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Correlations Between Seed, Seedling and Budling in the Avocado

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A number of workers (1, 2, 3, 4, 5, 6, 7) have reported on correlation studies of fruit-tree propagation materials at various stages from the nursery seedling to the orchard tree. In most of these studies significant correlations have been shown to exist between seedling size at time of budding and size of resulting budling.

We have not been able to find reports of investigations in which size of seed has been correlated with size of resulting seedling;[1] presumably such studies have not been undertaken because of difficulties associated with the measurement of the seeds, or the fact that commercial nursery practice involves growing the seedlings in seedbeds and later transplanting them to nursery rows. Neither of these difficulties exists with the avocado. The seed is large (see Table I) and a common practice is to germinate the seeds in bottomless paper pots in flats and to transplant the pots, while the seedlings are still small, direct to the nursery row. This seems to result in virtually no set-back to the growth of the seedlings.

TABLE I—Distribution, by Classes, of Avocado Seeds Used in Rootstock Experiment

Class Range in Seed Weight (Gms)	Number of Seeds	Class Range in Seed Weight (Gms)	Number of Seeds
11 to 15	27	36 to 40	23
16 to 20	191	41 to 45	9
21 to 25	264	46 to 50	4
26 to 30	178	51 to 55	3
31 to 35	76	———	—

MATERIALS AND METHODS

Propagations made for a rootstock experiment have provided the data used in the correlations reported here.

In the fall of 1928 several hundred fruits were obtained from a vigorous old seedling tree of the Mexican horticultural race *(Persea drymifolia),* one of a group of three isolated trees said to have been grown from seed of the same parentage. In the spring of 1930, 65 of the most uniform seedlings resulting from this seed were planted in an orchard row. In the fall of 1934, 16 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 flat, were taken at random from each tree, the seeds extracted and weighed, and planted in paper pots in flats, one flat per

[1]Subsequent to the preparation of this paper, our attention has been called to work by Brown (Brown, L. P. Factors influencing- the variation in size and productiveness of apple trees. Master's Thesis University of Wisconsin 1925), in which he shows that the seedlings grown from large seeds of the Wealthy variety averaged somewhat larger than those from small seeds.

[2]We are indebted to our colleague, Dr. J. Bialoglowski, for the statistical treatment of the data.

progeny. Germination was effected in the glasshouse and in the spring of 1935 the pots were transplanted to 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. It should be noted, however, that the trees were somewhat crowded during the last few months of their stay in the nursery.

The formula employed in determining the coefficient of correlation[2] is that suggested by Snedecor (8), namely $r = \frac{Sxy}{\sqrt{(Sx^2)(Sy^2)}}$. 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 correlation, the latter measurement and a similar one for the budlings 17 months later.

DATA AND DISCUSSION

The 772 seeds employed in the seed-seedling correlation appear to be a population very similar to that reported on by Erase and Tukey (6); indeed the frequency-distribution curve plotted from the data is almost identical. The distribution, by classes, is shown in Table 1. The data for the correlations are given in Tables II and III.

TABLE II—CORRELATION BETWEEN SEED, SEEDLING AND BUDLING IN THE AVOCADO

Correlation	Number of Individuals in Population	Correlation Coefficient	Standard Error	Ratio Between Coefficient and Error
Seed—seedling.....	772	0.427	±0.0300	14
Seedling—budling.....	629	0.327	±0.0357	9

The ratio between correlation coefficients and standard errors indicates satisfactory mathematical significance but neither correlation coefficient is regarded as sufficiently high to warrant consideration in relation to changes in commercial nursery practice.

Our coefficient for the correlation between size of seedling at time of budding and size of budling 17 months later is lower than that reported by most workers for similar stages in the propagation of other fruits, and is of the same general order of magnitude as those obtained by Sax (1) for the apple. It will be observed, however, that the coefficient of variation for the budling progeny is more than double that of the seedling progeny 17 months earlier. This strongly suggests the operation, after budding, of factors other than the size of seedling.

TABLE III—MEANS, DEVIATIONS AND COEFFICIENTS OF VARIATION

	Seedling Progeny	Budling Progeny
Mean	1.63	4.15
Standard deviation	±0.42	±2.33
Coefficient of variation	25±.2	56±.1

In our opinion there are several factors which may have operated to cause this result, of which time of bud start is believed to have played the most important role. Some of the buds started much sooner than others put in at the same time and the start of some was, of course, delayed by the necessity for rebudding the following spring. Lateness in start of bud may comprise a handicap which the budling never outgrows in the nursery. Sax (1, 2) and Gardner and Lincoln (9) have called attention to the influence of this factor. Other factors which may have exerted an influence are the crowding, to which reference has already been made, and the mixture of two scion varieties in the budling population.

CONCLUSION

Positive and mathematically significant correlations are reported for weight of seed, size of seedling at time of budding, and size of budling in the avocado but the magnitude of the correlation coefficients does not warrant changes in commercial nursery practice.

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