Proc. of Second World Avocado Congress 1992 pp. 515-520

Selection of Avocado Dwarfing Rootstocks

Alejandro F. Barrientos-Priego
Seccion de Fruticultura, Departamento de Fitotecnia, Universidad Autonoma Chapingo. Chapingo 56230, Edo. de Mexico, Mexico.

Salvador Sánchez-Colín and Juan J. Aguilar-Melchor
Centre de Investigaciones Cientificas y Tecnologicas del Aguacate en el Estado de Mexico (CICTAMEX). Apartado Postal 13, Toluca 50000, Edo. de Mexico, Mexico.

Alfredo López-Jimenez
Centre de Fruticultura, Colegio de Postgraduados. Chapingo 56230. Edo. de Mexico, Mexico.

Abstract. Ninety-eight seedlings of 'Colín V-33', established in 1981, were used as rootstocks to evaluate the degree to which they reduced the growth of the following scions: 'Rincoatl' and 'Colín V-33' (dwarf); 'Colín-Mex' and 'Colín V-10T (semi-dwarf); and '131 PLC', '175 PLC' and 'Hass' (standard). The seedlings were grafted in 1984. By 1990 there were large differences in growth. Evaluation was based on a comparison of the smaller trees with the largest tree of each cultivar or selection. Tree height was reduced from 32 to 68 %, canopy diameter from 27 to 67 % and trunk circumference from 39 to 79 %. Rootstock trunk circumferences ranged from 22 to 78 cm.

With the repeated suggestion (Hodgson, 1947 and Brokaw, 1982) that a dwarfing rootstock could help to solve some problems in avocado culture, a dwarfing rootstock has been one of the objectives of avocado research. In the world-leading breeding program of avocado conducted by Dr. B.O. Bergh at the University of California, Riverside which has obtained excellent new cultivars, seedlings of Mt4 (a very short internode type) were tested as possible dwarfing root-stocks. In the first years of development, the scions of cv. Bacon, Hass and Fuerte showed growth reduction (Bergh and Whitsell, 1962), but years later the dwarfing effect was gone (Bergh, 1976). Barrientos et al. (1986) suggested that cv. Colín V-33 might be an effective dwarfing root-stock for avocado. The objective of this research was to evaluate the potential of 'Colín V-33' seedlings as rootstocks for avocado.

Material and Methods

This study used 98 open-pollinated seedlings of 'Colín V-33'. They were planted out in 1981, spaced 5 x 5 m, at Coatepec Harinas, Edo. de Mexico. The seedlings were grafted in 1984 to 'Rincoatl1 and 'Colín V-33' (of dwarf size), 'Colín V-101' and 'Colín-Mex' (semi-dwarf), '131 PLS', '175 PLS' and 'Hass' (standard size).

In 1990, for each tree the following data were collected: tree height, canopy diameter, and trunk circumference of both the scion and rootstock. Rootstock dwarfing effects were assumed from large growth differences on these open-pollinated stocks; for each cv. or selection, the growth reduction of the smallest tree as compared with the largest was taken to be a rough estimate of the degree of the dwarfing effect of the rootstock.

Results and Discussion

After six years of growth (1990), there were large size differences within each cultivar or selection. For tree height, reductions in growth between the tallest versus the smallest tree varied from 68% for 'Colín-Mex' to 32% for '175 PLS' (Fig. 1). Typical height distribution of all trees is shown for '131 PLS1 (Fig. 2). Some of the variability in Figures 1 and 2 is no doubt due to environment, but we believe that the height extremes largely reflect the great genetic variation found in "Colín V-33' seedlings (Barrientos and Sanchez, 1982; Rubí, 1988).

With respect to canopy diameter, the reduction varied from 27% to 67% (Fig. 3). This parameter is important because it could determine planting density in an orchard. The reduction in tree trunk circumference varied from 39% to 79% (Fig. 4). Circumference of the rootstock varied from 22 to 78 cm (Fig. 5). As might be expected, rootstock circumference is correlated to a statistically highly significant degree with most graft growth parameters (Table 1). The correlation is more consistent with canopy diameter than with either graft trunk circumference or height, suggesting that these rootstocks may tend to be dwarfing more in tree spread than tree height. It is of interest that for the 'Colin V-331 parent none of the three growth parameters had a significant correlation with root-stock size; this may indicate that the dwarfness inherent in this cv. is not significantly enhanced by dwarfness of its seedling rootstocks.

No relationship was found between tree size and productivity for any cultivar or selection. The correlation coefficients were very low and not significant; for example, the largest was for 'Rincoatl' with $r = 0.27$. This may be very important as an indication that dwarfing rootstocks can give higher fruit density.

The dwarfing tendency of the rootstocks was not clear in the first 3 years after grafting. In the fourth year, notable differences were observed and were retained through the sixth year. In sweet cherry, the dwarfing influence of the rootstock was appreciable after two or three years in the field (Cummins, 1972; Gruppe, 1979). Dekers and Keulemans (1960) studied three plums on five clonal rootstocks during 15 years and concluded that the dwarfing effect observed in the seventh year was unchanged thereafter.

Attempts were made to correlate one-year-old seedling vegetative characteristics with dwarfing potential as rootstocks without success (Table 2), (see also Barrientos and Barrientos, 1990). Perhaps other proposed parameters such as stomata density (Barrientos and Sanchez, 1982) or percentage of bark transverse area (Lopez and Barrientos, 1987) could be used for initial screening of avocado dwarfing rootstocks.

The findings are supportive of selection for avocado dwarfing root-stocks using 'Colín V-33' as parent. However, it is necessary to evaluate clonal rootstocks to confirm the dwarfing effects, determine production performance and evaluate the root-stocks under stress conditions including edaphic factors and diseases (Ben-Ya'acov, 1985).

Literature Cited

Barrientos-Pérez, F. and A. F. Barrientos-Priego. 1990. Selección de portainjertos enanizantes de aguacate. III. correlaciones entre características de plántulas segregantes de 'Colín V-33' y los cirboles resultantes al injertar cultivares y selecciones. Memoria 1990 del CIC-FRUTICOLA-CICTAMEX. Coatepec Harinas, Mexico, p. 27-32.

Barrientos-Priego, A. F., M. W. Borys and F. Barrientos-Pérez. 1986. Rooting of avocado cuttings (*Persea americana* Mill.) cvs. Fuerte and Colin V-33. Calif. Avocado Soc. Yrbk. 70:157-163.

Barrientos-Pérez, F. and S. Sánchez-Colín. 1982. Height variability obtained from a new dwarf avocado tree population. Calif. Avocado Soc. Yrbk. 66:155-160.

Ben-Ya'acov, A. 1985. Selection of avocado rootstocks. S. A. Avocado Growers' Assn. Yrbk. 8: 21-23.

Bergh, B. O. 1976. Discussion-avocado rootstocks. Proceedings of the First International Tropical Fruit Short Course; The Avocado. J. Sauls, R. Phillips and L. Jackson, (eds.) Gainesville, Florida, p. 96-103.

Bergh, B. O. and R. H. Whitsell. 1962. A possible dwarfing rootstock for avocados. Calif. Avocado Soc. Yrbk. 46: 55-62.

Brokaw, W. H. 1982. Clonal rootstocks: personal observations and a peek into the future. Calif. Avocado Soc. Yrbk. 66: 81-92.

Cummins, J. N. 1972. Vegetatively propagated selections of *Prunus fruticosa* as dwarfing stocks for cherry. Atti 2d Convegno del Ciliegia, Verona, Italy p. 579-581.

Deckers, J.C. and J. Keulemans. 1960. Les sujets portegreffe du prunier. Le Fruit Beige, 3d trimester, p. 94-100.

Gruppe, W. 1979. The effect of some hybrid rootstocks on *P. avium* cv. 'Hedelfinger Riesenkirsche', preliminary results. Proc. Eucarpia Tree Fruit Breeding Symp., Angers, France, p. 1-24.

Hodgson, R. W. 1947. The California avocado industry. Univ. Calif. Agr. Ext. Ser. Circular 43. 93 p.

López-Jiménez, A. and A. F. Barrientos-Priego. 1987. Selection of dwarfing rootstocks of avocado (*Persea americana* Mill.); I. Studies of bark:xylem relationship in trunks of cv. Colin V-33 seedlings. Calif. Avocado Soc. Yrbk. 71: 225-234.

Rubí, M. 1988. Descripción de una población de segregantes de aguacate del cultivar de porte bajo 'Colín V-33'. Memoria 1988 del CIC-FRUTICOLA-CICTAMEX. Coatepec Harinas, Mexico, p. 21-30.

Table 1. Correlation coefficients of circumference of "Colin V-33" seedling rootstocks and growth parameters of 7 scion varieties 6 years after grafting.

Cultivar or Selection	Circumference of the rootstock and graft		
	Height	Canopy diameter	Circumference
Rincoatl	0.76 **	0.71 **	0.78 **
Colin V-33	0.31 NS	0.26 NS	0.20 NS
Colin V-101	0.40 NS	0.61 **	0.23 NS
Colin-Mex	0.81 **	0.88 **	0.82 **
131 PLS	0.77 **	0.82 **	0.83 **
1 75 PLS	0.47 NS	0.71 **	0.89 **
Hass	0.06 NS	0.78 *	0.36 NS

NS = non-significant; *= significant at P<,0.05; ** =significant at P<0.01.

Table 2. Correlation coefficients of 'Colín V-33' seedling characteristics and the resulting grafted trees.

One Year Old Seedlings	Grafts (1990):		
	Height diameter	Canopy circumference	Rootstock
Height	0.061 NS	0.045 NS	0.039 NS
Diameter	0.028 NS	0.009 NS	0.113 NS
Principal branches	0.047 NS	0.174 NS	0.041 NS
Secondary branches	0.011 NS	0.020 NS**	0.139 NS**
Tertiary branches	0.135 NS**	0.006 NS**	0.223 NS**
Total branches	0.011 NS	0.070 NS**	0.130 NS**
Total branch length	0.138 NS	0.179 NS*	0.114 NS
Principal branch length	0.045 NS	0.135 NS	0.004 NS

n = 50, NS = non-significant; *= significant at P<0.05; ** =significant at P<0.01.

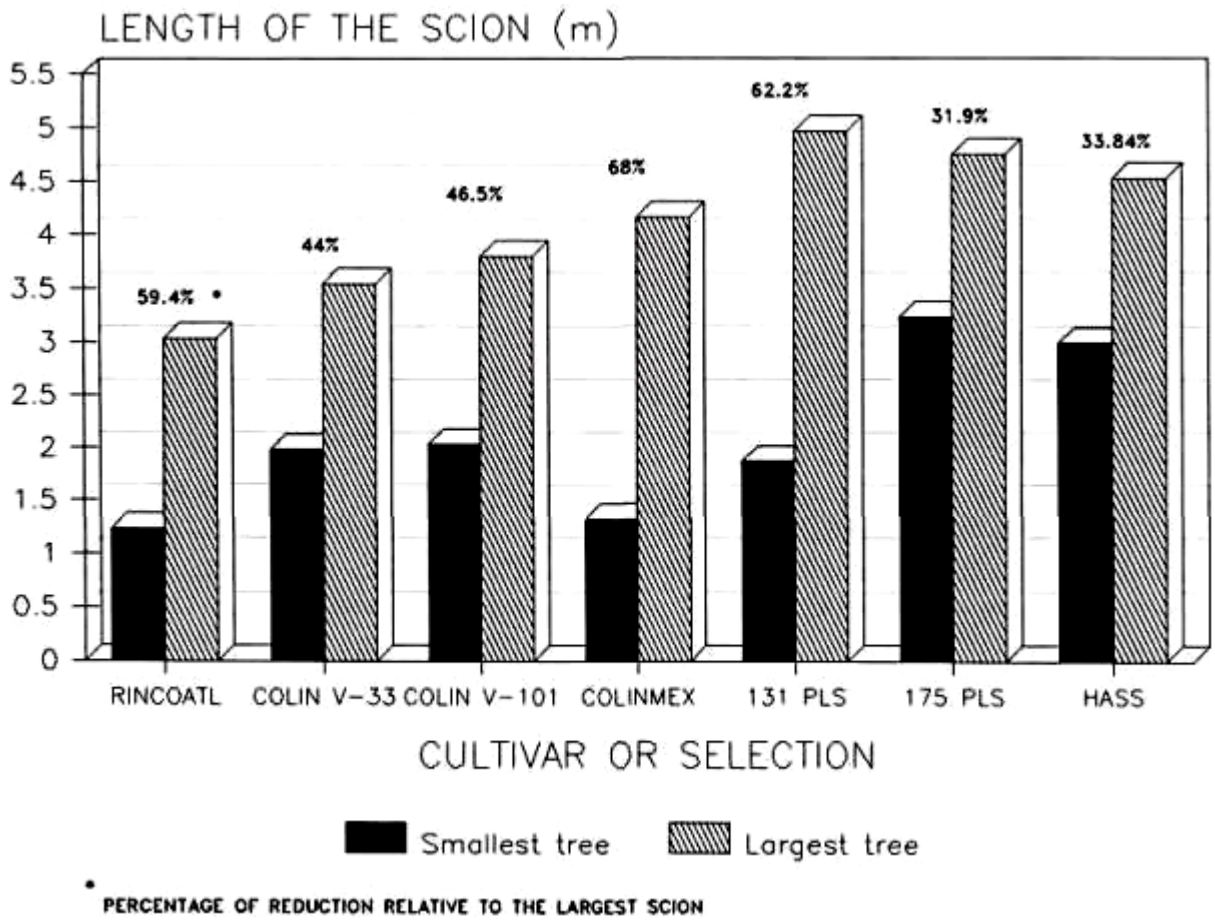

Fig. 1. Height extremes of six-year-old grafts on seedling rootstocks of 'Colin V-33'.

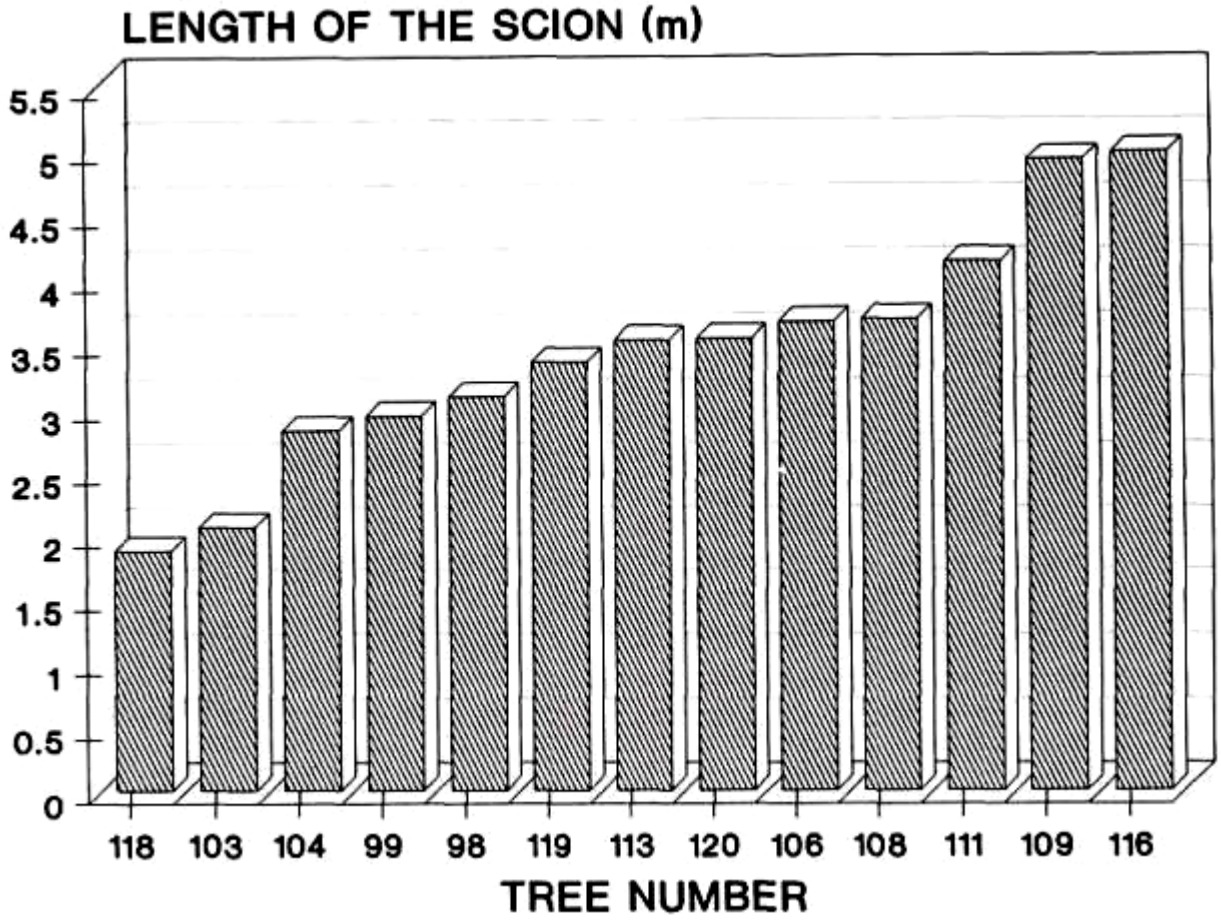

Fig. 2. Individual tree heights of six-year-old scions of '131 PLC' grafts on 'Colin V-33' seedling rootstocks.

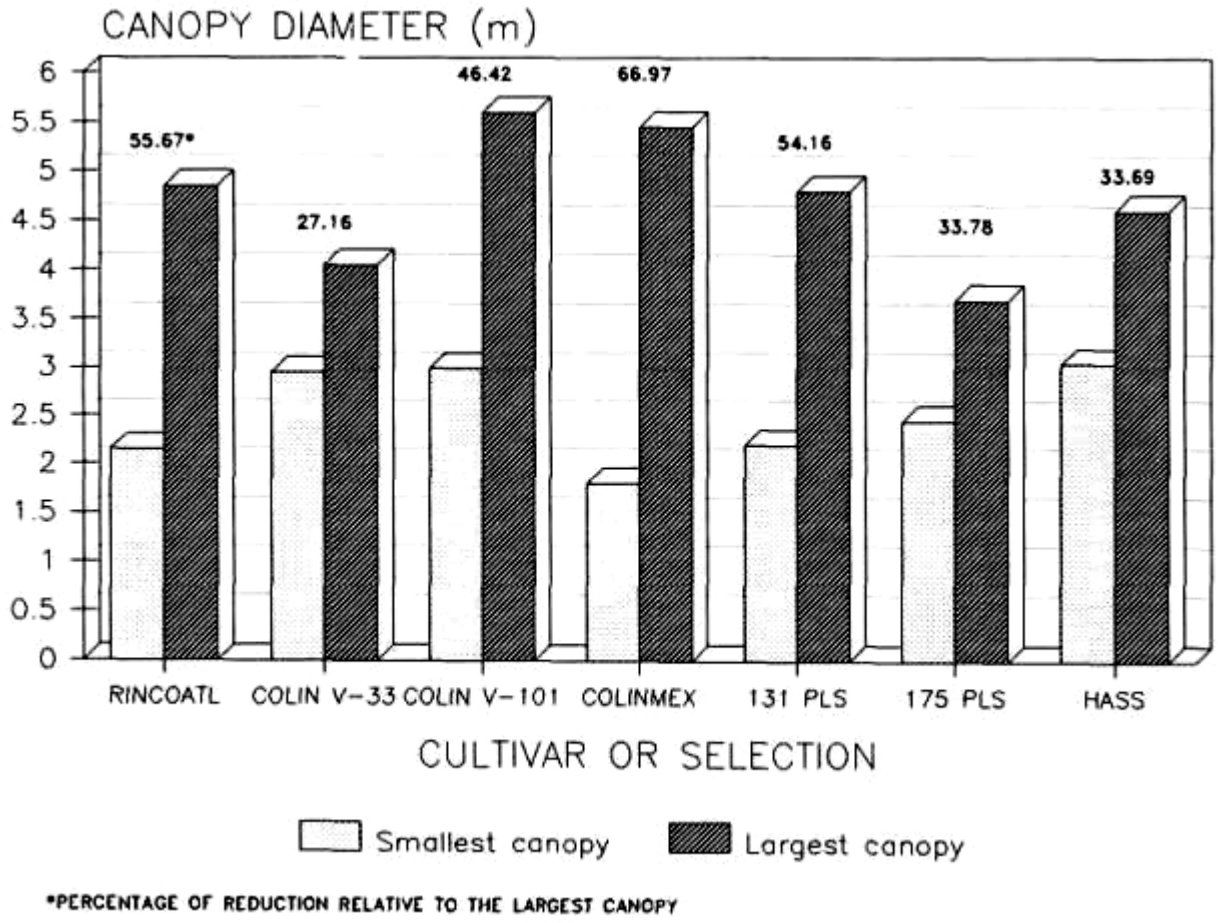

Fig. 3. Canopy diameter extremes of six-year-old grafts on seedling rootstocks of 'Colin V-33'.

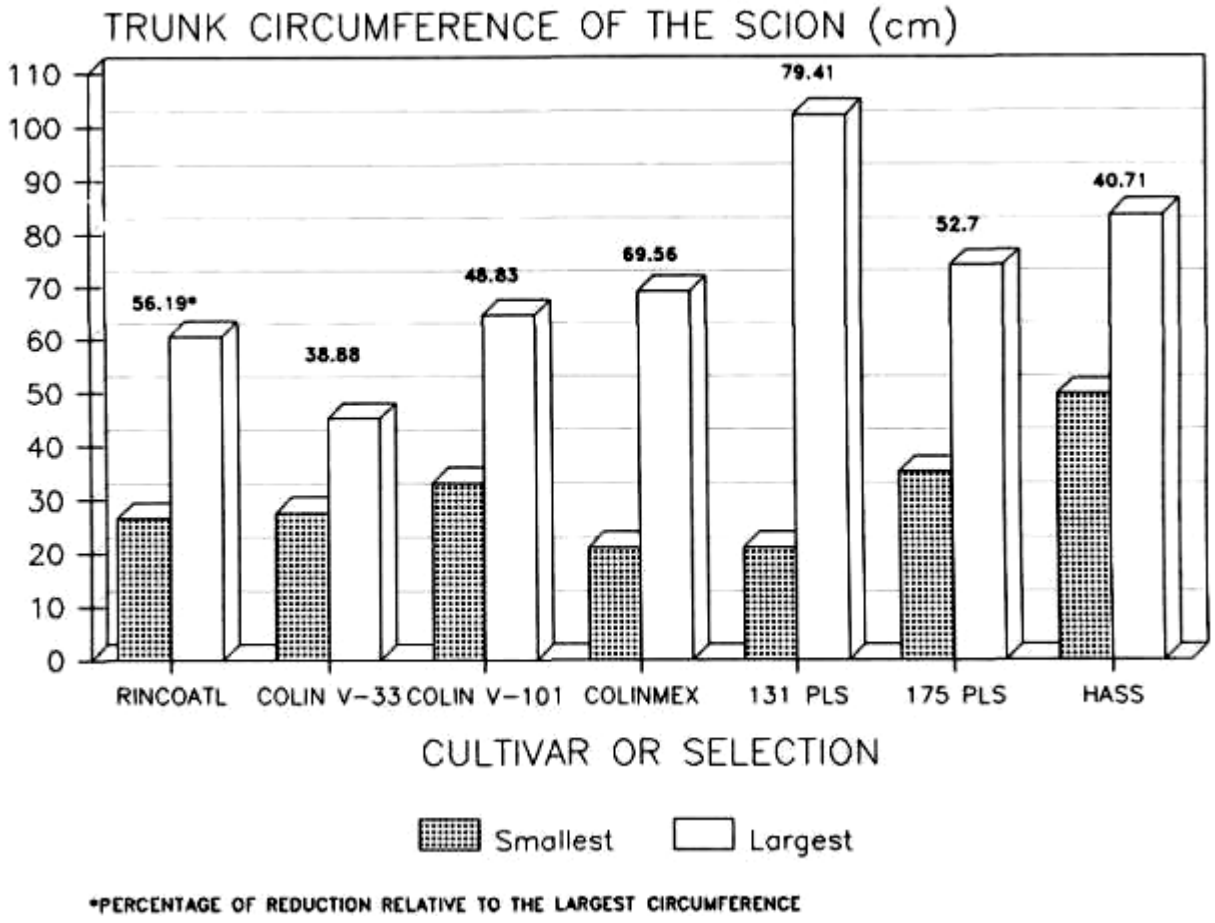

Fig. 4. Trunk circumference extremes of six-year-old grafts on seedling rootstocks of 'Colin V-33'.

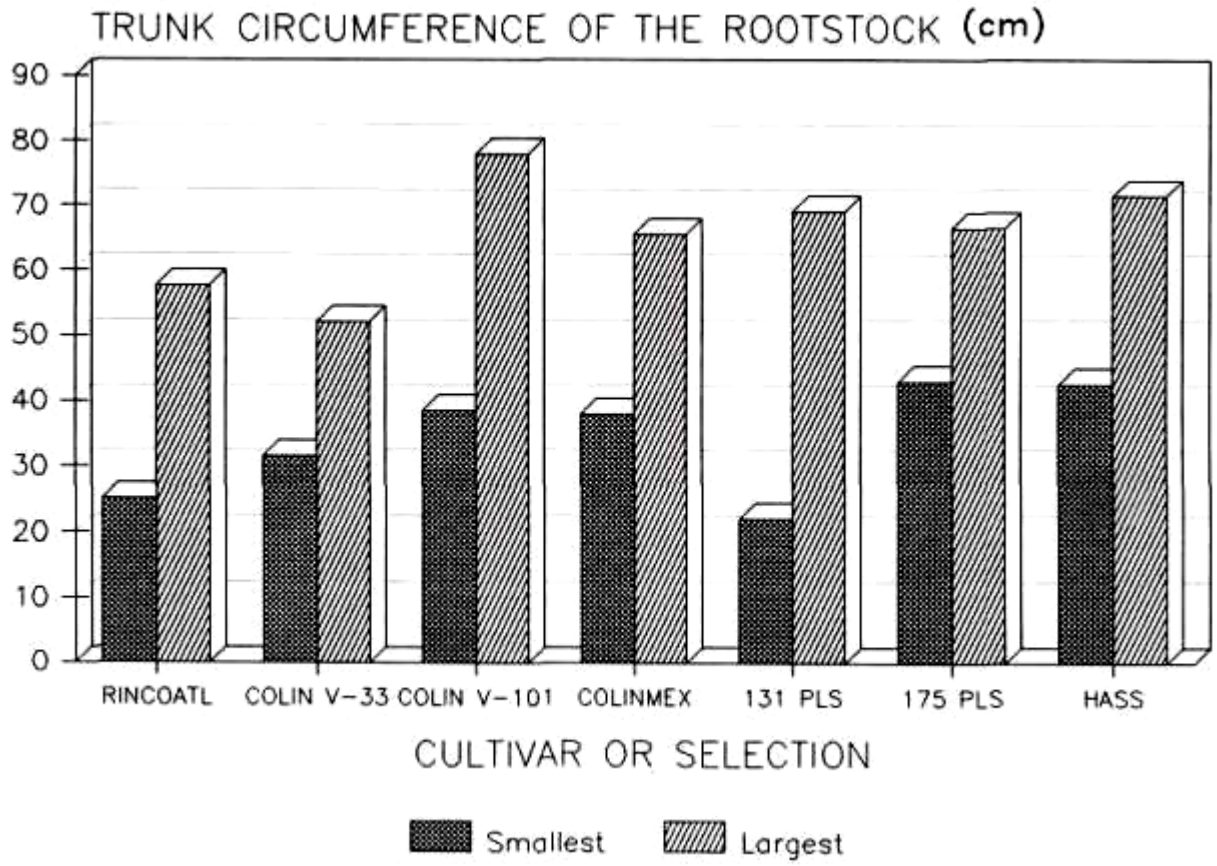

Fig. 5. Circumference extremes of nine-year-old 'Colin V-33' seedling rootstocks.