FINAL PROJECT REPORT

WTFRC Project Number: CH-05-508 (WSU Project 13C-3655-7299)

Project Title: Induction of Branches in Sweet Cherry Trees in the Orchard

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Budget History:

Item	**Year 1:** 2005	**Year 2:** 2006	**Year 3:** 2007
Salaries	4,200	4,368	4,543
Benefits	1,302	1,485	1,545
Wages	1,500	2,000	2,400
Benefits	240	220	276
Equipment	0	0	0
Supplies	500	800	1,000
Travel	2000	2,500	3,000
Miscellaneous	500	500	500
Total	10,242	11,873	13,264

Significant findings 2005:

- Scoring/Perlan (2,000 ppm) treatments to one-year-old unheaded leaders of two-year-old 'Sweetheart'/Mazzard trees at various times after green-tip showed best branching at 2-4 weeks after green-tip. This observation coincided with an extensive period of cold temperatures after green-tip.
- Two-year-old 'Sweetheart'/Mazzard tree central leaders were left unheaded and scored once in the middle of the leader shoot. Perlan (2,000 ppm) was equally effective for branch induction when applied to scoring cuts up to 24 hours after the cut was made.
- Thidiazuron, a powerful cytokinin product, was painted on two-year-old wood of three-year-old 'Sweetheart'/Mazzard trees at green-tip. At up to 500 ppm, this treatment was ineffective for producing new branching from the older wood.
- Unheaded leader shoots on second leaf 'Skeena'/Mazzard trees produced significant branching when scraped or notched bark was treated with Perlan (5,000 ppm) at green-tip. A light sanding of the bark plus Perlan paint did not result in additional branch development.
- Leader shoots on second leaf 'Lapins'/Mazzard trees were left intact or lightly headed. Leaders were then scored every 12 inches, notched every 12 inches or disbudded (one left/three removed). Painting scores or notches with Perlan (5,000 ppm) produced much branching, while painting disbudded sites produced no branching response.

Significant findings 2006:

- Where half-score cuts plus cytokinin treatment were made on the outside half of vertical, one-year-old leader shoots, the number of shoots formed was increased by two to five fold, with a large number of those shoots appearing on the lower two-thirds of the treated leader shoots.
- Half-score cuts on the outside portion of the leaders definitely promoted preferential lateral branching on the outside half of the treated leader shoots, mainly on the lower portions of those leaders.
- Shoot development was induced to some extent above a score plus cytokinin application as well as below the point of treatment.
- There was very little movement of the stimulative effect of a partial score or nicking cut plus cytokinin treatment laterally around the treated stem.
- Branch-induction results clearly showed that making cuts every 12 inches along the leader was just as effective for stimulating shoot development as making two or three times as many cuts plus cytokinin treatment (every 4 or 8 inches), thus reducing the labor input required.
- Successful lateral-branch induction did not require any attention be paid to the location of a half-scoring or nicking cut relative to nearby buds.
- Where various mixtures of cytokinin plus adjuvants were applied to unscored bark, no beneficial effect of the treatment on shoot development was observed.
- Scoring plus treatment with 5,000 ppm GA_{4+7} in 'Skeena' cherry was almost as effective for shoot induction as treatment with 6-benzyladenine alone.
- Application of thidiazuron (TDZ) at 1,000 ppm or of chlorophenylurea (CPPU, Prestige) at 500 ppm without added GA produced a weaker shoot induction response than normally observed when Promalin (5,000 ppm) is painted on scoring cuts. When GA_{4+7} was added to either cytokinin and painted on scoring cuts, shoot induction was the same as for the standard Promalin treatment.
- The only shoot-induction treatment with positive results on newly-planted 'Rainier'/G.5 trees was disbudding. The low vigor of their growth in year one did not allow for significant expression of bioregulator-mediated shoot induction.
- When cytokinin was mixed with 10 ppm of fixed Cu and applied to half-scoring cuts, the branch-induction effect was undiminished; thus Cu has no negative effect on the efficacy of cytokinin.

Significant findings 2007:

- Crushing the bark of one-year-old shoots of either 'Sweetheart'/Mazzard or 'Skeena'/G.6 trees with a pair of pliers did not induce branching per se. When Promalin was painted on the crushed bark, branch development was just as effective as if the bark had been scored or notched.
- Most surfactant supplements were not effective in aiding penetration of Promalin through uninjured bark of 'Sweetheart' trees.
- Combining 2,000 mg/liter Promalin with 1.5% v/v Pentra-bark and 2.5% v/v Agri-fos and applying directly to uninjured bark produced branching equivalent to the normal scoring plus Promalin (2,000 mg/liter) treatment.
- Painting the undiluted Promalin formulation (20,000 mg/liter) combined with 0.1% v/v Regulaid or with 1% v/v Pentra-bark on uninjured bark produced the same branching as the standard treatment with no evidence of foliar or bark phytotoxicity.
- Treating scoring cuts in one-year-old wood of second leaf 'Skeena'/G.6 trees with gibberellic acid alone produced as much lateral branching as treating with a cytokinin*/GA* mixture at the same concentration.
- Applied to scoring cuts at 5,000 mg/liter, GA_3 (Pro-Gibb 40) was less effective for inducing lateral branching than either GA_4 (Novagib 10L) or GA_{4+7} (Provide 10SG).

Results and Discussion:
Several points have been confirmed during this project. We demonstrated that if the epidermis on one-year-old wood is broken, the cytokinin product becomes very effective for branch induction. Underlying tissues do not need to be cut or damaged; therefore, large or deep cuts with heavy knives or saws do not improve branching. We showed that crushing bark with pliers was sufficient to breach the epidermis. This approach reduces the risk of personal injury to workers or excessive damage to trees by eliminating the need for knives. Disbudding produces points of injury but these are not sufficient to permit enough bioregulator to enter to achieve additional branching. We further confirmed that epidermal cuts do not need to be located above buds (i.e., notching), since the bioregulator moves from the point of absorption to nearby buds. Placing cuts on one side of a branch (nicking cuts) permits stimulation of branching primarily from one side of the shoot, which is useful if multiple leaders are being trained. The translocation of the cytokinin bioregulator is primarily downward from the site of application, producing the tendency for a directional response. Cu can be mixed with cytokinin bioregulators and applied to cuts without any negative effect on branching response. Since we have never observed a bacterial canker infection associated with branching, we do not know if this approach would eliminate the risk of such an infection. We do know that adding Cu to cytokinin does not affect the branching response. When cuts are made on one-year-old wood for branch induction, there is no reason to apply cuts closer than about 12 inches apart down the shoot. Closer treatments have not proven more effective for branching, since some translocation of bioregulators takes place from the site of the cut. Also heading back the shoot tip does not improve branching in the mid to lower parts of a one-year-old shoot, so heading should be avoided unless there is some other reason to make the cut. We also tried applying thidiazuron (TDZ), a powerful cytokinin, to two-year-old wood to stimulate branching; we did not cut into the bark and we did not see any branching response.

During this project we discovered that gibberellic acid (GA) alone appears to have the ability to stimulate lateral branching. This observation is interesting since GA is not normally associated with the control mechanism of apical dominance. In addition the presence of GA may help explain why cytokinin/GA mixtures work well for branch induction. However, based on the limited data we have acquired thus far, this observation deserves confirmation. Preliminary results from one trial suggest that GA_3, the isomer used routinely in the cherry industry for control of fruit maturity and flesh firmness, is not as effective as GA_4 or GA_7 for vegetative growth stimulation. This observation remains unconfirmed.

We have obtained encouraging results from initial tests of the concept of using apical-dominance-modifying bioregulators for branching without the requirement of injuring the bark. If we could eliminate the bark injury requirement, we could cut the labor cost for this procedure by at least 50%, reduce the risk of personal injury to workers and reduce, or eliminate, the potential for bacterial canker infections. Initial trials have focused on two approaches: 1) using higher concentrations of bioregulators to determine branching efficacy and potential for phytotoxicity and 2) combination of bioregulators with specific supplements known to strongly enhance penetration of products into plant tissues. We have seen initial positive results from using the undiluted formulation of Promalin and from combining regular concentrations of Promalin (2,000 to 5,000 ppm a.i.) with an additive named "Pentra-Bark" (Quest Products Corp). We plan to continue these studies to determine what approach appears to give the best results with the least risk of phytotoxicity. With further research we believe we will be able to eliminate the need for bark injury as a component of the process of lateral branch induction in young sweet cherry trees.

References:

Elfving, D.C. and D.B. Visser. 2007. Improving the efficacy of cytokinin applications for stimulation of lateral branch development in young sweet cherry trees in the orchard. HortScience 42:251-256.