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# Stimulation of Lateral Branch Development in Tree Fruit Nursery Stock with $GA_{4+7}$+BA

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***Abstract.*** **Spray applications of 1000 and 2000 ppm Promalin to scion growth of first year nursery trees of 'Bartlett' pear (*Pyrus communis* L.). 'Bing' cherry (*Prunus avium* L.), and 'Oregon Spurr II Delicious' apple (*Malus domestica* Borkh.), when scion growth was 40 to 60 cm, generally caused increased lateral branching in the nursery. Double applications of Promalin at reduced concentrations also showed promise. Chemical treatments usually affected neither branch angle or length on pear, often increased branch angle on apple, and often increased both length and angle on cherry. Tree height and caliper usually were unaffected. Chemical name used: $GA_{4+7}$+BA (Promalin).**

The use of well-branched nursery trees for orchard planting can shorten the time to commercial fruit production (16). The effect of cytokinins for overcoming apical dominance in many tree fruit, nut, and citrus cultivars has been well documented, and its use generally has stimulated quiescent lateral buds and subsequent lateral branch development (2, 6, 10, 12, 14, 17, 20). Promalin, a proprietary formulation of the cytokinin, BA and $GA_{4+7}$, (or a similar treatment) has been tested for its ability to induce lateral branching, with encouraging results (3, 4, 5, 7, 8, 9, 18, 19).

This paper reports the use of Promalin, BA alone, and Promalin plus added BA for production of branched, one-year nursery trees of 'Bartlett' pear, 'Bing' cherry, and 'Oregon Spur II Delicious' apple under central Washington conditions. 'Bartlett' pear represents an easily branched cultivar, whereas 'Bing' cherry and all spurred 'Delicious' apples that we have tested represent very resistant types (11).

Treatments listed in Table 1 were applied in June of 1982 at a commercial nursery near Quincy, Wash. Concentration and timing were determined by preliminary experiments at the same nursery in 1981. Where noted, a 2nd application of Promalin was made 1 week after an initial Promalin treatment to compare single and double treatments. Proprietary formulations of BA and Promalin were used in all experiments (Abbott Laboratories, N. Chicago, IL 60064). Promalin is a mixture of 1 $GA_4$: 1 $GA_7$ (1.8%w/w), but the ratio of $GA_4$ and $GA_7$ in the mixture is undisclosed. The upper 18 to 20 cm of actively growing scions of test trees were sprayed thoroughly with atomizer-type hand sprayers in June to wet bark and exposed leaf surface (15–20 ml/tree according to tree size) when trees reached a height of 40 to 60 cm. Buffer X at 3000 ppm (as suggested by Abbott Laboratories printed bulletins and personal communication) was included with all Promalin and BA treatments as a surfactant. A mechanical heading treatment was included, representing a common commercial practice, to stimulate branching. Three to 4 cm of shoot tip were removed on 15 June for apple and pear and on 22 June for cherry. An untreated control also was used. Three replications of 3 trees each were used for all treatments, using trees of uniform caliper and height.

Final data collection was made in November of the treatment year, just prior to digging. Only branches 10 cm in length or greater were counted and measured. Branch angles were measured to the nearest 5.0°C using a protractor. Trunk diameters were measured at a point 15–20 cm above the bud union where no swelling of the union occurred. Tree height was measured from the bud union. The 1982 results generally supported those of the previous year, and only the 1982 data are presented here. Few significant differences were observed in trunk diameter and tree height, and these data are, therefore, omitted and only significant differences are mentioned later in the text. Height to first branch was measured but did not vary significantly among chemical treatments, and no data are included.

*'Bartlett' pear.* An increase in the number of lateral branches was noted for single applications of 1000 and 2000 ppm Promalin (Table 1). A double 250 ppm Promalin, 250 ppm BA alone, and Promalin plus added BA (500/500 and 1000/500 ppm) promoted a significant increase in branching compared to controls, but there were few other significant differences among chemical treatments. Buffer X treated trees did not have statistically lower branch numbers than trees with the above treatments, and Buffer X treated trees were not better than controls. Previous observations regarding natural branching tendencies and ease of chemical stimulation with this cultivar (11) suggest that it does not exhibit strong apical dominance. It does not seem likely that Buffer X would have any effect on this process, however.

There was no significant difference in lateral branch length among chemical treatments or between chemical treatments and the control. Mechanical heading produced longer branches than any chemical treatment, but branch angle was more acute than controls. There were few other differences in branch angle.

Promalin at 250 ppm, double 500 ppm Promalin, and the 500/250 ppm Promalin/BA treatments caused significant tree height and trunk diameter reductions compared to the control or mechanical heading (data not shown).

*'Bing' cherry.* Miller (13) obtained increased spur and lateral shoot development from Promalin used on sweet cherries already planted in the orchard. Difficulty in inducing lateral branching of sweet cherries in the nursery has been reported previously (11, 15). Several treatments from this study showed promise for nursery use.

A single application of 2000 ppm Promalin produced significantly more branching than controls, mechanically headed trees, trees treated with Buffer X alone, or several of the other chemical treatments (Table 1).

There was little difference in branch length among chemical treatments, but many treatments produced longer branches than controls. All treatments produced wider branch angles than controls. Branch angles were wider on chemically treated trees than on headed trees, but differences were not always significant.

Mechanically headed trees were shorter and usually had smaller trunk diameters than other trees, but no difference was noted between chemical treatments and controls (data not shown).

*'Oregon Spur II Delicious' apple.* As with sweet cherries, resistance to chemical induction of branching in the nursery has been reported for spurred 'Delicious' (11). However, 'Oregon Spur II Delicious' responded favorably to some chemical branching treatments (Table 1). Single 1000 and 2000 ppm Promalin, double 250 and 500 ppm Promalin, and all Promalin plus BA treatments produced significantly more branches than controls, Buffer X and BA alone. The former treatments also produced greater branching than mechanical heading, but the differences were not all significant. Few significant differences were noted in branch length and angle.

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Table 1. The effect of $GA_{4+7}$+BA (Promalin), benzyladenine (BA) alone, combination sprays, and mechanical heading in the nursery on branching habit of 'Bartlett' pear, 'Bing' cherry, and 'Oregon Spur II Delicious' apple.[z]

| Treatment | Concentration (ppm) | 'Bartlett' Laterals/tree | 'Bartlett' Mean lateral length (cm) | 'Bartlett' Branch angle (°) | 'Bing' Laterals/tree | 'Bing' Mean lateral length (cm) | 'Bing' Branch angle (°) | 'Oregon Spur II Delicious' Laterals/tree | 'Oregon Spur II Delicious' Mean lateral length (cm) | 'Oregon Spur II Delicious' Branch angle (°) |
|---|---|---|---|---|---|---|---|---|---|---|
| Promalin[y] | 250 | 4.4 bc[x] | 37.1 b | 60.3 abc | 2.7 bcde | 40.7 abc | 39.2 ab | 4.7 bcd | 21.0 c | 60.1 a |
| | 500 | 6.7 abc | 46.8 b | 56.6 abc | 4.1 abcd | 39.1 abc | 40.4 ab | 4.7 bcd | 21.8 c | 58.6 ab |
| | 1000 | 7.9 ab | 42.3 b | 57.5 abc | 5.0 abc | 29.6 cd | 41.9 a | 6.6 ab | 23.7 c | 55.1 ab |
| | 2000 | 9.8 a | 29.7 b | 58.6 abc | 7.1 a | 38.6 bcd | 45.7 a | 5.1 abc | 26.1 c | 50.7 abc |
| Promalin (double appl.) | 250 | 8.7 ab | 42.0 b | 60.9 abc | 4.7 abcd | 37.0 bcd | 39.8 ab | 7.4 ab | 26.2 c | 54.4 ab |
| | 500 | 6.1 abc | 28.5 b | 54.9 bc | 3.2 bcde | 41.7 abc | 37.4 ab | 7.9 a | 28.3 bc | 51.2 abc |
| Promalin + BA | 250/250 | 5.1 abc | 39.8 b | 60.5 abc | 3.0 bcde | 47.7 ab | 41.4 a | 5.6 ab | 30.1 bc | 62.0 a |
| | 500/250 | 5.8 abc | 44.1 b | 56.9 abc | 2.9 bcde | 46.8 abc | 37.8 ab | 5.0 abc | 30.5 bc | 64.5 a |
| | 500/500 | 8.6 ab | 45.3 b | 59.9 abc | 3.6 bcde | 42.1 abc | 38.4 ab | 5.3 abc | 26.1 c | 59.7 a |
| | 1000/500 | 9.1 ab | 42.0 b | 59.6 abc | 5.6 ab | 36.5 bcd | 45.9 a | 5.3 abc | 25.6 c | 57.3 ab |
| BA | 250 | 8.2 ab | 37.9 b | 67.0 a | 2.2 cde | 38.7 bcd | 36.4 ab | 1.7 de | 30.7 bc | 62.3 a |
| | 500 | 4.3 bc | 32.3 b | 65.5 ab | 5.1 abc | 43.5 abc | 41.3 a | 1.1 e | 44.6 b | 50.0 abc |
| Mechanically headed | --- | 4.3 bc | 68.0 a | 51.3 c | 2.3 cde | 56.3 a | 29.2 b | 2.2 cde | 72.8 a | 46.0 abc |
| Buffer X | 3000 | 6.1 abc | 32.9 b | 63.6 ab | 1.8 de | 47.1 abc | 35.7 ab | 1.2 e | 26.4 c | 30.6 c |
| Control | --- | 1.9 c | 42.5 b | 67.1 a | 1.0 e | 21.2 d | 15.6 c | 1.6 de | 18.3 c | 37.6 c |

[z]Figures are means of 3 replicates of 3 trees as measured Nov. of 1982. Treatments made 8 June (apple) or 15 June (pear, cherry), 1982, except the double Promalin also was treated 8 June (pear), 15 June (apple), or 22 June (cherry). Average tree height at application, 61.6 cm (pear); 40.9 cm (cherry); 40.0 cm (apple).

[y]Proprietary mixture of BA and $GA_{4+7}$ in a mixture of 1 $GA_4$ : 1 $GA_7$ (1:8% w/w) is undisclosed.

[x]Mean separation within columns by LSD, alpha = 0.05.

Only 2000 ppm Promalin produced trees significantly shorter than controls. Smaller truck diameters occurred with 250 and 500 ppm Promalin, 500 ppm double Promalin, 500/500 ppm Promalin/BA, and the mechanically headed trees (data not shown).

Promalin showed considerable commercial potential for the production of well-branched, one-year trees of 'Bartlett' pear, 'Bing' sweet cherry, and 'Oregon Spur II Delicious' apple in Washington nurseries. This potential was especially encouraging in view of previous experience with sweet cherries and spurred 'Delicious' apples (11). Single applications of 1000 or 2000 ppm Promalin increased branching compared to the controls. The use of double Promalin applications appeared to merit further trial.

It has been suggested that the components of Promalin play a sequential role in lateral shoot production, with an initiation of growth stimulated by BA and subsequent elongation promoted by $GA_{4+7}$ (1). However, the effect on branch numbers of equal concentrations of BA alone and Promalin in the present trial generally were similar. This similarity indicates that GA may not always be necessary, or, at least, that the small positive effect may not be sufficient to justify the cost. These results agree with another recent study (7) that obtained similar branching responses from BA and BA + $GA_{4+7}$, and the author suggested that the effect of $GA_{4+7}$ was primarily physical rather than physiological.

Although some chemical treatments that produced desirable branching had some negative effect on tree size, this effect was rarely of statistical significance and probably of little commercial importance. Branch angle and length tended to be reduced on pears by chemical treatment, but the differences were rarely significant. On the other hand, chemical treatment often increased branch length and angle of cherry and branch angle of apple.

Stimulation of lateral branching by mechanical heading did not usually produce adequate branch numbers or desirable branch angles and had significant negative effects on tree size.

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