Effect of Daminozide, Chlormequat, and Paclobutrazol on Growth and Fruiting of 'Clapp's Favorite' Pears

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Abstract. Young 'Clapp's Favorite' pear trees (*Pyrus communis* L.) received soilapplied paclobutrazol at 6 g (a.i.) per tree in Nov. 1983, or foliar sprays of daminozide at 2000 ppm or two sprays of chlormequat at 1600 ppm in June, 1984. Terminal growth was reduced by daminozide and chloromequat the year of treatment and suppressed by chlormequat and increased by paclobutrazol the following year. The number of flower clusters per limb was increased by daminozide and chlormequat. All growth regulators reduced average leaf area and fruit stem length. Fruit length was reduced by paclobutrazol and average fruit weight by daminozide and paclobutrazol. The growth regulators did not affect flesh firmness, soluble solids, or yield. Chemical names used: butanedioic acid mono-(2,2-dimethylhydrazide) (daminozide), 2-chloro-N,N,N-trimethylethanaminium chloride (chlormequat), β -[(4-chlorophenyl)methyl]- α -(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol (paclobutrazol).

The major factor limiting pear production in many cultivars is the delay in bringing trees into full production. Growth regulators reduced tree vigor and promoted early fruit bud production in various pear cultivars, e.g., daminozide, chlormequat, and ethephon on 'Anjou' (9); chlormequat on 'Comice' (6); daminozide and chlormequat on 'Bartlett' (2, 4); and paclobutrazol on 'Anjou' (8). Our objective was to assess the efficacy of daminozide, chlormequat, and paclobutrazol in retarding growth and in inducing early cropping of pear trees.

Seven-year-old 'Clapp's Favorite' pear trees (in a commercial orchard) that had only light flowering were selected for uniformity of trunk diameter, and treatments were assigned to each of five single-tree replications in a randomized block design. Paclobutrazol at 6 g (a.i.) per tree was applied as a soil drench in Nov. 1983 in 2 liters of water solution per tree on a 1.5-m² area around and adjacent to the trunk. Daminozide was applied at 2000 ppm as a foliar spray in 1984 when new terminal growth was about 10 cm long. Chlormequat was applied in two foliar sprays of 1600 ppm in 1984. The first of these foliar sprays was applied when terminal growth was about 10 cm long and the 2nd was applied 2 weeks later.

Terminal growth measurements were taken

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on 10 random terminals around the tree in Fall 1984 and 1985. The average leaf area for the five trees of each treatment was determined using a Leaf Area Meter, LI-3000 (LI-COR) from a random sample of 10 leaves per tree from the mid segment of the current year's growth in 1985. During the 3rd week of May 1985, one limb in each of the four quadrants was chosen and the number of flower clusters counted on all 1-, 2-, and 3-year-old growth.

Fruit were graded at harvest in 1985 into the following diameter-size classifications: <57 mm, 57–64 mm, 64–70 mm, and >70mm. Fruit firmness was measured with a Magness–Taylor penetrometer just after harvest, followed immediately by a measurement of the soluble solids content of juice pressed from the fruit. Treatment effects on the fruit stem length and on fruit diameter and length were determined in 1985.

In 1984, daminozide and chlormequat reduced terminal growth while paclobutrazol did not (Table 1). In 1985, chlormequat reduced shoot growth and paclobutrazol increased growth (Table 1 and Fig. 1).

In 1985, all regulators applied reduced the average leaf area (Table 1). Daminozide and

chlormequat increased the number of flower clusters per sample on the 1984 growth but not on the 1982 or 1983 growth (Table 1). In 1985, all three growth regulators decreased fruit stem length, paclobutrazol reduced fruit length, but none of the growth regulators affected fruit diameter (Table 2 and Fig. 1).

Treatments did not alter fruit firmness or soluble solids content. The mean for fruit firmness and soluble solids contents were 6.7 kg and 7.5%, respectively. All three growth regulators increased the weight of pears in the <57 mm category, and paclobutrazol and chlormequat decreased the weight in the 64–70 mm group. The weight of fruit in the 57–64 mm and >70 mm size categories was not altered (Table 2).

The weight per 100 fruit was less in the paclobutrazol- and chlormequat-treated trees than in the daminozide-treated or control trees. However, the total weight of fruit from any of the treatments was not different from that of untreated trees (Table 2).

Stahly and Williams (8) reported that daminozide and chlormequat increased flowering in the year following application, but only chlormequat increased the final crop. We have noted a similar increase in crop due to chlormequat application but a decrease due to daminozide. The yield of the paclobutrazol-treated trees was marginally reduced, perhaps due to the stimulation of lateral growth caused by the growth regulant (Fig. 1).

Daminozide can reduce shoot growth of pear trees along with some reduction in fruit size (1). In the present study, daminozide reduced tree growth, and both chlormequat and paclobutrazol reduced fruit weight. Chlormequat was found (3) to reduce stem length by more than 50%. This work supports this finding and indicates that daminozide and paclobutrazol have a similar influence.

Since the number of flower clusters was increased by daminozide and chlormequat in 1985, but the total yield of fruit was not, the additional flowers obviously did not set.

The Netherlands' recommendation for controlling growth and improving fruitfulness of 'Comice' pear is an application of 1000 to 1600 ppm chlormequat when the new shoots have five to eight leaves and a repetition of this in 2 to 3 weeks if necessary (5). Increasing numbers of European growers are using multiple applications of <500 ppm of chlormequat to improve the productivity of mature trees (5). The growth regulant is ap-

Table 1. Effect of daminozide, chlormequat, and paclobutrazol on terminal growth in 1984 and 1985; on leaf area in 1985; and on the number of 1985 flower clusters on limb growth of 1982, 1983, and 1984 'Clapp's Favorite' pear trees.

Treatment	Terminal growth ^z (cm)		Leaf area (cm ²)	No. clusters			
	1984	1985	1985	1982	1983	1984	
Control	38.2 a	29.3 b	19.3 a	22.4	41.0	3.6 c	
Paclobutrazol	39.4 a	39.0 a	12.9 b	26.6	44.6	3.6 c	
Daminozide	20.8 b	32.5 b	11.8 b	31.4	67.8	28.0 a	
Chlormequat	20.6 b	19.0 c	13.0 b	31.2	52.6	17.6 b	

²Means within a column separated by Duncan's multiple range test, P = 0.05.



Fig. 1. Effect of paclobutrazol, daminozide, and chlormequat on terminal growth (top), and pedicel length and fruit shape (bottom) of 'Clapp's Favorite' pear in 1985; $\mathbf{A} = \text{control}, \mathbf{B} = \text{paclobutrazol}, \mathbf{C} = \text{daminozide}, \text{ and } \mathbf{D} = \text{chlormequat}.$

Table 2. Effect of daminozide, chlormequat, and paclobutrazol on stem length, fruit length and diameter, total yield, weight of the sample in each size category, and average weight per fruit on 'Clapp's Favorite' pears in 1985.

Treatment	Stem	Fruit diam (mm)	Fruit length ^z (mm)	To- tal yield (kg)	Weight of sample in each size category				
	length (mm)				<57 mm (kg)	57–64 mm (kg)	64–70 mm (kg)	>70 mm (kg)	Wt/fruit (g)
Control	28.2 a	59.5 a	73.7 a	30.1	1.1 d	6.0	5.9 a	0.2	131.0 a
Paclobutrazol	24.5 b	59.9 a	69.7 b	27.2	2.4 b	5.8	2.8 b		110.6 b
Daminozide	24.2 b	59.8 a	73.0 a	20.4	1.8 c	5.0	5.7 a	0.9	133.8 a
Chlormequat	23.6 b	59.6 a	72.7 a	33.5	3.6 a	5.5	2.4 b	0.1	114.2 b

^zMeans within columns separated by Duncan's multiple range test, P = 0.05.

plied several times at about 2-week intervals commencing shortly after petal fall. The present study indicates that a spray application of chlormequat could be useful to Nova Scotian pear growers to control growth and increased flowering of 'Clapp's Favorite' pear trees. However, further work is required to determine the optimum concentration and number of sprays.

In a field trial in Washington state, a sim-

ilar application of paclobutrazol on 'd'Anjou' (8) reduced shoot extension during the 2nd growing season. Comparable extension growth in this study increased and about the final one-third curved upwards. However, plant growth under the trees in the area treated with this substance was shortened. Further investigation is needed to determine if the contrasting harvest seasons for these two cultivars, climates under which they were grown, or some other factors are responsible for certain different responses to paclobutrazol.

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