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TOLERANCE OF OPEN-POLLINATED DICKINSON AVOCADO SEEDLINGS TO LIME SOIL

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SUMMARY

The split seed technique was used to experimentally compare growth of Dickinson (Guatemalan) avocado seedlings in lime and nonlime soil. Thirty pairs of seedlings, each pair genetically identical, have been grown for eleven months with one of each in lime soil and the other one in nonlime soil. Half of the plants in lime soil were in soil artificially limed with calcium carbonate to five per cent by dry weight of soil. The remainder of the lime soil was from four different avocado groves where chlorosis existed. Genetic variability existed in the susceptibility of the seedlings to lime-induced chlorosis. About one third of the seedlings in artificially limed soil were severely stunted and another third were slightly stunted relative to the nonlime soil. There was far less detrimental effect for the natural lime soils used than for artificially limed soil. Several of the seedlings grew just as well in lime as in nonlime soil. All of them in nonlime soil were as large or larger than those in lime soil.

INTRODUCTION

Halma and Goodall[1] and Halma and White[2] have reported that Guatemalan avocado rootstocks are probably more susceptible to chlorosis than are Mexican rootstocks. North and Wallace[3] have indicated a great range of variability in tolerance to lime soil within Edranol (Guatemalan) seedlings and within Topa Topa (Mexican) seedlings. In general the Topa Topa were considerably more tolerant than were the Edranol. The chlorotic seedlings were very easy to make green by soil applications of chelated iron, but it is our opinion that genetically weak seedlings, so far as resistance to lime-induced chlorosis is concerned, should, if detected, be eliminated from the nursery. The present study is being conducted to obtain additional data about growth of avocado seedlings in lime soil. It 'was especially desired to learn if some seedlings would grow as well in lime soil as in nonlime soil.

MATERIALS AND METHODS

Dickinson seeds, all from a single open-pollinated tree growing in the Subtropical Horticultural Orchard of the University of California at Los Angeles, were used in this study. Each of 50 seeds was divided in half by breaking the cotyledons apart by the

method of Traub and Auchter[4] and germinated to produce pairs of genetically identical seedlings. In this procedure each cotyledon contains half of the embryo so that a seedling develops from each. One of these was planted in lime soil and one in nonlime soil. Whenever one of a pair was larger than the other, the larger was planted in the lime soil.

TABLE 1

Height, area of stem, and increment of growth from the ninth to eleventh month of pairs of identical Dickinson avocado seedlings grown separately for eleven months in nonlime and lime soils

Group	No. of pairs	Height			Cross-sectional area of stem[a]			Height increase last 60 days		
		Non-lime	Lime	Difference	Non-lime	Lime	Difference	Non-lime	Lime	Difference
		cm.	cm.	%	cm.^{2}	cm.^{2}	%	cm.	cm.	%
					Artificial Lime					
Lime little effect	4	116	122	+5.2	1.65	1.45	-12.1	18.5	17.0	-8.8
Lime slight effect	6	121	109	-9.9	1.43	1.38	-3.5	22.0	17.3	-21.4
Lime large effect	4	124	69	-44.4	1.63	.93	-42.9	11.5	7.7	-33.0
Mean	14	120	101	-15.8	1.55	1.27	-18.1	18.0	14.5	-19.4
					Natural Lime					
Lime little effect	8	108	118	+9.3	1.50	1.68	+12.0	14.3	14.3	0.0
Lime slight effect	4	125	116	-7.2	1.63	1.50	-8.0	23.0	9.9	-57.0
Lime large effect	4	119								
Mean	16	115	111	-3.5	1.55	1.55	0.0	16.1	11.9	-26.1

[a] One inch above cotyledon on Dec. 15, 1953.

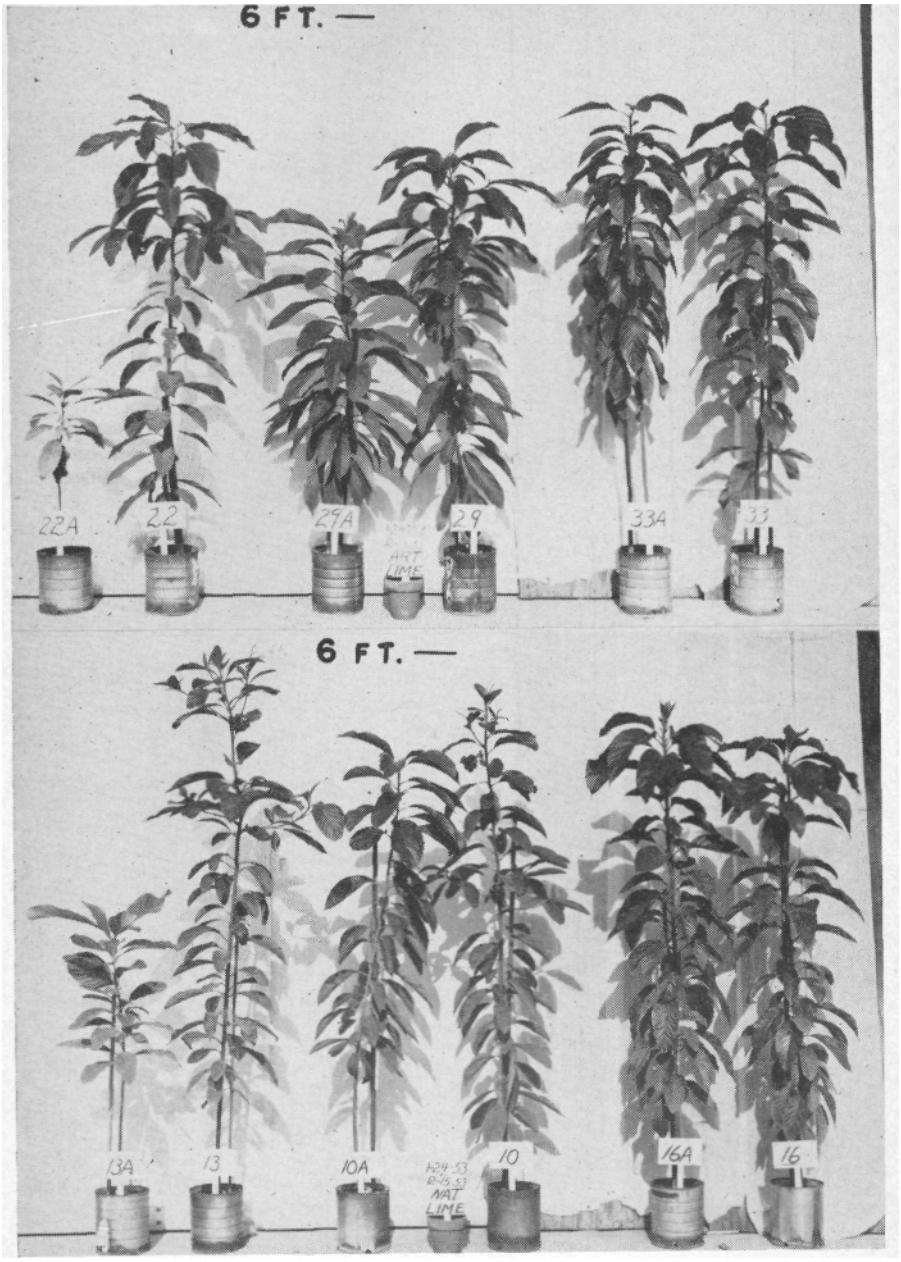

Fig. 1. Top: *Three pairs of Dickinson avocado seedlings, each pair genetically identical, with one seedling of each pair (22,29,23) grown eleven months on nonlime soil and the other seedlings (22A, 29A, and 33A) grown in the same soil limed with five per cent calcium carbonate.* Bottom: *Three pairs of similar seedlings with one of each (13,10,16) in the same nonlime soil as above and the other in lime soil from orchards having chlorotic avocado trees. The results indicate a genetic difference in tolerance to lime soil.*

The natural lime soils used in the study were obtained from orchards having lime-induced chlorosis in Santa Barbara, Orange, and Ventura counties. They ranged in pH from 6.6 to 8.3 and in calcium carbonate from none (surface soil) to four per cent. The

nonlime soil was potting soil used routinely by the Department of Subtropical Horticulture and was obtained from an uncropped hillside on the campus. The artificially limed soils consisted of this same potting soil with which, on the oven-dry basis, five per cent U.S.P. calcium carbonate had been mixed.

Containers used were undipped one-gallon tin cans each containing two drainage holes. Tap water was used for irrigation. Nitrogen as ammonium nitrate was added when its need was indicated. The plants were grown on benches in a heated, well-lighted glasshouse in which the night temperatures were not permitted to fall below 65°F. The seeds were cut and placed in flats for germination on December 1, 1952. Seedlings were planted into the treated soils in the cans on January 24, 1953. Growth measurements were taken periodically.

RESULTS AND DISCUSSION

A summary of the total growth of the avocado seedlings is in table 1 and figure 1. Artificial lime proved to be more damaging to the Dickinson seedlings than were the natural lime soils used. About one third of the seedlings in the artificial lime were considerably affected (44.4 per cent height reduction) and another third were only slightly affected (10.7 per cent height reduction). Another third were slightly taller in lime soil (5.2 per cent) but this third had an average reduction of 12.1 per cent in cross sectional area one inch above the cotyledon. This same group in artificial lime increased in height 8.8 per cent less during the 60 days between the 9th and eleventh month than did the corresponding seedlings in nonlime soil.

About one half of the seedlings in natural lime soil were unaffected and those affected were, on the average, larger than those affected in the artificially limed soil. The reason for this is possibly that the U.S.P. calcium carbonate was more active than the natural calcium carbonate in the soil. It was possibly more finely divided and not coated with organic matter like some soil calcium carbonate.

Of most significance was that many of the seedlings appeared to do just as well in lime soil as in nonlime soil. This was true at least up until the seedlings were eleven months old at the time of this writing. In no cases was there any evidence of stunting of plants in the nonlime soil relative to the lime soil. The use of lime soil then may be a means of eliminating some possibly undesirable rootstocks in the nursery, especially if the trees are to be planted in orchards having lime in the soil. Guatemalan seedlings possibly will be little used; however, a small percentage of Mexican seedlings are also susceptible to chlorosis.[1,2,3] It should be pointed out that as yet we have no assurance that any avocado is completely resistant to chlorosis under very high-lime conditions. It is likely that any avocado will be chlorotic where environmental conditions such as soil moisture and temperature, in addition to high lime, are conducive to chlorosis. These effects can best be learned by field plots such as those of Halma et al.[1,2] in high-lime soil. Since some avocado seedlings may be more susceptible to lime-induced chlorosis than others, it may be highly undesirable to keep chlorotic ones in the nursery green by artificial means such as iron containing chelates, iron sulfate, or sulfur, and then use them in orchards containing lime soil. This precaution is perhaps in order until more information is available.

LITERATURE CITED

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