California Avocado Society 1948 Yearbook 33:113-116

Progress Report on Effects of Plant Growth Regulator Sprays on Avocados

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The alternate bearing habit of avocado trees is one of their most undesirable features. Not only does production alternate from a large crop one year to a small one the next, but under certain climatic conditions beyond man's control, this cycle is interrupted so that several consecutive years of low or high production may result (Hodgson 1948). Low production has been attributed to inadequate fruit-set as an abundance of flowers is produced every year.

Generally speaking, a fruit-set has occurred when growth of the fruit begins after flowering. If fruit growth is not initiated after flowering then no set of fruit has occurred. Failure of the fruit to develop to maturity after once beginning to grow is not a problem of lack of fruit-set, but one of a growth failure due to other factors.

Plant growth-regulating chemicals may be used to increase fruit-set of tomatoes and several other herbaceous plants. To induce fruit-set of tomatoes, the growth regulators are generally sprayed on the flower cluster at the time of opening of the first flower buds. If pollination is prevented, even seedless tomatoes may be grown. Although thus far no success in increasing fruit-set using these materials has been reported for apples, dates or citrus (Avery and Johnson, 1947), it seemed worthwhile to study their effect on avocado fruit-set. This paper reports progress to date on these studies.

Preliminary trials to increase avocado fruit-set were conducted in 1946 and 1947. At this time water sprays containing up to 60 p.p.m (parts per million) 2,4-D were applied to Fuerte avocado flower clusters in full bloom. No definite increases in fruit-set were observed except in one trial where it appeared that the number of seedless avocados were increased as a result of the treatment. The formation of seedless avocados is well known to growers. Some seasons the trees may bear a number of seedless fruits known in the trade as "cukes". They are of little market value since usually they fail to become much longer than two to three inches, entailing excessive picking costs.

Additional avocado fruit-set trials were conducted in 1948. Survey tests were made using between forty and fifty different formulations which included nine of the well known growth regulators tested at various concentrations of from ten to one thousand p.p.m. The chemicals used were: triethanolamine salt of 2,4-diochlorophenoxyacetic acid; isopropyl ester of 2,4-diochlorophenoxyacetic acid; butyl ester of 2,4,5-trichlorophenoxyacetic acid; ortho chlorophenoxyacetic acid; indole butyric acid; alpha

naphthalene-acetic acid; naphthalene acetamide; beta naphthoxyacetic acid; and 2,4-dichloronaphthoxyacetic acid. The sprays were applied to individual blossom clusters both just before and during full bloom on several trees in a number of localities throughout southern California. Here, as well as in all subsequent tests, drenching sprays were used. By the latter part of April, 1948, one formulation, which happened to be number 13, appeared to have increased the fruit-set of Fuerte avocados. Number 13 formulation consisted of 500 p.p.m. 2,4-D added as the isopropyl ester in kerosene. This was one of the formulations least expected to give a positive response, and the thought of spraying trees with undiluted kerosene containing as much 2,4-D as 500 p.p.m. seemed fantastic.

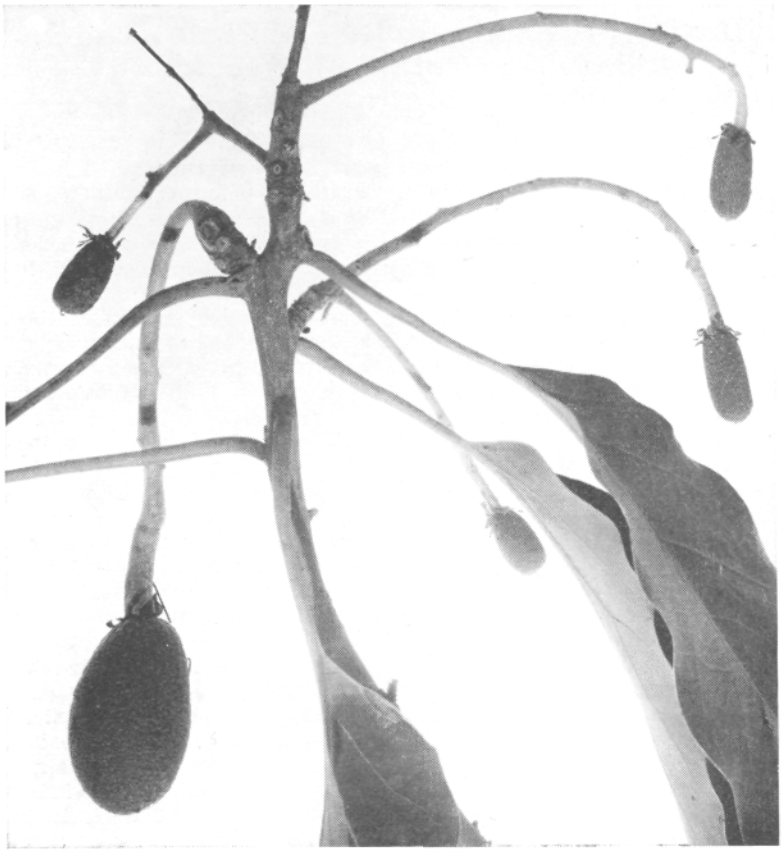

Fig. 1. Formation of Seedless Fuerte Avocados as a result of spraying with 10% kerosene emulsion containing 50 p.p.m. 2,4-D on the basis of the final volume of emulsion. The single large fruit at lower left is seed bearing.

On the basis of this clue, however, additional plots were established in May, 1948, testing 2,4-D at this concentration in kerosene as well as at concentrations ranging from 250 p.p.m. to 750 p.p.m. In these plots separate branches of the trees were sprayed, except in a few instances where either halves or whole trees were sprayed with 2,4-D at 20 p.p.m. Various other compounds chemically related to 2,4-D were also applied as water sprays on halves of trees at concentrations as high as 50 p.p.m.

From the above plots it appeared that the 2,4-D (isopropyl ester) applied in kerosene at

500 p.p.m. increased the fruit-set of Fuerte avocados. An increase in set was also observed where a 10 per cent kerosene emulsion was applied containing 50 p.p.m 2,4-D. The increase in set was quite obvious by June; however, during August it became apparent that the young fruit were developing without seeds. (Fig. 1.) By September it was evident that most of the fruit-set induced by the sprays was not continuing growth, even as much as naturally occurring seedless fruit. When observed in October, most of these fruit had dropped off so that there was little, if any, difference in the number of seedless fruit on the sprayed portion of the trees compared to the non-sprayed. No apparent fruit-set was observed on Puebla, Hass, Henry's Select, or Ryan, although the tests on these varieties were inadequate for final conclusion.

Another interesting observation from the 1948 plots showed that 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) was extremely injurious to avocados at a concentration of 20 p.p.m. On some Fuerte trees this spray caused the leaves to become yellow and drop off and killed branches up to an inch and a half in diameter. It appeared that the Hass variety was the most susceptible to 2,4,5-T injury; the Puebla variety was more resistant, and the Fuerte variety was the most resistant. On the Hass avocado injury was observed within two or three weeks after spraying. Some Hass avocado trees had more injury on the south side than the north. The Puebla and Fuerte varieties did not show obvious injury for five to six weeks.

It is just barely possible that 2,4,5-T, applied at a much lower concentration than 20 p.p.m., will bring about desirable rather than undesirable responses. This may follow by virtue of the fact that it induced a violent response at 20 p.p.m. whereas 2,4-D at this same concentration had no apparent effect. It appears that 2,4,5-T, on avocados, is more active physiologically than 2,4-D.

Studies are being conducted in cooperation with Dr. C. A. Schroeder of the College of Agriculture, University of California at Los Angeles, to determine if 2,4,5-T in extremely minute amounts, or if 2,4-D at higher concentrations in kerosene emulsions, will induce any favorable responses on avocados. Applications of these two materials to Fuerte avocados are now being made at intervals of six weeks to determine their effect on production and fruit quality.

A second possible use of plant growth regulators in the avocado industry may be to reduce mature fruit drop. The effect of 2,4-D in reducing pre-harvest drop in citrus has been demonstrated. In some districts, the Nabal avocado may have a heavy mature fruit drop. However, very limited data obtained during this past season from plots established by Mr. J. J. Coony, University of California, Assistant Farm Advisor for San Diego County, indicated that a 20 p.p.m. 2,4-D water spray was ineffective in reducing the drop. In the Corona district in September of this year, a 25 p.p.m 2,4-D water spray was likewise ineffective in reducing the drop of immature fruit of Fuerte avocados. As with fruit-set, it is possible that 2,4,5-T may reduce preharvest drop where 2,4-D thus far has failed. Data on this point may be obtained from tests now in progress.

A third use of growth regulators in avocados may be in budding. It seems possible that they may be used to increase the "take" (survival) of buds. Often avocado buds do not grow because the "eye" (bud primordium) drops out of the bud patch. Perhaps this separation may be controlled with growth regulators. From the one preliminary test

made thus far, only negative results were obtained. It appeared that a water solution of 2,4-D at 750 p.p.m. or 2,4,5-T at 20 p.p.pm was injurious when applied with a paint brush over the outside of the bud immediately after insertion in the stock.

To summarize, it was found as a result of survey experiments, that:

(1) Under some conditions, 2,4-D increased the set of seedless avocado fruit ("cukes"). These fruit did not grow as large as the seedless avocados formed without 2,4-D sprays. Seedless fruit induced to form as a result of a spray applied in May had nearly all dropped off the tree by October.

(2) A water spray containing 20 p.p.m. 2,4,5-T caused severe leaf injury and killed branches up to an inch and a half in diameter.

(3) Of ten different growth regulating chemicals tested, 2,4-D and 2,4,5-T appeared to be the most promising for future study.

(4) As yet, it is not possible to come to final conclusions regarding the effect of 2,4-D and 2,4,5-T on the yield of seed-bearing avocados. Fruit production from plots now being established should answer this question.

The authors express appreciation to the various avocado growers for their enthusiastic cooperation. Acknowledgment is made for the splendid help of Mr. George Goodall and Mr. J. J. Coony, Assistant Farm Advisors of Ventura and San Diego counties, in establishing field plots in those areas.

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