**FINAL REPORT**

**WTFRC Project #CH-02-202** **WSU Project #13C-3655-3298**

**Project title**: Induction of branches (feathers) in sweet cherry trees in the nursery and orchard

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**Objectives:**

1. Evaluate use of bark-injury techniques (scoring, notching) in conjunction with growth-stimulator bioregulator treatments (cytokinins, gibberellins, cyclanilide, other products) under orchard conditions for improving the effectiveness of branch induction in young trees at the dormant and green-tip growth stages.
2. Assess the relation of timing of green-tip treatments on efficacy of branch development and quality of the lateral branches formed.
3. Assess the effect of cyclanilide on branch development in young, vigorous sweet cherry trees in the orchard. Examine the potential for combining chemical branch induction with later treatments of Apogee and/or Ethrel for stimulation of flowering and cropping.
4. Determine the relationship of cultivar and vigor level to responses to cyclanilide.
5. Evaluate cyclanilide and cytokinin/gibberellin applications to sweet cherry trees in the nursery on overall development of the trees, development of lateral branches (feathers) and occurrence, if any, of phytotoxicity or other negative side effects.
6. Assess the relation of timing of applications in the nursery to development of branching, location of branch development on the tree, number, angle and quality of the lateral branches formed.
7. Relate the height of cyclanilide-induced branching in nursery trees to height of the shoot tip at the time of application to develop a criterion for determining the correct application timing for desired branch height on feathered trees.

**Significant findings**:

Over the three-year period of this project, 44 trials were undertaken to assess a variety of methods of bioregulator use with or without bark-injury treatments at various times of the growing season to encourage profuse lateral branching in unpruned sweet cherry trees. Unpruned young sweet cherry trees produce virtually all branching from the terminal portion of shoots due to their very strong apical dominance. Trials were initiated to examine the potential of cyclanilide to induce bud development in the spring on buds from the previous growing season as well as buds on 2-year-old wood. Other trials examined the potential for application of scoring and notching with and without supplemental treatment with various bioregulators at the green-tip stage for stimulation of lateral branch formation. Applications of various bioregulators during spring after shoot growth began were made to evaluate the usefulness of those products for breaking apical dominance and induction of branching during the growing season.

**Methods**:

Over the three-year period of this project, 44 trials were undertaken to assess various aspects of bioregulator use for induction of branching in fall/winter, at the green-tip stage of development in the spring, and during the active growing season. Trials were conducted on young, non-fruiting sweet

cherry trees on Mazzard seedling and on Gisela rootstocks. Bioregulators tested included cyclanilide, Promalin®, Maxcel®, and thidiazuron (TDZ), a powerful cytokinin. Products were applied alone or in combination as sprays or dispersed in latex paint in conjunction with various bark injury treatments, such as scoring, notching, girdling or vertical cuts.

**Results and discussion**:
During the course of this project, progress was made on all objectives. Detailed results are not available for 2004 projects as of this writing (September 2004) but observations will be reported here. The following results and conclusions have been obtained during the three years of this project:

***A. Induction of branching during the dormant period (fall, winter).***

1. Cyclanilide at up to 5,000 ppm and/or Promalin® at up to 500 ppm applied in latex paint as bands over 3-4 buds on the mid-shoot to lower-shoot portions of the previous season's shoot growth prior to budbreak on the cultivars 'Bing' and 'Rainier' was ineffective at inducing any bud development that spring, either from treated buds or from any other buds on the treated shoots.
2. Cyclanilide at up to 15,000 ppm mixed with Superior spray oil as an adjuvant was applied to trunks and trunk crowns in either October or March, before budbreak of young trees of 'Bing', 'Rainier', 'Skeena' or PC8011-3 cherry trees to test the potential for translocated effects on branching. Although positive effects of such treatments have been found in pear, no beneficial effects on branch induction in sweet cherry trees were observed.

***B. Induction of branching during the bud break period (green-tip).***

1. At green tip, painting one-year-old buds on the previous season's shoot growth or painting bands around the bark between buds with up to 5,000 ppm Promalin did not produce any benefit on lateral-branch development in young 'Bing' or 'Skeena' trees.
2. Painting buds at green-tip with cyclanilide at up to 1,000 ppm or painting notched buds with 250 ppm cyclanilide did not produce significant lateral branch development in young 'Bing' or 'Skeena' trees.
3. Scoring vertical, one-year-old vigorous shoots every foot, starting at one foot below the terminal, did not increase the number of shoots but did improve their vertical distribution, assuring that some emerged from the lower portions of the scored shoots.
4. Scoring plus Promalin treatment appeared to be most effective at green-tip. Similar treatments applied two weeks after green-tip did not produce as strong a response.
5. Notching and disbudding improved branching somewhat but did improve the formation of new branches from the lower portions of treated shoots.
6. Scoring one-year-old shoots plus painting the cuts with 5,000 ppm Promalin increased lateral branching up to fivefold in 'Bing', 'Rainier' and 'Lapins' trees while also assuring that good lateral branching took place from the lower portions of shoots, where branching normally does not occur.
7. Promalin only works well as a branch-induction treatment in sweet cherry when the bark barrier is interrupted with some form of injury at the time of Promalin application. Promalin applied to scores, girdles or notches produces a strong branching response in vigorous trees in the total absence of pruning.
8. Treating vertical cuts with Promalin showed that the Promalin branching effect moves mainly downward, only slightly laterally. Thus, the way Promalin is used can influence the location of resultant branching.
9. Applying Promalin along with a bark-injury method also produces branching on horizontal shoots, but the induced branches are less vigorous that those produced on vertical shoots.
10. Notching or scoring plus Promalin applied to two-year-old branch sections did not produce much benefit in terms of lateral branching. There was a tendency to induce the formation of a few

strong, vertical, sucker-like shoots, which could only be made useful if careful follow-up management was used to train those shoots before they harden into position.

11. Concentrations of Promalin above 5,000 ppm should either not be used or used with great care. Treatments with 10,000 ppm Promalin produced phytotoxic effects on the cambium in one trial.
12. Care should be taken to use tools for scoring that do not produce a wide cut. In these trials, use of a saw blade of 2.0 mm width produced a girdling effect that resulted in considerable damage. Girdling does not improve the branching response. Scoring should only be done with a sharp knife blade.
13. Notching can be done with a blade of up to 1.0 mm width; a greater width of cut subjects the tree to possible excessive injury.
14. In two years of applying knife and saw cuts to young cherry trees at green-tip, not one infection of bacterial canker occurred as a result, even when rain took place on the same day as the injury treatments were applied. These results should not be interpreted to mean that bacterial canker infection is not a serious risk when using bark-injury methods. More research is needed to assess the level of risk for bacterial canker bark injury poses at this time of year.
15. Notching and disbudding techniques, which do not involve an overall interruption of apical dominance as does scoring, lost effectiveness in the lower portions of treated shoots. Apparently the apical dominance effect in shoots increases with distance from the terminal; this increased effect is most easily overcome with methods such as scoring plus bioregulator treatments that produce a strong interruption of apical dominance.
16. Notching is used commercially to increase branching in young trees. In our trials, notching alone produced a success rate of between 18 and 37% (i.e., only one out of every 3-5 notched buds produced a shoot).
17. To this point in the research program, effective branch induction using scoring and Promalin is very labor intensive. Further work is planned to determine if more efficient ways can be found to obtain the tremendous improvement in branching we have seen without as much investment of time in labor.

***C. Induction of branching during the early season (shoot growth just starting).***

1. Cyclanilide sprays at up to 100 ppm with or without Promalin (500 ppm) applied to the lower halves of one-year-old, vertical leader shoots of ‘Bing’ and ‘Sweetheart’ trees when shoot growth was just beginning had no effect on inducing lateral branching from the treated sections.

***D. Induction of branching during the growing season.***

1. In trials on young, non-fruiting trees of ‘Bing’, ‘Rainier’, ‘Skeena’ and ‘Tieton’, cyclanilide at 50-500 ppm applied when new terminal shoots were 18-30 cm in length produced lateral branching from the actively growing new shoots. The new shoot growth occurred from the group of lateral buds that were in the shoot tips at the time of treatment. A single treatment with cyclanilide temporarily interrupts apical dominance, producing a flush of new shoots.
2. Using Promalin alone (250-500 ppm) or combining it with cyclanilide has produced some benefits in some trials and little improvement in branching in other trials. Cyclanilide appears to be a more consistent branching agent for cherries.
3. Preliminary trials with thidiazuron (TDZ, Dropp®) at 100 ppm produced bud activity but did not result in normal lateral branch development. Further work is needed at different concentrations to fully assess the potential benefit of this powerful cytokinin-like bioregulator for branch induction in sweet cherry trees, as well as more work with combinations of TDZ with other branch-induction materials.
4. Applying cyclanilide at 200 ppm did not significantly improve branch formation over 100 ppm but substantially increased phytotoxicity on leaves.

5. Cyclanilide or cyclanilide plus Promalin treatments to older wood of ‘Sweetheart’ trees when shoot growth was about 19 cm in length did not result in any improvement in branching.
6. Observations indicate that cyclanilide-induced branching is directly dependent on the vigor of the treated shoots at the time of treatment. The best branching response is found in vertical shoots, a weaker branching response is observed in inclined or horizontal shoots, and a poor response is obtained when trees are not growing strongly.
7. Preliminary trials have been carried out with double applications of cyclanilide to try to improve the branching response under orchard conditions. So far, double applications under orchard conditions have not produced a strong benefit in terms of branching.

***E. Nursery applications.***

1. Cyclanilide at 50-100 ppm has produced excellent feathering in ‘Bing’, ‘Skeena’ and ‘Lapins’ trees in the nursery.
2. Using Promalin alone (250-500 ppm) or combining it with cyclanilide has produced some benefits in feathering in some trials and little improvement in other trials. Cyclanilide appears to be a more consistent feathering agent for nursery cherry trees.
3. Timing cyclanilide treatments is critical, since the location of induced feathers depends on tree height at the time of treatment. Preliminary work has been carried out to develop a reliable criterion for determining the timing of cyclanilide applications in relation to the height at which lateral branching is desired. Different markets demand branching at different heights, hence the importance of a reliable timing criterion.
4. In 2003, detailed trials suggested that cyclanilide-induced feathering was induced at 10-18 cm ABOVE the height of the shoot tip at the time of treatment. This observation confirms the hypothesis that the buds that are activated by cyclanilide are those deep in the shoot tip at the time of treatment. Hence cyclanilide produces a very localized, as well as temporary, interruption of apical dominance.

**Summary**:
Effective treatments for interrupting sweet cherry apical dominance and inducing lateral-branch formation have been developed for the early spring (green-tip) timing and for later, after shoot growth has begun. The approaches at these two times are quite different. At green-tip, the objective is to induce pre-existing buds on the previous season’s (one-year-old) shoots to develop into branches. At this timing, the most successful branching has been obtained where the bark barrier is interrupted and mixtures of cytokinin/gibberellic acid (e.g., Promalin®) are applied to the wounded area(s). Simple painting of buds or scoring or notching alone is not sufficient to assure an effective branching response. In addition, auxin-metabolism inhibitors such as cyclanilide are ineffective at this time, even when the bark barrier is interrupted. At this point in this research program, the methods that are most effective for green-tip branch induction are very labor intensive. Further research is needed to develop more efficient means of obtaining the same or better results for less cost.

After shoot growth has begun, chemical branch induction is only possible on buds on the new, green shoot growth being produced that season. Treatments applied at this time that are effective on green tissue do not stimulate branch development from older, pre-existing buds on the woody portions of the tree. At this time of year, both auxin-metabolism inhibitors and cytokinin/GA mixtures are effective for lateral branch induction, but the auxin inhibitor cyclanilide appears to be more effective. Because only buds deep in the shoot tip are induced to grow, the timing of the application directly affects where the new branches develop. Because the interruption of apical dominance is temporary, a flush of branches develops, but it has not been possible thus far to produce any kind of sustained branching from one or two applications of either auxin-inhibiting or cytokinin-based growth-promoting bioregulators. Flowering the year following branch-induction treatments in non-fruiting

trees has not been increased. It is anticipated that increased lateral branching will benefit productivity over a longer term period.

The growing season-type branching treatments have been most effective and appear to have the most useful application for production of branched trees in the nursery. With the move to size-controlling roostocks and higher density plantings for sweet cherry, we expect the demand for branched trees from the nursery will increase greatly.

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**Summary of total project costs:**

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| Project duration: | Three years |
| Total project costs: | $25,048 |