Citrus Fruit Size Studies

experimental test of 2,4-D sprays to increase orange and grapefruit fruit size

Wm. S. Stewart and H. S. Hield

Further tests with 2,4-D sprays are necessary before any recommendations for their commercial use to increase fruit size are justified.

It is not known if spraying costs will be repaid by the resulting size increase. The effect of repeated 2,4-D applications over a number of years is not known. Some citrus trees, however, which now have been sprayed annually for three years show no injury. These plots are being continued.

On the basis of 17 experiments performed since May 1946, it appears that a single 2,4-D spray applied anytime from several weeks before flowering to three to four months afterwards can increase the fruit size of the coming year's crop. Spraying with 2,4-D during this period not only increased fruit size but lengthened the growing period—hence delayed maturity—and reduced the number of fruits. Although the number of fruits was reduced, box production was not necessarily lowered since, because of the size increase, fewer fruits were required to fill a box.

Application of 2,4-D as described herein is expected to shift the production peak about one packing size toward larger sizes. Since the diameter difference between packing size 288 and 252 is only one eighth of an inch, this increase will probably not be apparent unless a large number of fruits are measured or the packout statement obtained for fruit from treated and nontreated trees in the same grove.

The fruit size effect of 2,4-D is 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. There is no apparent advantage, and a possible disadvantage, in 2,4-D spraying of recently top-worked trees which have just a few very vigorous growing shoots.

The concentration of 2,4-D to use in the spray is determined by the time of application after flowering. The following concentrations of 2,4-D are suggested for experimental use to increase fruit size of Navel and Valencia oranges and grapefruit:

Time of application — Concentration of 2,4-D in spray

4– 8 weeks after flowering . . . . . 16 ppm (parts per million)

8–12 weeks after flowering . . . . . 24 ppm

12–14 weeks after flowering . . . . . 32 ppm

14–16 weeks after flowering . . . . . 40 ppm

According to this schedule, if full bloom occurred during the first week of April, then the 16 ppm 2,4-D spray should be applied during May, or the 24 ppm during June, or the 32 ppm during the first half of July, or the 40 ppm the last half of July. Applications during this last period seem to be the least likely to induce significant size increases.

These sprays probably will not lower quality of either oranges or grapefruit. However, if higher, excessive concentrations of 2,4-D are applied, quality will probably be lowered to such an extent that the fruit are worthless culls although of extremely large size. The poor quality is owing to a thick, rough peel; enlarged oil glands in the rind; large rudimentary seeds; excessively large protruding navels in Navel oranges; a cylindrical fruit-shape; and grapefruit and Valencia oranges with rudimentary navels.

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 improve with maturity. Thus, 2,4-D-sprayed trees harvested at the very beginning of the season may have lower quality than nontreated fruit or than if harvested later.

The 2,4-D spray may be prepared for experimental use by diluting 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 unformly distributed throughout the spray mixture. Further data than now available may show ester forms of 2,4-D to be more efficient than the amine salts.

The amounts of several of the weed killing 2,4-D preparations to use for prep-

Continued on page 14

Amounts of 2,4-D weed killing preparations to add to 500 gallons of water to prepare 2,4-D sprays of from 16 to 40 ppm. One fluid ounce (fl. oz.) or 30 cubic centimeters (cc.) or 30 milliters (ml.) equal approximately two level standard tablespoons.

FORMULATION**	Amount of 2,4-D to add to 500 gallons* and time of applications			
	16 ppm 4–8 weeks after flowering	24 ppm 8–12 weeks after flowering	32 ppm 12–14 weeks after flowering	40 ppm 14–16 weeks after flowering
Dow Formula 40				
Fl. oz.	2	3	4	5
Cc. or ml.	60.8	91.2	121.6	152.0
Thompson's Liquid Weedicide Concentrate				
Fl. oz.	2	3	4	5
Cc. or ml.	60.8	91.2	121.6	152.0
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
duPont 46% isopropyl ester				
Fl. oz.	2½	3¾	5	6¼
Cc. or ml.	75.8	113.7	151.6	189.5

* To prepare smaller amounts use proportionately less material. For example, to prepare 100 gallons of spray use 1/5 the above amounts; to prepare 200 gallons, use 2/5 the above amounts, etc.

** These are furnished as a convenience 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 beside those listed here would be equally satisfactory for the experimental use of 2,4-D to increase citrus fruit size.

PHOSPHATE

Continued from page 11

concentrations greater than 0.50 ppm deficiency is unlikely to occur—only two out of 30 soils gave a response.

In the light of field and greenhouse results, the following ranges of phosphate in water extract are suggested for tentatively defining the status of available phosphorus in a given soil.

Class *1*. Response likely, less than 0.30 parts per million of phosphate.

Class *2*. Response uncertain, from 0.30 to 0.50 parts per million of phosphate.

Class *3*. Response unlikely, greater than 0.50 parts per million of phosphate. It must be emphasized that these ranges of phosphate are expressed on the solution basis.

An anticipated response to phosphate fertilization implies that only phosphorus is the limiting element and that there exists no toxic condition in the soil. In California often nitrogen must be added to secure a phosphate response.

In the case of a phosphorus-deficient soil, response can be expected only when sufficient amounts of phosphate have been added. In the case of a soil containing minerals of the kaolinite type, fixation would be great. This would require considerably more phosphate for a response or a banding of the fertilizer in the immediate vicinity of the roots.

The ranges of phosphate suggested for interpretation of the chemical extraction apply only to the crops listed, mainly pastures, field crops and truck crops.

Field experiments suggest that these responses are especially pronounced for winter crops.

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The above progress report is based on Research Project No. 1157.

CLINGS

Continued from page 9

is becoming moist is to compare the thermometer readings.

Because of the large trimming losses—pits and peel—the over-all drying ratio is less favorable than for other fruit. A good quality fruit dries about 9:1 and a higher ratio is found for orchard run lots.

To complete the reduction of moisture content to about 20%, the fruit is removed from the dehydrater and allowed to stand for several hours.

In foggy climates this plan can not be followed, for standing fruit might actually absorb additional moisture from the air. In such places, the temperature at the finishing end of the tunnel is reduced to about 150° F and the drying finally completed while the fruit is still in the tunnel.

The cooled fruit is removed from the trays to clean, wooden boxes for temporary storage before shipping.

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CITRUS

Continued from page 10

aration of 500 gallons of 2,4-D spray are given in the accompanying table.

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. Applications of four gallons per tree or less do not appear to be satisfactory at the concentrations listed. It seems reasonable to expect that spray-dusters, boom sprayers, or other equipment applying at least six gallons per tree of the 2,4-D sprays listed, would be satisfactory.

Much more information is needed on application methods before more than these tentative conclusions may be drawn.

Inasmuch as 2,4-D used to reduce mature fruit drop has been found to be compatible with the usual spray chemicals, it seems likely that when used at somewhat higher concentrations for fruit size increase it will likewise be compatible.

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

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.

Trials are now in progress to compare 2,4-D with 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and other chlorinated phenoxy acids for effectiveness in increasing fruit size. Preliminary data indicate that 2,4,5-T is at least as effective as 2,4-D.

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, delayed maturity, dark green young fruit; somewhat rough, pebbly rind to maturity; and thick fruit-stems.

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SPINACH

Continued from preceding page

trace of fungus penetration or development. The freedom from disease, then, can be considered to be true immunity, rather than high-level resistance.

The consistent reaction of the immune stocks during the winters of 1947–48 and 1948–49, have not suggested the presence of any physiologic strains of the fungus in the Davis areas, although there was ample opportunity for infection from natural sources throughout the course of the experiments.

Because of the predominantly dioecious habit of spinach, self-pollination is not normally possible. Inheritance data, therefore, have been secured on the first generation resulting from the cross between immune and susceptible plants and on the first backcross of immune first generation plants to the susceptible types.

The results of these experiments have shown that immunity is simply inherited as a single dominant genetic character. Because of this, it will be possible to transfer to commercial spinach varieties the complete freedom from downy mildew which has been found in the Iranian variety.

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TIMBER

Continued from page 7

Whitaker's Forest is situated in one of the most productive timber types in California. Sugar pine, ponderosa pine and white fir are all important timber trees, and the sequoias here have demonstrated their ability to grow in height and volume at a rate exceeding that of most softwood tree species.

The east portion of the forest above the camp clearing is cooler and somewhat more moist than the west portion and contains a mixed stand of sugar pine, white fir and sequoia with occasional incense cedars and black oaks.

Ponderosa pines appear in greater number towards the west with increase in warmth and dryness and the sequoias drop out of the stand before the west boundary is reached.

From there west on the National Forest there are virtually no sequoias at this elevation. A heavy stand of mature ponderosa pine on the ridge west of the property produced a large volume of timber when cut under National Forest timber sale in 1944 and 1945.

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