Chlorosis in Avocado

may be caused by nutrients in soil or genetic variations in the variety

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In the first article of a two-part progress report on the relative susceptibility of avocado rootstocks to chlorosis evidence was presented to the effect that young avocado trees on Guatemalan rootstocks are less tolerant to a type of chlorosis—yellowing of leaves—than trees on Mexican stocks. The evidence was based mainly on information obtained in two rootstocks plots, one located in Santa Barbara County and one in Orange County. In the former 70% and in the latter 78% of the trees on Guatemalan stocks became chlorotic about one year after planting, while only 1% of the trees on Mexican stocks in both plots showed the disorder. In November 1951, 40% of the chlorotic trees on Guatemalan stocks in the Santa Barbara County plot and 35% in the Orange County plot were either dead or seemingly beyond recovery. Since then the condition of the surviving chlorotic trees has fluctuated. In November 1952, it was uncertain as to what percentage would develop into normal trees.

In two rootstock plots and in one nursery additional evidence was obtained that Guatemalan varieties—as a group—are less tolerant to chlorosis than are Mexican varieties. Very limited information indicates that West Indian may be classed with Mexican in this respect.

One of the plots, located in Santa Barbara County and planted in April, 1949, consisted of 113 seedlings, but losses reduced this to 93, of which 46 were Guatemalan, 38 Mexican, and 9 West Indian. There were six Guatemalan varieties—Nabal, Challenge, Itzamna, Dickinson, Anaheim, Mayopan—and five Mexican varieties—Topa Topa and four other unnamed seedlings not hitherto used. There was only one variety of West Indian—Waldin—the seed of which came from Florida.

In the spring of 1951—two years later—about half of the seedlings were grafted to MacArthur and half to Rincon. Up to the time of grafting no chlorosis was evident, but five months later 30% of the 46 Guatemalan showed the disorder in varying degrees; 13% of the Mexican were affected, while the West Indian trees were free of the disorder

In this plot chlorosis occurred about two years after planting, whereas in all of the other affected plots it had appeared within a year. Also all affected trees, with but three exceptions—all Guatemalan—showed improvement within a few months. By August 1951 they appeared to have fully recovered, that is, the trees had made vigorous growth which showed no chlorosis symptoms. The scion variety had no effect on the chlorosis development or recovery.

The other rootstock plot in which chlorosis occurred is located in Ventura County. It was planted in May 1951 to 126 Hass trees. Freeze damage the following winter reduced the number to 112. Of this latter number, 49 are on Guatemalan stocks, which include, in addition to the six varieties mentioned for the first plot, the following: Hass, Taft, Lyon, Ryan, MacArthur, a total of 11 varieties. Forty-eight trees are on Mexican—Topa Topa, Ganter, Dyke, Mexicola, Northrop, Blake, Gherkin. The last named has been used in only a few rootstock plots. Fifteen trees are on West Indian—Waldin and Lula. While the latter is listed as a Guatemalan-Mexican hybrid, it seems to resemble West Indian more closely. Both Waldin and Lula seeds came from Florida.

About one year after planting, 31% of the trees on Guatemalan stocks showed chlorosis in varying degrees. None of the Mexican or West Indian was affected. Two months later all but three trees appeared to have recovered, and in November 1952 there were no recurrences or new cases. Here as well as in the Santa Barbara County plot the chlorosis situation differed from that in the plots reported last year in that recovery was rapid and that no serious losses were suffered.

Additional information on chlorosis was obtained in a nursery in Ventura County. Apparently an unfavorable soil condition—high salinity—existed in this area because about 50% of Mexican seedlings planted by the grower either died or were rendered useless for grafting. The nursery occupied several strips of land between rows of four-year-old lemon trees which showed some chlorosis symptoms.

In May 1951, 340 seedlings were planted in one of the vacant strips. Two hundred and eight were Guatemalan of the following 11 varieties: Anaheim, Carlsbad, Challenge, Dickinson, Edranol, Hass, Itzamna, MacArthur, Mayopan, Nabal, Lyon. Six Mexican varieties included Blake, Duke, Ganter, Mexicola, Northrop, Topa Topa. Eighteen Lula seedlings represented the West Indian type. The seedlings were planted in regular order and each variety was replicated 18 to 20 times. A few days after the grafting of most of the seedlings to the Dickinson variety a desert wind killed 23 Guatemalan and 22 Mexican and one Lula. Many others suffered injuries in varying degrees.

About one month before grafting, observations showed 9% of the Guatemalan more or less chlorotic. None of the Mexican or Lula was affected. The following spring—1952—63% of the 85 remaining Guatemalan, 5% of the 92 Mexican, and 11% of 17 Lula showed chlorosis in varying degrees. There were many borderline cases which were difficult to classify. The percentage among Guatemalan varieties ranged from 25% to 92%, among Mexican 0% to 13%. This included grafted as well as nongrafted seedlings or those on which the graft had failed. The incidence of the disorder was nearly equally distributed among grafts and seedlings.

A consistent trend as to degree of susceptibility of different varieties has not been indicated by observation made in these studies, but this does not necessarily mean that differences do not exist. The observations were limited to randomized rootstock test plots, and although some 50 such plots have been planted during the past nine years,

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Topa Topa Row—right—practically free from chlorosis, only 5% affected; Dickinson Row—*left*—73% chlorotic. A large proportion of the Dickinson seedlings also showed severe leaf burn. Trees shown a few months after planting.

2, 4, 5-T on Apricot

effects include early maturity, larger fruits, less preharvest drop

Julian C. Crane

A single application of 2,4,5-T to apricot resulted in early fruit maturity, increased fruit size, reduced preharvest fruit drop, and under certain conditions development of red color in the fruit.

Accompanying these beneficial effects in some instances are certain undesirable features, both of the fruit and the trees.

Tests with this growth regulating substance on the apricot were begun in 1951. Depending upon time and concentration of the application, Royal apricots in the Green Valley area matured a maximum of 18 days early and were up to 35% larger in volume than the unsprayed fruits.

The increase in fruit size was the result of a stimulation in growth of the flesh which was up to 21% thicker than that of the unsprayed fruit. In certain instances the fruits were stimulated to grow so much and so rapidly that they split open; the split areas later became infected with brown rot and other fruit spoilage diseases. Of less consequence was the killing of the tips of vigorously growing shoots. A concentration of 100 parts of 2,4,5-T per million parts of water applied at the initiation of pit hardening combined more of the beneficial and less of the harmful effects than applications made otherwise.

Investigations during the 1952 season included semi-commercial scale application to three apricot varieties—Stewart, Royal, and Derby—under different environmental conditions. The following chemical formulations of 2,4,5-T were tested: ammonium salt, trialkylamine salt and the propylene glycol butyl ether ester. The latter formulation, at a low concentration of 12 ppm, proved to be so toxic to the fruit and foliage as to preclude its use in further experimentation.

A concentration of 100 ppm of either the ammonium or trialkylamine salts applied shortly after the beginning of pit hardening brought about fruit growth responses similar to those in 1951. Fruit volume was increased from a minimum of 25% in the Stewart variety to a maximum of 37% in the Royal variety, the Derby being in between. Measurements of the flesh showed that this portion of the fruit increased in thickness from a minimum of 9% in the Stewart variety to a maximum of 20% in the Royal. On a fresh-weight basis, the average increase in yield of fruit was 17% for the Stewart, 22% for the Derby, and 28% for the Royal. Fruit maturity was hastened three days in the Stewart and Derby varieties and as much as 10 days in the Royal variety.

Objectionable features as a result of spray application were tiny cracks in the skin at the blossom end of the fruit or cracks along the suture that were from $\frac{1}{16}$" to over an inch in length. This condition varied depending upon variety, location of the experiments, and time of spray application. At one location 5% of the sprayed Royal fruits developed cracks, whereas at another location 70% of the fruit of this variety were thus affected. The Derby variety was completely free of the trouble.

Under California conditions the apricot generally produces three vegetative growth flushes each year. The first and most vigorous flush is terminated during the time of pit hardening in the fruit. The second and third flushes follow during early and late summer.

Trees sprayed with 2,4,5-T failed to produce the second and third growth flushes. Growth the following year, however, was normal when 2,4,5-T was not applied. Injury to the first growth flush in the form of tip die-back also varied with location and time of 2,4,5-T application. In an orchard at Winters, only an occasional branch with tip burn could be found while in an orchard at Green Valley almost all branches were injured in this manner. Tip burning of the shoots is not particularly objectionable, however, since the regular pruning practice on mature trees generally involves their heading back or removal.

A striking effect of 2,4,5-T application in one particular orchard was the pronounced development of red color in the fruit as it matured. Under different environmental conditions, however, an identical concentration of the spray applied at approximately the same time in another orchard failed to induce red color development, although fruit size was increased and maturity hastened.

Preharvest fruit drop is a problem with some apricot varieties and apparently under certain environmental conditions. Fruit drop may begin about the time of pit hardening and continue until maturity, or it may occur just prior to harvest. Trees sprayed with 50 ppm of 2,4,5-T were found at harvest time to have dropped only 10% of their fruits while comparable unsprayed trees dropped 30% of their crop. The spray was found to be equally effective on all varieties tested. Since 2,4,5-T application brought about a marked reduction in fruit drop during a period of 50 to 60 days, time of application for this purpose alone does not appear critical. It would appear to depend upon the type of fruit drop expected with a particular variety in a given location.

Although 2,4,5-T application appears to offer considerable promise in apricot culture, recommendations for its use can not be made until more extensive data are obtained regarding concentration and time of application under different environmental conditions and the effect of the material upon vegetative growth and fruit production when applied year after year.

Effect of 2,4,5-T Application upon Flesh Thickness in the Royal Apricot

Treatment	Flesh thickness (mm)	Increase over unsprayed (%)
Unsprayed	14.65	...
25 ppm	15.57	6.3
50 ppm	16.97	15.8
100 ppm	17.76	21.2

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Sprayed (s) and unsprayed (us) Stewart, Royal, and Derby apricots one month after an application of 100 ppm of 2,4,5-T on April 12, 1952.