RESPONSES OF THOMPSON SEEDLESS TABLE GRAPES TO APPLICATIONS OF THE GROWTH REGULATOR, 4-CPA

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During the past year a number of table-grape growers have become interested in the use of 4-chlorophenoxyacetic acid (4-CPA) on Thompson Seedless grapes. Interest developed first in the Coachella Valley where 4-CPA was used in conjunction with gibberellin sprays to yield a further increase in berry size and to enlarge the cap-stem structures. This report gives more information about the nature, usage, and effects of the plant-growth-regulator, 4-CPA.

What is 4-chlorophenoxyacetic acid (4-CPA)?

This plant growth regulator is closely related chemically to the broad-leaf weed killer, 2,4-D. It is produced synthetically and marketed under various trade names, of which Grape-Fix is the most commonly known to California grape growers. It also is used commercially in dilute solutions to induce the set of tomatoes where environmental conditions are unfavorable for normal pollination and fertilization.

4-CPA is classified as a pesticide chemical and is not registered with the U. S. Department of Agriculture for use on grapes as yet, although its applications is considered legal because of historic usage. The effective date of Public Law 86-139, as it affects Section 408 of the Federal Food Drug and Cosmetic Act, has been extended, however, for certain chemicals including 4-CPA, until January 1, 1964. After this time, unless registration is effected and a tolerance given, its use will not be considered proper and a zero residue tolerance will be in effect.

When was 4-CPA first used on grapes?

4-CPA was first tested successfully on grapes in 1949 by Drs. R. J. Weaver and W. O. Williams in the University of California experimental vineyards at Davis. They tried 10 plant-growth regulators on Thompson Seedless and Black Corinth grapes. Results showed larger berry size and no injury with the lower concentrations of 4-CPA. The other materials tested were too injurious or less effective. Continued research during the subsequent years also developed data on the enlargement of the capstems and the stronger attachment of these structures to the berries.

Local tests and commercial trials

As a result of Dr. Weaver's work in Davis, farm advisors in the table-grape counties conducted local trials to determine the response of 4-CPA under varying climatic conditions and to find the most desirable concentrations. These tests, some in conjunction with Dr. Weaver, showed responses of Thompson Seedless and Black Corinth grapes similar to those obtained in Davis, except that lower concentrations were most effective. Although 15 ppm was an optimum value for Thompson Seedless at Davis, only 10 ppm were needed in the San Joaquin Valley, and 5 ppm in the Coachella Valley for large berry size without vine injury. These 1952 trials stimulated considerable grower interest, and many commercial applications were made the following year. Market response varied considerably to the large Thompson Seedless berries presented as the result of 4-CPA spraying. Premium prices were offered in some cases, although some skepticism was indicated that such large, round-berried bunches were Thompson Seedless variety. Some growers still continued using 4-CPA and gained considerable experience and know-how. Some of these general experiences are listed as follows:

1. Only thrifty vines respond with satisfactory berry size increase. Weak or poor vines show little or no response, nor do overcropped vines.

2. With a berry size increase there usually is a delay in maturity of the grapes. This delay is due in part to the increased crop load and probably also as a direct result of the material, 4-CPA.

3. The capstems (pedicels) are noticeably enlarged and their adherence to the berries is increased considerably. Dr. Weaver, in his tests, measured the force to pull the capstems away from the berries and found a $2\frac{1}{2}$-fold increase in retention of the sprayed berries.

4. Particularly for late-ripening Thompsons or those held on the vines for storage, the increase in berry size resulted in tighter bunches which were much more subject to summer bunch rot in some years.

5. Berries sprayed with 4-CPA tend to be rounder in shape than normal berries and more similar to berries of the White Malaga variety. In contrast, the shape of berries sprayed only with gibberellin tends to be markedly elongated.

Results of Coachella Valley Tests

In 1953, trials with varying concentrations of 4-CPA, with and without girdling, were conducted in seven Thompson Seedless vineyards in the Coachella Valley. Results are summarized as follows:

a) Berry size was strikingly increased by 4-CPA applications when used with girdling. A concentration of 5 ppm seemed best.

b) Spraying with 4-CPA alone was not as effective in enlarging berries as the standard practice of girdling.

c) Vine damage occurred in some vineyards at concentrations of 10 or 15 ppm 4-CPA and was greater in those vineyards that also suffered wind damage.

d) With the 5 ppm concentration, the maturity of the grapes in four of the tests was delayed (2 to 11 percent less sugar on the same sample date).

What is the present status of 4-CPA?

The recent interest in the use of 4-CPA has been stimulated by:

1. The development of even larger berries where 4-CPA is used with gibberellin than by gibberellin and girdling alone.

2. The relatively low cost of applying 4-CPA.

3. The desire to minimize the number of loose berries that in some cases seems to accompany girdled vines whose clusters are sprayed with gibberellin. The exact role of gibberellin in the development of these loose berries has not been determined as yet.

There are also some distinct drawbacks to the use of 4-CPA.

1. Delayed maturity. This is of particular importance in the early-producing districts. The delay in maturity is roughly proportional to the berry size (crop) increase.

2. For unexplained reasons, 4-CPA at low concentrations considered safe has occasionally caused serious vine damage. Responses from vineyard to vineyard may be erratic even in the same year. The accompanying photographs show damage which occurred to the vines, canes, and bunches in a Thompson vineyard in the Coachella Valley where the grower was reported to have used a spray concentration of 5 ppm.

   a. In this case, the vines ceased growth after applications.

   b. The young tender leaves became distorted, the veins cleared and were drawn together, giving a nettle-leafed effect very similar to the damage caused by 2,4-D.

   c. The weakened canes, leaves, and bunches were much more subject to burn.

   d. The canes began to crack in longitudinal streaks, and profuse callus formation developed in these cracks and eventually over-spilled the crack areas.

   e. The clusters were arrested in their development, the main stems cracked in longitudinal streaks similar to that of the canes. Then, enlarged callus formation developed in these splits.

   f. The selection of fruiting canes for the next year's crop will be a difficult task for the grower.

   g. Despite this injury, the grower was able to market much of his fruit, but with considerable loss of crop and difficulty in selecting and trimming.

What of the future of 4-CPA use in our vineyards?

1. It seems that when 4-CPA is used in conjunction with girdling and gibberellin sprays, it might even further enhance berry size. However, more careful research is needed to determine the optimum concentration that might be used.

2. If 4-CPA is used on grapes, use it with caution and with a light hand. Delay in maturity can be expected, and possibly some damage to the vines.

3. Errors made in measurement of the concentrate solution can be serious, since the vines do not tolerate over-doses of this material. Mistakes can be disastrous.

Above: Severe damage to a cluster and cane of Thompson Seedless resulting from a 4-CPA application in 1962. Note the pronounced cracking of bark and the shriveled berries. Photographed July, 1962.

Right: Shoot tip of Thompson Seedless showing foliar damage resulting from an application of excess 4-CPA. Note the buckling and distortion of the leaves, particularly the youngest ones.

Above: A Thompson Seedless vine showing the damage from an application of 4-CPA (5 p.p.m.). Injury to the shoots has partially defoliated the vine and exposed the fruit.

Right: A closeup of the bases of the shoots in a Thompson Seedless vine showing the type of bark cracking resulting from excess 4-CPA. It will be difficult to find undamaged canes for next year's crop.