Increasing Branching of Landscape Pear Trees With Promalin and Dikegulac-sodium[1]

Tadeusz Jacyna[2], Christopher J. Starbuck[3] and Mark R. Ellersiek[4]
Stark Brothers Nursery and Orchards Co
Louisiana, MO 63353

Abstract

One-year-old trees of *Pyrus calleryana* 'Bradford', 'Aristocrat' and 'Redspire' on 'OHF 97' rootstock were treated in a nursery with foliar sprays of Promalin at 750 or 1500 ppm ai or dikegulac-sodium (Atrimmec) at 1440 or 2880 ppm ai in June 1989. Untreated trees of the three pear cultivars averaged less than one branch per tree at the end of the season, while 'Bradford' and 'Aristocrat' treated with Promalin at either concentration averaged over 10 and 'Redspire' averaged 9. Dikegulac promoted branching of all cultivars however, unlike Promalin, reduced tree height and resulted in visibly narrower branching angles.

Index words: branching, feathering, Promalin, Atrimmec, growth regulators.

Species used in this study: Callery Pear (*Pyrus calleryana* L.).

Growth regulators used in this study: Promalin (BA + GA_{4+7}), *N*-(phenylmethyl)-1*H*-purin-6-amine + (1α,2ß,4aα,4bß,10ß)-2,4a,7-trihydroxyl-1-methyl-8-methylenegibb-3-ene-1,10-dicarboxylic acid 1,4a-lactone; Atrimmec (dikegulac), 2,3:4,6-bis-*O*-(1-methylethylidene)-a-L-*xylo*-2-hexulofuranosonic acid.

Significance to the Nursery Industry

Demand is increasing for branched landscape trees that are small enough to be easily planted by the homeowner but also have a form that adds immediate appeal to the landscape. While tree producers are responding to this demand, growth habits of some species, such as *Pyrus calleryana* make production of small branched trees difficult. The results of this research indicate that foliar application of Promalin to one-year-old trees in June increases branching considerably without reducing tree height. Promalin-treated trees had over ten times as many branches as untreated trees. This technique should make production of branched landscape pear trees much more practical. While Atrimmec also increased branching, the effect was less dramatic and the trees were generally less aesthetically pleasing than Promalin-treated trees.

Introduction

Retail nursery customers often want an inexpensive tree that is easily planted but of a size and form that will add immediate appeal to the landscape. Wholesale nurseries have responded to this demand by producing sizable bare root and container-grown trees. One problem often encountered in producing this type of plant material is poor branching. While it may be possible to attain adequate size in one growing season, it is difficult to induce branching with some species. This is particularly true for cultivars of *Pyrus calleryana* such as 'Bradford' and 'Aristocrat' (4). Branching varies with species, cultivar, rootstock, cultural practices, propagation technique and climate (4, 9). Although mechanical removal of shoot tips increases lateral shoot production by nursery trees, the resulting tree structure is undesirable in that crotch angles tend to be too acute (7). Physiologically, the branching process is regulated by a phenomenon called apical dominance, which is controlled by a balance between auxin and cytokinin levels within the plant (12).

Since Sachs and Thimann (12) first reported that cytokinins were active in releasing buds from apical dominance, several researchers have reported success in inducing branching of different species with foliar applications of BA or Promalin (BA + GA_{4+7}) (2, 5, 6). Dikegulac-sodium (Atrimmec) has also been used as an agent to promote branching of some plants (1, 10).

The objectives of this research was to determine whether Promalin or Atrimmec could be practically used to promote branching of landscape pear cultivars during field nursery production.

Materials and Methods

In June 1989, 45 one-year-old, uniform budded trees each of *Pyrus calleryana* 'Bradford', 'Aristocrat' and 'Redspire' were selected in nursery rows at Stark Brothers Nursery in Louisiana, MO. The average initial heights of 'Bradford', 'Aristocrat' and 'Redspire' trees were 119, 118 and 97 cm (47, 46 and 38 in) respectively. Three 3-tree replicates of each cultivar were sprayed to runoff with tap water, Promalin (BA and GA_{4+7}) at 750 or 1500 ppm ai or Atrimmec (dikegulac-sodium) at 1440 or 2880 ppm ai. Buffer X at 3000 ppm was included as a surfactant for Promalin treatments as indicated by label instructions. Adjacent trees were shielded during spraying, and depending on the cultivar, the spray was confined as much as possible to the foliage on the terminal 30–45 cm (12–18 in) of each tree by directing the spray. At the time of treatment, the trees had no branches. Trees were not pruned at planting or during the experiment.

In October, height and number of branches (longer than 1 cm [0.4 in]) above and below the lower limit of the treatment zone were determined. Branch count data were transformed by sx = square root of (x + 1) to normalize the distribution before analysis of variance and mean separation by Least Significant Differance.

[1]Received for publication September 30, 1993; in revised form February 17, 1994. University of Missouri Agricultural Experiment Station Publication No. 12,007.

[2]Research Specialist. Present address: Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY 14456

[3]Associate Professor of Horticulture, Plant Science Unit, University of Missouri, Columbia, MO 65211.

[4]Research Assistant Professor, University of Missouri, Columbia, MO 65211.

Table 1. Total branch numbers and numbers of branches in the upper and lower parts of trees of three cultivars of landscape pear sprayed with Promalin and Atrimmec.

Plant Growth Regulator	Conc (ppm)	Cultivar								
		Bradford			Redspire			Aristocrat		
		upper[y]	lower	total	upper	lower	total	upper	lower	total
Control		0.0d[z]	0.0b	0.0e	0.3b	0.8a	1.1b	0.4c	0.1b	0.5c
Promalin	750	9.9a	0.7b	10.6b	6.2a	2.7a	8.9a	10.9a	1.1b	12.0a
Promalin	1500	11.6a	1.7a	13.3a	6.7a	2.6a	9.1a	10.3a	2.2a	12.5a
Atrimmec	1440	2.6c	0.4b	3.0d	4.6a	1.6a	6.0a	2.2b	0.9b	3.1b
Atrimmec	2880	5.8b	0.3b	6.1c	5.2a	1.6a	6.8a	3.8b	1.8a	5.6b

[z]Means within a column followed by the same letter are not significantly different at the .05 level. Analysis of variance and mean separation with LSD were conducted using square root transformed data. Values shown are actual means.

[y]Upper and lower refer to the zones above and below the lower limit of spray application respectively.

Results and Discussion

Both Promalin and Atrimmec strongly affected branching of each cultivar (Fig. 1). Controls had fewer total branches than plants treated with either growth regulator product at either concentration (Table 1). Promalin at both concentrations increased branching of 'Bradford' and 'Aristocrat' more than either concentration of Atrimmec. The high concentration of Promalin induced more branching in the lower part of 'Bradford' trees than did the high concentration of Atrimmec. These results are similar to those reported by Keever et. al. (5) in which container grown, Promalin-treated 'Bradford' trees produced up to 12 times more branches than untreated controls.

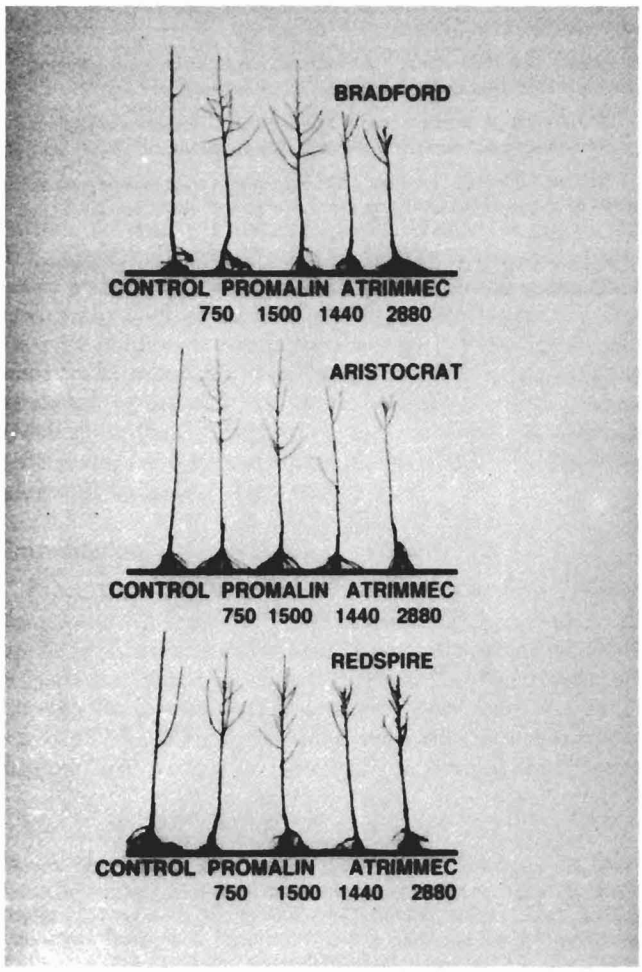

Fig. 1. Computer enhanced photographs showing the characteristic growth habits of 'Bradford', 'Aristocrat' and 'Redspire' pear trees treated with tap water (control), Promalin at 750 ppm or 1500 ppm or Atrimmec at 1440 or 2880 ppm.

Most of the branch promotion occurred in the upper part of the tree (above the lower limit of treatment) for each cultivar. However, the average number of branches in the lower parts of 'Bradford' and 'Aristocrat' trees treated with 1500 ppm Promalin was greater than that on the lower part of controls (Table 1). Since BA is readily transported to the area above the application zone (11), increased axillary development of plants treated with Promalin usually occurs at and above the treated area (6). The results of this study are consistent with these findings. Previous research has, however, shown that BA can move both acropetally and basipetally in plants (8). Increased branch formation below the application zone by Promalin-treated 'Bradford' and 'Aristocrat' trees suggests that there was basipetal movement of growth regulators, especially in trees treated with the high rate of Promalin.

The branching pattern of 'Redspire' trees was different from those of 'Bradford' and 'Aristocrat'. 'Redspire' control plants tended to have more branches in the lower half of the tree than did controls of the other two cultivars (Table 1). The genetic inclination of 'Redspire' trees to produce lower branches diminished the potential for a response to Promalin. This characteristic may explain why the number of lower branches on Promalin-treated 'Redspire' trees was not significantly different from that on controls, while it was for trees of the other two cultivars.

The upper portions of 'Bradford' and 'Aristocrat' trees were more responsive to Promalin than Atrimmec, whereas 'Redspire' was equally responsive to both chemicals (Table 1). Varietal differences in response to growth regulating chemicals have been reported by others (2, 6). While the reasons for such differences are not clear, it is possible that varietal differences in quantities of endogenous auxins and cytokinins might have made the cultivars differentially responsive to Promalin (an exogenous cytokinin source) or Atrimmec (an auxin suppressor). Similar results with other plants have been reported (1).

Atrimmec-treated trees in this study produced short branches with visibly more acute branch angle, thus making these trees unattractive (Fig. 1). Reduction in tree height caused by Atrimmec is usually associated with a decrease in

Table 2. Final heights (cm) of trees of three cultivars of ornamental pear sprayed in June with Promalin and Atrimmec[y].

Plant Growth Regulator	Conc (ppm)	Cultivar		
		Bradford	Redspire	Aristocrat
Control		166a[z]	135a	166a
Promalin	750	163a	135a	160a
Promalin	1500	164a	128b	155a
Atrimmec	1440	138b	117c	117b
Atrimmec	2880	129c	113c	115b

[z]Means within a column followed by the same letter are not significantly different at the .01 level (LSD).

[y]Note: Initial height of Bradford = 119 cm; sprayed above 79 cm. Initial height of Redspire = 97 cm; sprayed above 68 cm. Initial height of Aristocrat = 118 cm; sprayed above 84 cm.

crotch angle of branches produced before growth regulator treatment (10).

There was a distinct difference in the effects of the two materials on tree height. While Atrimmec at both concentrations reduced the plant height of trees of all cultivars, Promalin had no effect on tree height (Table 2). Promalin and Atrimmec have different modes of action in promoting lateral bud development. Promalin is believed to work sequentially with an initiation of bud growth stimulated by BA and subsequent elongation caused by GA_{4+7} (2). Atrimmec, being a morphactin, inhibits terminal bud development, thereby destroying apical dominance and inducing axillary branching (3). This difference in mode of action may explain the difference in the form of trees treated with Promalin and Atrimmec.

While both Promalin and Atrimmec increased branching of the three cultivars of *P. calleryana* studied, Atrimmec-treated trees were significantly shorter at the end of the study than were controls and Promalin-treated trees. Promalin-treated 'Bradford' and 'Aristocrat' trees had increased branching both above and below the lower limit of treatment, making them more aesthetically pleasing than Atrimmec-treated trees (Fig. 1).

Literature Cited

1. Bocion, P.F. and W.H. deSilva. 1975. Group of new chemicals with plant regulatory activity. Nature 258:142–143.

2. Cody, C.A., F.E. Larsen and R. Fritts, Jr. 1985. Stimulation of lateral branch development in tree fruit nursery stock with GA_{4+7} + BA. HortScience 20:758–759.

3. desilva, W.H., P.F. Bocion and H.R. Walther. 1976. Chemical pinching of azalea with dikegulac. HortScience 11:569–570.

4. Haserdot, H. and T.D. Sydnor. 1983. Growth habit of five cultivars of *Pyrus calleryana*. J. Arboriculture 9:160–163.

5. Keever, G.J., W.J. Foster, J.W. Oliver and M.S. West. 1993. Increasing 'Bradford' pear crotch angles and lateral shoot counts with benzyladenine and promalin sprays. HortScience. 28:678.

6. Miller, P. 1983. The use of promalin for manipulation of growth and cropping of young sweet cherry trees. J. Hort. Sci. 58:497–503.

7. Quinlan, J.D. and K.R. Tobutt. 1990. Manipulating fruit tree structure chemically and genetically for improved performance. HortScience. 25:60–64.

8. Pieniazek, J. and L.S. Jankiewicz. 1965. Acropetal and basipetal transmission of 6-benzylamino purine, effect on dormant apple seedlings. Bull. Acad. Polon. Sci. 13:607–609.

9. Preston, A.P. 1968. Pruning and rootstocks as factors in the production of primary branches on apple trees. J. Hort. Sci. 43:17–22.

10. Ramirez, H., A. Rumayor and V. Martinez. 1983. Induction of feathers by growth substances in nursery apple trees. Acta Horticulturae 137:83–85.

11. Sterrett, J.P. and P.L. Hopkins. 1980. Response of apple buds to pressure injection of abscisic acid and cytokinin. J. Amer. Soc. Hort. Sci. 105:917–920.

12. Sachs, R. and K.V. Thimann. 1967. The role of auxins and cytokinins in the release of buds from dominance. Amer. J. Bot. 54:136–144.