Abstract. Container-grown 'Loring'/Lovell seedling peach trees [Prunus persica (L.) Batsch] trained to four current-season extension shoots (ES) were treated with 60, 240, or 960 mg of foliar-applied paclobutrazol (PBZ)/liter 8 weeks after shoot growth began, followed 2 weeks later by a 50-mg spray of gibberellic acid (GA3)/liter. PBZ reduced both the post-treatment increment in trunk cross-sectional area (ΔTCA) and current-season shoot length (ΔES) by up to 26% and 43%, respectively, as compared to control. GA3 increased ΔTCA by 45% and stimulated an increase in ΔES, especially on the trees treated with PBZ at 0 and 60 mg-liter⁻¹. PBZ had reduced the total length of lateral shoots (LS) developing on the ES by up to 48% and 38% as compared to control by 2 and 14 weeks, respectively, after PBZ application. However, the GA3 application increased the total LS length by 38%. The ES positioned at the two most basal locations on the tree trunk produced a 31% increase in LS length per ES, but there was no interaction between ES location and PBZ or GA3 influence on the final growth parameters. Total plant dry weight and root : shoot ratio were not affected by PBZ, but GA3 increased plant dry weight 38% and decreased the root : shoot ratio. Chemical name used: β-[(4-chlorophenyl) methyl]-α-(1,1-dimethylethyl)-1-1,2,4-triazole-1-ethanol (paclobutrazol).

High-density peach orchards have the potential to hasten economic returns by quickly bringing an orchard into full production (Hansche et al., 1979). However, after 3 to 4 years of growth, high-density peach trees usually fill their allotted space in the orchard and produce an excess of shoots, jeopardizing fruit yield and quality.

PBZ reduced shoot elongation in pome (Dalziel and Lawrence, 1984; Shearing et al., 1985; Stinchcombe and Copas, 1982) and stone (Costa et al., 1986; Coston, 1986; Edgerton, 1986; Gaash, 1986) fruit trees and increased flowering (Edgerton, 1986; Shearing et al., 1985; Tukey, 1983; Webster and Quinlan, 1984b) with no apparent phytotoxicity (ICI Americas, 1982; Edgerton, 1986) or reduction in fruit size (Quinlan, 1981). PBZ might be used to manage growth in high-density plantings. However, reduction of shoot growth in peach must be carefully controlled, since fruiting occurs primarily on 1-year-old shoots 20 to 80 cm long (Feucht, 1981). Peach tree vigor varies with environmental stresses from year to year in eastern North America, making it difficult to predict the amount of growth control needed. GA3 can stimulate growth previously inhibited by PBZ (Dalziel and Lawrence, 1984; Steffens et al., 1985) and might be used to overcome excessive PBZ inhibition of shoot growth. The objective of this experiment was to study the effects of PBZ and GA3 on growth and development of young 'Loring' peach trees.

One-year-old, 1-cm-caliper 'Loring'/Lovell seedling peach trees were planted in standard black plastic pots containing 0.014 m³ Promix BX (Premier Peat Co., New Rochelle, N.Y.) medium (1 peatmoss : 1 perlite : 1 vermiculite) (by volume), supplemented with 26 g of 14.0N-6.1P-11.6K controlled-release fertilizer (6.6% NH₄-N, 7.4% NO₃-N, 23 g dolomitic limestone, and 0.15 g chelated Fe. The dormant trees were held in cold storage at 7 to 9 °C.

The trees were placed outdoors on 2 June and each trunk was headed back to 40 to 60 cm above the crown. All but four lateral branches existing at planting were removed. One new current-season extension shoot (ES) was trained from the base of each of the retained laterals. The three most proximal ESs were trained to grow at ≈45° from vertical, but the most distal ES was trained vertically as the central leader. The relative ES location on the tree trunk was used to categorize it as a basal, mid-basal, mid-distal, or distal ES. The trees were watered as needed, and fertilized with 400 mg of 20.0N-8.7P-16.6K soluble fertilizer/liter (8% NH₄-N, 12% NO₃-N) twice a week for 1 month beginning 15 July, and then three times a week for the remaining 3 months.

The treatments were applied to single-tree plots in a 4 × 2 factorial experiment in a randomized complete-block design with six replications. Each of four levels (0, 60, 240, or 960 mg a.i./liter) of PBZ (Cultur 2SC, ICI Americas, Wilmington, Del.) were applied to the shoots of each tree to drip when they were ≈43 cm in length (30 July). GA3 (ProGibb, Abbott Labs.) at two levels (0, or 50 mg a.i./liter) was applied 2 weeks after the PBZ treatments. Tween-20 was included in each spray at 0.2% (v/v) concentration. Controls were sprayed with distilled water plus adjuvant.

The trunk diameter and length of ES were measured before the first PBZ spray and 3, 6, and 12 weeks thereafter. The lateral shoots (LS) developing on the ES were counted and measured for total length per ES 2, 8, and 14 weeks after PBZ treatment. The LS number per ES was determined for two length categories: <1 and >1 cm. Each tree was divided into leaves, stems, and roots on 12 Nov.; and the dry weights of all plant parts determined.

The data were analyzed using a polynomial regression for PBZ concentration averaged over GA3 levels, except where a significant interaction required a separate regression for each GA3 level. The ES location on the tree trunk was considered an independent variable for the analysis of ES and LS parameters. The data used in the regression for PBZ concentration were averaged over ES location on the tree trunk and over GA3 levels, except where interactions were significant. The model used and calculations of partial F values were the same as described by Liyembani and Taylor (1989). The effect of GA3 level where interaction with PBZ concentration was not significant was tested with an analysis of variance, as was ES location on the tree trunk. All analyses were done using the Statistical Analysis System (SAS) program package (SAS Institute, Raleigh, N.C.).

PBZ reduced the net change in TCA (ΔTCA) of young peach trees by as much as 26% as compared to control (Table 1). In contrast, PBZ applied in foliar sprays of 1000 to 2000 mg-liter⁻¹ did not affect trunk growth of apple trees in the year of application (Elfving, 1983). GA3 increased the ΔTCA 45% over the control (Table 1). A similar
effect was seen on 3-year-old plum trees treated with GA3 (75 mg liter−1) plus 2, 4, 5-tri-chlorophenoxypropionic acid as a fruit setting aid, after foliar sprays of PBZ (Webster and Quinlan, 1984a). However, GA3 (50 mg liter−1) application 4 weeks after full bloom to young tart cherry trees did not affect TCA through the year following treatment (Stang and Weidman, 1986).

PBZ decreased the net change in extension-shoot length (ΔES) on trees not subsequently treated with GA3 in a linear fashion with increasing concentration of PBZ (Table 1). However, the cubic response of ΔES with increasing PBZ concentration on trees also treated with GA3 suggested a slight stimulation of ES growth with the 60 mg liter−1 PBZ application. This response to the low PBZ concentration is very similar to the ES response of young ‘Loring’ peach trees tested similarly (but without GA3) in the previous experiments with orchard grown trees (Stang and Weidman, 1989). It seems that PBZ at low concentrations can slightly stimulate development of short shoots or the elongation of long shoots beginning to slow in growth.

PBZ did not influence total plant dry weight or root : shoot ratio. However, GA3 increased the total plant dry weight ≈38% over control and reduced the root : shoot ratio. Our results suggest PBZ and GA3 can be used to manipulate peach tree growth. Future experiments with orchard grown trees should determine the minimum GA3 concentration and application frequency necessary to sustain shoot elongation on trees where growth was suppressed too much by PBZ. The possible integration of PBZ or its analogues and GA3 in a cultural management system for high-density peach orchards should be explored.

*Literature Cited*

Relationship Between Densities of Pear Psylla and Twospotted Spider Mite and Pear Leaf Nutrient Levels

David Sugar, T.L. Righet1, and P.H. Westigard
Oregon State University, Southern Oregon Experiment Station, 569 Hanley Rd., Medford, OR 97502

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Abstract. Differential population levels of pear psylla (Psylla pyricola Foerster) and of twospotted spider mite (Tetranychus urticae Koch) were established in 'd'Anjou', 'Bartlett', and 'Bosc' pear (Pyrus communis) trees by application of selective insecticides and acaricides. Numbers of psylla or mites counted were used to calculate psylla days and mite days by averaging numbers per leaf on successive sampling dates and multiplying this average by the number of days between samples. The N concentration of apparently uninjured shoot leaves of 'd'Anjou' and spur leaves of 'Bartlett' were negatively related to mite days. The reduction in N induced by mites on 'd'Anjou' shoot leaves was large enough to affect fertilizer recommendations based on foliar N. Phosphorus concentration was negatively related to mite days in both shoot and spur leaves of 'd'Anjou', but not in other cultivars. Other leaf nutrients were not consistently affected. Densities of the pear psylla were not correlated with foliar mineral nutrient concentrations, although high population levels were not established in this study.

The pear psylla and twospotted spider mite are major economic pests in Pacific Northwest pear production (2, 11). Injury thresholds have been established for these pests in southern Oregon based on studies of tree performance and fruit injury (11). However, specific information on their effects on tree nutrition is lacking. Feeding by other mite species can cause ultrastructural changes and affect the growth regulator balance within leaf cells of fruit trees (10). The fecundity of both the pear psylla and twospotted spider mite is influenced by pear leaf nutrient concentration (4, 6, 7), but, conversely, the influence that populations of these pests may have on leaf nutrient concentrations has not been evaluated.

Guidelines for fertilizer application in commercial pear production are based on nutrient analysis of mature leaves (9). If pest activity influences leaf nutrient levels, the nutrient requirements of infested trees may be different than those of uninfested trees. Changes in levels of several nutrients in apple leaves were correlated with infestation by the spotted tentiform leafminer (1), and defoliation by the yellowheaded spruce sawfly increased N, P, K, Mg, and Cu while reducing Ca and Mn in remaining leaves of white spruce (3). This study sought to determine the effect of varying densities of pear psylla and twospotted spider mite on nutrient levels in pear leaves.

Study areas. Two blocks of pear trees at the Southern Oregon Experiment Station, Medford, were used. Block 1 was 0.5 ha, composed of 'd'Anjou' and 'Bartlett' cultivars on Old Home X Farmingdale rootstocks spaced 3.7 × 1.2 m. The block was subdivided into 12 areas, for four treatments, each replicated three times. Each replicate contained eighty 20-year-old trees including equal numbers of each pear cultivar. Chemical treatments to manipulate pear psylla and twospotted spider mite densities were applied by commercial air-carrier sprayer set to deliver 935 liters of spray/ha. Block 2 consisted of 0.17 ha of 30-year-old 'Bosc' pear trees, spaced 7.3 × 3.7 m. Ten single-tree replicates for each of the four treatments were placed in a randomized block design and pesticides were applied using conventional high-pressure handgun equipment (1740 liters/ha at 17.6 kg·cm⁻²). Manipulation of pear population of both pests. The four treatments in each of the two study blocks were imposed to create varying densities of pear psylla and twospotted spider mite. These treatments were: 1) low mite, low psylla; 2) high mite, low psylla; 3) low mite, high psylla; 4) high mite, high psylla. To accomplish these objectives, a combination of cyhexatin (Pictrac 50W) at 1.1 kg a.i./ha and formetanate (Carzol 925P) at 1.4 kg a.i./ha was applied for psylla control, the low mite, low psylla plot received both acaricide and psyllacide, while these were used separately.