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Effects of Growth-Regulating Sprays on Fruit Set of Avocado[1]

WM. S. STEWART[2] and H. Z. HIELD,
University of California Citrus Experiment Station,
Riverside, Calif.

The alternate-bearing habit of the Fuerte variety of avocado in southern California is one of its most undesirable features. Low production in "off" years is attributed to inadequate fruit set, since flowers are produced in abundance every year. Hodgson (6, 7), after a careful study of this problem, has concluded that warm weather during flowering favors fruit set. He considers that the first heavy fruit set of a young tree initiates the alternate-bearing cycle, which then continues without interruption unless abnormal weather conditions cause high or low production for more than one year at a time. Such a "change in stride" has occurred four times during a 22-year period.

In some seasons, under certain weather conditions as yet undefined, large numbers of seedless fruits may be set. Generally, these fruits are of little market value, since they fail to grow much longer than 2 to 3 inches and picking involves excessive cost.

In this study fruit set was considered to have occurred if fruit growth was initiated after flowering. Failure of the fruit to develop to maturity after once beginning to grow was not considered a problem of fruit set, but one of growth failure due to other factors.

Plant growth regulators can increase fruit set and may induce growth of seedless fruit of tomatoes and several other vegetable crop plants (1), and can induce growth of seedless figs (2, 11) and increase the yield of parthenocarpic Bartlett pears (3). However, they have not as yet been used successfully to increase fruit set of such diverse tree crops as apples (4), dates (8), olives (5), and citrus (9).

Survey experiments were begun in 1946 to determine the effects of various growth-regulating chemicals on fruit set of avocado. A progress report was published in 1948 (12). A summary[1] of the survey experiments and results of a later yield experiment are reported here.

SURVEY EXPERIMENTS

Survey experiments were conducted during the spring in five different avocado districts in southern California. In these tests flower clusters, or small branches bearing flowers, were sprayed with solutions of various growth regulators. The following chemicals were tested at concentrations of 10, 50, 150, and 500 ppm: the triethanolamine salt 1 and isopropyl ester of 2,4-dichlorophenoxyacetic acid (2,4-D), and the butyl ester of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). The chemicals ortho-chlorophenoxyacetic acid, indole butyric acid, alpha naphthalene acetic acid, naphthalene-acetamide, and beta naphthoxyacetic acid were tested at concentrations of 100 and 1000 ppm; 2,4-dichloronaphthoxyacetic acid[3] was tested at 100 ppm only. All these materials were

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[2]Present address: P.O. Box No. 3166, Pineapple Research Institute, Honolulu 2, T. H.
[3]Supplied by E. I. du Pont de Nemours & Co., Inc.

applied as water sprays containing 0.25 per cent emulsifiable oil except the triethanolamine salt of 2,4-D, which was applied in water alone, and the isopropyl ester of 2,4-D which was applied in kerosene.

It was found that none of the experiments increased the set of normal fruit but that under some weather conditions the light spray with kerosene containing 500 ppm 2,4-D as the isopropyl ester increased the set of seedless fruit, in comparison with that of nonsprayed flower clusters. Lower concentrations of 2,4-D did not have this effect. Seedless fruits resulting from the 2,4-D spray applied in May grew to a length of about 1 inch, and by October nearly all had abscised.

A 20-ppm water spray of 2,4,5-T caused very severe leaf injury and killed branches as large as 11/2 inches in diameter. This response was not observed with sprays of 2,4-D, even at a concentration of 500 ppm.

YIELD EXPERIMENT

Materials and Methods:—On the basis of the survey tests, an experiment was established to determine fruit production when entire trees were sprayed with 2,4-D. Since 2,4,5-T had shown a marked physiological (toxic) effect on the tree at a concentration of 20 ppm, it was included in the experiment, but at the nontoxic concentration of 2 ppm.

The experiment was established in a young Fuerte (Newman strain) avocado orchard near Santa Ana, California. The trees had come into bearing in 1947, and average production of the experimental trees in 1947, 1948, and 1949, in pounds per tree, was 29.7, 10.2, and 62.3, respectively. The sprays were therefore applied to flowers that would mature off-crop fruit in the fall of 1949 and early in 1950. A randomized block design was used for the experiment, with seven replicates and one tree per treatment in each replicate.

The sprays were prepared as quick-breaking, tank-mix emulsions containing 5 per cent kerosene (10). The emulsifying agent was 0.25 pound blood albumin per 100 gallons of spray mixture. The isopropyl ester of 2,4-D was added to make 500 ppm in the kerosene or 25 ppm in the final volume of spray mixture. The butyl ester of 2,4,5-T was added at 2 ppm in the final volume of spray. Both esters were of technical grade and were added to the kerosene before emulsification. A standard power sprayer with tank agitation was used.

Drenching sprays were applied to different trees on one of four dates during the flowering period, from November, 1948, to May, 1949. At the time of the first application, November 3, 1948, only a few sporadic flower clusters were open, but at subsequent applications, at about 6-week intervals, there was an abundance of open flowers. Production was recorded as pounds of fruit per tree.

Results:—There were no significant differences between the treatments in production of normal fruit (Table 1), and the sprays had no injurious effect on the trees. It was found, however, that the 2,4—D spray applied April 25, 1949, induced large numbers of seedless fruits (Fig. 1), and that more of these fruits occurred on the south sides of the trees than on the north sides. None of the 2,4—D applications at other dates, and none of the *2,4,5*-T sprays at any time, increased the yield of seedless fruit. Apparently, both plant and weather conditions on April 25 were favorable for induction of seedless fruit by 2,4-D. Since more seedless fruit developed on the south side of the tree than on the north side, this response may be related to temperature and carbohydrate supply.

Table 1. Yield of normal fruit from Fuerte avocado trees sprayed with a 5 per cent kerosene emulsion containing either 2,4–D or 2,4,5–T (Fruit harvested fall and winter of 1949).

Treatment	Date of application	Yield of normal fruit per tree[a] (pounds)
Nonsprayed (control)	———	30
25 ppm 2,4-D as isopropyl ester	Nov. 3, 1948	33
	Dec. 18, 1948	19
	Mar. 10, 1949	22
	Apr. 25, 1949	24
2 ppm 2,4,5-T as butyl ester	Nov. 3, 1948	23
	Dec. 18, 1948	39
	Mar. 10, 1949	25
	Apr. 25, 1949	19
Least significant difference:		
5 per cent	———	17.7
1 per cent	———	23.6

[a]Figures represent averages of seven trees each.

The fruit induced by the *2,4—D* grew to a length of 2 to 3 inches, and had failed to abscise as late as January 17, 1950, when final observations were made. In the survey experiments the seedless fruit seldom became more than 1 inch in length before abscission. It is of interest that the production of large numbers of parthenocarpic fruit failed to lower production of normal fruit significantly, compared with trees which bore few if any parthenocarpic fruit.

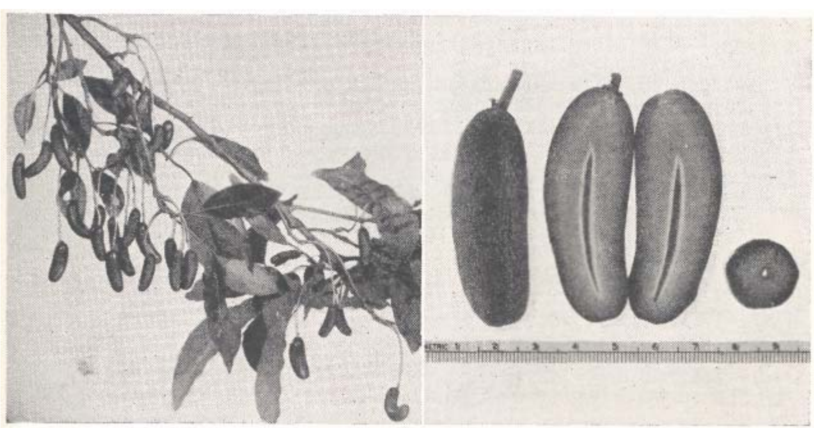

FIG. 1. Left, branch of Fuerte avocado tree sprayed with 25 ppm 2,4–D as the isopropyl ester in a 5 per cent kerosene emulsion. Note numerous seedless fruits. Right, single fruit, whole and in cross section. (Tree sprayed April 25, 1949; photographed January 17, 1950, by L. C. Erickson.)

SUMMARY AND CONCLUSIONS

On the basis of a prior survey with various chemicals, a yield experiment was conducted in which Fuerte (Newman strain) avocado trees were sprayed with 2,4—D or 2,4,5—T on one of four dates during the flowering season. A 5 per cent kerosene emulsion containing either 25 ppm *2,4—D* as the isopropyl ester or 2 ppm 2,4,5—T as the butyl ester, was applied as a drenching spray. It was found the sprays had no significant effect on yield of normal fruit, but that the 2,4—D applied : in April increased the yield of seedless fruit. The 2,4,5—T failed to induce any apparent responses in fruit growth.

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