correlation between height and number of branches was found. High heritability of branch number was also found and a relationship between stomatal density and reduced height of the trees.

Introduction

Orchards with relatively few large trees per hectare and grown on seedling rootstock gradually made way—via reduced stature forms — for high-density plantings. The reason for this change was the need to achieve early cropping, high yield per unit area, and high fruit quality. Reducing stature in avocado trees has been a goal of fruit breeders (Bergh and Whitsell, 1962). A new dwarf avocado clone (COLIN V-33) was discovered by Mr. Salvador Sanchez-Colin as a chance seedling of cv. Fuerte in Ixtapan de la Sal, Mexico. This "genetic dwarf" is capable of high productive efficiency and high fruit quality.

An experiment was designed to establish the breeding value of this dwarf genotype that determines their influence on the next generation.

Material and Methods

Evaluation for height was made in a first-generation orchard of one year old seedlings, derived from seed of an open pollinated compact block of the dwarf avocado "Colin V-33". The most valuable characteristics of this new variety are: Originated in Ixtapan de la Sal, Mexico, by Salvador Sanchez-Colin. Registered with AGE-001-40280 number by the Mexican Agricultural Direction in 1980. Chance seedling of cv. Fuerte. Fruit: Fuerte type; 6 inches length; 3/4-pound weight; pyriform; skin bright green and thick; surface slightly rough; peeling quality excellent; flesh clear, free of fiber; buttery texture with rich nutty flavor, melting quality excellent; seed small, one-tenth-pound, conical, filling the cavity completely; blooming time from October to December, crop season November to January. Tree: vigorous; prolific; dwarf compact; spreading strong lateral branches;

efficient and productive; leaves dark green with undulated margins. The degree of association between branches and height of the avocado trees was measured by correlation and regression. Heritability (h2) estimates, obtained from regression of progeny means on the mean of one parent, were calculated from $b^{=}½h^2$ (Falconer, 1970).

Stomatal density was estimated on the dorsal surface of leaves, midway between the third and fourth veins by mean of a quickfix film (Beakbane et al., 1975). Estomatal density were examined under a power objective (40xl2.5x). Ten such observations were made from each of the ten leaf samples, 100 observations per clone of avocados cv. Fuerte, Hass, an Intermediate (No. 44), and the dwarf (Colin V-33).

Results

Trees varied considerably in height from 18 cm through 145 cm (table 1) (figure 1). The reduction of plant height results from the inhibition of internode elongation as a consequence of reduced subapical meristematic activity or even abortion of the terminal bud. Consequently, there is temporary or permanent cessation of apical dominance, permitting axillary bud and branch development which results in natural pruning. In general branched trees are shorter than those with a single axis. A highly significant negative correlation (r= -0,79**) (figure 2) between height and number of branches was found. High heritability of branch number was obtained (h^2 = 0.74) (figure 3). A relationship between stomatal density and reduced height of the trees was also found (table 2).

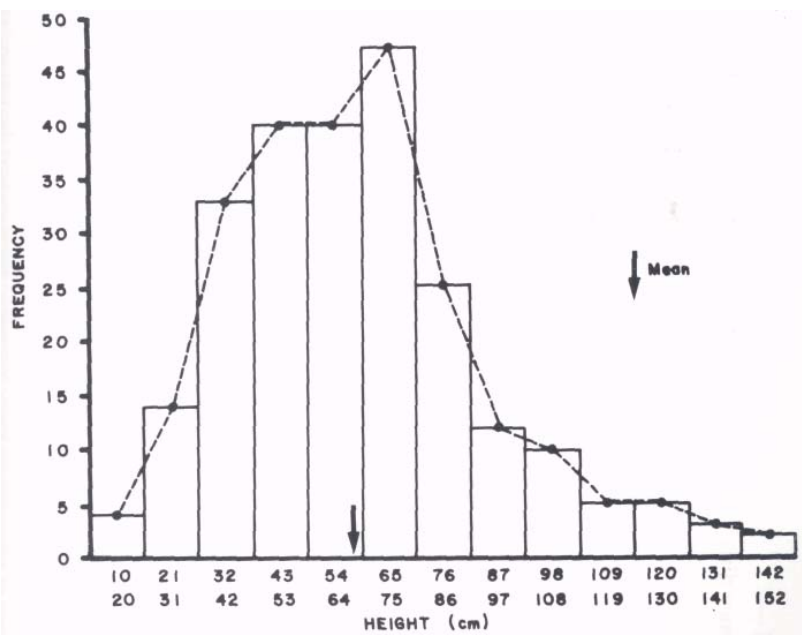

FIG 1—Height distribution of COLIN. V-33 dwarf avocado segregants at Coatepec, MEXICO.

TABLE 1—

Frequency distributions for height of an avocado tree population derived from the dwarf avocado clone 'Colin V-33'.

	Class Centers (height)													Statistics			
Character	15	26	37	48	59	70	81	92	103	114	125	136	147	n	$\bar{x}$	s	cv
Height	4	14	33	40	40	47	25	12	10	5	5	3	2	240	63.6±1.7	25.8	40

n= number of trees: $\bar{x}$= mean: s= standard deviation; cv= coefficient of variability.

TABLE 2—Stomatal density of avocado leaves

Vigour Group	Dwarf	Intermediate	Normal	
Clones	Colin V-33	No. 44	Fuerte	Hass
Number of stomata (field 40 x 12.5x)	x= 44.22 ± 0.57	x= 31.4 ± 0.52	x= 22.98 ± 0.37	x= 21.7 ± 0.37
Statistics*	s= 4.03 cv= 9.11 n= 100	s= 3.65 cv= 1.66 n= 100	s= 2.63 cv= 11.40 n= 100	s= 2.62 cv= 12.07 n= 100

* n= number of microscopic field; x=mean; s= standard deviation; cv= coefficient of variability.

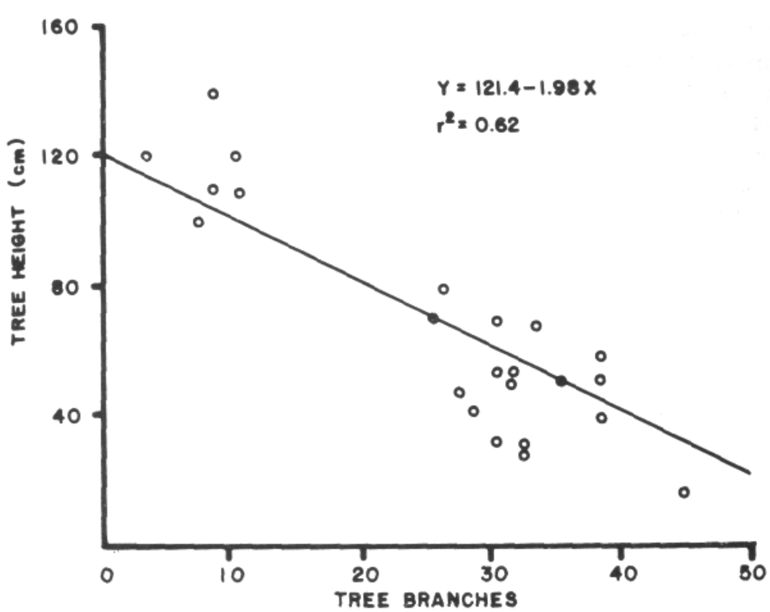

FIG 2—Regression line of the relationship between branches and height of the dwarf avocado trees.

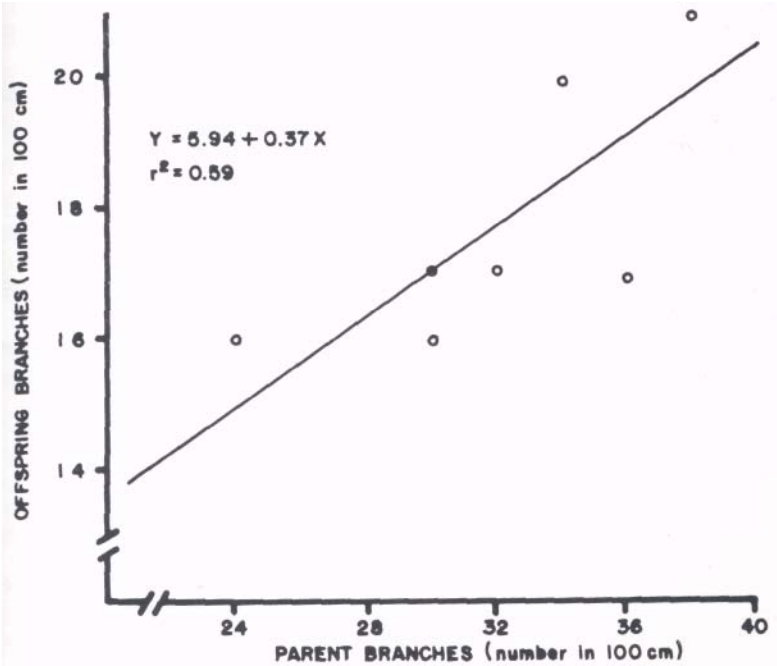

FIG 3— Regression line of the relationship between offspring branches and parent branches.

Discussion

The most important tissues controlling stem elongation are the shoot apical and subapical meristems, the apical meristem and/or the young leaves, through production of growth regulating materials, regulate activity in the subapical meristematic region, where most of the cells of the elongate shoot are produced (Sachs, 1965). The results presented here suggest that tree height was reduced by severely inhibiting apical meristematic activity and by reducing apical control of axillary shoots and simultaneous growth of many shoot axes which, owing to competition for limited nutrients, reduces the elongation of one or a few axes, on the same root system. Thus, Vanched trees are shorter than those with single axis as estimated by the highly significant negative correlation (r= -0.79**) found between height and number of branches.

High heritability estimates (h^2 = 0.74) indicate that progeny number of branches and height will be predictable in subsequent generations.

Stomatal density, estimated from plastic film replicas of leaf surfaces may provide a simple mean of making an initial classification of avocado dwarf seedlings into groups related to their probable growth potential.

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