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Selection of Dwarfing Rootstocks of Avocado *(Persea americana* Mill.)

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I. STUDIES OF BARK: XYLEM RELATIONSHIP IN TRUNKS OF CV. COLIN V-33

[The text of the original manuscript for this paper has been slightly modified to reflect to some degree in this presentation the American idiomatic use of English. Tables are presented without modification, as they were prepared by the authors.]

SUMMARY

Six-year-old seedlings of 'Colin V-33' (a dwarf avocado) were grouped in tall and dwarf trees in order to study the relationship between bark: xylem and growth parameters of the trees. Tall trees had a height average of 5.75 m, and the dwarf ones 1.55 m. The results indicated that a higher proportion of transversal bark area (22.7%) occurred in dwarf trees than in tall trees (12.9%) High correlations were found between percent of transversal bark area with height (r = -0.89**) and with trunk circumference (r = -0.91**), as well as trunk circumference with height (r = 0.90**). These findings are in agreement with those found in other tree species, such as apple and mango.

INTRODUCTION

Avocado production is based fundamentally in the use of seedling rootstocks. Therefore, the trees reach a great height and develop large canopies that in time make difficult practices like picking and pest and disease control. Also, productivity is lower because of shading among trees. One of the objectives of the research worldwide is to find dwarf cultivars and dwarfing rootstocks that could help solve this problem. This goal in avocado is of great importance because its achievement could facilitate picking and orchard management and increase productivity by increasing plant density.

In Mexico has been developed the cv Colin V-33 with the main characteristic of being dwarf (Barrientos and Sanchez, 1982) and the ability of reducing the height of 'Fuerte' when used as interstock (Barrientos, *et al.,* 1987).

In avocado, there are no studies of bark: xylem relationship, as in other fruit trees in which it was found that this relationship is associated with the elongation growth and that dwarf trees have a higher proportion of bark than normal size trees (Jaumien and Faust, 1985; Mukherjee and Das, 1980). The purpose of this research is to study the relationship between bark: xylem and growth of different groups of avocado, ranked by vigor.

MATERIAL AND METHODS

Six-year-old 'Colin V-33' seedlings were chosen from plot "La Cofradia" (PLC), located in Coatepec Harinas, State of Mexico, to form two groups of six trees each, tall trees and dwarf trees. From each tree, fractions of bark were cut from five points around the trunk at a height of 20 cm. The bark thickness was measured with vernier. Trunk circumference was measured at the height of 20 cm before the bark was cut.

With the trunk circumference data, the transversal total area was calculated; and using bark thickness data, the transversal area of the bark was calculated. The formulae used are presented in Fig. 1.

To compare both groups in proportion of bark transversal area with respect to xylem transversal area (in percentage), statistical analyses were made of circumference of the trunk and tree height using a "t" test procedure. One tree was used as an experimental unit, with six replications. Correlation analysis was made between percentage of bark area, tree height, and trunk circumference.

RESULTS

Highly significant differences were found in height between the two groups. The dwarf trees had an average height of 1.55 m (Table 1), and the tall trees had an average height of 5.75 (Table 2). Also, highly significant differences were found in trunk circumferences: Dwarf trees had an average circumference of 37.16 cm (Table 1); for tall trees, the average was 66.80 cm (Table 2).

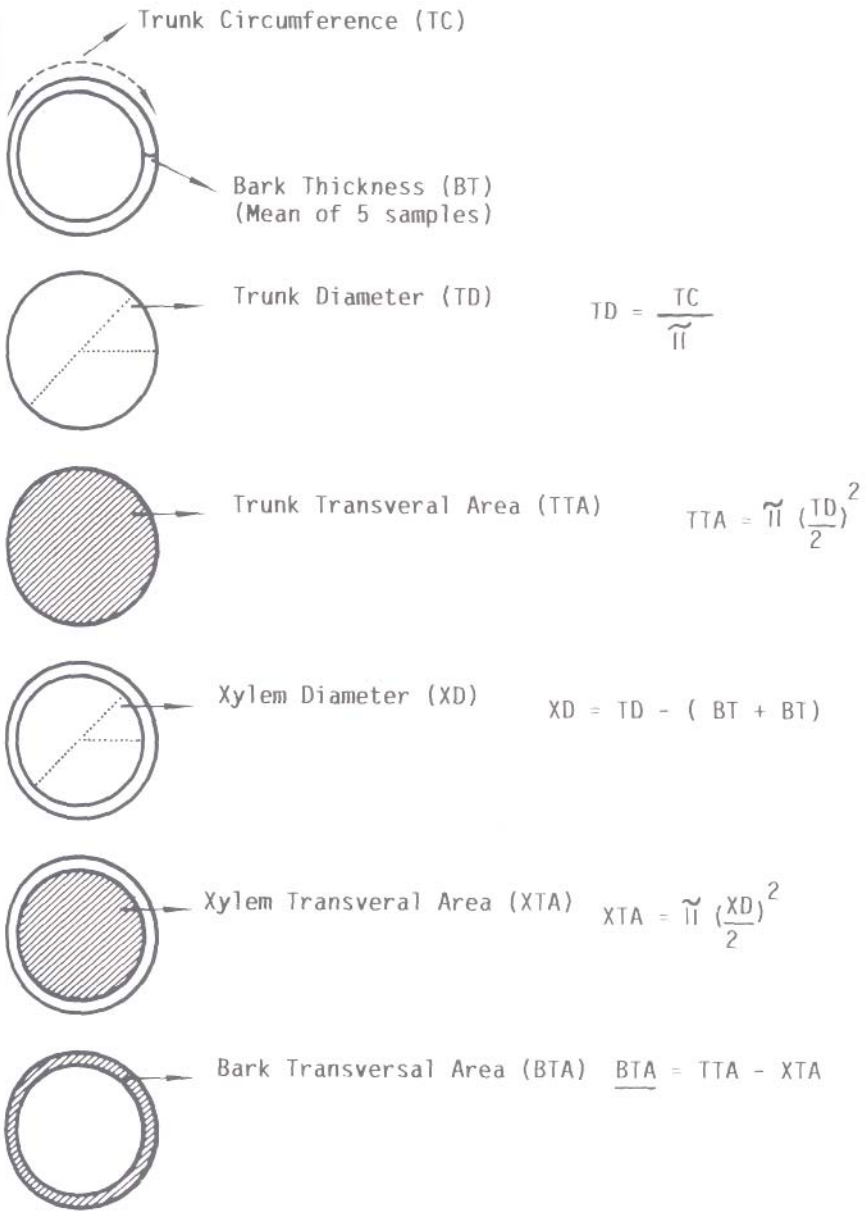

Fig. 1. *Formulae used to calculate bark transversal area of the trunk.*

Table 1. Growth parameter of 6 years old dwarf seedling trees of 'Colin V-33'.

Number of tree	Height (m)	Trunk circumference (cm)	Bark thickness (cm)	Bark thickness C.V.*
390 PLC	1.20	30.50	0.57	4.8 %
331 PLC	1.40	32.60	0.60	5.1 %
196 PLC	1.50	28.40	0.71	8.9 %
323 PLC	1.50	42.50	0.81	2.1 %
280 PLC	1.70	40.00	0.69	2.1 %
170 PLC	2.00	49.00	0.80	6.0 %
Average	1.55	37.16	0.69	
C.V.	16.1 %	19.6 %	12.9 %	

* Average of samples
C.V. Coefficient of variability

Table 2. Growth parameter of 6 years old tall seedling trees of 'Colin V-33'.

Number of tree	Height (m)	Trunk circumference (cm)	Bark thickness (cm)	Bark thickness C.V.*
122 PLC	5.00	57.20	0.59	6.0 %
159 PLC	5.00	61.50	0.76	6.6 %
155 PLC	6.00	62.00	0.64	8.4 %
268 PLC	6.00	63.00	0.69	9.5 %
237 PLC	6.00	86.30	0.70	5.2 %
229 PLC	6.50	71.00	0.82	6.6 %
Average	5.75	66.8	0.70	
C.V.	9.7 %	14.3 %	10.7 %	

* Average of 5 samples
C.V. Coefficient of variability

The proportion of bark area was higher in dwarf trees than in tall trees (Table 3), and there were highly significant differences in vigor between the two groups.

Table 3. Proportion of transversal bark area with respect to xylem, expressed in percentage.

Number of tree	Dwarf trees	Number of tree	Tall trees
390 PLC	22.27	122 PLC	12.58
331 PLC	22.10	159 PLC	15.04
196 PLC	29.05	155 PLC	12.63
323 PLC	22.66	268 PLC	13.63
280 PLC	20.76	237 PLC	9.96
170 PLC	19.48	229 PLC	14.07
Average	22.72		12.94
C.V.	13.31 %		12.17 %

C.V. Coefficient of variability

In the correlation analysis, it was found that between tree height and the proportion of bark area, there was a negative and highly significant coefficient of r = -0.89** (Fig. 2). A similar correlation (r = -0.91**) was found between circumference of the trunk and the proportion of bark area (Fig. 3). Between tree height and trunk circumference, the correlation (r = 0.90**) was positive and highly significant (Fig. 4).

DISCUSSION

The results obtained for the avocado dwarf seedlings of 'Colin V-33' are similar to the findings for such other fruit trees as apple (Jaumien and Faust, 1984) and mango (Mukherjee and Das, 1980), where the bark: xylem relationship was associated with tree size and there was a higher proportion of bark in dwarf trees. We have also found that 16-year-old trees of 'Colin V-33' (dwarf avocado) have thicker bark (1.09 cm) than their seedling rootstock of Mexican race (0.60 cm) (Fig. 5). Lockhard and Schneider (1981) proposed that the greater thickness in the bark of the dwarf trees is associated with a higher degradation of auxins by IAA-oxidase, peroxidase, and phenolic compounds that are present in the bark. As a consequence of this reduction of auxin supply, there is a reduction in the production of citokinins by the roots that alters the normal growth pattern of the tree. Probably, this is the reason why 'Colin V-33' dwarf seedlings show this type of pattern.

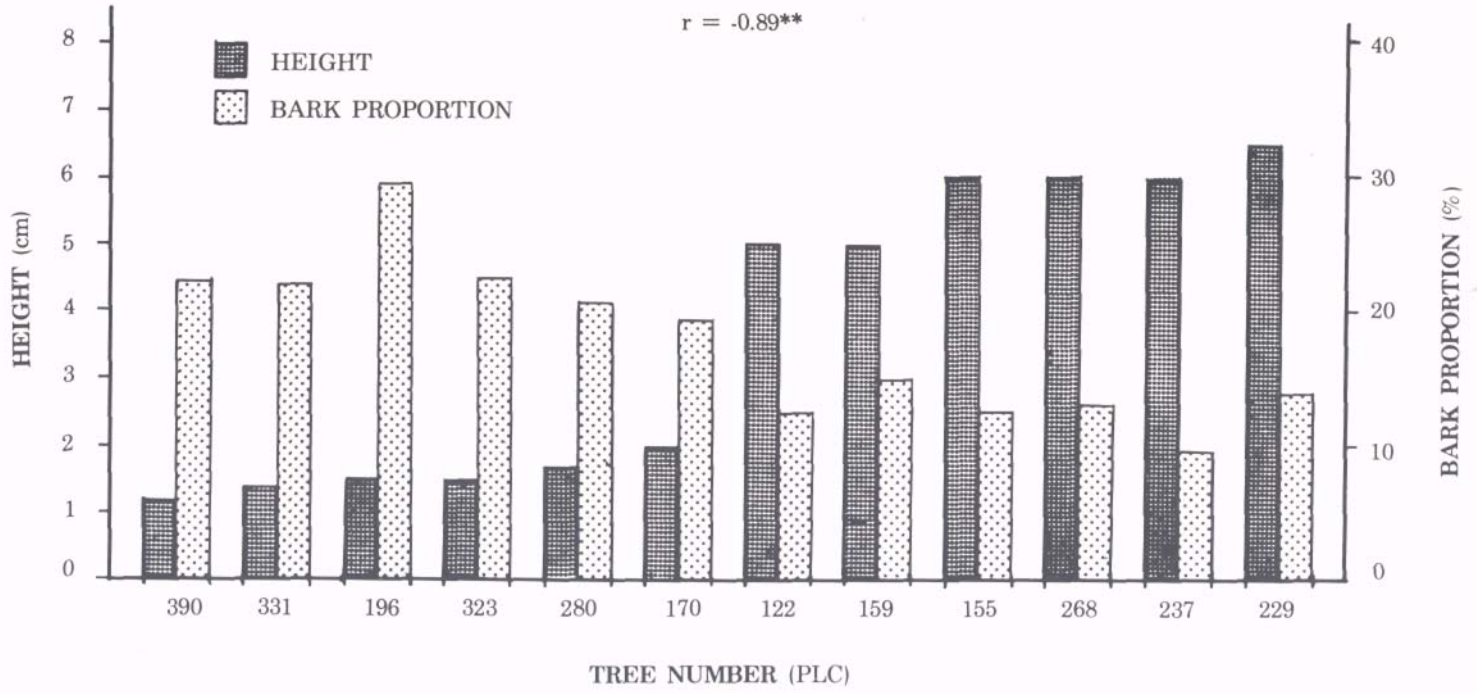

Fig. 2. *Correlation between height and bark proportion of the trunk of six year old 'Colin V-33' seedlings; **Highly significant.*

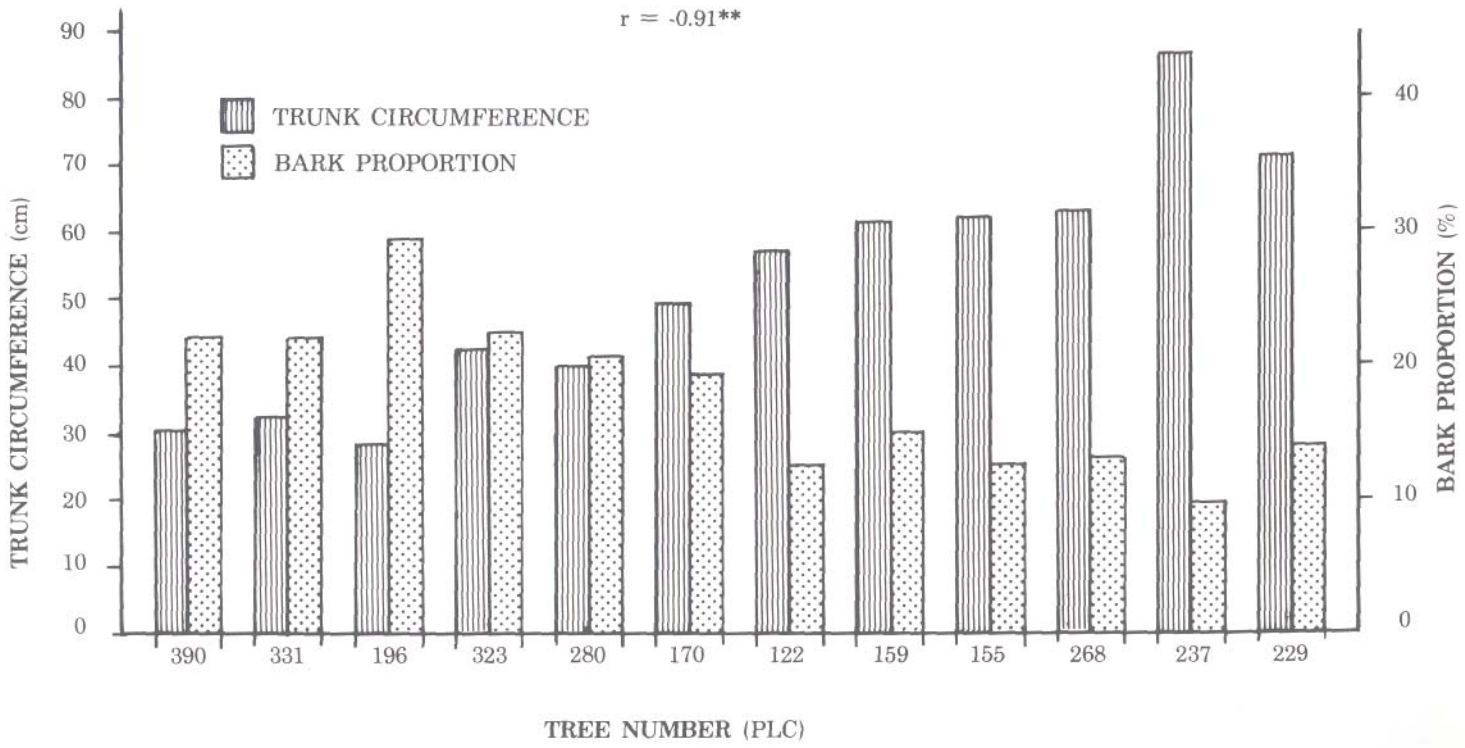

Fig. 3. *Correlation between trunk circumference and bark proportion of the trunk of six year old 'Colin V-33' seedlings; **Highly significant.*

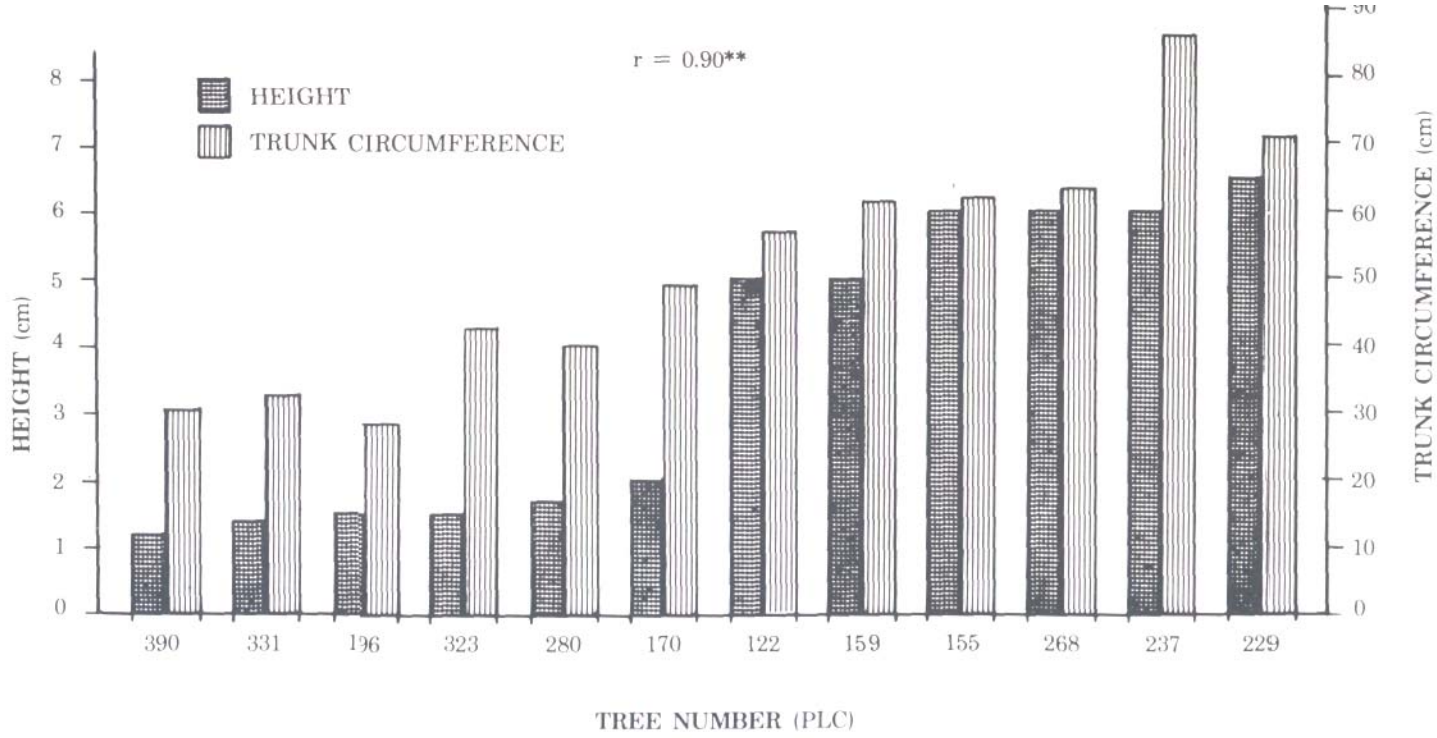

Fig. 4. *Correlation between height and trunk circumference of six year old 'Colin V-33' seedlings; ** Highly significant.*

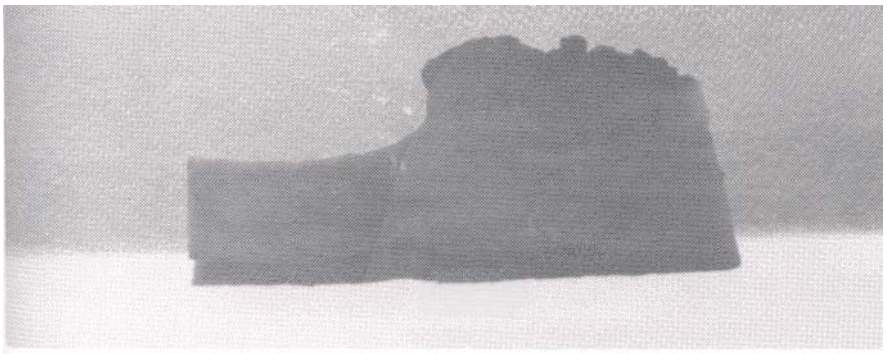

Fig. 5. *Bark of 'Colin V-33' scion (right) and Mexican race seedling rootstock (left). Graft union 16 years old.*

Fig. 6. *Dwarf avocado tree '390 PLC', six years old.*

Fig. 7. *Tall avocado tree '229 PLC', six years old.*

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