

AVOCADO POLLINATION TESTS

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The experiments, observations, and records described in this paper are the work of the Point Loma Homestead in the avocado orchard at the International Theosophical Headquarters, Point Loma, Calif. The work was done by the Homestead's Horticultural Department in connection with the educational activities of the College there. The writer alone is responsible for his conclusions given in this report.

In a previous report of progress, entitled "Avocado Pollination and Bees," which was published in the recently issued 1923 Annual Report of the Avocado Association, we gave details, but not all the results, of pollination tests the Homestead had made on a few varieties. Numerous growers and scientific investigators in the public service, who saw or heard of the tests while in progress, wish to know the results.

Since the earlier report was written the dropping of immature Fuerte fruits has stopped and some interesting facts have become apparent; therefore a further report is now possible. It is not necessary to repeat in this report all the details included in the former. We give the figures, some explanations and a few other remarks.

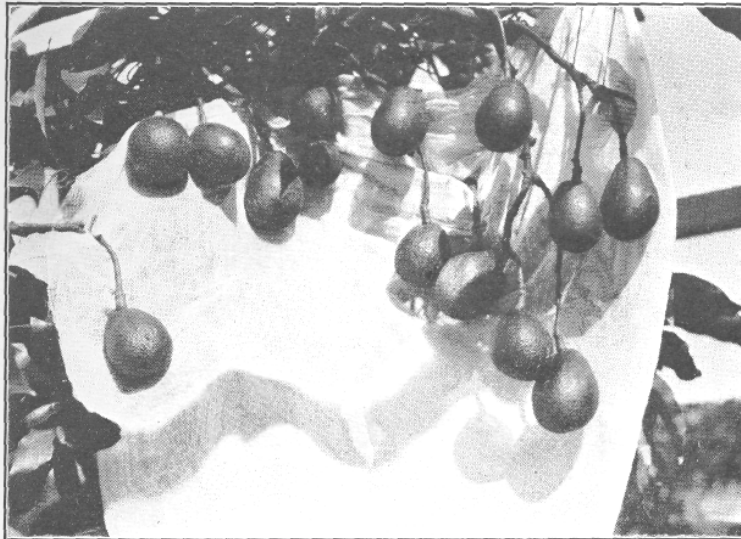
In the Homestead's orchard there are about 20 budded varieties in bearing and a considerable number of bearing Mexican seedlings. An apiary with 17 swarms of bees is at the orchard. All the trees tested were healthy and first class in appearance, but not large. Three of the Fuerte trees are on a soil strip, badly lacking in richness, but they had been made fairly vigorous by an excess of irrigation. It is our observation and it is good horticultural science that when avocado trees are in such a vigorous, sappy, but not richly nourished condition, they cannot bear well. This year, contrary to their usual habit, none of our Fuertes have borne as well as most of the older varieties, which are seriously over-bearing.

The studies and records of avocado blossoms made at Point Loma while Dr. Stout was making his careful studies in Los Angeles County, confirm many of the facts published by him. But, as he pointed out in a published interview, such blossom studies are incomplete until subjected to practical tests. It is not therefore surprising that the same tests, made here, were later advocated in detail by Dr. Stout after he had proven the hand pollination method impossible. The Homestead's tests with nettings and bees are practically the same as tests made by the State University on prunes and plums in California.

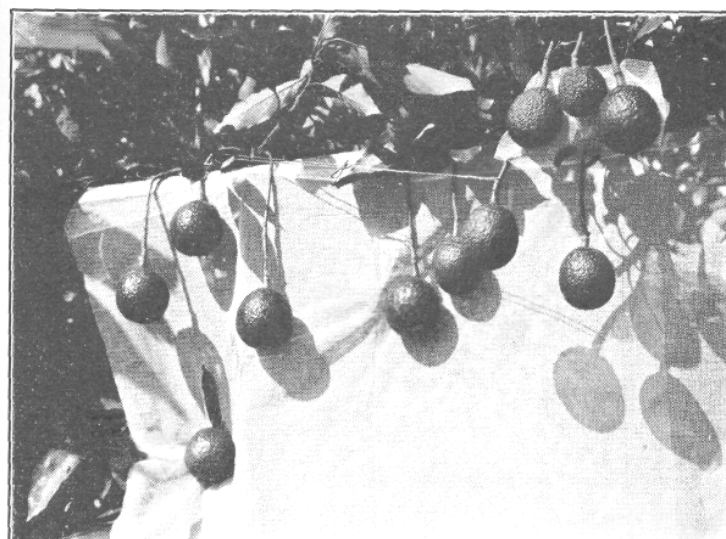
At the beginning of the last blooming season, parts of three Fuerte trees were covered with netting on framework, to test self-pollination in comparison with cross-pollination. Considerable care was taken in placing the nettings so that half of each tree should be inside the netting and half outside. A swarm of bees was kept under each netting. The

bees were fed an abundance of honey and kept in good condition under the care of the Homestead's bee expert. No bees could get into or out of the nettings. The blossoms on the half trees under the nettings could get only Fuerte pollen. The nettings isolated the covered parts of the trees as completely as though they had been growing in an orchard composed only of Fuertes with no other variety near them. But the half of each tree which was not covered was open to cross-pollination from the many adjoining varieties, and great numbers of bees were at work in all parts of the orchard.

After the blooming season, the nettings were taken off, but the framework and a few strips of netting are still in place to insure accuracy in the counting of the fruit. No fruit has been lost by accident and none has ever yet been lost by high wind.



Fuerte fruits from blossoms that had been in a net with bees and could receive only pollen of their own variety.



Dickinson fruits from blossoms that had been in a net with bees and could receive only pollen of their own variety.



Avocados of the Katherine Tingley variety from blossoms that had been in a net with bees and could receive only pollen of their own variety.

On the Fuerte trees tested for self-fertility, the fruits produced and now approaching maturity are as follows:

	No. of Fruits		No. of Fruits
1 st Tree, inside the net	48	Outside the net	56
2 nd Tree, inside the net	6	Outside the net	5
3 rd Tree, inside the net	12	Outside the net	4
	<hr/>		<hr/>
	65		65
Total inside the nets, 66 fruits			
Total outside the nets, 65 fruits			

The writer, at least, has been much surprised by this and some other results of our tests.

Quite a number of small seedless fruits still on the trees, but which will never develop,

were not counted. The number of these seedless fruits appears to be similar on the self-pollinated parts of trees and on the trees open to cross-pollination. It has been supposed that the many small seedless fruits produced by Fuertes show the need for more cross-pollination, but in these tests the total prevention of cross-pollination has not produced more of the seedless fruits.

It is well known to those who have studied pollination of fruits that many deciduous fruits drop worse until maturity if only self-pollinated than they do if cross-pollinated. If cross-pollination will cause more avocado fruits to reach maturity, that is what we need. Since mid-summer successive counts have shown that there was no dropping whatever from those parts of the Fuerte trees which had been inside the nets and received only pollen of their own variety. But until Autumn, the half trees which had been open to cross-pollination continued to drop quite a number of fruits from no evident cause. If cross-pollination had been needed, the reverse should have taken place. The irregularities of the dropping, following this and the other tests were puzzling and kept the results uncertain until all dropping finally stopped. Netting had remained over the trees during the long blooming season. Its removal and the slight change in intensity of sunlight evidently was the cause of the small weak fruits dropping rapidly during Spring and early Summer, leaving no weak ones to drop later, whereas some weak fruits on trees and parts of trees that had not been shaded by nets continued some growth for a time and dropped during late Summer and Autumn.

The purpose of the Fuerte tests was to determine whether or not, some other variety must be planted or grafted close to Fuertes, or whether that trouble and expense is unnecessary. The result shows that the Fuertes tested, would have borne just as well with no other variety within miles. Perhaps in time, a variety can be found whose pollen can be proven beneficial to the Fuerte.

One tree of the Katherine Tingley variety was tested. The part which was open to cross-pollination produced a fair crop. The part from which all cross-pollination was excluded, over-bore as this variety frequently does.

There was one netting covering two trees. On one of the trees, two varieties are growing, so that under the netting there were three varieties: the Fuerte, the Blakeman and the Katherine Tingley, with a swarm of bees. Presumably these trees received much more cross-pollination during most of the blooming season, than any other trees in the orchard. But the crops resulting are not heavy. In fact, the crops on them are much less than the crops on part of one Fuerte and the part of a Katharine Tingley tree from which all possible cross-pollination was excluded. These varieties which were under the same net together produced less than the general average for the orchard. Whereas if increased cross-pollination had been a help they should have borne more fruits than any other trees. The Blakeman in this netting must have received a very much greater amount of cross-pollination because of being in the netting with the Fuerte. The hive of bees was located under the Blakeman foliage during the whole of its blooming season. But 35 per cent of the Blakeman fruit dropped between the middle of August and the middle of October, whereas a portion of this Blakeman tree which was outside the net and therefore received only an ordinary amount of cross-pollination, did no dropping after July. Evidently Fuerte pollen was no help to the Blakeman and did not make it hold its fruit.

Perhaps bees confined in a net, force open more closed and half-closed blossoms than they do under normal orchard conditions; but if so, that forcing of closed blossoms did not increase the crops on the three varieties enclosed together in one net.

Part of one Dickinson tree was under a netting with bees. The dropping of fruits has not entirely ceased on this tree so that a final count cannot yet be made. The number of fruits now on the tree are less on the part which had only self-pollination than on the part which was open to cross-pollination. The effect produced on this tree by the slight shade of the netting was such as to make the value of this test doubtful. The shading decreased the growth and affected the appearance of the foliage. There is evidence that it also decreased the crop inside the netting.

The fact that in this locality most avocado trees bear less on the shaded portions of each tree than on the sunniest side of the tree indicates that their bearing would be affected by the shade of a netting. We believe modifications of our tests can be devised that will eliminate this uncertainty. The shade of the netting had almost no effect on the temperature and humidity inside the nets. With the aid of the director of the Weather Station on our grounds, it was found that temperature and humidity remained practically the same inside and outside the nettings.

Our blossom records and Dr. Stout's show that the Dickinson receptive and pollen shedding blossom periods overlap but very little and that very seldom, less in fact than any other variety commonly planted. But the Dickinson and other varieties tested for self-fertility produced immense numbers of small fruits under the nets and a large proportion of these small fruits contained seeds. The Dickinson separated by the netting from all other varieties received a great abundance of its own pollen, notwithstanding that its blossom-periods do not overlap.

Half of another Dickinson tree was under a net with no bees under the net and none could get under it nor were there any other insects in this net except possibly a few thrips. This half of a tree which no bees could visit has no fruit. But the other half of the same tree was freely visited by bees and has a crop that is heavy for so small and young a tree. A study of the blossoms shows that many varieties are like the Dickinson and require bees or other insects for pollination.

The Homestead hopes to make further pollination tests, perhaps with modifications. Tests on some other varieties may give very different results.

Perhaps in time some one may be able to find and prove a few highly successful combinations to cross-pollinate each other.

From 1918 to 1921 the Homestead budded other varieties onto one side of some avocado trees to determine by this method whether increased cross-pollination would increase their crops. A few of the most interesting of these combinations are the following:

In 1918 a Fuerte limb was budded onto one side of a Challenge tree. Dr. Stout's blossom records and ours show that these two varieties are adapted to cross-pollinate each other. Previous to this year this fine large Fuerte limb had borne only one fruit. It set a very heavy crop this year, but dropped most of it notwithstanding being on the same tree with Challenge. This tree is one of the largest and best appearing of the forty

Challenge trees in the orchard. None of the others has any variety budded on the same tree with it. Records of fruits produced show that previous to this year this Challenge produced the least fruit of any of the forty. This year it has 133 fruits which is only half as much as the average for the nearest half-dozen other Challenge trees. Most of its crop is located on the side of the tree furthest from the Fuerte limb. In lighter vein someone has remarked that too much cross-pollination seems to have been a bad thing for this tree!

In 1918 and later, the Katherine Tingley variety was budded on several Harmons. These varieties over-lap each other freely in their daily blossom periods. But the Harmons have borne practically nothing, even this year, when nearly all other varieties here are bearing most heavily.

We hear of avocado trees at a distance from all others, which have a heavy crop this year. In view of the cross-pollination problem, it would be very interesting to know whether there are many such and of which varieties.

Five years ago, Mme. Tingley directed the Professor of Botany in the College to assist in beginning some preliminary studies of avocado blossoms. The writer then formed and has since held the opinion that the need for cross-pollination is a reasonable hypothesis and worth an effort to prove. But the results of the tests so far made show that the source of the pollen in these cases was not the most important factor. It was also evident to those who were watching closely that the variety of each tree and the vegetative condition of each tree and of each branch, before and while blooming, determined the amount of the crop irrespective of the pollination tests. None of the trees or branches were lacking in health and vigor, but some had too much watery new growth to be in good bearing condition.

Much of the work of the tests was carried out under the supervision of Abbott Clark. Others helped on all stages of the work and watched it all with much interest. Detailed records were kept and we confirmed each other's observations.

Unquestionably there are practical cultural means of greatly increasing avocado productiveness—means not yet generally emphasized in full. As our observations have progressed, more and more detailed evidence has accumulated to show that it is the trees and the branches whose foliage is well matured and well nourished, but without too much sappy new growth that bear the heavy crops. We believe this has not heretofore been sufficiently recognized in regard to avocados. We believe a full recognition of it gives great promise for the future of avocado productiveness. A mature, well-nourished condition of foliage with a moderate amount of well-distributed new growth can be secured by the right amount of irrigation, fertilization and right management of the soil. It is necessary to have accurate control of the amount of irrigation and the amount of soil moisture, and also to recognize that the requirements of different varieties are not the same. Besides these requirements there are, of course, other factors which cannot be overlooked. To us it is apparent that we must follow the methods known and recommended by the horticultural experts in the public service and also study the condition of our trees. Considerable evidence can be found to show that when the proper methods of maintaining the right vegetative condition are recognized and worked out in detail and applied, and only the best varieties chosen, those who are

most successful will have to guard against overbearing. Our experience convinces us, that when we have learned how to do everything needed and not too much of anything, we will have bounteous crops.

There is a quotation that we can all appreciate from one of the World's masterpieces of literature, which says: "Help Nature and work on with her, and Nature will regard thee as one of her creators and make obeisance."