A REVIEW OF PACLOBUTRAZOL USE ON NEW ZEALAND STONEFRUIT CROPS

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SUMMARY

The plant growth regulator paclobutrazol has been tested in New Zealand on a range of stonefruit crops using soil application. On young cherry trees paclobutrazol restricted shoot growth by over 30% and increased fruit weights. On apricots paclobutrazol gave up to 22% reduction in shoot growth and a 9% increase in fruit weight. Results on peaches and nectarines showed an average 30% reduction in shoot growth and enhancement of fruit weight, size and colour. The biological effects demonstrated offer the prospect of increased tree planting density and lower costs for protective structures. These could significantly affect the economics of stonefruit production.

INTRODUCTION

Paclobutrazol is a triazole-based plant growth regulator which inhibits gibberellin synthesis in plants, thus reducing cell elongation and, consequently, vegetative growth. As a result of the reduction in vegetative growth more plant assimilates are available for flower bud formation, fruit set and fruit development (Hawkins 1986).

Leonard (1986) reviewed paclobutrazol and its worldwide development, observing that stonefruits as a group are particularly responsive to soil applications. In New Zealand most of the early work with paclobutrazol has been concentrated on stonefruit. On these crops, the demand on time, the cost and the risk of disease spread associated with pruning were seen as problems which could be addressed, whilst Wilton (1986) has identified shading as a cause of death of fruiting buds. The prospect of smaller trees could also have a major influence on orchard design, especially planting density, and the nature of protective structures.

This paper reviews the effects of paclobutrazol and the significance of these on cherry, apricot, peach and nectarine crops. It includes examples of data which indicate the nature and magnitude of these effects.

METHODS

Paclobutrazol (Cultar) was applied as a soil treatment and rates were calculated on a per tree basis. The appropriate dose was diluted with water and, where trickle irrigation was available, applied to the "dripper zone". Where this was not available, application was by a collar drench close to the tree trunk. Trees were 3-6 years old at time of treatment. Paclobutrazol was usually applied during the late winter dormancy period.

RESULTS AND DISCUSSION

Cherry

The responses to paclobutrazol by young cherry trees as described by Jacyna (1985) included a significant decrease in all growth characteristics except the number of spurs/shoot which increased in the season of application (Table 1). In the season following application, yield components were favourably affected (Table 1).

In eight large block evaluation areas in Marlborough, Brown (1987b) demonstrated an average 46% reduction in vegetative growth of 4-6 year old trees from a winter application of 0.5 g/tree

As well as benefits arising from reduced pruning (or the need to thin out trees), less disease and any favourable yield effects, the ability to contain cherry tree size will permit lower-cost covering structures and higher density planting. Harvesting costs
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would also be reduced since a greater proportion of fruit could be picked from the ground.

TABLE 1: Effects of paclobutrazol on growth and yield of sweet cherry (*Jacyna* 1985). Treatments applied August 1984. Vegetative growth measured 1 year after treatment and yield 2 years after treatment.

	Untreated	Paclobutrazol 3 g ai/tree
Growth Character		
Tree height (cm)	302	200
Canopy diameter (cm)	177	76
Mean shoot length (mm)	62	7
Number of spurs/shoot	2.1	18.9
Yield Components		
Number of flowers/limb	148	326
Weight of 100 fruit (g)	839	1110
Yield (kg/tree)	1.8	2.2

Apricot

In a trial in Hawkes Bay Harris (1987a) showed significant reductions in shoot growth and enhancement of fruit quality from the application of paclobutrazol to 4 year old apricots (Table 2). The main factor contributing to the enhanced fruit quality was the near elimination of strong erect shoots originating from within the canopy (water shoots), giving greater light penetration and improved colour. A further block of 100 trees were treated and gave results consistent with those from the replication trial. A 33% reduction in lateral growth and the elimination of the long (>0.5m) water shoots were recorded in the block.

Jacyna *et al* (1985) also showed that paclobutrazol at rates of 0.5–2 g/tree reduced extension growth and number of water shoots and increased fruit weights in Moorpark apricots grown on a Tatura trellis support structure.

TABLE 2: Effects of paclobutrazol on growth and yield of Sundrop apricots.

		Untreated	Paclobutrazol g ai/tree		
			1.0	2.0	4.0
Growth Character 181 DAT					
Mean terminal shoot growth (mm)		524	435	434	416
Mean inner shoot growth* (mm)		193	53	43	45
Yield Character 133 DAT					
% fruit in colour class	Green	21	11	8	6
	Yellow	69	72	69	69
	Orange	10	17	23	25
Av. fruit weight (g)		42.4	46.1	45.8	45.8

*Shoots originating from old wood within the tree canopy.

Peach and nectarine

Because of similar growth habit and management, these two crops have been placed together in terms of product activity analysis and registration progress. Since peach and nectarine crop best on 1 year wood, sufficient growth has to occur during the

season to provide it. Shading of fruiting buds is a problem with these crops and any reduction in this should increase yield potential.

A trial in Canterbury on Halehaven peaches (Luxton 1987) showed a 34-56% reduction in extension growth with paclobutrazol applications of 0.5 to 1.0 g/tree (Table 3). Water shoots were virtually eliminated by the 0.5 g/tree rate. Yield data were not obtained but fruit were observed as having enhanced colour. Pruning wood weights showed a useful reduction in winter pruning requirement (Table 3).

A trial on Golden Queen peaches in Hawkes Bay (Harris 1987b) gave similar results with a 34% reduction in extension growth and a near elimination of water shoots at 1 g/tree. The summer pruning requirement was eliminated. The crop is trained on a Tatura trellis support and tree shading had resulted in very poor fruiting in the lower canopy. Observations of treated trees indicated an increase in the fruitfulness of buds for the 1987/88 season.

TABLE 3: Effects of paclobutrazol on growth of Halehaven peach. Applied 11 September 1986.

	Date Measured DAT	Untreated	Paclobutrazol g ai/tree		
			0.5	0.75	1.0
Mean extension growth (mm)	203	549	364	320	241
No. water shoots/tree	161	32	2	0	0
Pruned wood (kg/tree)	282	3.2	2.8	2.3	1.7

In a trial on Fantasia nectarines in Central Otago Brown (1987a) showed that paclobutrazol at rates of 0.125 to 1.0 g/tree. reduced extension growth by between 37 and 87%. There was a tendency towards a greater fruit weight at 0.25 g/tree. Higher rates which gave greater growth control tended to have a lesser effect on fruit weight. The number of fruit in large classes also increased as a result of paclobutrazol application. The percentage of fruit in the largest size (71 to 80 mm diameter) group increased from 14% in untreated to 30% at 0.25 g/tree (Table 4).

This trial was sited in Central Otago on Molyneux shallow gravelly loam. The soil characteristics, including a relatively low colloid content, explain the marked response at relatively low rates since paclobutrazol is bound to clay particles.

A trial on Royal Giant nectarine (Jeffery 1985) also demonstrated a considerable reduction in extension growth and enhanced fruit characteristics from paclobutrazol application. A rate of 0.25 g/tree reduced extension growth by 73% compared to untreated and gave an increase in mean fruit weight of 26% (Table 5). The rate of 0.5 g/tree gave an even greater, possibly excessive, level of growth suppression. Fruit colour was greatly enhanced (Table 5).

TABLE 4: Effects of paclobutrazol on growth and fruit size of Fantasia nectarines. Treatments applied 28 August, 1985, assessed on 15 March 1986, 192 DAT.

	Untreated	0.125	Paclobutrazol g ai/tree		
			0.25	0.5	1.0
Mean shoot growth (mm)	425	268	222	120	63
Average fruit weight 80/ treatment (g)	148	146	163	158	157
% Fruit, 71-80 mm diameter	14	14	30	25	23

TABLE 5: Effects of paclobutrazol on growth and yield of Royal Giant nectarine. Treatments applied 19 October 1983, yields measured 126 DAT

		Paclobutrazol g ai/tree	
Untreated		0.25	0.5
Mean shoot length (mm)	525	143	93
% fruit in 25%	8	0	0
colour class 50%	70	57	53
75%	22	43	47
Mean fruit weight (g)	122	154	132

Present and future status

Paclobutrazol, as the Cultar formulation, is registered for use on stonefruit crops in eight countries including New Zealand where it has full registration for use on cherry and apricot crops and a limited use permit for use on peach and nectarine crops.

The product has been taken up enthusiastically by cherry growers whose industry faced two immediate problems. In order to meet export fruit quality standards many were contemplating the huge cost of covering structures, whilst a significant proportion of plantings had reached the stage where young trees had already grown to occupy all available space.

Adoption by New Zealand growers of other stonefruit crops will probably be less spectacular in the initial stages but there are other features likely to appeal. Among them are reduced pruning, less opportunity for the spread of disease, enhanced spray penetration, plus the possibility of improved fruit quality and yield. In future, at least in the absence of suitable dwarfing stocks, paclobutrazol could significantly influence the economics of stonefruit production. Changes such as high density planting hedgerow configuration, relatively low-cost cover structures and ground level harvesting may also be future possibilities.

Furthermore, the fact that the use of paclobutrazol is being developed in southern hemisphere countries, against which New Zealand must compete for export markets, should not be overlooked.

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