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Correlations between Size of Seed, Seedling and Nursery Tree in the Avocado

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ORIGIN OF THE INVESTIGATION

This study is an outgrowth of a rootstock experiment started in 1934, which involved the planting of 832 Mexican avocado seeds and required the keeping of detailed measurements of each resulting plant, from the seed through all successive stages of propagation to the nursery tree, ready to plant in the orchard. If for a given age group the largest nursery trees are preferable for orchard planting, a widely accepted assumption which still awaits adequate proof, analysis of these data should provide information bearing on the answers to certain questions, in which nurserymen are interested, as follows:

1. Do large seeds give rise to large seedlings, and vice versa? Is selection for size of seed of value or importance in propagation of the avocado?

2. Do large seedlings produce large budlings (nursery trees)? Is selection for size of rootstock seedling of value or importance in avocado propagation?

The results of this investigation to date appear to provide evidence of some importance in this connection, which is the occasion for this report.[1]

MATERIALS AND METHODS

In the fall of 1928 several hundred fruits were obtained from a vigorous old seedling tree of the Mexican avocado **(Persea drymifolia),** one of a group of three isolated trees said to have been grown from seed of the same, but unknown, parentage. In the spring of 1930 sixty-five of the most uniform seedlings resulting from this seed were planted in an orchard row. In the fall of 1934 sixteen trees, representing the range of variation exhibited by this row, were selected as parent trees for the rootstock experiment. Fifty-two fruits, the number of paper pots accommodated by a greenhouse flat, were taken at random from each tree, the seeds extracted and weighed and planted in bottomless paper pots in flats, one flat per progeny. The seeds were germinated in a greenhouse and in the spring of 1935 the pots were set out in nursery rows. In general, the seedlings made excellent growth and reached budding size by the fall of that season.

Height measurements were made at frequent intervals until lateral shoot development started, after which diameter measurements were substituted. The seedlings were budded in late October and early November just prior to which the final seedling measurement was taken. It was necessary to do some re-budding in the spring of 1936.

Two-thirds of the seedlings were budded to the Fuerte variety, the others to Nabal. Diameter measurements were continued until the spring of 1937; the final budling measurement was made March 29, just prior to the preparation of the trees for transplanting to the orchard.

The conditions under which the trees were grown are considered to be similar to those which exist in commercial practice, and nurserymen who inspected the trees agreed that they were above average size for their age (See page 96); indeed this resulted in some crowding during the last few months in the nursery.

The method of analysis employed has consisted of simple statistical treatment of the measurement data recorded during the various stages of propagation, from the seed to the resulting budling (nursery tree), with special reference to the degrees of variability and correlation exhibited by the plant materials at different stages in the process of propagation. The formulas and procedures employed are those suggested by Snedecor.[2] For the seed-seedling correlation the data used were seed weight in grams and cross-sectional area of seedling at time of budding, a year later; for the seedling-budling correlations, the latter measurement and a similar one for the budlings, 17 months later.

The 832 seeds with which the start was made ranged in weight from 11 to 55 grams (slightly over one-third ounce to two ounces) with the greater part of them, 633, falling in the half-ounce to ounce range (16 to 30 grams). From the original start, 772 seedlings (93 per cent) attained buddable size and 629 budlings resulted, a yield of 76 per cent.

DATA AND DISCUSSION

The correlation coefficients, and other data pertinent thereto, are shown in table 1.

The coefficient expressing the correlation between weight of seed and size of seedling resulting therefrom falls within the accepted range of significance though the value is not high. This may be interpreted to indicate moderate positive correlation between the two, a clearly evident tendency for large seeds to produce large seedlings, small seeds to give rise to small seedlings, and medium-sized seeds to produce seedlings intermediate in size.

TABLE 1

Correlation between seed, seedling and budling.

Correlation	Size of Population	Correlation Coefficient	Ratio between coefficient and error
Weight of seed and size of resulting seedling	772	0.427	14 to 1
Size of seedling and of resulting budling	629	0.327	9 to 1
Size of seedling and of fall start budling	489	0.501	15 to 1
Size of seedling and of spring start budling	140	0.505	8 to 1

The value for the coefficient expressing the correlation between size of seedling and of budling resulting therefrom, exhibits mathematical significance, but is considerably lower. It may be interpreted to indicate positive correlation between the two but not of a high order. In comparison with the results obtained by investigators working with other fruits[3] this coefficient is surprisingly low, which suggests the probability of some condition within this progeny the effect of which was to reduce the normal degree of correlation. Reference to table 2 reveals the fact that the range of size variation in the budling progeny was more than twice as great as that exhibited by the same plants, as seedlings, 17 months earlier. This is considered to indicate that something associated with budding was responsible for the greatly increased variability, and decreased correlation. That time of bud-start was the factor of importance in this connection is suggested by the marked rise in the correlation coefficients obtained by segregation of the budlings into groups on the basis of time of bud-emergence (see table 1); indeed these coefficients exhibit a relatively high degree of correlation and approach those obtained in similar studies of other fruits. The importance of this factor has been emphasized by other investigators.[4] It is concluded therefore that, where time of bud start is the same, large avocado seedlings exhibit a pronounced tendency to produce large budlings (nursery trees), and vice versa.

TABLE 2

Variability in seedling and budling progenies

	Seedling progeny 772 plants	Budling progeny 629 plants
Mean	1.63	4.15
Standard deviation	±0.42	±2.33
Coefficient of variation	25±.2%	56±.1%

In view of the pronounced rise in correlation coefficients which resulted from segregation of the budlings on the basis of time of bud-start, it seemed desirable to measure the variability exhibited by the two progenies. The results are given in table 3. It will be observed, from the coefficients, that in both progenies the budlings exhibited greater variability than the seedlings which served as their rootstocks, but that in the case of the spring bud-start progeny variability was nearly twice as great as in the fall bud-start group. It will be noted also that, whereas the seedlings averaged about the same diameter for the two groups, the average diameter for the budlings resulting from fall bud-start was nearly twice as great as that for the spring bud-start group. It is concluded therefore that variables, at present unknown, are introduced with spring start of the buds, which are of greater magnitude than those associated with fall bud-start; also that budlings resulting from spring start of the buds are much smaller than those resulting from fall bud-start.

TABLE 3

Variability in fall and spring bud-start progenies.

	Fall bud-start 489 plants		Spring bud-start 140 plants	
	Seedlings	Budlings	Seedlings	Budlings
DATE OF MEASUREMENT	Oct. 1935	Mar. 1937	Oct. 1935	Mar. 1937
Mean diameter (inches)	0.57	0.99	0.54	0.56
Standard deviation (cm.²)	±0.39	±1.86	±0.52	±1.14
Coefficient of variation	23±.6%	37±.7%	34±.2%	70±.3%

Finally, as a check on the conclusions indicated by the correlation coefficients, direct comparisons were made of the budlings produced from large and small seedlings. The results are shown in table 4. The data show clearly that budlings produced from large seedlings average larger than those from smaller seedlings.

TABLE 4

Size of budlings from large and small seedlings. All from fall bud-start.

Size group	Average diameter (inches)	
	Seedling	Budling
Largest 100	0.64	1.01
Smallest 100	0.50	0.87
Largest third (167)	0.62	0.99
Smallest third (151)	0.52	0.85

SUMMARY AND CONCLUSIONS

By means of correlation studies conducted on a progeny of 772 avocado seedlings, which gave rise to 629 budlings, the following conclusions were reached:

1. Other things being equal, large seeds tend to produce large seed lings; small seeds tend to give rise to small seedlings; and medium-sized seeds tend to produce seedlings intermediate in size.

2. When time of bud-start is the same, large seedlings tend to produce large budlings (nursery trees), and vice versa.

3. Budlings resulting from fall start of the buds are larger and more uniform than budlings from spring start of the buds.

POSSIBLE RELATION TO NURSERY PRACTICE

If the desire of the nurseryman is to produce large and uniform trees in the shortest possible time, the following practices will promote the attainment of that objective:

1. Discarding the smallest seeds of any given lot.

2. Discarding the smallest seedlings of any given lot.

3. The employment of the late summer or fall budding, where practicable.

ACKNOWLEDGMENT

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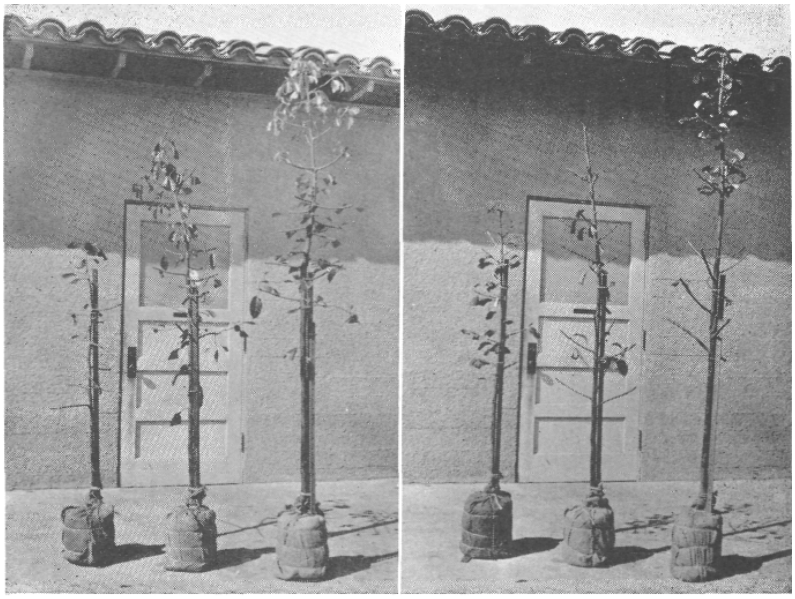
1. See also Hodgson, K. W., and E. R. Eggers. Correlations between seed, seedling and budling in the avocado. Proc. Amer. Soc. Hort. Sci. 35 (1937): 372-374. 1938.
2. Snedecor, G. W. Sec. 91, Chap. 23:883-416. In Loomis, W. E., and Charles A. Shall. Methods in Plant Physiology. 4V2 pp. McGraw-Hill. New York. 1937.
3. See the following citations:

a. Burkholder, C. L., and L. Greene. Influence of size of mahaleb seedlings on nursery grades. Proc. Amer. Soc. Hort. Sci. 26 (1929): 96-97. 1930. Ibid. 27(1980) :86-86. 1931. Ibid. 28(1931):478-475. 1932.
b. Webber, H. J. The basis of selection in the improvement of citrus nursery stock, Proc. Amer. Soc. Hort. Sci. 27 (1930): 114-119. 1931.
c. Gardner, F. E., and G. E. Yerkes, The size of apple seedlings in relation to the growth of the scion variety. Proc. Amer. Soc. Hort. Sci. 27 (1930): 131-135. 1931.
d. Tukey, H. B., and Karl D. Erase. Correlation studies of the growth of apple and cherry trees in the nursery from the seedling to the two-year budded tree. N. Y. State Agr. Exp. Sta. Tech. Bul. 185. 1931.
e. Erase, Karl D., and H. B. Tukey. The relation between the size of apple seedling rootstock and size of orchard tree. Proc. Amer. Soc. Hort. Sci. 34(1986): 298-304. 1987.

4. See the following citations:

a. Sax, K. Bud and root selection in the propagation of the apple. Proc. Amer, Soc. Hort. Sci, 1928: 244-250. 1924.
b. Sax, K. Bud and root selection in the apple. Maine Agr. Exp. Sta. Bul. 344. 1928.
c. Gardner, F. E., and P. B. Lincoln. Factors influencing the variability of apple trees in the nursery row. I. Time of bud start. Proc. Amer. Soc. Hort. Sci. 29(1932) :367-370. 1983.



Variation in size of nursery trees in the progeny employed in this study.
Left: Fuerte. Right: Nabal.