Rootstock, Pruning, and Soil Fumigation in Relation to Dormancy and Cold Hardiness of 'Redhaven' Peach

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Abstract. The effects of rootstock, pruning, and preplant soil fumigation on floral bud dormancy status and shoot cold hardiness of 'Redhaven' peach [*Prunus persica* (L.) Batsch] trees were monitored. Dormancy status, expressed as percent floral budbreak, was significantly affected by rootstock and pruning, although differences were small. In late January, significant interactions occurred between rootstock and pruning treatments, as well as between pruning and soil treatments. Pruning of trees on Lovell rootstock resulted in significantly lower budbreak as compared to trees on Nemaguard and unpruned trees on Lovell. Also, for trees pruned in December, higher budbreak was associated with those growing in fumigated vs. nonfumigated soil. Treatment effects on dormancy status did not correspond with treatment effects on hardiness. In fact, differences in hardiness were minimal and probably not biologically meaningful.

Factors known to predispose trees to peach tree short life (PTSL) include, but are not limited to, a high population of ring nematode [*Cricone-mella xenoplax* (Raski) Luc and Raski], pruning in October through January, and rootstock (Brittain and Miller, 1978). Although the ultimate cause of death remains uncertain, the role of freeze injury in the occurrence of PTSL has been emphasized in the southeastern United States. Treatments associated with increased survival have also been reported to result in greater cold hardiness of peach shoots on a PTSL site (Nes-

mith and Dowler, 1976; Yadava and Doud, 1978).

Freeze injury to peach trees in the southeastern United States occurs primarily during later winter or early spring (Prince, 1966), when premature dehardening may occur in response to periodic high temperatures. Relative depth of dormancy was hypothesized to be related to the tree's ability to maintain hardiness during such intermittent warm periods. We, therefore, studied the effect of PTSL-predisposing factors on relative floral bud dormancy status in relation to shoot cold hardiness of 'Redhaven' peach trees.

Cold hardiness and dormancy status were determined on current-year's growth (1988) of 4-year-old 'Redhaven' peach trees growing on a PTSL site near Macon, Ga. Calcitic lime (1700 kg-ha⁻¹) was incorporated into the soil (Orangeburg sandy loam) to a depth of 20 cm in Aug. 1984 and surface-applied in Nov. 1985. Treatments were arranged in a split-plot design with liming as the main plots. Liming had not previously affected PTSL at this site; thus, nonlimed plots were omitted (Sharpe et al., 1989). Subplot treatments included preplant soil fumigation (561 kg methyl bromide/ha), time of pruning (December vs. March), and rootstock (Love11 vs. Nemaguard seedlings); treatments were

arranged in a 2 × 2 × 2 factorial, with six replications, in a randomized complete block design. Trees previously pruned in March are referred to as unpruned. Two apparently healthy trees were selected from each experimental unit. About every 2 weeks, from 7 Nov. 1988 to 27 Feb. 1989, two preselected 1-year-old shoots per tree were removed and tested for cold hardiness. Beginning 5 Dec., one additional shoot per tree was removed to determine relative depth of dormancy. Shoots collected before 3 Jan. died before any budbreak was observed.

Cold hardiness was estimated on 5-cm shoot sections obtained 10 to 35 cm from the terminal end. Sections, one from each shoot, were wrapped in distilled water-moistened tissue paper, placed in a plastic bag, sealed, and either held at 4C as the temperature control or placed in a -3C ethylene glycol circulating bath. Ice formation in treatment samples was initiated with ice crystals, and tissues were allowed to equilibrate overnight. Temperatures were lowered at a rate of 2.5C/h and held for 1 h at each treatment temperature; these (at 5C intervals) varied with sampling date, based on expected hardiness level. Samples were thawed at .4C overnight, then held at 23C in the dark for 4 to 6 days. Viability was determined based on a visual rating of tissue browning (1 = normal, 5 = completely brown). The estimated killing temperature for each tree's shoots is the temperature at which the average rating was ≥ 4 (complete browning of c a m b i u m).

Shoots for dormancy status determination were held at 21 ± 3C under natural daylength (≈ 10 h) in a container through which fresh tap water flowed continuously. The basal ends of cuttings were recut weekly to prevent xylem blockage. Relative dormancy status is expressed as the percentage of floral buds at or beyond the green calyx stage (Scalabrelli and Couvillon, 1986) after 6 weeks.

Killing temperature and percent budbreak, on a per-tree basis, were tested by analysis of variance. Percentage data were transformed by arcsin conversion before analysis. Means were converted back to percentage data for presentation.

Few significant treatment differences were observed in either percent budbreak or cold hardiness throughout the study period. Percent budbreak was most notably affected by pruning on Love11 rootstock and by soil fumigation of Dec.-pruned trees (Table 1). In both cases, the treatments known to promote viability on PTSL sites (i.e., fumigation and not pruning until March) resulted in higher percent budbreak. However, higher budbreak was not always associated with the beneficial treatment. For example, although differences were small, percent budbreak of shoots was generally higher on the more susceptible Nemaguard rootstock than on Lovell.

Deacclimation of shoots coincided with the

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Table 1. Relative dormancy status of 'Redhaven' peach shoot cuttings (n = 6 for all means).

Main effects ^z	% Floral budbreak after 6 weeks				
	Shoot harvest date				
	3 Jan.	17 Jan.	30 Jan.	14 Feb.	27 Feb.
Rootstock					
Lovell	1 b	6 a	1 5 ^y	42 b	50 a
Nemaguard	2 a	9 a	2 6	49 a	48 a
Pruning					
Unpruned	1 a	10 a	2 6 ^y	4 9 ^y	49 a
Dec.-pruned	2 a	5 b	14	4 2	49 a
Soil treatment					
Control	1 a	7 a	1 8 ^y	4 3 ^y	48 a
Fumigated	1 a	8 a	22	4 8	50 a
Significant interactions ^{x,w}					
Rtsk × Prn					
Lov, Unpruned	---	---	24 a	---	---
Lov, Dec.-pruned	---	---	8 b	---	---
Nem, Unpruned	---	---	29 a	---	---
Nem, Dec.-pruned	---	---	22 a	---	---
Prn × Soil					
Unpruned, Cont	---	---	28 a	50 a	---
Unpruned, Fum	---	---	25 ab	48 a	---
Dec.-pruned, Cont	---	---	10 c	37 b	---
Dec.-pruned, Fum	---	---	19 b	48 a	---

^zMain effect means separated by F test ($P \leq 0.05$), within sampling date.^yMain effects not interpreted due to significant interactions.^xSignificant interaction ($P = 0.05$) means compared by individual contrasts at $P \leq 0.05$.^wRtsk = rootstock, Prn = pruning treatment, Soil = soil treatment (preplant fumigation applied as 98% methyl bromide plus 2% chloropicrin at 561 kg-ha⁻¹), Lov = Lovell, Nem = Nemaguard, Cont = control, Fum = fumigated.

gradual release from dormancy observed between 17 Jan. and 27 Feb. Treatment effects on dormancy status, however, did not cor-

respond with treatment effects on hardiness. In fact, differences in hardiness were minimal and probably not biologically meaning-

ful (data not presented).

Although cold injury is thought to be one of the leading causes of PTSL in the southeastern United States, treatments to control PTSL had little effect on cold hardiness. This result, together with the fact that the treatments affected dormancy, suggests the possibility of a connection between dormancy status and PTSL, independent of cold hardiness.

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