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Effect of ethephon application on bud and stem hardiness and bloom delay of 'Redhaven' peach trees

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bruary sampling dates, respectively (Table 2). An ethephon-induced increase in bud hardiness has been reported in peach, cherry, and sour cherry following 1000-1000 mg·l⁻¹ of fall ethephon treatments (Proebsting, l.c.). However, this beneficial effect was offset by increased peach tree death and a reduction in cherry fruit tree performances.

We have demonstrated that ethephon at 150 mg·l⁻¹ applied at 50% leaf drop stage has a positive influence on the flower bud hardiness level of peach throughout the fall and winter. In addition, late fall ethephon treatment delayed bloom without reducing 'Redhaven' peach tree performance (Crisosto *et al.*, l.c.). We still do not know whether the enhancement in hardiness is a direct result of the action of ethephon on the bud physiology or an indirect effect via the alteration of the dormancy status of the plant.

However, from our previous experience (Crisosto *et al.*, l.c.), fall ethephon had to be applied early enough to reduce primordia development for sufficient bloom delay, while ethephon for increased bud hardiness is most effective when applied in late bud development after 50% leaf drop.

3. Results and Discussion

Treatment of 150 mg·l⁻¹ ethephon applied at 10%, 50%, and 100% leaf drop stages delayed full bloom by 8, 5, and 3 days, respectively (Table 1). The early application (10% leaf drop stage) was more effective in delaying bloom than the later applications. Ethephon, applied at the 10% leaf drop stage, reduced the number of flowers to half that of the control. However, ethephon at the same concentration but applied at the later stages did not reduce flower number (Table 1). The presence of leaves at the time of treatment resulted in a reduction in flower and fruit numbers. Such damage can be avoided by removal of leaves prior to an ethephon spray (Crisosto *et al.*, 1987). Fruit set was not affected by any of the ethephon treatments at 150 mg·l⁻¹. This indicates that the reduction in yield caused by an ethephon spray is due to reduced number of flowers and not from fruit set.

The effect of ethephon at 150 mg·l⁻¹ applied at 50% leaf drop stage on tissue hardiness is shown in Figures 1 and 2. Flower bud hardiness of the controls increased from -14°C in November to a maximum of -25°C in January and decreased to -15°C by February (Table 2). However, stem hardiness was hardly affected. Maximum hardiness was achieved after the chilling requirement for 'Redhaven' was satisfied on 12 January 1987. Proebsting *et al.* (1959), and Proebsting and Mills (l.c.) reported similar levels of hardening for 'Elberta' peach.

Regression analysis for T_{50} and conductivity were significantly different between the treated and untreated check at the same date of sampling (data not shown), indicating the positive action of fall ethephon for improving the hardiness on 'Redhaven' flower buds.

Table 1 – Effect of timing fall ethephon at 150 m·l⁻¹ on 'Redhaven' peach performance, 1987

Treatments: Ethephon (mg·l⁻¹)	Treatments: Stage of development	No. flowers/ cm²TCSA[z]	No. fruits/ cm²TCSA	Fruit/ flower	Bloom delay (days)
0	—	16.0	7.8	.51	0
150	10% leaf drop	7.2	3.8	.52	8
150	50% leaf drop	14.2	9.2	.55	5
150	100% leaf drop	15.5	8.1	.47	3
LSD .05 level		6.3	4.1	ns	2.5

[z]Trunk cross-sectional area.

Table 2 – Effect of 150 mg·l⁻¹ ethephon applied at 50% leaf drop stage on tissue hardiness of 'Redhaven' peach determined by visual browing test during the dormancy period, Corvallis, Oregon, 1986-1987.

Sampling date	Temperature (°C) required to kill 50% of the tissue (T_{50}): Control, Floral bud	Control, Stem	Ethephon (150 mg·l⁻¹), Floral bud	Ethephon (150 mg·l⁻¹), Stem
15 Nov	-14	-15	-17	-15
15 Dec	-10	-18	-17	-22
15 Jan	-25	-24	-32	-25
15 Feb	-15	-22	-24	-23

Table 3 – Effect of fall timing of 150 mg·l⁻¹ ethephon sprays on tissue hardiness of 'Redhaven' peach trees, February 15, 1987

Treatment: Ethephon	Treatment: Stage	Temperature (°C) required to kill 50% of the tissue (T_{50}): Bud (browing visual test)	Stem (browing visual test)	Stem (conductivity)
0	—	-15	-22	-18
150	10% leaf drop	-16	-20	-17
150	50% leaf drop	-24	-23	-25

The time of ethephon application is critical in increasing the hardiness levels and delaying bloom without affecting peach performance. Proebsting and Mills (l.c.) reported that ethephon did not affect hardiness if applied in September on stone fruit buds. In our study, trees sprayed at 10% leaf drop did not differ in hardeness to the controls (Table 3). The lack of difference in measured hardiness in conductivity from the electrolyte leakage method may be due to the increased salt leakage in most peach buds from the early fall ethephon spray at the 10% leaf drop stage (Table 3).

References

BALLARD J.K., PROEBSTING Jr. E.L., TUKEY R.B., (1972) – *Critical temperatures for blossom buds.* – Peaches. Washington State Univ. Ext. Cir. 373.

COSTON D.C., KREWER G.W., ELKNER T.E., WILLIAMSON J.G., SIMS JR., E.T. (1985) – *Chemical treatments to delay bloom in peach.* – J. Amer. Soc. Hort. Sci., 110(6): 874-877.

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Keywords: Conductivity, electrolyte leakage, T_{50}.

Abstract: Fall application of ethephon at 150 mg·l^{-1} at the 10, 50, and 100% leaf drop stages delayed 'Redhaven' peach bloom by 8, 5, and 3 days, respectively, in 1987. At the 10% leaf drop stage, ethephon reduced flower and fruit number by almost half the amount produced by trees untreated or treated with ethephon at the 50 and 100% leaf drop stages. Fruit set was not affected by any of the ethephon treatments. Hardiness measured as percentage of bud survival was greater following the 50% leaf drop treatment through the dormancy period. Chemical name used: (2-chloroethyl) phosphonic acid (ethephon).

1. Introduction

Stone fruit species bloom early in the spring when probability of frost damage is high and conditions are often unfavorable for pollination and fruit set (Lombard *et al.*, 1981). Delaying bloom would reduce the risk of frost and improve pollination and fruit set damage. Ethephon (250-2000 mg·l^{-1}) sprayed after harvest successfully delayed bloom in stone fruit trees but also reduced yield (Coston *et al.*, 1985; Dennis, 1976; Gianfagna *et al.*, 1986).

Proebsting and Mills (1969) reported a 3-4°F increase in hardiness of 'Elberta' peach bud survival after a fall application of 1000-2000 mg·l^{-1} ethephon. However, this increase in hardiness was offset by phytotoxic effects including gumming and reduced number of flowers.

The objective of this study was to determine the optimum date of ethephon application to 'Redhaven' peach trees to delay bloom and increase frost hardiness without affecting tree performance. Our approach was to use a low concentration of ethephon applied late in the fall and evaluate the effect on bud and stem hardiness, bloom delay, and fruit set.

2. Materials and Methods

Twelve-year-old 'Redhaven' peach trees at the Lewis-Brown Horticulture Farm, Corvallis, Oregon, were sprayed with 150 mg·l^{-1} ethephon at 10% leaf drop (7 October 1986), 50% leaf drop (22 October 1986), and 100% leaf drop (1 November 1986) stages in a complete randomized plot design. Four limbs from each of five replicate trees were selected to determine bloom delay and yield components. Bloom delay was determined as the number of days to reach full bloom in relation to the control (Ballard *et al.*, 1972). In the following spring, flower and fruit number were determined as the number per branch on a cross-sectional area basis. Fruit set was based on the number of retained fruit per flower before thinning.

Hardiness was determined on a 10 cm portion of the stem from the mid-sections of terminal shoots. Twenty stem sections containing 5 nodes of floral buds each were collected on 15 Nov., 15 Dec., and 15 Feb. for controlled freezing tests. The samples were wrapped with moistened cheesecloth and aluminum foil, then placed into a programmable freezer. Freezing was initiated at -4°C for 15 hours and then cooled at a rate of 5°C/hr (Proebsting and Mills, l.c.). Samples were then withdrawn from the freezer at 5°C intervals from -5 to -40°C. Viability of the stem tissue was evaluated by the electrolyte leakage method (Ketchie *et al.*, 1972) determined 24 hours after thawing, and visual browning (Proebsting and Mills, 1961) of bud and stem tissues two weeks after the freezing test.

The value T_{50} (temperature at which 50% of bud population is killed) was determined as suggested by Proebsting and Fogle (1956). Data were subjected to an analysis of variance to determine significant differences among treatment means. The data were further analyzed using mean separation (LSD). Regression analysis was done on arcsine transformed percentage on the conductivity data and regression equations for each sampling date were calculated and compared.

Ethephon applied at 50% leaf drop increased flower bud hardiness 3, 7, 7, and 9°C for samples collected in November, December, January, and Fe-

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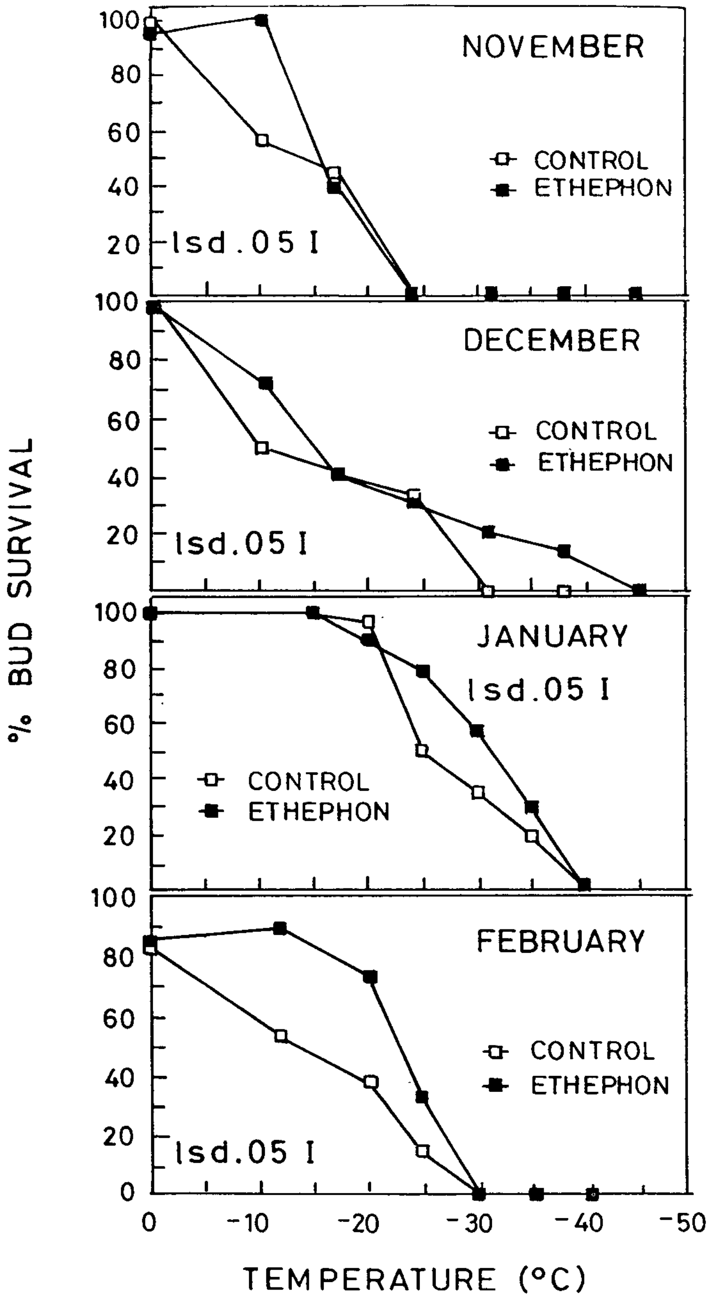

Fig. 1 – Effect of 150 mg·l⁻¹ ethephon applied at 50% leaf drop stage on 'Redhaven' bud survival determined by browning visual test. Corvallis, 1986-1987.

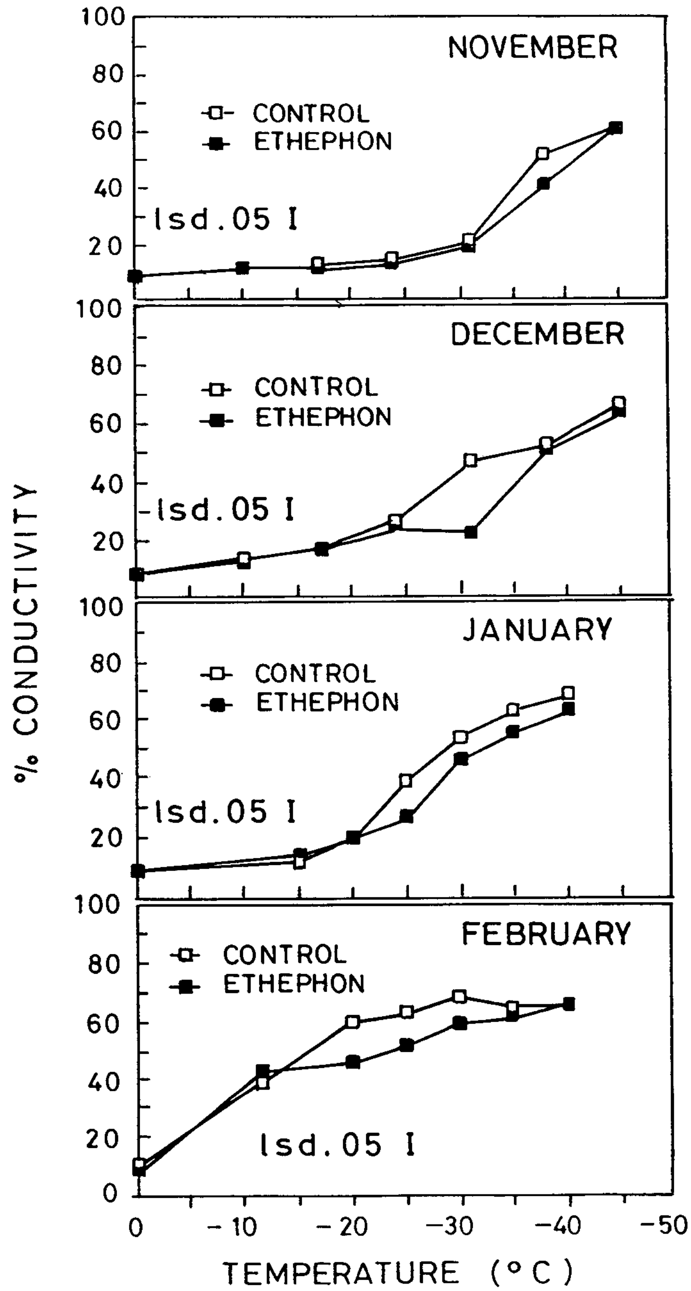

Fig. 2 – Effect of 150 mg·l⁻¹ ethephon applied at 50% leaf drop stage on 'Redhaven' stem survival determined by conductivity test. Corvallis, 1986-1987.

CRISOSTO C.H., LOMBARD P.B., FUCHIGANI, L.H., (1987) – *A possible fall ethephon mechanism of action on bloom delay on 'Redhaven' peach trees.* – J. Amer. Soc. Hort. Sci., (In press).

DENNIS F.G., Jr. (1986) – *Trials of ethephon and other growth regulators for delaying bloom in tree fruits.* – J. Amer. Soc. Hort. Sci., 101: 241-245.

GIANFAGNA T.J., MARINI R., RACHMIEL S., (1986) – *Effect of ethephon and GA_4 on time of flowering in peach.* – HortScience, 21(1): 69-70.

KETCHIE D.O., BEEMAN C.H., BALLARD A.L. (1972) – *Relation of electrolytic conductance to cold injury and acclimation in fruit trees.* – J. Amer. Soc. Hort. Sci., 97: 403-406.

LOMBARD P.B., WOLFE J., COLLINS M.D., (1981) – *Evaporative cooling as an Oregon alternative in frost protection system of pears.* – Oregon State Univ. Ag. Expt. Sta. Cir. 681.

PROEBSTING E.L., JR., (1959) – *Cold hardiness of 'Elberta' peach fruit buds.* – Proc. Amer. Soc. Hort. Sci., 74: 144-153.

PROEBSTING E.L., JR., FOGLE H.W., (1956) – *An apparatus and method of analysis for studying fruit bud hardiness.* – Proc. Amer. Soc. Hort. Sci., 68: 6-14.

PROEBSTING E.L., JR., MILLS H.H., (1961) – *Loss of hardiness by peach fruit buds as related to their morphological development during the pre-bloom and bloom period.* – Proc. Amer. Soc. Hort. Sci., 78: 104-110.

PROEBSTING E.L., JR., MILLS H.H., (1969) – *Effects of growth regulators on fruit bud hardiness in Prunus.* – HortScience, 4(3): 244-245.