

Bloom Thinning of 'Winblo' Peach and 'Fantasia' Nectarine with Monocarbamide Dihydrogensulfate

Stephen C. Myers¹

Department of Horticulture, University of Georgia, Athens, GA 30602

Andrew King²

The Horticulture and Food Research Institute of New Zealand, Clyde, New Zealand

Amy T. Savelle

Department of Horticulture, University of Georgia, Athens, GA 30602

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Abstract. Mature 'Winblo'/Lovell peach [*Prunus persica* (L.) Batsch] trees in Georgia were treated with five concentrations of D-88, a 79 % to 82 % active ingredient formulation of monocarbamide dihydrogensulfate: 0 (water only), 2.5, 5.0, 7.5, and 10.0 ml-liter⁻¹. All treatments were made by airblast application at 1200 liters·ha⁻¹ when trees were at 95% full bloom. The number of flowers on three limbs per tree was counted 3 days before and fruitlets 25 days following treatment. Regression analysis revealed a linear thinning response to concentration, with 10.0 ml-liter⁻¹ reducing the number of flowers per limb cross-sectional area by 56% over the nonthinned control. Mature 'Fantasia' nectarine trees in New Zealand were treated with four concentrations of D-88: 0 (water only), 2.5, 3.75, and 5.0 ml-liter⁻¹. All treatments were made by handgun application to runoff when trees were ≈2 days past full bloom. The number of flowers per limb was counted 6 days before and fruit 62 days following treatment. Regression analysis revealed a linear thinning response to concentration, with 5.0 ml-liter⁻¹ reducing the number of flowers per limb by 55 % over the nonthinned control. Total yield (kilograms of fruit) per tree was the same for all treatments, although fruit size on sprayed trees was larger. No phytotoxicity or fruit finish injury was observed.

The advantages of thinning peach are well-established (Fadley, 1923; Havis, 1962; Shoemaker, 1933; Tukey and Einset, 1939; Weinberger, 1941). Thinning flowers or fruit aims to increase fruit size and overall crop value and maintain tree structure (Byers, 1987). Reducing the total number of flowers or fruit, thereby increasing the leaf: fruit ratio, results in a relative increase in assimilates available to remaining fruit and shoots. As a result, thinning increases individual fruit weight (Farley, 1923), advances fruit maturity (Havis, 1962; Weinberger, 1941), and increases current season's shoot growth and flower bud formation (Byers and Lyons, 1985; Myers, 1986; Tukey and Einset, 1939). Thinning responses

are closely related to environmental conditions, soil moisture levels, and pruning (Morris et al., 1962). Fruit and shoot responses are positively related to thinning severity (Farley, 1923) and timing (Havis, 1962; Myers, 1986), with bloom thinning having the greatest effect and diminishing as time of thinning is delayed after bloom. As such, delaying unwanted flower or fruit removal can have a negative impact on the current and subsequent season's cropping potential. When considering the benefits of early thinning, however, the hazards of late spring freezes and natural waves of fruit drop should not be overlooked (Farley, 1923; Weinberger, 1941).

Thinning has been accomplished with chemical and physical means. Removing fruit by hand remains the most common and selective method, as specific spacings and fruit sizes can be differentiated (Byers, 1987; Weinberger, 1941). Mechanical shaking methods, which selectively thin fruit based on their mass, remove the largest fruit and thereby decrease fruit yield and value (Berlage and Lanmo, 1982).

Chemical means, including synthetic hormones and desiccating agents, have been used experimentally to thin peach, but have had disadvantages related to phytotoxicity, variability, or lack of industry interest to pursue labeling and commercialization (Byers, 1988; Byers and Lyons, 1983). Currently, to our knowledge, there are no commercially avail-

able chemical thinning compounds for use on peach or nectarine. In the absence of these compounds, removing fruit by hand remains the most common thinning technique and consequently one of the most labor-intensive and expensive production practices.

A promising new compound, monocarbamide dihydrogensulfate (Unocal Corp., West Sacramento, Calif.), received 1992 approval for use as a bloom thinner on apples in Washington, Oregon, and Idaho. Previous research with several apple cultivars in Australia and Washington (Williams, 1991) showed fruit set in trees treated with 0.25% and 0.50% of the chemical to be reduced up to 50% over nontreated controls. Leaf necrosis was observed, however, at 0.50%, although tree performance and fruit growth were not affected negatively. To our knowledge, efficacy of monocarbamide dihydrogensulfate as a bloom thinner on peach or nectarine has not been reported.

The objective of this preliminary research was to determine the effect of selected rates of D-88, a 79% to 82% active ingredient formulation of monocarbamide dihydrogensulfate, on flower or fruit counts of 'Winblo' peach and 'Fantasia' nectarine trees when applied during bloom.

'Winblo' peach (Georgia) (Expt. 1). Mature 'Winblo'/Lovell peach trees at the Univ. of Georgia Horticulture Farm in Athens were selected for uniformity based on tree size and flower density. Trees, planted at a 5.2 × 5.2-m spacing, were trained and pruned uniformly to an open center with three to four primary scaffolds, which were subdivided into six to eight structural fruiting limbs at a height of 1.5 to 2.0 m, with a maximum tree height of 3 m. The orchard was maintained in accordance with standard local fertilization and pest control recommendations.

The experiment was designed as a randomized complete block with two replications and five treatments. Each treatment tree was completely bordered on all sides with guard trees. As such, each experimental unit consisted of a square block of nine trees with the treatment tree in the center.

On 13 Mar. 1992, 3 days before treatment, three limbs of uniform bloom density per tree were tagged and the number of blooms per limb counted. Limb diameter 2 cm above the point of origin also was measured.

Treatments consisted of five concentrations of D-88: 0 (control), 2.5, 5.0, 7.5, and 10.0 ml-liter⁻¹. The control trees were sprayed with water only. Treatments were applied with art airblast sprayer calibrated to deliver 1200 liters·ha⁻¹ when trees were at 95% of full bloom. As such, the effective material rate at 10.0 ml-liter⁻¹ and a sprayer volume of 1200 liters·ha⁻¹ was 12.0 liters D-88/ha. Applications were made in a series of four passes to simulate normal airblast application to a whole block of trees. As such, each treatment tree was sprayed four times: once on each side and once from the opposite side of each adjacent guard row. All treatments were applied on the morning of 16 Mar. under clear skies, light wind (1 km·h⁻¹), and air at 4 to 5°C.

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¹Associate Professor of Horticulture.

²Research Associate.

Table 1. Influence of monocarbamide dihydrogensulfate (D-88) on number of flowers or fruit in 'Winblo' peach at Athens, Ga. (1992).

D-88 concn (ml-liter ⁻¹) ^a	D-88 application rate (liters-ha ⁻¹)	No. flowers or fruits/limb xsa ^b		Fruit remaining (%)
		13 Mar.	9 Apr.	
0 ^c	0	22.1	8.1	36.2
2.5	3	25.3	7.7	29.1
5.0	6	13.5	3.3	22.1
7.5	9	24.5	6.1	25.6
10.0	12	17.1	2.6	15.9
Linear		0.4699	0.0398	0.0170

^aAverage of three limbs/tree; number of flowers/square centimeter of limb cross-sectional area (xsa).^bD-88, a 79% to 82% a.i. formulation of monocarbamide dihydrogensulfate, was applied at 95% full bloom on 16 Mar. 1992 with an airblast sprayer delivering 1200 liters-ha⁻¹.^cWater only applied.

Table 2. Influence of monocarbamide dihydrogensulfate (D-88) on number of flowers or fruit and yield of 'Fantasia' nectarine, Clyde, New Zealand (1991).

D-88 concn (ml-liter ⁻¹) ^a	No. flowers or fruits/limb ^b		Fruit remaining (%)	Total yield (kg/tree)	Avg fruit wt (g)
	16 Sept.	25 Nov.			
0 ^c	116.3	66.3	57.3	37.6	67.1
2.50	102.2	38.0	37.4	37.6	68.3
3.75	99.3	37.2	38.5	35.3	72.8
5.00	105.5	26.3	25.7	38.1	75.2
Linear	0.5205	0.0001	0.0153	0.7384	0.1084

^aOne limb/tree measured.^bD-88, a 79% to 82% a.i. formulation of monocarbamide dihydrogensulfate, was applied at full bloom plus 2 days on 24 Sept. 1991.^cNonthinned.

Flowers, now as fruit, per tagged limbs were recounted on 9 Apr., 25 days after treatment. No further thinning or fruit size measurements were collected due to excessive fruit loss, which resulted from an overnight freeze of -6C on 11 Apr. 1992. Evidence of phytotoxicity was noted, and fruit finish injury was evaluated on remaining fruit.

'Fantasia' nectarine (New Zealand) (Expt. 2). Mature 'Fantasia' nectarine trees at the Horticulture and Food Research Institute of New Zealand, Clyde, were selected for uniformity based on tree size and flower density. Trees were trained to a central leader and managed using standard local fertilization and pest control recommendations.

The experiment was designed as a randomized plot with two replications and four treatments. Each replicate consisted of a minimum of three "trees per treatment. Treatments consisted of four concentrations of D-88: 0 (control), 2.5, 3.75, and 5.0 ml-liter⁻¹. They were applied via handgun to runoff at 10:15 AM on 24 Sept. 1991 in calm conditions, with air at 10C. Flowering stage of trees was ≈2 days past 100% full bloom. No additional hand thinning was performed on any of the treatment trees.

On 16 Sept. 1991, 6 days before treatment, one limb per tree was selected and flowers counted. The number of fruit per tagged limb was recounted on 25 Nov. 1991, 62 days after treatment. All fruit on each tree were harvested and weighed on 2-3 Mar. 1992. Fruit from the tagged limbs were weighed and average fruit size determined. Evidence of phytotoxicity and fruit finish injury was recorded.

The number of blooms persisting on limbs

of nonthinned trees during the postbloom period decreased by 64% in Georgia and by 43% in New Zealand (Tables 1 and 2). Flower and subsequent fruit retention are influenced by environmental and physiological factors (Byers, 1987). Thinning at bloom or during Stage 1 decreased subsequent fruit drop compared to trees thinned later (Tukey and Einset, 1939). In our study with peach, late spring freezes were a major contributing factor to reduced numbers of flowers.

Both peach and nectarine trees treated with D-88 at bloom had fewer flowers remaining during the postbloom period than the controls (Tables 1 and 2). In the study with 'Winblo' peach, 10.0 ml-liter⁻¹ reduced the number of flowers per limb cross-sectional area by 56% compared to the nonthinned control, as measured 25 days after application. With 'Fantasia' nectarine, 5.0 ml-liter⁻¹ thinned similar to the high concentration in the peach study, reducing flower count by 55% over the nonthinned control. Similarity in thinning with the two rates may be due to the influence of application method on response, as distribution characteristics could be expected to be different between handgun and airblast application. Another important consideration with peach, where airblast application was used, is the cumulative effect of material deposited from adjacent rows during treatment on a "block basis." Byers et al. (1985) noted that this "adjacent row" contribution during typical block treatment can be as much as 30%. As such, before designing subsequent trials, application methodology must be considered when evaluating the results of this study.

Byers and Lyons (1983) suggested that the desired fruit density for commercial peaches in Virginia is about five to six fruit/cm² limb cross-sectional area. In our study, the high concentration in conjunction with late spring freezes resulted in a peach flower density that was likely suboptimal. With 'Fantasia' nectarine, D-88 thinned, as measured 62 days after application, but did not affect total yield at harvest, possibly due to differences in subsequent fruit drop during the growing season. At harvest, there was a linear effect of thinning on fruit size at $P = 0.1084$. No phytotoxicity or fruit finish injury was observed in either study. However, there were few peach fruit to evaluate due to losses from a late freeze.

Additional research is needed to determine the influence of cultivar, environmental conditions, and application methodology on response to monocarbamide dihydrogensulfate as a bloom thinner. Based on these preliminary results and the critical need for a more cost-effective means of thinning stone fruits, additional research and development is warranted.

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