


Uncontrolled vegetative growth (left) shades lower areas of peach trees and may affect fruit development. Treatment reduced excessive growth (above), eliminated summer pruning, and increased yield in a close-planted orchard.

Chemical growth regulator for peaches

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Excessive vegetative growth in peach orchards shades the lower portions of trees and decreases fruit bud development, makes expensive summer pruning necessary, and causes crowding between trees in close plantings. The problem is greatest in early-maturing peach cultivars. In trees harvested in May to July, top growth continues until the end of summer; the competitive effect of fruit, which decreases the summer vegetative growth of later maturing cultivars, is reduced after harvest.

Growth of other fruit species has been controlled by pruning, rootstocks, cultivar selection, and chemical treatment. For various reasons, these options have not been satisfactory in peaches.

A new plant growth regulator that reduces vegetative shoot growth, paclobutrazol, has shown promise in stone fruits. We therefore conducted a field study of its use on an early-maturing peach cultivar.

Field trial

The three-year trial was begun in 1983 in a fifth-leaf, close-planted (605 trees per acre) 'Flavorcrest' peach orchard in Fresno County. Paclobutrazol was applied to the soil annually in December at rates of 0.5, 0.75, 1, and 2 pounds per acre; an untreated control was included. The material was injected into the soil about 6 inches deep on both sides of the trees by tractor-drawn shank. The soil was a Ramona loam with a loam-gravelly substratum. There were 15 trees per treatment replicated four times in a randomized complete block design.

Each year we measured vegetative growth (shoot internodal lengths, watersprout growth, trunk diameters, tree dimensions, and development of dead and live shoots), pruning and fruit-thinning time (average worker-hours per replication), yield, fruit size, fruit color, and fruit quality (split pits, firmness, total soluble solids, acidity). Leaf analysis was also performed.

Results

Vegetative growth. Paclobutrazol reduced overall vegetative growth, decreasing length between nodes of one-year-old fruitwood, compared with control shoots (table 1). The vigorous watersprouts arising from lower scaffolds of treated trees were significantly shorter than on controls (fig. 1). Paclobutrazol-treated trees had smaller dimensions (table 1), and grew less in trunk diameter (table 2) than did control trees.

Significantly more dead shoots appeared in the lower, shaded portions of the control trees than in treated trees. The following spring, more new fruitwood shoots developed in the lower portions of treated trees than in the controls (fig. 2).

Pruning. There were no significant differences among treatments in time taken for standard dormant pruning during the three-year trial, even though there were differences in vegetative growth. This was because the same number of cuts were made regardless of shoot length.

Many peach growers prune early-maturing cultivars twice in the summer to minimize shading from vigorous post-harvest growth that can reduce fruitwood formation. Paclobutrazol decreased watersprout growth, eliminating the need for summer pruning.

Fruit thinning. In April, each tree was thinned to 150 fruits in 1985 and 175 fruits in 1986 and 1987. Treated trees took 1.6 to 2.6 times longer to thin than control trees in 1985 and 1986 (table 3) because of the markedly greater numbers of flowers and fruit. There were no differences in fruit thinning time in 1987. The higher fruit numbers resulted from the significant increase in fruitwood in the lower portions of treated trees.

TABLE 1. Effect of paclobutrazol on vegetative growth

Treatment	No. of nodes /8″ shoot*	Tree dimensions (Ht x W)*	
	1986	1985	1986
		sq ft	
Control	10.9 a	216 a	225 a
Paclobutrazol (lb/acre):			
0.5	12.3 b	154 b	161 b
0.75	12.2 b	169 b	174 b
1.0	13.1 bc	157 b	161 b
2.0	13.8 c	156 b	149 b

*Numbers in columns followed by different letters are significantly different (DMR test at 5% level).

TABLE 2. Effect of paclobutrazol on trunk diameter

Treatment	Trunk diameter increase*		
	1983-84	1984-85	1985-86
		inches	
Control	4.3 a	3.9 a	3.2 a
Paclobutrazol (lb/acre):			
0.5	2.2 b	2.0 b	1.4 b
0.75	2.3 b	2.8 b	1.3 b
1.0	2.6 b	1.4 b	1.4 b
2.0	2.1 b	2.2 b	1.2 b

*See table 1 footnote.

TABLE 3. Effect of paclobutrazol on fruit thinning time

Treatment	Worker-hours/replication*		
	1985	1986	1987
Control	1.85 a	1.70 a	2.34 a
Paclobutrazol (lb/acre):			
0.5	3.85 b	2.66 ab	3.01 a
0.75	3.39 ab	3.08 b	2.74 a
1.0	4.79 b	3.43 b	3.10 a
2.0	3.38 ab	2.83 b	2.78 a

*See table 1 footnote.

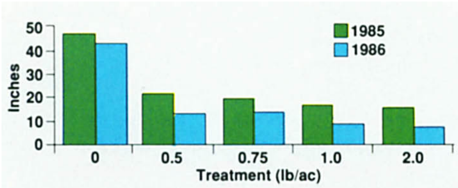

Fig. 1. Watersprouts from lower scaffolds were significantly shorter in paclobutrazol-treated trees than in controls.

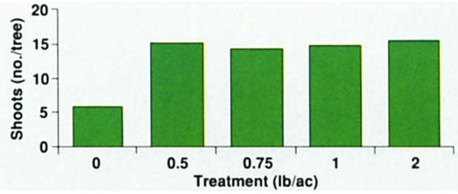

Fig. 2. Significantly more new fruitwood shoots developed in the lower portions of treated trees than in controls.

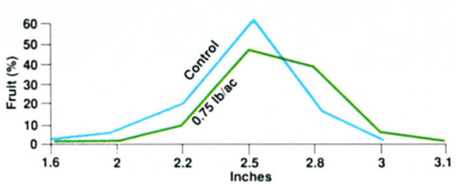

Fig. 3. Fruit size distribution at the 0.75-pound paclobutrazol rate in 1986 was typical: treated trees had larger fruit than controls.

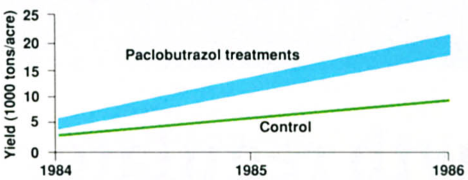

Fig. 4. Yields of treated trees showed cumulative gains of 13 to 18 tons per acre over controls in the three-year study.

After thinning, random 100-fruit samples were gathered from the ground from each treatment and weighed. Paclobutrazol-treated fruits were significantly larger than controls in 1986.

Fruit size. Fruits were sized by machine. The 1986 fruit size distribution in controls compared with the 0.75-pound paclobutrazol rate (fig. 3) is typical of all three years: overall fruit size from treated trees was significantly larger than in controls. The increase in fruit size may have occurred as raw materials diverted from vegetative growth became available to the fruits.

Although a statistical analysis was not conducted, control trees generally produced more undersized fruits that did not reach minimum marketable size, compared with treated trees.

Yield. In 1984 and 1985, a single overall harvest was made when an estimated 60 percent of the fruit showed red skin color. In 1986, three harvests were made, each based on normal commercial harvest maturity. Yields of treated and control trees were similar in 1984, while in 1985 and 1986, paclobutrazol-treated trees produced higher yields (table 4). Treated-tree yields showed a cumulative gain of 13.2 to 18.4 tons per acre over controls in the three-year experiment (fig. 4). This result is noteworthy, because all trees were thinned to the same number of fruits.

Fruit color. Fruits on treated trees developed color earlier in all three years. In the multi-harvest of 1986, most fruits in paclobutrazol treatments matured in the first two harvests, while most control fruits reached maturity in the second two harvests. Earlier fruit color attained in the paclobutrazol treatments was due to vegetative growth reduction (shorter internodes and reduced watersprout growth), which allowed more sunlight to penetrate the trees.

Split pits. The number of fruits with split pits in the 'Flavorcrest' variety often increases as fruit size increases. We did not conduct a statistical analysis, but in 1985 and 1986, even though fruits of paclobutrazol treatments were consistently larger than controls, there were indications of a reduced incidence of split pits.

Firmness, soluble solids, and acidity. We used standard procedures to analyze a 20-fruit random sample from each treatment.

No significant difference in firmness was found in 1984, but paclobutrazol-treated fruits were softer than controls in 1985 and at the first harvest of the multiple harvest in 1986.

Soluble solids content was often lower in treated fruits than in controls in all three years. Acidity also was often lower in fruit from paclobutrazol trees than from controls; therefore, when the soluble solids/acid ratio was calculated, there were no significant differences among any of the treatments, indicating that fruits remained palatable. The study did not include a taste panel, because paclobutrazol has not been cleared by the U.S. Environmental Protection Agency.

Leaf analysis. Leaf analyses were made annually in July. In 1984 and 1985, there were no significant differences between treatments and control in the nutrients nitrogen, phosphorus, potassium, calcium, magnesium, and zinc. In 1985 and 1986, treated trees contained higher levels of calcium but lower levels of potassium (table 5). Phosphorus was significantly higher in treated trees only in 1986.

In 1986 only, fruit of treated trees sampled just before harvest showed no increase in calcium content, when compared with controls, even though there were increased calcium levels in the leaves.

Conclusions

In our three-year study in a closely planted, early-maturing peach orchard, soil-applied paclobutrazol reduced vegetative growth (shorter and fewer watersprouts, shorter internodes, smaller trunk diameters, and reduced tree dimensions). The need for summer pruning was virtually eliminated, but the time taken for winter pruning was not altered.

Effects from reduced vegetative growth in this orchard included better distribution of sunlight into trees, increased fruitwood development in the lower half of the trees, greater fruit set, more thinning, enhanced fruit size, and ultimately a significantly higher yield.

Earlier fruit maturity and more uniform fruit color resulted in a more compact harvest and fewer total pickings.

No detrimental effects or disorders such as fruit decay or disease due to paclobutrazol were encountered in the three-year experiment.

Determination of optimum concentrations to apply will require keen observation and careful record-keeping by the grower. For successful management of vegetative growth, attention will have to be given to local conditions including soil type, length of growing season, irrigation, water quality, temperature, and variety.

Paclobutrazol is not at present registered for use in peaches in California.

TABLE 4. Effect of paclobutrazol on yield

Treatment	Yield* 1984	1985	1986	3-yr cumulative
	tons/acre			
Control	9.2 a	6.8 a	8.3 a	24.4 a
Paclobutrazol (lb/acre):				
0.5	11.3 a	11.7 b	14.7 b	37.6 b
0.75	12.4 a	15.0 b	15.4 b	42.8 b
1.0	11.7 a	13.2 b	16.3 b	41.2 b
2.0	11.7 a	13.3 b	15.0 b	40.0.b

*See table 1 footnote.

TABLE 5. Effect of paclobutrazol on leaf nutrients calcium and potassium

Treatment	1985* Ca	1985* K	1986* Ca	1986* K
	%			
Control	1.87 a	2.70 a	2.32 a	2.69 a
Paclobutrazol (lb/acre):				
0.5	2.05 ab	2.12 b	2.57 ab	2.04 b
0.75	2.48 c	2.21 b	2.67 b	2.15 b
1.0	2.19 abc	2.03 b	2.69 b	1.92 b
2.0	2.32 c	1.98 b	2.76 b	2.01 b

*See table 1 footnote.

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