FINAL PROJECT REPORT

WTFRC Project Number: CH10106

Project Title: Branch induction in two-year-old wood of sweet cherry

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Other funding sources: NONE

Total Project Funding: $5,875

Budget History:

Item	2010	2011
Salaries[1]	0	0
Benefits[1]	0	0
Wages[2]	1,000	1,500
Benefits[2]	150	225
Equipment	0	0
Supplies[3]	200	300
Travel[4]	1,000	1,500
Miscellaneous	0	0
Total	2,350	3,525

[1] No technical help indicated since Technician position no longer exists. Time-slip help is absolutely essential to collect the volume of data needed to set up trials and evaluate growth responses to the various bioregulator applications involved.

[2] Time-slip help substitutes for unfilled Technician position. Time-slip benefit rate is calculated at 15%.

[3] This category includes miscellaneous supplies, non-capital equipment, consumables, repairs, etc. that are needed to carry out the research project.

[4] Treatment application and data collection at distant sites, all off-station. Includes vehicle lease-to-purchase, operating, repair costs.

Objectives:

1. Test cytokinins without GA to determine efficacy for stimulation of lateral branch development on two-year-old wood using both cuts and high surfactant concentration additives to evaluate efficacy of cytokinins for bud activation and penetrability of older bark.
2. Assess whether supplementation or substitution of cytokinin-based treatment solutions with GA produces any beneficial effect on branching of older wood.
3. Evaluate the characteristics of induced branches on older wood and determine follow-up strategies for modification of branch growth habit if needed.
4. Evaluate effects of treatments to older wood on pedicel development of flowers borne on treated wood sections.

Significant findings 2010:

1. All of the three orchards used for these studies experienced significant cold damage to buds and/or woody tissues from the Oct. 11, 2009 freeze event. The three orchards were located from Stayman Flats near Chelan, WA to the Sunrise orchard near Moses Coulee. In all three locations, the minimum temperature that night reached between 21 and 15°F during the freeze, and in all three locations the rate of temperature decrease overnight equaled or exceeded -1.8°F (-1°C) per hour, a rate sufficient to produce significant damage to unacclimated tissues.
2. In a comparison of Promalin, Maxcel and ProVide (Valent BioSciences) applied to scoring cuts on two-year-old wood of 'Sweetheart' trees, only Maxcel (5,000 ppm) showed some increase in branching over control, but extensive wood damage from cold (low of 21°F on Oct. 11, 2009) significantly compromised the branching potential in this trial.
3. Promalin (5,000 ppm) applied to scoring cuts only modestly increased lateral branching on two-year-old wood of 'Sweetheart' cherry trees compared to untreated control trees. Combining Promalin with Pentra-bark surfactant (Quest Products Corp.) at up to 15% v/v and applying these bioregulator/surfactant mixtures as bands to two-year-old wood of 'Sweetheart' cherry trees was completely ineffective for branch induction. Again, significant wood and bud damage, severe enough to result in the removal of some trees, compromised the results.
4. In a block of 'Early Robin'/Mazzard trees near the Columbia River (Stayman Flats), Promalin (5,000 ppm) applied to scoring cuts only increased branching from two-year-old wood by about two-fold. Bud damage due to cold appeared to limit branching potential. Mixing Promalin with Pentra-bark at up to 15% v/v and applying these mixtures as bands at intervals on two-year-old wood had no effect on branching.
5. Applying either scoring or bioregulator banding to two-year-old wood of 'Early Robin' trees either every 15 or every 30 cm along the two-year-old wood made no difference in branching response.
6. Two trials examined the effects of the surfactants Syl-Tac (Wilbur-Ellis) or Yucca-Aide (Monterey Ag Resources) as supplements for Promalin (2,000 ppm) when applied to scoring cuts or as bands on one-year-old wood of 'Sweetheart' cherry. All the experimental trees were subjected to a low of 15°F on Oct. 11, 2009, resulting in some dieback on terminals of one-year-old wood and an unknown amount of internal tissue damage. The death of the terminal portion of the one-year-old leader acted much as a heading-back cut, producing some stimulation of branching among the remaining live buds. Promalin plus scoring produced about twice the branching of untreated controls, suggesting that cold injury combined with the heading-back effect may have compromised the potential for additional branch induction with bioregulators.
7. In both of these trials, Syl-Tac at 2, 5 or 10% v/v and Yucca-Aide at 0.25, 2 or 15% v/v improved branching as much as did scoring plus Promalin. The other surfactant-concentration

treatments were ineffective. Terminal dieback on one-year-old wood was present in almost every tree in each trial. The uneven branching response to surfactant supplementation may have been due in part to non-visible vascular damage in the treated branch sections.

Significant findings 2011:

1. Four trials, two on one-year-old wood and two on two-year-old wood, were established in a young orchard of 'Bing'/G.6 trees near Wenatchee, WA. Two trials on two-year-old wood of 4th-leaf 'Chelan'/Mazzard trees were established in Pasco. One trial was established on two-year-old wood on 5th-leaf 'Selah'/Mazzard trees in East Wenatchee. The trees turned out to have suffered variable amounts of tissue and bud damage from the late Nov. 2010 freeze event, with the trees near Wenatchee more severely affected. Although the leader shoots on the Wenatchee 'Bing' trees were unpruned, every tree suffered some killing of the upper portion of the new leader shoot that grew in 2010. Thus the trees in spring, 2011 behaved as if they had been headed back in the winter, creating a stimulus for lateral-branch development due to interrupted apical dominance.
2. In a comparison of several different cytokinin/gibberellic acid products applied to scoring cuts at green-tip on two-year wood of 'Chelan' trees that suffered only minor cold damage, scoring alone was no better than no treatment for induction of branching.
3. On both two- and three-year-old 'Chelan' wood, any bioregulator product (Maxcel, Promalin, Pro-Gibb, ProVide, Novagib or GA_7 alone) combined with Syl-Tac surfactant (0.5% v/v) and applied to scoring cuts 15 cm apart resulted in improved branch induction.
4. Surprisingly, on older 'Chelan' wood, any gibberellic acid formulation applied to scoring cuts produced better lateral-branch induction than 6-benzyladenine (Maxcel) alone.
5. In contrast, on two-year-old wood of winter-injured 'Bing'/G.6 trees, any GA + scoring did not induce branching as well as Maxcel (6-BA only) + scoring. Is this a varietal difference or somehow related to the winter damage situation?
6. Increasing the concentration of Promalin combined with Regulaid surfactant applied to scoring cuts on two- and three-year-old wood of 'Selah' trees resulted in a comparable improvement in branching despite some cold injury to buds. Quality of branching at the highest Promalin concentration (20,000 ppm, undiluted product straight from the bottle, no Regulaid) was similar to that from lower concentrations (wide crotch angles, no upright suckers). Branch induction on older wood may be enhanced by higher bioregulator concentrations.
7. In a test of a variety of surfactants combined with Promalin (5,000 mg a.i./liter) and applied as sloppy bands every 15 cm without scoring cuts on 'Bing' trees near Wenatchee, no treatment produced any improvement in lateral branching.
8. Crotch angles of induced branches on two-year-old wood on young 'Bing' trees were unaffected by any treatment. In addition, no induced branches developed into upright suckers. The average crotch angle of induced branches was around 70° - 80°, resulting in desirably flat induced shoots with no evidence for promotion of undesirable sucker growth.
9. Despite post-treatment temperatures in the acceptable range, branching response of two-year-old wood of 5th-leaf 'Chelan'/Mazzard trees was quite limited, due in part to killing of some lateral buds by cold the previous November. Nevertheless, Promalin + scoring produced about a 6 to 10-fold increase in branching compared to untreated controls, scoring + surfactants only, or Promalin + surfactants painted onto unscored bark.
10. In April, 2011, two trials were conducted on one-year-old wood of young 'Bing'/G.6 trees on which a variable amount of that one-year-old wood had been damaged by cold the previous November.
11. Combining various surfactants with Promalin (5,000 mg a.i./liter) and applying those solutions as sloppy bands every 30 cm on the living portion of the one-year-old wood, lateral branching was improved by supplementation of Promalin with either Syl-Tac (5% v/v),

Pentra-bark (5% v/v) or Rocket DL (4% v/v). Lateral branching was similarly stimulated by scoring every 30 cm and painting the scoring cuts with Promalin plus Regulaid (1% v/v). Mixing the surfactants Prolec (0.5% v/v) or Canhance (10% v/v) with a similar concentration of Promalin and applying as sloppy bands did not result in improved branching.

12. Combining the surfactant Canhance (10% v/v) with various bioregulators, each at 5,000 mg a.i./liter and applying each solution to scoring cuts on one-year-old wood of young 'Bing'/G.6 trees, Promalin and Pro-Gibb produced an improvement of over 50% in lateral-branch development from treated wood. The gibberellins ProVide and GA_7 alone were nearly as effective. Canhance alone and Maxcel plus Canhance were completely ineffective for stimulation of branching.
13. Limited observations indicated that the presence of GA in a branch-induction treatment could increase pedicel length on fruit set on spurs on treated wood.

Methods:

Three trials were initiated in 2010 and five in 2011 to examine effects of cytokinins vs. gibberellins along with scoring vs. surfactant treatments on branch induction on two-year-old wood. Two additional trials were initiated in 2010 and two more in 2011 to examine in greater detail the potential for surfactants to substitute for scoring or nicking cuts in one-year-old wood in stimulating lateral branch development. The trials focused on whether surfactants could substitute for cutting the bark on two-year-old wood for encouraging penetration of bioregulators into active tissues, whether GA alone could induce branching on two-year-old wood as has been demonstrated for such treatments on one-year-old wood, whether the distance between scores or banded bioregulator treatments on two-year-old wood had any beneficial effect on branch induction, and whether concentration of Promalin influenced branching success on older wood.

Results and discussion:

One goal of the program was to determine whether gibberellic acid (GA) alone can induce lateral branching in two-year-old wood of sweet cherry. Previous research has clearly shown that GA alone is about as effective as cytokinin for branch induction in one-year-old wood. One advantage this finding confers is that GA products are OMRI-approved, and thus can be used in organic orchards. They are also a bit cheaper than Promalin. Winter injury precluded clear conclusions in 2010. In 2011 the branching results, although diminished to some degree by winter injury sustained in late Nov. 2010, showed that GA products alone were effective for branch induction on two-year-old wood in 'Chelan' cherry, but less strongly in 'Bing'.

In several of the trials, comparisons of surfactant concentrations vs. using scoring cuts to improve bioregulator penetration were undertaken. Despite some cold damage effects in these trials, it was clear that when we applied Promalin to scoring cuts, branching was improved to some extent in every case. These results showed that if there were live buds present on two-year-old wood and that wood had not been killed outright by either the 2009 or 2010 cold events, those living buds could be activated if the Promalin could penetrate into active tissues. Results of the two trials with one-year-old wood confirmed this observation.

In the case of the one-year-old wood, killing the terminal portion of those shoots altered the apical dominance situation by producing the equivalent of a heading-back cut. This physiological change resulted in a certain amount of increased branching, thus limiting the degree to which additional branching could be induced by the bioregulator applications themselves. On one-year-old wood, three surfactant treatments, Promalin plus either Pentra-bark (Quest), Rocket DL (Monterey) or Syl-Tac (Wilbur-Ellis) resulted in sufficient

bioregulator penetration into one-year-old wood to stimulate branching over and above the stimulus produced by cold damage to the upper portion of that wood.

None of the surfactant-supplemented treatments showed significant branching activity on two-year-old wood in the absence of scoring. It appears clear that surfactants alone, even at high concentrations (up to 15% v/v), do not provide a reliable method for assuring bioregulator penetration through the bark and into active tissues on two-year-old or older wood. Our trials indicate that successful branch induction on branch sections older than one year require some form of bark injury to open a path for successful penetration of bioregulators.

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Reports Published:

Elfving, D.C., D.B. Visser and J.L. Henry. 2011. Gibberellins stimulate lateral branch development in young sweet cherry trees in the orchard. **International Jour. of Fruit Sci. 11:41-54.**

Elfving, D.C. 2010. Plant bioregulators in the deciduous fruit tree nursery. **Acta Horticulturae 884:159-166.**

Elfving, D.C. and T.R. Schmidt. 2010. Bioregulator sprays. p. 133-146. In: M. Bush (coord.), **2010 Crop Protection Guide for Tree Fruits in Washington. EB 0419.**

Executive Summary

1. No surfactant tested, even at high concentration (up to 15 % v/v), was capable of producing sufficient penetration of cytokinin- or gibberellin-based bioregulators through the bark to successfully induce lateral branching on two- or three-year-old wood in young sweet cherry trees. Only when such bioregulators were combined with scoring cuts to permit penetration into living tissues did lateral branching occur on older wood.
2. Gibberellic acid (Pro-Gibb, Novagib, ProVide or GA_7) alone proved effective for induction of lateral branching on two- or three-year-old wood of sweet cherry trees when applied to scoring cuts. This observation suggests that these products may have a role for branch induction in organic sweet cherry orchards.