

2,4-D and Citrus Fruit Sizes

increase of citrus fruit size primarily due to accelerated growth rate from spray treatment

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For the sixth successive year the grower of Valencia oranges apparently is faced with small-sized fruit in 1950—even though the size is larger than in 1949.

On the basis of results obtained during the 1949 Valencia season from spray applications of 2,4-D in 1948 the percentage of large-sized fruit was increased. From the nonsprayed trees 33.9% of the packed boxes of fruit was size 220—2⁵/₈-inch diameter—and larger, whereas on those sprayed with 2,4-D, 46.2% was in this category. This is a 36% increase owing to the 2,4-D. Also, per 100 trees, there was a gain of 28.0 packed boxes of fruit size 220 and larger but a decrease of 19.8 boxes of size 252—2¹/₂-inch diameter—and smaller. The spray induced a very slight decrease—1.6%—in percentage of first-grade fruit and a similar very slight increase—1.0%—in the percentage of loose fruit—juice, culls, and rots. These figures indicate that a profit would have resulted from the use of 2,4-D during the past five years when prices have favored large-size Valencia oranges.

The situation with Navel orange growers is the reverse of that of the Valencia grower as the 1950 crop of Navel oranges is of large fruit size—and should the 1951 crop be similar, means of increasing the Navel orange fruit size will not be a problem.

During the past year packing house results were obtained from 10 large-scale experiments in commercial groves on the effect of 1948 2,4-D sprays on yield, size, and quality. Eight of these experiments were with Valencia oranges, four experiments were in Orange County, and two were with Washington Navel oranges in the Claremont district of Los Angeles County. Data on the effect of 2,4-D sprays on fruit size of grapefruit were obtained in 1948.

Growth

The size increase resulting from the use of 2,4-D is primarily due to an accelerated growth rate. Fruit on the sprayed trees apparently remained physiologically younger than fruit on the nonsprayed trees. This was shown, for example, during the period when the fruit was changing color since there were more green fruit on the treated than on the

nontreated trees. Responses in growth due to the 2,4-D which may contribute to keeping the fruit young are:

1. A thicker fruit-stem in proportion to the fruit diameter.

2. A direct effect of the 2,4-D in stimulating the growth of certain tissues of the fruit.

3. A reduction in the number of fruit per tree. Although the number of fruit may be reduced, production has not been lowered since fewer of the larger fruit are required to fill a box. In fact, an increase in the box production total was found usually.

Age of Trees

The fruit size effect of 2,4-D was more pronounced on trees five to 10 years old than on older ones. The same treatment may be used on young or old trees. No advantages have been observed as a result of spraying trees less than five years of age with 2,4-D. It is possible that resultant curling of young leaves on very small young trees would retard their growth. Likewise, there is no apparent advantage, and a possible disadvantage, in 2,4-D spraying recently topworked

trees which have just a few very vigorous growing shoots.

Timing and Concentration

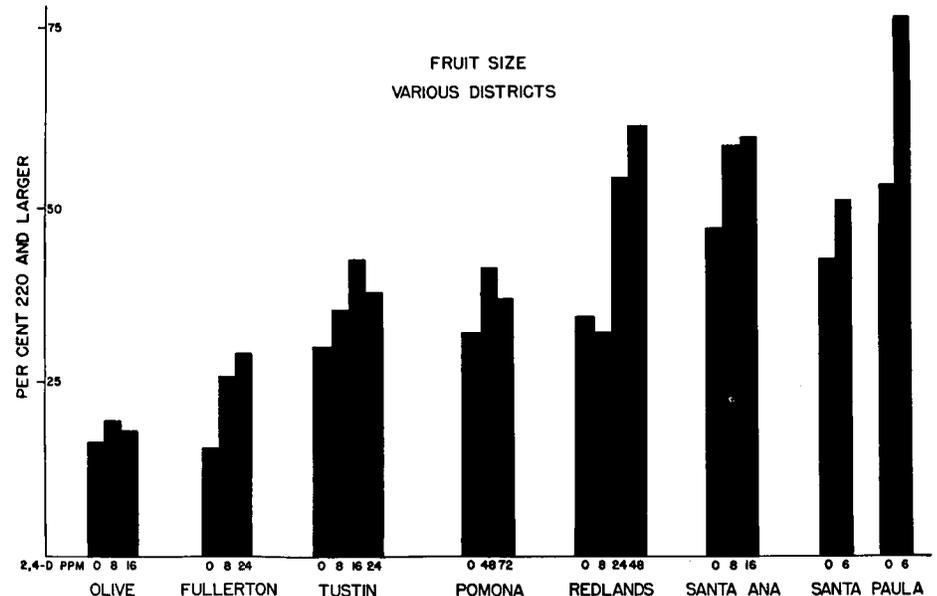
Only one spray application should be made during the season to increase fruit size of either Valencia oranges or grapefruit.

Concentration of 2,4-D to Use for Increasing Fruit Size when Applications Are Made at Different Stages of Fruit Development. Spray Only Once.

Fruit diameter, Valencia orange, approximate	Fruit age, approximate	Concentration of 2,4-D, as parts per million
3/16 inch	4 to 6 wks.	16 ppm
3/8 inch	6 to 10 wks.	24 ppm
1/2 inch	10 to 12 wks.	32 ppm
5/8 inch	12 to 14 wks.	40 ppm

The concentration of 2,4-D to use in the spray may be determined by observing the average size—diameter—of the young fruit. Age of the young fruit as the number of weeks from flowering is an-

Continued on next page



Percentage of packed boxes, fruit size "220"—2⁵/₈-inch diameter—and larger, harvested in 1949 from Valencia orange trees sprayed in June or July, 1948, with various concentrations of 2,4-D. Experiments located in various districts of southern California as indicated.

other guide which may be followed in determining the concentration of 2,4-D to use.

On the basis of the above the following concentrations of 2,4-D are suggested:

If full bloom occurred about April 15th, then the 16 ppm—parts per million—2,4-D spray should be applied during the latter half of May which is when the fruit would be about three-sixteenths inch in diameter, or the 24 ppm spray during June when the fruit is about three-eighths inch in diameter, or the 32 ppm during the first half of July when the fruit is about one-half inch in diameter, or the 40 ppm the last half of July when the fruit is usually five-eighths inch or more in diameter. As the fruit grows older and increases in size it seems to become less responsive to 2,4-D. In the above schedule this is compensated for by increasing the concentration of 2,4-D. Hence the applications should all induce about the same increase in size.

These sprays have not been observed to lower fruit quality appreciably. However, if higher, excessive concentrations of 2,4-D are applied, quality may be significantly decreased and size and coarseness of the fruit excessively increased. The quality is lowered primarily because of the thick, rough rind. The following may also contribute to its lowered quality: enlarged oil glands in the rind; large rudimentary seeds; fruit an elongated, cylindrical shape; excessively large protruding navels in Navel oranges; and, rudimentary navels in grapefruit and Valencia oranges.

In districts where an early market is sought 2,4-D sprays for size increase would be undesirable because of the maturity delay. Also certain quality factors of the juice improve with maturity during the early part of the harvest season. Thus 2,4-D sprayed trees harvested at the very beginning of the season may have lower juice quality than if harvested later.

Preparation and Application

The 2,4-D spray may be prepared from 2,4-D weed killer preparations. The liquid 2,4-D weed killing formulations, such as esters and amine salts, are preferred to the powder types since the liquid forms become rapidly and uniformly distributed throughout the spray mixture. Thus far the esters have been the most widely used form for fruit-size sprays.

Experimentally the spray has been applied as a complete coverage spray of from 15 to 20 gallons per tree to as little as about six gallons per tree. Standard spray equipment was used. Applications of four gallons per tree or less do not appear to be satisfactory at the concen-

trations listed. Commercial applications with spray dusters, boom sprayers, or other equipment applying at least six gallons per tree have been found to be satisfactory.

The 2,4-D has been found to be compatible, at the concentrations given in the accompanying table, with all of the usual spray chemicals and may be successfully combined with them for application as a single spray. In some instances during the past year 2,4-D was applied in May or early June with cryolite and only a very light crop resulted. It was apparent, however, that this was owing to an unexpected increase in citrus red mite—red spider—and was not an effect of the 2,4-D application.

When applying 2,4-D, it seems desirable to reduce the curling of the new young leaves by delaying application until after the initial rapid leaf growth has occurred. In some trials, although leaf curling has been severe, it has not reduced production or fruit quality. Succeeding leaf-growth flushes usually have appeared normal.

Studies now in progress on the use of 2,4,5-T—2,4,5-trichlorophenoxyacetic acid—to increase size of Valencia oranges show promise and will be reported as soon as results are available. For the 1950 season, however, it seems very desirable to use 2,4-D in preference to 2,4,5-T in view of the wide experience with 2,4-D compared with the amount of data concerning 2,4,5-T.

Spraying Valencia oranges and grapefruit with 2,4-D to increase fruit size of next season's crop has not been found to increase fruit size of the current, mature crop. It will, however, effectively reduce mature fruit-drop of the current crop.

The over-all effect of 2,4-D sprays to increase citrus fruit size seems to be an accentuation of the juvenile characteristics of the fruit. This includes large fruit size as well as a dark green appearance of the young fruit; a somewhat rough and pebbly rind up to maturity; and, a thick fruit-stem.

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Amounts of 2,4-D Weed Killing Preparations to Add to 500 Gallons of Water to Prepare 2,4-D Sprays of From 12 to 40 ppm for Valencias or Grapefruit. One Fluid Ounce (fl. oz.) or 30 Cubic Centimeters (cc.) or 30 Milliliters (ml.) Equal Two Standard Tablespoons.

Formulation*	Amount of 2,4-D to add to 500 gallons* and time of application			
	16 ppm 4-6 weeks after flowering (Fruit 3/16 inch in diameter)	24 ppm 6-10 weeks after flowering (Fruit 3/8 inch in diameter)	32 ppm 10-12 weeks after flowering (Fruit 1/2 inch in diameter)	40 ppm 12-14 weeks after flowering (Fruit 5/8 inch in diameter)
Esteron 44				
Fl. oz.	2½	3¾	5	6¼
Cc. or ml.	77.0	115.5	154.0	192.5
Weed-no-more 40				
Fl. oz.	3	4½	6	7½
Cc. or ml.	95.0	142.5	190.0	237.5
du Pont 46% isopropyl ester				
Fl. oz.	2½	3¾	5	6¼
Cc. or ml.	75.8	113.7	151.6	189.5
Thompson's Liquid Weed-icide Concentrate				
Fl. oz.	2	3	4	5
Cc. or ml.	60.8	91.2	121.6	152.0
Dow Formula 40				
Fl. oz.	2	3	4	5
Cc. or ml.	60.8	91.2	121.6	152.0

* The preparation of smaller amounts requires proportionately less material. For example, 100 gallons of spray require 1/5 the above amounts; for 200 gallons, 2/5 of the above amounts should be used.

** Furnished as a convenience only to the grower. No recommendation of one preparation over another is intended or implied. Of necessity this list is incomplete. Other 2,4-D formulations besides those listed here would be equally satisfactory for experiments to increase citrus fruit size.