Proc. Fla. State Hort. Soc. 53:147-149. 1940.

FERTILIZER STUDIES WITH AVOCADOS

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After the establishment of the Sub-Tropical Experiment Station in 1930, one of the first research projects planned was the setting out of a test block of standard avocado varieties, especially for a study of certain fertilizer problems but also for comparing different rootstocks and different methods of preparing holes for planting. Trees were grafted to order in the spring of 1931, and in November and December of that year they were set out in the grove. Varieties selected were Pollock, Trapp, Waldin, Collinson, Schmidt, Lula, and Linda.

Each variety is planted in a solid block, 3 trees wide and 28 trees long, with A and B varieties alternated to assure good pollination conditions. Trees are set 20 feet apart each way, with a 30 foot spacing every 6 rows across the length of the variety blocks, for a roadway. The long rows are planted uniformly as to hole preparation, but each of the 3 rows in each variety block represents a different method. Since these differences are uniform for all varieties and for all tests here reported, it is not of interest to discuss these different methods. Suffice it to say that thus far we have observed no differences in tree growth which can be correlated with these planting methods.

A series of fertilizer plots was laid out in the fall of 1932. These plots were 3 trees wide and ran across the variety blocks, so that each plot contained 9 trees of each variety, with two exceptions. The plot at the south end of the blocks contained only two rows or six trees of each variety, and the last plot on the north was of a single row only, or three trees per variety. Beyond this plot to the north were some rootstock plots, which served as sort of a buffer, and the southernmost plot has been left out from the tables of data so that it may similarly function.

The fertilizer problem originally planned was a study of the effect of various percentages of nitrogen from organic sources. It had long been held by growers and writers that the avocado required a large amount of its nitrogen from organic sources, if it was to thrive, but no experimental work seemed available in support of this thesis. As various other fertilizer problems were being attacked in cooperation with owners of bearing groves, we reserved this new Station planting for this problem of organic nitrogen.

The fertilizer practices of the successful growers varied greatly, but the most commonly used analysis seemed to be a 5-7-5 with about 66% of the nitrogen derived from organic sources. Accordingly, we chose this as the basis for our work, or our control, and compared with this mixture having 100%, 33%, and 0% of their nitrogen from organic sources. These mixtures have been maintained since the beginning, but in the fall of 1934, two years after starting the tests, a change in analysis was made. Other

tests in bearing groves had by this time indicated no advantage for the high phosphorus content of the 5-7-5, and since 1934 the analysis has been 5-5-5, in terms of ammonia, or 4-5-5 in terms of nitrogen, as now expressed, i. e., 4% N, 5% P_2O_5, 5% K_2O. Applications have been made in March, June or July, and October, the usual thrice-a-year program of fertilization.

The organic sources used have been, for the last six years, cotton-seed meal and either blood-and-bone tankage or fish scrap, each being the source of half of the organically derived nitrogen. The inorganic source has been sulphate of ammonia until the last three years, when cyanimide has been used as a partial source of nitrogen in the 0% and 33% plots. For technical reasons cyanamide is classed as non-protein organic nitrogen, but in its availability, solubility, and effect on soil microorganisms it is comparable to inorganic rather than organic sources.

Not all of the seven original varieties are still in the test. The Schmidts were nearly all killed in the 1934 freeze, and were replaced by another variety not yet in production. The Lindas were topworked last year to a better variety. And the Pollock crop has been too erratic for use in this report. There remain the Lula, Collinson, Waldin, and Trapp varieties, for which we have data on three consecutive seasons' production for trees now 8 years old from setting out and 9 years from grafting. Table 1 shows the data for these varieties, averaged for the three years. Three of the four varieties show a definite crease in production with increases in percentage of nitrogen from organic sources, up to 66%. In no case is the yield for 100% organic sources as good as that for 66%, and we seem warranted in concluding that it is not desirable, much less necessary, to derive all of the nitrogen for avocado fertilizers from organic materials.

On the other hand, the data do not clearly indicate that it is more desirable to have 66% than 33% of the nitrogen from organic sources. For the fertilizer materials used in the 33% mixture cost about 80% of what the materials used in 66% mix cost, and the differences in yield seem to be of about the same magnitude. However, the yields differ by more than 10 pounds, whereas the fertilizer cost per tree differs by less than 10 cents, and the analysis higher in organic nitrogen still justifies itself.

Another series of plots has developed gradually in this test planting. The original series contained one extra plot which received a mixture varying in analysis with the season. Some growers were persuaded that more nitrogen and less potash in the spring, with less nitrogen and more potash in autumn, was the only way to fertilize avocados satisfactorily, and we wanted to check the hypothesis. This plot has received from the start a 6-8-3 analysis in spring, 4-8-10 in autumn, and the control analysis in the summer, all based on 66% of the nitrogen from organics.

The single row plot at the north end was also used from the first as a test for the value of manganese for avocados, since its value for some truck crops had just been demonstrated for the marl properties nearby. The trees have received the control fertilizer with 200 lbs. $MnSO_4$ added per ton.

In the fall of 1935, a control plot was changed to receive additional applications of nitrogen intermediate to the usual applications of complete fertilizer. Thus this plot, the Extra N plot, receives control fertilizer in March, July, and October, and in addition, receives a pound or so per tree of sulphate of ammonia in early January, May, and

September. Our idea was to maintain a more uniform availability of the readily leached nitrogen.

About a year later, starting in the spring of 1937, we set up another plot to receive a double application of the control mixture at each fertilizing. This plot had previously received the control fertilizer since the start. The statement is often made that the avocado is a gross feeder and that the more heavily the tree is fertilized, the better they like it. We determined to give them a chance to show how they responded to a full table.

In Table 2 are found the average yield per tree for the past three seasons on these plots. The control plot is of course the same one as the 66% Organic N plot in Table 1. It seems fairly evident that neither the addition of manganese nor the variations in the analysis with the season have been profitable practices as compared with the control procedure. The Collinson trees return a minority opinion in the rendering of this decision, just as they did for the percentage of nitrogen series, and have shown a gain in yield from manganese apparently.

The outstanding feature of this table is, however, the high yields resulting from intermediate applications of nitrogen. The trees of this plot have yielded in every instance a larger crop than those of any other plot. The trees receiving a double helping at every meal have not equaled the control plot in one case and in no case equaled those given a little snack between meals. The data for 1939-40 season alone are of particular interest because the double application was begun in 1937 and had little chance to affect the first crop here included. But for the past season too, the Extra N plot has greatly outyielded the much more expensive Double.

Pollocks have been particularly mentioned as needing lots of fertilizer, and many growers have assured me that liberal feeding would make them bear. Last summer there was a good crop of Pollocks in the Station grove, but the control plots lead, with the Extra N following fairly closely and the Double plots way behind. Evidently heavy fertilizing is not the cure for Pollocks.

The trees of the Extra N and Double plots are markedly larger and of deeper green color than those of other plots, but the growers' profits come from the size of crop and not from size of tree. Perhaps in a few years more the Double plot will make use of the larger size trees to bear more heavily, but thus far this hope has not been justified by results.

These plots were laid out by the senior author, as Horticulturist in charge of the Subtropical Experiment Station, in collaboration with Mr. L. R. Toy, and were cared for by him through the end of the 1937-38 seasons. During the past two seasons the work has been continued by the junior author. These studies will be reported in more detail in another publication later.

Average Yields Per Tree In Lbs. Seasons 1937-38 through 1939-40

Table 1

Treatment	Lula	Collinson	Waldin	Trapp
0%. Org.	75	37	41	18
33% Org.	82	35	53	21
66% Orog.	-00	32	70	35
100% Org.	79	27	63	25

Table 2

Treatment	Lula	Collinson	Waldin	Trapp
Control	100	32	70	35
Double	74	36	80	39
Extra N	127	52	93	35
Varied	81	34	45	24
Mn	62	47	58	21