Orange Fruit Sizes

potassium applications increase size of fruit in long-term fertilizer studies

E. R. Parker and Winston W. Jones

Fertilizers which supply potassium to the soil increased the size of orange fruits during a long-term fertilizer experiment at Riverside.

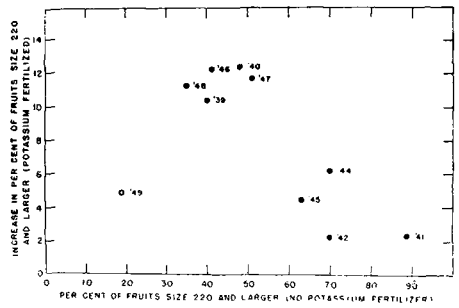
A relation between fruit sizes and potassium supply had not been recorded before in California where the citrus soils contain relatively large amounts of potassium. Considerable quantities are also supplied by the application of manure and other bulky organic materials which are widely used in citrus fertilizer programs.

Fruit-size increases following potassium applications have been observed in experiments in sand cultures and in field trials conducted in Florida and in foreign countries. Those experiments—conducted under conditions of severe potassium deficiency—gave small yields as well as small sized fruits.

Reduction in yields were not found in the Riverside trials—where no symptoms of potassium deficiency were observed on the leaves or twigs of the trees. The size of the oranges apparently is a very sensitive index of the potassium supply.

The increases in fruit size in the Riverside experiment were obtained by applications of sulfate of potash and of manure or other bulky organic materials. The use of the bulky organics gave greater yields because such materials create more favorable soil conditions as well as supply potassium.

The experimental trees are of the Washington navel variety on sweet orange roots, planted in 1917. The fertilizer experiment was started in 1927. The soil, which previously had not been fertilized, is classified as Ramona loam.



Relations in the crops harvested 1939–1949 between the average annual increase in the size of the fruit, due to fertilization with sulfate of potash, and the average size of the fruit of trees which did not receive this fertilizer. The 1949 crop suffered damage by pests, wind and frost. Data are expressed on a volume basis.

The effects of potassium supply on fruit size were studied in plots which received sulfate of potash. Leaf analyses confirmed the relations between fruit size and potassium in a large group of fertilizer treatments.

The packing house grades and sizes of the fruit of all of the treatments were obtained in 14 crop years. The fancy and choice grades were sized in 1931–1934.

In 1939–1942 and 1944–1949 all of the grades, including the standards, culls and rots, were sized. When necessary, the fruits of the lower grades were measured by hand. Thus a count of all fruits and their grades and sizes was obtained since 1939. The fruit sizes were summarized as the percentage of the total volume of fruit which was of size 220 or larger—220 or fewer fruits per packing box.

Average Effects of Fertilization with Sulfate of Potash on Fruit Size, Expressed in Various Ways, and on other Characteristics of the Crop. Harvests of 1941–1949

Fertilizer treatment	Fruits size 220 and larger (per cent by volume)	No. of fruits per packing box	Fruit diameter (inches)	No. of fruits per tree	Yield (pounds)	Fancy and choice grades (per cent by volume)	
						Total of all sizes	Size 220 and larger
Potash	61.77	225.3	2.604	422.6	163.74	76.54	52.39
No potash	54.83	236.9	2.559	426.2	158.46	74.56	45.68
Difference	6.94	-11.6	0.045	-3.6	5.28	1.98	6.71

Sulfate of Potash Fertilizer

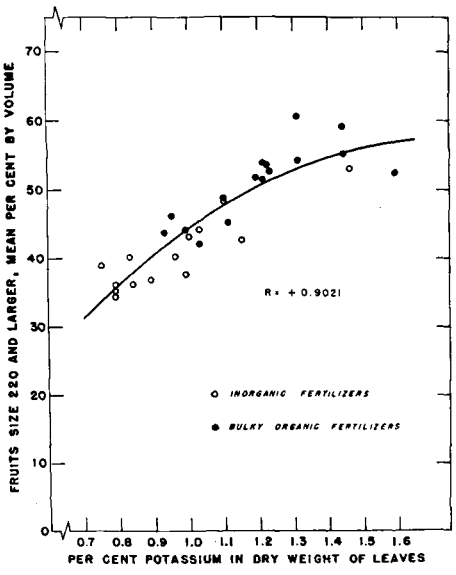
The effects of added potassium on fruit size were determined by comparing the fruit of paired treatments. Five replicated treatments which received sulfate of potash were compared with five which did not receive this fertilizer. The paired treatments were similar in other respects. No organic materials were used in this series of treatments. Generally one pound of potash was applied each year to each potash-fertilized tree. The percentage of large sizes was usually greater for the fruit of the trees which received the potash fertilizer.

During the early years of the experiment—1931 to 1934—the effects of the potash fertilizer on fruit size were small and inconsistent. They could have occurred by chance. In later years potash caused increased size of fruit, but the increases varied in magnitude.

In the crops picked in 1939 and 1940 the increases were appreciable. At that time the trees were affected to a moderate degree with nitrogen deficiency. It was first thought that this deficiency influenced the results, especially since the rate of nitrogen application was increased in 1940 and small effects of potash occurred in the crops of 1941–1945. However, in 1946–1948, potash applications increased fruit size appreciably. The nitrogen theory was therefore abandoned. In 1949 the effect of potash was again small but this crop was damaged by pests, winds and frost.

A study of the annual effects of potash applications on fruit size suggested a reason for the variations which were observed. The increases were compared with the average size of the fruit harvested in the same season from the check trees which received no potash fertilizer. Ex-

Continued on page 10



Relations between the average size of the fruit—expressed as the percentage of fruits size 220 and larger, by volume—of the crops harvested 1946–1949 and the potassium content of the dry matter of leaves sampled in December, 1948. The data are for trees which have received various fertilizer programs.

tered, it appears that the most satisfactory spray that can be recommended for general use is as follows:

Standard lead arsenate.....	3 pounds
Safener—a commercial basic zinc sulfate product containing 50% zinc expressed as metallic	1 pound
14% nicotine dry concentrate	1 pound
Light medium summer oil emulsion containing 80% to 83% oil.....	⅓ gallon
Water	100 gallons

The nicotine should be slurried before and during the addition of the standard lead arsenate and the safener. The slurried ingredients should be added to the spray tank—with agitator going—when the tank is one-third to one-half filled with water and the oil added when the tank is three-fourths or more full.

A single application of the above spray mixture should result in satisfactory control for the entire season.

In regions where infestations of the codling moth have been severe, a single timely application of the following spray should result in satisfactory control:

Standard lead arensate.....	3 pounds
DDT, 50% wettable powder.	½ pound
Safener—a commercial basic zinc sulfate product containing 50% zinc expressed as metallic	½ pound
14% nicotine dry concentrate	1 pound
Light medium summer oil emulsion	⅓ gallon
Water	100 gallons

The same procedure for mixing is followed here as for the straight standard lead arsenate spray.

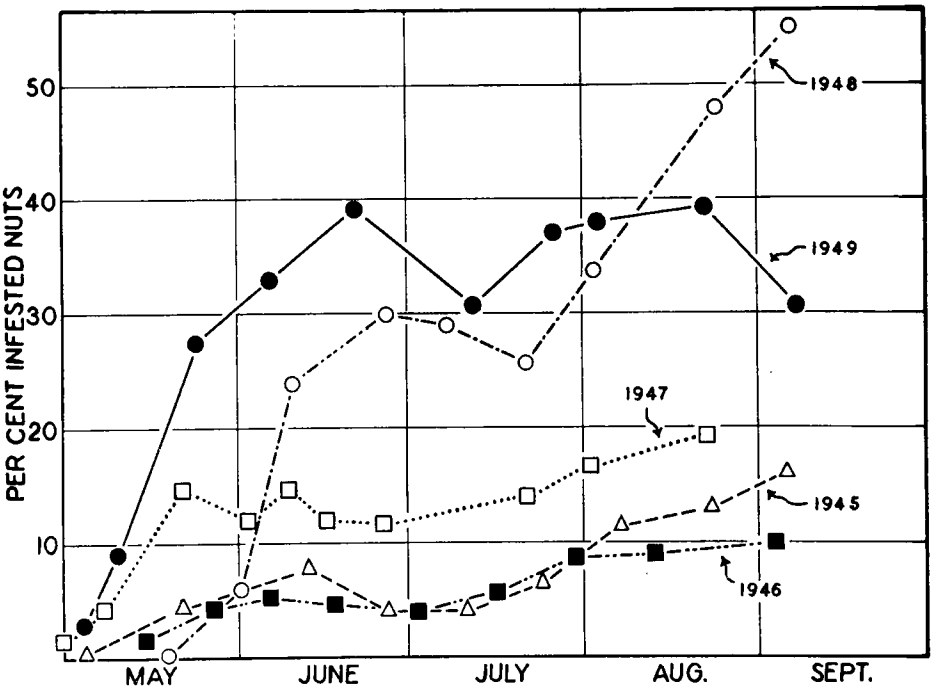
Although not a recommended treatment, some growers might be interested in applying the following DDT spray:

DDT, 50% wettable powder.	1 pound
Depositor	⅓ pound
14% nicotine dry concentrate	1 pound
Light medium summer oil emulsion	⅓ gallon
Water	100 gallons

In mixing this spray the DDT and depositor should be slurried together then the nicotine slurried and the former added to tank—with agitator going—when the tank is one-third to one-half full, followed by the nicotine and then the oil.

There are growers who have speed-type sprayers who would like to use that equipment to treat their orchard. For these growers the following spray is recommended:

50%, DDT wettable powder.	10 pounds
Depositor	3 pounds
14% nicotine dry concentrate	9 pounds
Light medium oil emulsion..	3⅓ gallons
Water	500 gallons



Trend of infestation during the maturing of the crop in the check trees associated with the experimental plots at Linden

This spray mixture should be applied to large trees at the rate of 22 gallons per tree. The number and kind of nozzles and the rate of speed to travel to insure proper application as recommended by the manufacturer for successful control should be established.

One properly timed and applied treatment should control the codling moth for the entire season.

Insecticides used for the control of walnut insects are poisonous and care should be used in handling and applying them. Particular caution should be used with such materials as tetraethyl pyrophosphate and parathion. When using these insecticides be certain to follow carefully the precautions as given on the containers.

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ORANGE

Continued from page 5

cluding the 1949 crop, it was evident that the fertilizer caused greater increases in fruit size in the years when the fruit of the check trees was small. When the fruit of the check trees was large, the effects of potash applications were small. This suggests that potash fertilization tends to offset the effects of seasonal factors which restrict the growth of the fruit. These factors are presumably of a climatic origin, but their nature is not known.

The effects of potash fertilization upon the size and other characteristics of the fruit of the 1941–1949 crops are shown in the accompanying table. The average increase in the percentage of fruit size 220 and larger was 6.9; the average decrease in the number of fruits per packing box was 11.6; while the average increase in the diameter of the fruit was 0.045 inch. The small increase in the average diameter had a considerable effect upon the packing house sizes.

Fertilization with sulfate of potash did not affect the number of fruits harvested from the trees. Evidently there was no effect on fruit setting or preharvest drop. Since the use of potash fertilizer resulted in larger fruits, the weight of the crop was increased a little.

The commercial grade of the fruit was only slightly improved by potash fertilization. This improvement was associated with the larger size of the fruit. Large sizes were apparently graded more leniently. Although the over-all improvement in grade was small, it exerted a favorable effect upon the percentage of the fruit which is both larger in size and of better grade.

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