quantities of fruit for grading by commercial sorting crews. Fruit from five different pickings were accumulated in cold storage until all of the crop was harvested; then they were run through the packinghouse using the same sorting crew.

In the past, when evaluating the quality of only 40 to 50 fruit per treatment, it was impossible to relate the improved color and size of the fruit to treatment. The increase in the number of packed boxes of commercial fruit based on improved fruit quality represents a direct benefit to fruit growers.

Observations have continued on the plots reported on in this paper, and we conclude that gibberellin biosynthesis inhibitors applied at optimum rates are a valuable addition to cultural practices used on stone fruit in Chile. These conclusions agree with those of other authors (1, 3, 10).

Literature Cited

1. Frez, A. 1984. Dwarfing peaches by pruning and by paclobutrazol. Acta Hort. 146:235–241.
2. Lurssen, K. and W. Reisser. 1985. Chemistry and physiological properties of the new plant growth regulator RSW0411. Proc. British Crop Protection Conf.–Weeds, Vol. 1 BCPC Publ., Croydon. p. 121–128.
3. Martin, G.C., F. Yoshikawa, and J. La Rue. 1986. Management of paclobutrazol in a 'Flavorcrest' peach orchard. XXII Intl. Hort. Congr. Univ. of California, Davis. (Abstr. 1022)
4. Quinlan, J.D. 1981. Recent developments in chemical control of tree growth. Acta Hort. 114:114–151.
5. Quinlan, J.D. and A.D. Webster. 1982. The effects of the growth retardant PP333 on the growth of plums and cherries. XXI Intl. Hort. Congr., Vol. I, Hamburg, F.R.G. (Abstr.)
6. Turkey, L.D. 1983. Vegetative control and fruiting on mature apple trees treated with PP333. Acta Hort. 137:103–109.
7. Webster, A.D. and Andrewsil, L. 1985. Fruit thinning Victoria plums (*Prunus domestica* L.) preliminatry studies with paclobutrazol. J. Hort Sci. 60(2):193–199.
8. Williams, M.W. 1984. Use of bioregulators to control vegetative growth of fruit trees and improve cropping efficiency. Acta Hort. 146:97–104.
9. Williams, M.W., E.A. Curry, and D.B. Visser. 1984. Methods of application of paclobutrazol on deciduous fruit trees. HortScience 19:577.
10. Williams, M.W. and E.A. Curry. 1985. Chemical control of vegetative growth of pome and stone fruit trees with GA biosynthesis inhibitors. Acta Hort. Proc. Intl. Soc. Hort Sci. Growth Regulat. Symp., Rimini, Italy.

Chemical Control of Vegetative Growth of Deciduous Fruit Trees with Paclobutrazol and RSW0411

Eric A. Curry

Tree Fruit Research Laboratory, Agricultural Research Service, U.S. Dept. of Agriculture, 1044 N. Western Avenue, Wenatchee, WA 98801

The use of chemicals to control vegetative growth of fruit trees at the Tree Fruit Research Laboratory in Wenatchee, Wash. began 25 years ago. Vegetative growth of apple seedlings in greenhouse trials was first controlled with foliar applications of butanedioic acid mono (2,2-dimethylhydrazide) (daminozide) (B-9, Alar). Field trials then were conducted on both apple and young cherry trees (3, 4). Daminozide also has been used to improve annual return blooming and fruit set, promote red skin color development, delay maturity, and improve storability of apple cultivars. Often, the high rates needed to control vegetative growth have reduced fruit size and fruit length, resulting in flat fruit shape (4, 13, 28). The latter phenomenon is important, for 'Delicious' apple for which "typiness" is a strong marketing characteristic and therefore an economic benefit. This paper presents results of continuing research on the control of excessive vegetative growth of deciduous fruit trees.

β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol (Paclobutrazol) (PP333, Cultar) is a growth regulator which inhibits both sterol (8, 25) and gibberellin biosynthesis (10, 19). It has similar effects on many deciduous fruit crops (7, 14, 18, 24) as well as on other biennial and annual crops (2, 9, 29). At high rates, paclobutrazol reduces internode length, leaf size, fruit size, and fruit length of apples. The degree of these negative effects on the fruit may be reduced by using moderate rates of paclobutrazol, treating with gibberellic acid (GA_3), or by treating with the combination of GA_{4+7} plus *N*-(phenylmethyl)-1*H*-purin-6-amine (benzyladenine) (Promalin) at or near anthesis (26). Ideally, an inhibitor of vegetative growth applied on 'Delicious' apple trees should not reduce fruit size or alter fruit shape, either in the year of application or in subsequent seasons (17).

For several years, chemicals which are structurally related to paclobutrazol have been evaluated to determine their effect on vegetative growth and fruit quality. These chemicals were applied by various methods reviewed in previous reports (5, 6). The results of a comparison study of two growth retardants on apple and a successful method of applying these chemicals to cherry and nectarine trees are described.

PACLOBUTRAZOL AND RSW0411 ON APPLES

Greenhouse

In 1982, 1-year-old 'Red Chief Delicious' apple trees grown in the greenhouse were treated with paclobutrazol or (E)-(RS)-cyclohexyl-4,4-dimethyl-2-(1h-1,2,4-triazol-1-y1)pent-1-en-3-ol (RSW0411) (Mobay, Kansas City, Mo.), these two chemical compounds have closely related molecular structures (Fig. 1). Pots were covered with polyethylene before treatment, and tree trunks were wrapped with an absorbent tissue to prevent sprayed chemical from running down along the trunk and therefore becoming available for root uptake. Aqueous suspensions containing 800 ppm of either chemical plus 1% Regulaid, a nonionic surfactant, were sprayed onto newly growing shoots of ≈25 cm in length.

Paclobutrazol controlled shoot elongation for 11 weeks after treatment. Trees treated with RSW0411 showed a similar initial control of shoot growth; however, growth resumed ≈6 weeks after treatment (Fig. 2). This transient effect suggested RSW0411 might be either less persistent or less effective as an inhibitor of GA biosynthesis than paclobutrazol. Thus, RSW0411 offers potential where less persistent growth inhibition is desirable.

Field

Trees selected for orchard trial were vigorous 4-year-old spur-type 'Ace Delicious' propagated on seedling rootstocks planted 1.3 × 6 m in a furrow-irrigated sandy loam soil in central Washington. In Mar. 1984, either paclobutrazol or RSW0411 was applied to the soil by continuous injection to a depth of 15 to 20 cm beneath the soil surface and 45 cm from the tree trunk. Both compounds were applied at the rate of 0.6 g a.i./cm trunk diameter. Five six-tree replicates were treated per treatment. Terminal growth of 10 upright shoots was measured on 20 trees in each treatment in Aug. 1984. The following spring, fruit blossom and fruit set counts were taken on these same trees using two limbs per tree. Terminal shoot growth

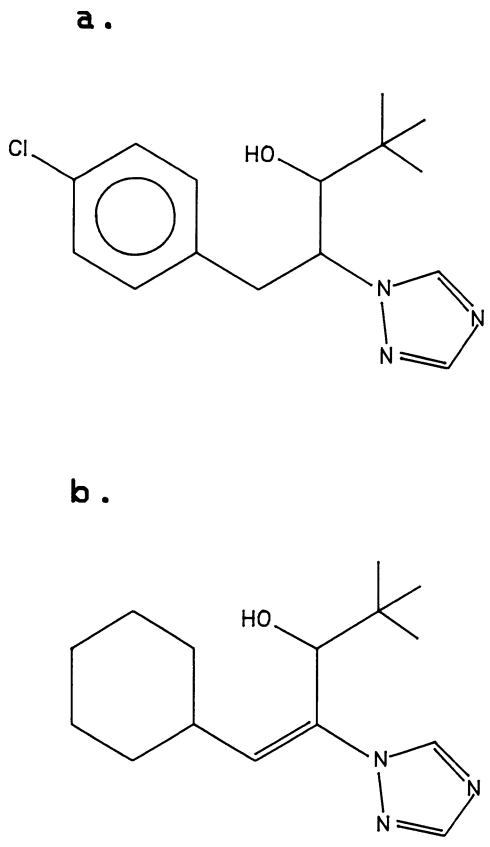

Fig. 1 Molecular structures of (**a**) paclobutrazol; and (**b**) RSW0411.

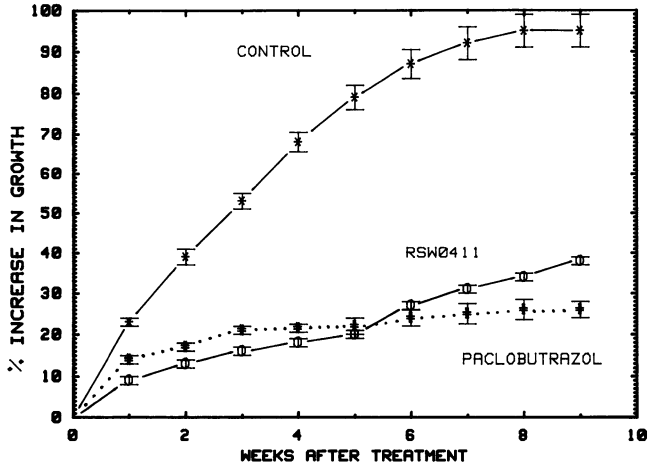

Fig. 2 Percentage increase in growth of 1-year-old 'Red Chief Delicious' apple trees treated with aqueous foliar suspensions containing 800 ppm paclobutrazol, 800 ppm RSW0411, or H_2O control (bars indicate ± SE).

was measured as previously described in 1985 after growth ceased. Yields were recorded at commercial harvest, and fruit quality was evaluated on 20 fruit in each of the following size categories: 80, 88, 100, 113, and 125 (no. of fruit in a 19 kg box). Distal 10-cm sections of four shoots per tree were collected from four trees per treatment in Dec. 1985. These were lyophilized and ground with a Wiley mill to pass a 40-mesh screen. Carbohydrates were extracted and analyzed according to methods previously described (12, 22). An elemental analysis was also conducted using a Beckman Spectraspan V plasma emission spectrometer. Flower bud density, fruit set, and shoot growth were measured in 1986 as described for the preceding year.

Terminal shoot growth in 1984 was reduced by 41% with RSW0411 compared to 49% on trees treated with paclobutrazol (Table 1). This effect on vegetative growth was attributed largely to the furrow method of irrigation which concentrated the chemical toward the root zone to allow rapid uptake. Similar rates on comparable size trees at sites under sprinkler irrigation did not show such a noticeable first year effect on vegetative growth (data not shown). The effect of treatment on flower bud induction the first year was also evident by the increase in flowering the following spring (Table 1). There was no effect on fruit development in the year of treatment (data not shown). Trees treated with paclobutrazol in both 1985 and 1986 continued to show a reduction in shoot growth >90%; whereas shoots on those treated with RSW0411 were reduced 43% in 1985 and 53% in 1986 (Table 1). Flower bud induction in 1985 increased with reduced vegetative growth (Table 1). Both chemical treatments delayed anthesis 2 to 4 days. This delay may have contributed to the significant increase in fruit set on treated trees in 1985 in spite of a frost at the time of full bloom. Although fruit were not thinned in 1985, flower bud density and fruit set in 1985 were almost the same for all treatments (Table 1). Shoot tissue analysis indicated that trees treated with paclobutrazol and RSW0411 had higher levels of fructose and glucose than treated trees (Table 2). Paclobutrazol treated trees also had increased levels of Ca, P, Zn, and Fe (Table 3). There was no significant difference in the levels of Mg, K, B, Cu, or N among treatments (data not shown).

Fruit treated with paclobutrazol generally increased in diameter and were reduced in length, compared with both RSW0411 and control (Table 4). Fruit treated with RSW0411 had normal fruit shape characteristics. Firmness of fruit treated with paclobutrazol was higher than values obtained from both RSW0411 and controls. Firmness and carbohydrate values for RSW0411 treated fruit were between those for controls and paclobutrazol. Soluble solids from both paclobutrazol and RSW0411-treated fruit were greater than that from controls (Table 4). Differences occurred irrespective of fruit size. Levels of fructose, glucose, sucrose, and sorbitol in the juice were all higher in both chemical treatments compared to the control (Table 5). Reduction in acidity of fruit treated with paclobutrazol was greater than in RSW0411 treated fruit (Table 4).

PACLOBUTRAZOL AND RSW0411 ON STONE FRUITS

Some workers have controlled growth of various species with foliar applications of paclobutrazol (13, 28). Others believe, however, there is not enough consistency of results with soil and foliar methods (6, 29). Therefore, organic solvents were tested to carry triazoles through the bark tissue. Previous reports indicate trunk bark applications can be used to apply insecticides (15, 16), nutrients (20, 23), and growth regulators (1, 21).

In Apr. 1985, 48 trees of each of 6-year-old 'Bing' cherry and 7-year-old 'Red Gold' central leader-trained nectarine trees were selected for trunk bark treatment. Solutions containing 25,000 ppm of either paclobutrazol on RSW0411 were prepared by dissolving

Table 1. Shoot growth, percent fruit set, and number of buds/cm² of limb cross-sectional area of 4-year-old 'Ace Delicious' trees on seedling rootstock treated by soil injection in Mar. 1984 with paclobutrazol or RSW0411.[z]

	1984	1985			1986		
Treatment	Shoot growth (cm)	Shoot growth (cm)	Flower buds (no.)	Fruit set (%)	Shoot growth (cm)	Flower buds (no.)	Fruit set (%)
Control	64.7 a[y]	52.6 b	3.4 b	14.6 b	66.4 a	11.9 a	57.8 a
Paclobutrazol	33.0 c	4.9 c	8.1 a	83.6 a	3.6 c	13.0 a	49.3 a
RSW0411	38.4 b	29.8 a	5.0 ab	66.9 a	31.6 b	13.3 a	65.0 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.
[y]Frost during full bloom of controls.

Table 2. Carbohydrate analysis of shoot tissue excised in Dec. 1985 from 'Ace Delicious' trees treated by soil injection in Mar. 1984 with paclobutrazol or RSW0411.

Treatment	Carbohydrates (10^{-3}kg·kg^{-1} dry wt)			
	Fructose	Glucose	Sorbose	Sucrose
Control	2.72 c[z]	3.27 b	43.2 a	41.4 b
Paclobutrazol	3.60 a	3.87 a	40.2 a	50.1 b
RSW0411	3.16 b	3.38 ab	38.4 a	72.1 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

Table 3. Elemental analysis of shoot tissue excised in Dec. 1985 from 'Ace Delicious' trees treated by soil injection in Mar. 1984 with paclobutrazol or RSW0411.

Treatment	Elements			
	Ca (%)	P (%)	Zn (ppm)	Fe (ppm)
Control	1.63 b[z]	0.158 b	52.1 b	55.2 b
Paclobutrazol	2.33 a	0.188 a	96.5 a	89.8 a
RSW0411	1.65 b	0.161 b	63.9 b	79.6 ab

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

Table 4. Length, diameter, length/diameter (L/D) ratio, Stem length, firmness, soluble solids, and acidity of fruit harvested in Sept. 1985 from 'Ace Delicious' trees treated by soil injection in Mar. 1984 with paclobutrazol or RSW0411.

Treatment	Length (mm)	Diameter (mm)	L/D	Stem length (mm)	Fruit firmness (N)	Total soluble solids (%)	Acidity (%)[z]
Control	73.4 a[y]	75.9 b	0.98 a	26.1 a	68.6 c	12.4 b	0.270 a
Paclobutrazol	68.7 c	77.0 a	0.89 c	4.1 c	83.5 a	13.4 a	0.251 b
RSW0411	71.3 b	76.6 ab	0.93 b	15.7 b	75.4 b	13.9 a	0.260 ab

[z]As malic acid

[y]Mean separation within columns by Duncan's multiple range test, 5% level.

Table 5. Carbohydrate analysis of juice from fruit of similar size from 'Ace Delicious' trees treated by soil injection in Mar. 1984 with paclobutrazol or RSW0411.

Treatment	Carbohydrates (mg/ml juice)			
	Fructose	Glucose	Sucrose	Sorbose
Control	7.22 b[z]	5.23 b	0.51 b	0.75 b
Paclobutrazol	8.88 a	6.22 a	1.16 a	1.75 a
RSW0411	7.94 ab	5.56 ab	0.83 ab	1.37 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

formulated material in 100% WK Surfactant (E.I. DuPont De Nemours). These materials were applied to a 50-cm section of the tree trunk 10 cm above the soil line. An additional treatment consisted of loosely wrapping a conical shaped polyethylene skirt around the painted portion of the trunk. The tree trunk and polyethylene skirt were joined by wrapping with parafilm to prevent the chemical from washing down along the trunk into the root zone by either rainfall or sprinkler. The following treatments were made: a) solvent alone in 1985; b) solvent alone in both 1985 and 1986; c) 25,000 ppm paclobutrazol in 1985; d) 25,000 ppm paclobutrazol in 1986; e) 25,000 ppm paclobutrazol in 1985 and 1986; f) 25,000 ppm paclobutrazol in 1986 + skirt; and g) 25,000 RSW0411 in 1986.

Shoot growth of both nectarine and cherry trees was significantly reduced by all treatments in 1985 (Table 6). In 1986, the amount of growth reduction was less than in 1985. The greater effect in 1985 was likely due to the application of treatments a month earlier than in 1986. RSW0411 also showed an effect similar to paclobutrazol on nectarine and to a lesser extent on cherry. Reduction in leaf area correlated well with the reduction in shoot growth (Table 6). A continuous examination of the bark on treated trees has shown no phytotoxicity where the solvent was allowed to air dry. Gumming occurred when flagging ribbon was wrapped on the trunk of cherry trees immediately after application, and drying was not as rapid. There was some necrosis and peeling of the outer suberized layer with this particular carrier on younger trees.

Results of these experiments suggest an important alternative method of applying growth retarding materials to stone fruit trees. Advantages are an effect is seen the first year, a comparatively small amount of material is used, and contamination of the environment is reduced.

CONCLUSION

One of the concerns in field experiments with paclobutrazol has been the inconsistency of results among sites. Because the chemical

Table 6. Effect of trunk bark painting 'Bing' cherry or 'Red Gold' nectarine trees with a solution of 25,000 ppm paclobutrazol or 25,000 ppm RSW0411 in 100% DWK surfactant on shoot growth in 1985 and on shoot growth, total, and individual leaf area in 1986.

Treatment	Year		Shoot length 1985 (cm)	Shoot length 1986 (cm)	Total leaf area (cm^2)	Area/ leaf (cm^2)
	1985	1986				
Cherry						
Control	−	−	64.8 a[z]	65.7 a	1889.1 ab	65.2 ab
DWK	+	−	58.1 b	62.3 ab	1957.8 ab	67.4 ab
DWK	+	+	53.9 b	63.3 ab	1865.8 b	66.7 ab
DWK + Paclobutrazol	+	−	40.8 c	44.3 c	1629.3 d	54.3 c
DWK + Paclobutrazol	+	+	39.7 c	45.1 c	1746.3 c	61.7 b
DWK + Paclobutrazol	−	+		47.4 c	2034.4 a	61.2 b
DWK + Paclobutrazol (skirt)	−	+		46.4 c	1629.9 d	68.4 a
DWK + RSW0411	−	+		59.8 b	1922.3 ab	66.0 ab
Nectarine						
Control	−	−	69.1 a[z]	43.6 a	790.3 a	30.1 a
DWK	+	−	47.1 b	32.9 bc	770.2 a	30.1 a
DWK	+	+	47.9 b	35.2 b	822.8 a	27.6 a
DWK + Paclobutrazol	+	−	19.6 c	23.1 d	771.7 a	19.3 cd
DWK + Paclobutrazol	+	+	22.4 c	17.3 e	589.1 a	18.5 d
DWK + Paclobutrazol	−	+		29.7 c	665.7 a	21.3 c
DWK + Paclobutrazol (skirt)	−	+		28.8 c	679.6 a	24.2 b
DWK + RSW0411	−	+		22.4 d	574.8 a	22.9 bc

[z]Mean separation within commodity columns by Duncan's multiple range test, 5% level.

is most active systematically, and because conditions differ from plot to plot, responses have ranged from no effect to severe overdosing manifested as no terminal growth, reduced leaf size, and small fruit. This variability, together with the apparent persistence of the chemical in the environment or in the tree itself, in some instances has created long-term studies out of preliminary trials. Where small amounts of paclobutrazol were used as trunk applications on stone fruit to control growth, the results were outstanding for controlling excessive vegetative reduction. There is, however, a need for alternatives for controlling growth of pome fruit species.

Other compounds may significantly reduce vegetative growth while minimizing the risk of overtreatment. RSW0411 applied to apples at the same rate as paclobutrazol controlled growth to a desirable degree for three seasons. In 1987, trees treated with RSW0411 resumed normal growth; however, those treated with paclobutrazol are still showing signs of overtreatment (data not shown). Further research is needed to determine why the response to other chemicals differs from that of paclobutrazol.

By applying either paclobutrazol or RSW0411 to the trunks of stone fruit species in an organic solvent, such as DWK, one minimizes the deposition of the chemical in the environment. We have shown trunk applications to be an effective method of applying growth retardants to cherry and nectarine trees. By standardizing the length of trunk painted, the amount applied is directly proportional to the diameter of the tree, providing a simple metering system. Tree trunks covered with polyethylene skirts showed growth control the results and suggests the chemical penetrated the bark and was taken up through the xylem stream. This method of treatment could be useful in areas of low rainfall or where there is no above-ground irrigation.

Growth retardants can become valuable tools for fruit growers throughout the world. Research must continue to answer questions and to solve the problems which arise in the development of new technology.

Literature Cited

1. Backhaus, R.A., R.M. Sachs, and H.Z. Hield. 1986. Tree growth inhibition by bark application of morphactins. HortScience 11:578–580.
2. Barrett, J.E. and C.A. Bartuska. 1982. PP333 effects on stem elongation dependent on site of application. HortScience 17:737.
3. Batjer, L.P., M.W. Williams, and G.C. Martin. 1963. Chemicals to control tree size. Proc. Washington State Hort. Assn. 59:107.
4. Batjer, L.P., M.W. Williams, and G.C. Martin. 1964. Effects of N-dimethyl amino succinamic acid (B-Nine) on vegetative and fruit characteristics of apples, pears and sweet cherries. Proc. Washington State Hort. Assn. 85:11–16.
5. Curry, E.A. and M.W. Williams. 1983. Promalin or GA_3 increase pedicel and fruit length and leaf size of 'Delicious' Apples treated with paclobutrazol. HortScience 18:214–215.
6. Curry E.A., and M.W. Williams. 1984. A comparison of methods of application of growth retardants to apple and pear trees. Proc. Plant Growth Regulat. Soc. Amer. xx:151.
7. Curry, E.A. and M.W. Williams. 1986. Effects of Paclobutrazol on fruit quality: apple, pear and cherry. Acta Hort. 179:721–730.
8. Dalziel, J. and D.K. Lawrence. 1984. Biochemical and biological effects of kaurene oxidase inhibitors, such as paclobutrazol, p. 43–57. In: R. Menhennett and D.K. Lawrence (eds.). Biochemical aspects of synthetic and naturally occuring plant growth regulators. British Plant Growth Regulat. Group, Monogr. 11.
9. DeJong, T.M. and J.F. Doyle. 1984. Leaf gas exchange and growth responses of mature 'Fantasia' nectarine trees to paclobutrazol. J. Amer. Soc. Hort. Sci. 109:878–882.
10. Fellman, J.K. and W.H. Loesher. 1986. Comparative studies of sucrose and manitol utilization in celery (Apium graveolens L.) Physiol. Plant. (In Press.)
11. Hedden, P. and J.E. Graebe. 1985. Inhibition of Gibberellin biosynthesis by paclobutrazol in cell-free homogenates of *Cucurbita maxima* endosperm and *Malus pumila* embryos. J. Plant Growth Regulat. 4:111–122.
12. Henry, M.J. and H.D. Sisler. 1984. Effects of sterol biosynthesis-inhibiting fungicides on cytochrome-P-450 oxygenations in fungi. Pesticide Biochem. Physiol. 22:262–275.
13. Jackson, J.E. 1981. Chemical control of shoot growth. Rep. E. Malling Res. Sta. p. 25–27.
14. Jaggard, K.W., D.K. Lawrence, and P.V. Biscoe. 1982. An understanding of crop physiology in assessing a plant growth regulator on sugar beet. In: J.S. McLauren (ed.). Chemical manipulation of crop growth and development. Butterworths, London.
15. Jeppson, L.R., M.R. Jesser, and J.O. Complin. 1952. The trunk application as a possible method of using systemic insecticides on citrus. J. Econ. Entomol. 45:669–671.
16. Norris, D.M. 1967. Systemic insecticides in trees. Annu. Rev. Entomol. 12:127–148.
17. Quninlan, J.D. 1981. New chemical approaches to the control of fruit tree form and size. Acta Hort. 120:95–106.
18. Quinlan, J.D. and A.D. Webster. 1982. Effects of the growth retardant PP333 on the growth of plums and cherries. Proc. XXI Int. Hort. Congress, p. 1071.
19. Raese, J.T. and E.C. Burts. 1983. Increased Yield and suppression of shoot growth and mite populations of 'd'Anjou' pear trees with nitrogen and paclobutrazol. HortScience 18:212–214.
20. Sachs, R.M. and W.P. Hackett. 1972. Chemical inhibition of plant height. HortScience 7:440–448.
21. Shearing, S.J. and T. Jones. 1986. Fruit tree growth control with Cultar-which method of application? Acta Hort. 179:505–512.
22. Sterrett, J.P. 1985. Paclobutrazol: a promising growth inhibitor for injection into woody plants. J. Amer. Soc. Hort. Sci. 110:4–8.
23. Tukey, H.B., R.L. Ticknor, O.N. Hinsvark, and S.H. Wittwer. 1952. Absorption of nutrients by stems and branches of woody plants. Science 116:167–168.
24. Wample, R.L. and E.B. Culver. 1983. The influence of paclobutrazol, a new growth regulator, on sunflower, J. Amer. Soc. Hort. Sci. 108:122–125.
25. Wiggins, T.E. and B.C. Baldwin. 1984. Binding of azole fungicides related to diclobutrazol to cytochrome P-450. Pesticide Sci. 15:206–209.
26. Williams, M.W. and G.C. Martin. 1967. Quantitative gas chromatography of sugars and related polyhydroxy compounds in horticultural crops. HortScience 31:68–69.
27. Williams, M.W., R.D. Bartram, and W.S. Carpenter. 1970. Carryover effect of succinic acid 2,2-dimethylhydrazide on fruit shape of Delicious apples. HortScience 5:257.
28. Williams, M.W. and L.J. Edgerton. 1983. Vegetative growth control of apple and pear trees with ICI PP333 (paclobutrazol) a chemical analog of Bayleton. Acta Hort. 137:111–116.
29. Williams, M.W., E.A. Curry, and G.M. Greene. 1986. Chemical control of vegetative growth of pome and stone fruits trees with GA biosynthesis inhibitors. Acta Hort. 179:453–458.