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PREBLOOM

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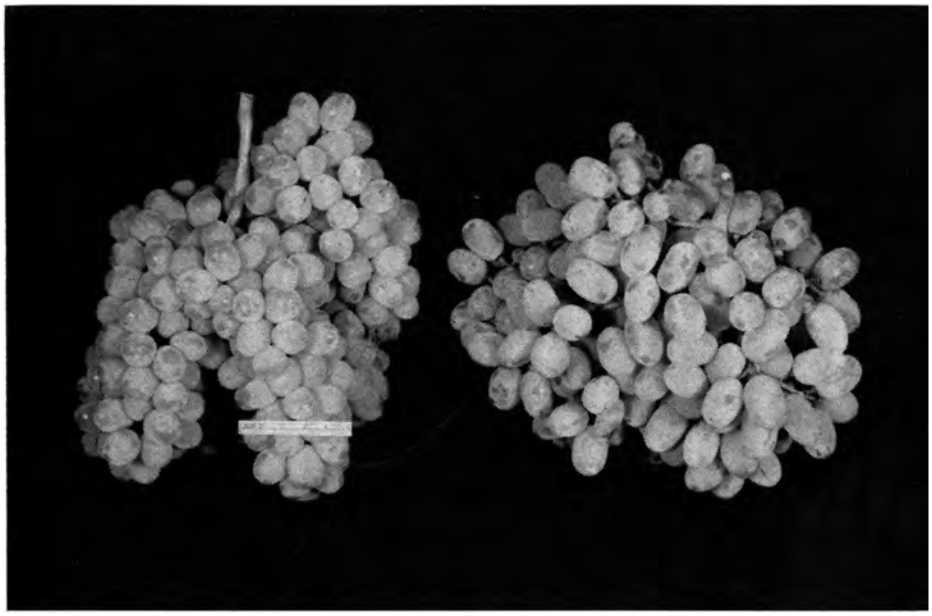

Photo 1. Cluster above left, was not treated with GA_3; cluster, right, received 20 ppm of GA_3 at bloom. Cluster to left was cluster thinned and berry thinned by hand at prebloom stage (note compactness). Cluster to right was thinned similarly at prebloom, but was sprayed with gibberellin at bloom stage (note cluster produced is looser, and berries are larger).

Photo 2. Lower photo shows Thompson Seedless cluster to left that was cluster thinned at prebloom, then berry thinned by hand at shatter stage (note compactness). Cluster to right was thinned similarly at prebloom stage, but also received a bloom spray of gibberellin (note this cluster has large, elongated berries and is very loose).

THOMPSON SEEDLESS GRAPES must be thinned to allow production of loose clusters of well-developed berries. In recent years, the usual shatter-stage thinning has become a major labor-consuming operation for the grower. Hand thinning during the prebloom period, while foliage is light, clusters are small, and shoots are 12 to 16 inches long, would be economically desirable but has not been practical because of the increase in berry set, resulting in tight clusters.

Experiments performed at Davis in 1965 showed that gibberellin applied at bloom time (when 40% of the calyptras had fallen) reduced the set of berries and produced looser clusters. Experiments were performed in 1966 in which early hand thinning was used in conjunction with subsequent bloom-time applications of gibberellin to loosen the cluster.

U. C. vines

Mature Thompson Seedless vines in an irrigated vineyard at the University of California, Davis, were pruned to four canes for these experiments. In one series of tests, vines were cluster-thinned to 20 per vine, April 22, when the clusters were about 4 inches long and the shoots about 16 inches long. At bloom time on May 14, when about 50% of the calyptras had fallen, vines were sprayed with gibberellin at 20 ppm. At the shatter stage following bloom, May 31, all clusters were berry-thinned by removal of the apical half of each cluster. Five or six laterals were retained on each cluster. In a second

THINNING
Seedless grapes when followed spraying with
GIBBERELLIN

Photo 3. From left to right: No gibberellin treatment; GA_3 at 20 ppm at bloom stage; GA_3 at 40 ppm at the shatter stage; GA_3 at 20 ppm at bloom and 40 ppm at shatter. Note that the largest berries are produced by the multiple sprays.

test, both cluster and berry thinning were accomplished on April 22, and bloom sprays of gibberellin were then applied. In a third test, both cluster and berry thinning were accomplished on May 31, during the shatter period—on vines that had previously been treated with a bloom spray of gibberellin. In a fourth test, prebloom cluster thinning was performed but no gibberellin was applied, and berry thinning was done with thinning shears at the shatter stage. In a fifth test both cluster thinning and berry thinning were performed at the prebloom stage, and no gibberellin was applied at bloom. In a sixth test cluster and berry thinning were performed during the shatter period, and no gibberellin was applied. The third and sixth series of tests mentioned would be considered standard thinning practice, with and without sprays of gibberellin. The potassium salt of GA_3 (gibberellic acid) was used and "Triton B-1956" was added as a wetting agent. The clusters and all foliage in the cluster area were thoroughly wetted. There were three replications of three vine treatments. All vines were trunk-girdled on May 25, at the shatter stage, so that very large berries would be produced.

Clusters indexed

Fruit was harvested August 18 and clusters were indexed from one to five, according to looseness. Clusters in class 1 were very loose and easily bent, class 5 clusters were very compact and could not be bent without crushing the berries, and ratings 2, 3 and 4 were intermediate. The range of commercially desirable fruit would include classes 2, 3, and 4. Clusters in class 3 were the most desirable (for looseness). The number of berries per centimeter of primary lateral rachis was determined on the second and third lateral of three clusters from each vine. This measure of the number of berries that set may be more valuable for looseness evaluation, because it is not affected by berry size.

The results show that prebloom hand thinning of Thompson Seedless produces very tight clusters, but acceptable loose clusters develop when followed by a bloom spray of gibberellin (table 1; photos 1 and 2). Bloom sprays decreased the set of berries, resulting in looser clusters. The reduction in set was sufficient that, even when prebloom thinning was used, the clusters were definitely looser than those shatter-thinned in the usual way and not sprayed.

A second series of experiments showed that spraying at bloom *and* shatter time produced larger berries than did spraying once at either time. In one test, vines were sprayed with GA_3 at 20 ppm on May 14 (bloom time), when about 50% of the

TABLE 1. GIBBERELLIN BLOOM SPRAY TREATMENT OF THOMPSON SEEDLESS GRAPES AS AFFECTED BY TIME OF CLUSTER- AND BERRY-THINNING

Treatment	1	2	3	4	5	6
Time of cluster thinning	Prebloom	Prebloom	Shatter	Prebloom	Prebloom	Shatter
Time of berry thinning	Shatter	Prebloom	Shatter	Shatter	Prebloom	Shatter
Bloom spray of GA_3	yes	yes	yes	no	no	no
Looseness index*	3.0^{ab}	3.4^{bc}	2.8^{a}	4.0^{cde}	4.2^{de}	4.4^{e}
Berries/cm. of lateral	3.9^{ab}	4.7^{bc}	3.4^{a}	6.7^{d}	6.9^{d}	5.4^{c}

*Looseness index: class 1, very loose, easily bent clusters; class 5, very compact clusters that could not be bent without crushing the berries; and classes 2, 3, and 4, intermediate and most desirable (both tables).

[a-e]Those values with a different superscript letter, are significantly different at the 5% level (both tables)

TABLE 2. EFFECTS OF GIBBERELLIN TREATMENTS ON CLUSTER LOOSENESS, BERRY COUNT, AND WEIGHT OF THOMPSON SEEDLESS GRAPES

	Looseness index	Berries per cm. of lateral	Weight per berry (gm)
20 ppm of GA_3 at bloom	2.8^{a}*	3.5^{a}	3.28^{a}
40 ppm of GA_3 at shatter	4.1^{b}	4.9^{b}	4.02^{b}
20 ppm GA_3 at bloom and 40 ppm GA_3 at shatter	3.0^{a}	3.1^{c}	4.75^{c}

Photo 4. From left to right: berries were sprayed with GA_3 at 20 ppm five days before bloom; beginning of bloom; 25% capfall, 50% capfall, 75% capfall; 100% capfall; and two days after bloom and just prior to shatter. Note that later sprays produced larger berries.

calyptras had fallen. In a second test, vines were sprayed with gibberellin at 40 ppm on May 24, after the shatter of berries following bloom. In a third test plot, vines received both of these treatments. The results at harvest on August 12 showed that berries sprayed at shatter were larger than those sprayed at bloom, but that the largest berries resulted when both sprays were applied (table 2; photo 3). Clusters sprayed at bloom were less compact than those sprayed at shatter, and the fewest berries per centimeter of primary rachis were produced by the multiple spray.

Timing

A third series of experiments concerned the timing of bloom sprays to produce looser clusters. Vines were sprayed about five days before bloom, at the initiation of capfall, at 25% capfall, 50% capfall, 75% capfall, 100% capfall, and two days later, just before shatter commenced. The results at harvest on August 16 showed that the optimum time for spraying was between 25 and 75% capfall. With earlier sprays there was less increase in berry size (photo 4) but adequate thinning occurred. Later sprays produced larger berries, but the degree of thinning was reduced, causing more compact clusters to be produced. These results show that there is considerable latitude during bloom, in which good loosening effects may be obtained along with good increases in berry size.

A fourth experiment was conducted to determine the optimum GA_3 concentration for berry size increase as well as cluster loosening when applied at full bloom (50% of calyptras fallen). Vines were sprayed on May 15 with GA_3 at 0, 2.5, 5, 10, 15, 20, or 40 ppm. At harvest time, August 10, berry weight and looseness were adequate when GA_3 applications ranged from 10 to 20 ppm. GA_3 at 2.5 ppm resulted in some increase in berry size and some loosening. There was sufficient loosening with GA_3 at 5 ppm but increase in berry size was small. There was considerable variation in berry size in clusters treated with GA_3 at 40 ppm and looseness in some cases was excessive. There was also considerable variation in amount of berry elongation among berries, and in many clusters there were an excessive number of shot berries.

Since this is the first year of testing prebloom thinning by hand followed with bloom spraying, further research is required before such techniques can be recommended for commercial use.

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NEW SYSTEMS for greenhouse management have been introduced in recent years that necessitate changes in some of the traditional methods of growing greenhouse crops. Evaporative cooling. infra-red heating, elevated levels of CO_2, and positive ventilation may each, if improperly used, result in changes in plant response that are not necessarily to the grower's advantage. When one aspect of a plant's environment is altered, it is necessary to reevaluate the total production system to bring all factors back into balance.

In the spring of 1965, a greenhouse operator in the San Francisco Bay area reported carnation plants were reacting as they do when subjected to high night temperatures, followed by days of low light conditions (weak growth, widely spaced internodes, and loss of leaf curl). The thermostat was set at 55° F, the usual temperature setting for this time of year, and a seven-day hydrothermograph showed the daytime air temperature holding at a satisfactory level.

Positive ventilation

A major change in this greenhouse was the recent installation of a positive ventilating system. A plastic tube, 24 inches in diameter had been suspended from the

Locations of thermocouples on vertical rods in poly-tube-ventilated greenhouse (note 12-inch spacing, except for position 5, at bud height halfway between 4 and 6).