**FINAL PROJECT REPORT**

**Project Title:** Bioregulators, fruit loosening, mech harvest of sweet cherry

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**Other funding sources:** None

**WTFRC Collaborative expenses:**

| Item | 2007 | 2009 |
|---|---|---|
| **Stemilt RCA room rental** | | |
| **Crew labor** | 840 | 900 |
| **Shipping** | | |
| **Supplies** | | |
| **Travel** | 520 | 600 |
| **Miscellaneous** | | |
| **Total** | **1360** | **1500** |

**Total Project Funding:** **Year 1:** 15,518 **Year 2:** 17,723 **Year 3:** 19,427

**Budget History:**

| Item | **Year 1:** 2007 | **Year 2:** 2008 | **Year 3:** 2009 |
|---|---|---|---|
| **Salaries** | 7,000 | 7,500 | 8,000 |
| **Benefits** | 2,380 | 2,550 | 2,720 |
| **Wages** | 1,200 | 1,500 | 1,800 |
| **Benefits** | 138 | 173 | 207 |
| **Equipment** | 0 | 0 | 0 |
| **Supplies** | 800 | 1,000 | 1,200 |
| **Travel** | 4,000 | 5,000 | 5,500 |
| **Miscellaneous** | 0 | 0 | 0 |
| **Total** | 15,518 | 17,723 | 19,427 |

**Objectives:**

1. GA may provide a tool for crop-load adjustment in sweet cherries by reducing return bloom, but it also affects the current season's crop quality. Explore the possibility of finding a suitable GA program that both contributes to reduced return bloom and favorably affects current season's fruit quality.
2. Alternative approaches to loosening sweet cherries for mechanical harvest will be explored using new bioregulator products that directly inhibit auxin transport from the fruit. When auxin transport is reduced, abscission layers are supposed to become active and loosening should occur. Such products might also be useful in conjunction with reduced rates of ethephon. Reducing the ethephon rate reduces its negative effects on fruit quality.
3. Alternative products will be examined for potential activity to offset or negate the negative effects of ethephon on fruit quality.

**Significant findings 2007:**

1. Ethephon again effectively loosened 'Bing' cherries when applied approximately 14 days before harvest. However, only the lower concentration of ethephon (150 mg/liter a.i. or 0.5 pint/100 gallons) combined with "Pentra-Bark" penetrant reduced flesh firmness significantly. The factors that influence the relation between fruit loosening and firmness loss are unknown. No visible effects on defoliation were observed with any ethephon treatment.
2. Two known auxin transport inhibitors, cyclanilide and diflufenzopyr (DFFP), were tested on limbs of 'Bing' cherries for efficacy in loosening and effects on flesh firmness loss.
3. Cyclanilide at 500 mg/liter destroyed the crop due to phytotoxicity; this product does not appear promising.
4. The potent auxin transport inhibitor DFFP at 0.5-5 mg/liter a.i. did not induce fruit loosening, flesh firmness loss nor defoliation.
5. Methyl jasmonate (MJ) has been proposed as a possible fruit loosener for sweet cherries. At 1000 mg/liter a.i., MJ did not loosen fruit, stimulate flesh firmness loss or induce defoliation.
6. Applications of $GA_3$ and $GA_7$ to 'Rainier'/G.5 trees in 2006 produced a small reduction in flower buds per spur in 2007. In addition, $GA_3$ reduced flowers per bud in proportion to concentration, while $GA_7$ did not.
7. GA treatments on 'Rainier'/G.5 trees in 2006 did not produce significant effects on mean fruit size, brix, percent red color or percent of crop in fruit-size classes in 2007 at any of three harvests. Compensating fruit set on differential bloom may have accounted for this observation.
8. $GA_3$ at up to 75 mg/liter improved mean fruit size but had no effect on fruit firmness or total yield when applied in 2007 to 'Sweetheart'/G.5 trees. Bloom and crop characteristics data will be taken in 2008.
9. Cytokinin products applied to 'Bing'/G.1 trees 6 days after full bloom (fruit diameter 4.8±0.1 mm) failed to improve fruit size. The cytokinins were thidiazuron (TDZ, Dropp, Bayer Crop Science), forchlorfenuron (CPPU, Kim-C1 Co.), and 6-benzyladenine (BA, Maxcel, Valent Biosciences), each applied at either 10 or 50 mg/liter. These concentrations may not have been high enough to stimulate cell division in sweet cherry fruit.
10. The high rate of TDZ reduced fruit red color rating at harvest. The other cytokinin treatments had little effect. There were no significant effects of any treatment on fruit firmness at harvest.

**Significant findings 2008:**

1. 2008 was a difficult year for cherry growers. Extensive early cold and frost conditions compromised crop loads and crop quality in many orchards. No trials were carried out in 2008.
2. A GA trial on 'Sweetheart' cherry applied in 2007 to examine effects on crop load and fruit size in 2008 was damaged by spring cold temperatures in 2008 and was not evaluated.

**Significant findings 2009:**

3. Glycine-betaine [GB, the active ingredient in "Blue-Stim" (Monterey Ag. Resources, Fresno, CA)] had little effect on fruit removal force or any fruit-quality parameter at harvest in 'Bing' sweet cherries when applied on one of two dates (3 weeks before harvest or 1.5 weeks before harvest) or on both dates.
4. GB did NOT alter flesh firmness, but slightly darkened flesh red color.
5. Soil-applied Sil-Matrix (K-silicate, PQ Corp., Valley Forge, PA) drenched around the trunks of 'Bing' sweet cherry trees 6 and 3 WBH did not affect either fruit removal force or flesh firmness.
6. Sil-Matrix retarded external fruit color development when applied alone, but this effect was totally offset when ethephon was applied after Sil-Matrix had been applied.
7. Sil-Matrix had no effect on total soluble solids or titratable acidity, but reduced Sugar/Acid Ratio (SAR) when ethephon was also applied.
8. Sure-seal (Ca acetate hydrate, Agros Organics, Fair Lawn, NJ) is reported to control fruit cracking and may also favorably affect fruit flesh firmness or other fruit-quality parameters.
9. Sure-seal had no effect on fruit removal force but appeared to reduce flesh firmness nearly as much as, but not in addition to, ethephon.
10. Limited evidence suggests Sure-seal may have reduced fruit size, internal red flesh color, TSS and TA, but did not affect SAR.
11. In the three trials conducted in 2009, ethephon applied 2 WBH at 3 pt/acre consistently reduced fruit removal force from around 700 g to about 300 g, a level satisfactory for mechanically harvested fruit removal.
12. Ethephon also consistently reduced flesh firmness, improved both external and internal fruit color, reduced both TSS and TA, but had little effect on SAR.

**Results and Discussion:**

Since the repeated absence of beneficial effects of sprayable MCP (e.g., "Harvista") on control of fruit firmness loss in ethephon treated cherries (2003-2006), we have been exploring other possible options for loosening fruit. A main direction in 2007 was the examination of auxin-transport inhibitors, based on the physiological principle that auxin transport to an abscission zone keeps that group of cells healthy, preventing abscission. Once auxin flow is reduced, or eliminated, the abscission zone begins to deteriorate, which ultimately should lead to the separation of the fruit from the tree.

In 2007 we tested methyl jasmonate, diflufenzopyr (a powerful anti-auxin from Chemtura) and cyclanilide (another anti-auxin from Bayer) in comparison to ethephon alone or supplemented with the cytokinin forchlorfenuron (CPPU). Ethephon produced the same results as it has every year since 2001, namely, loosening of fruit with, in the case of 2007, little effect on flesh firmness except where the penetrant "Pentra-bark" was combined with ethephon. The factors that influence the relation between fruit loosening and firmness loss in ethephon treated fruit are unknown. At the concentrations used, the anti-auxins were ineffective for loosening fruit. Cyclanilide at 500 mg/liter produced substantial phytotoxicity to both leaves and fruit, but no loosening. The physiological activity in sweet cherry trees of methyl jasmonate is not understood, but it was also ineffective for loosening fruit. Since, with the notable exception of cyclanilide, there were no symptoms of any kind of phytotoxicity or defoliation due to any other treatment, it is possible that product concentrations were too low to produce abscission in sweet cherry trees.

In 2009, three products were tested either alone or along with a standard ethephon application (3 pt/acre 2 weeks before commercial harvest) to evaluate possible effects on fruit quality. Glycine-betaine (Blue-Stim), potassium silicate (Sil-matrix) and calcium acetate hydrate (Sure-seal) showed limited effects on fruit quality parameters at harvest, but in no case was the ethephon-mediated loss of

flesh firmness beneficially affected. In 2009 the ethephon effect on fruit was similar to its effects in the seven previous seasons in which it has been tested.

GA trials oriented toward managing crop load have so far not proven to produce as dramatic results as we had hoped. Because GA applications affect the current season's fruit maturity, as well as bloom formation for the next year, the concentration range must be chosen such that neither goal is unfavorably affected. So far, our results have been inconsistent, which may be a reflection of the differential effects of one season vs. another on factors that influence flower-bud induction and formation. This lack of predictable results, along with the increasingly severe effects of higher GA concentrations on fruit maturation, do not encourage further work at this time.

**References:**


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# EXECUTIVE SUMMARY

Over the three-year period 2007-2009, we explored other possible options for loosening fruit besides ethephon. In 2007 we tested methyl jasmonate, diflufenzopyr (a powerful anti-auxin from Chemtura) and cyclanilide (another anti-auxin from Bayer) in comparison to ethephon alone or supplemented with the cytokinin forchlorfenuron (CPPU). Ethephon produced the same results as it has every year since 2001, namely, loosening of fruit with, in the case of 2007, little effect on flesh firmness except where the penetrant "Pentra-bark" was combined with ethephon. The factors that influence the relation between fruit loosening and firmness loss in ethephon treated fruit are unknown. At the concentrations used, the anti-auxins were ineffective for loosening fruit. Cyclanilide at 500 mg/liter produced substantial phytotoxicity to both leaves and fruit, but no loosening. The physiological activity in sweet cherry trees of methyl jasmonate is not understood, but it was also ineffective for loosening fruit.

In 2009, three products were tested either alone or along with a standard ethephon application (3 pt/acre 2 weeks before commercial harvest) to evaluate possible effects on fruit quality. Glycine-betaine (Blue-Stim), potassium silicate (Sil-matrix) and calcium acetate hydrate (Sure-seal) showed limited effects on fruit quality parameters at harvest, but in no case was the ethephon-mediated loss of flesh firmness beneficially affected. In 2009 the ethephon effect on fruit was similar to its effects in the seven previous seasons in which it has been tested. Planned trials for 2008 were terminated due to excessive fruit damage due to severe frost incidence that year.

GA trials oriented toward managing crop load did not produce as dramatic results as had been hoped for. Because GA applications affect the current season's fruit maturity as well as bloom formation for the next year, the concentration range must be chosen such that neither goal is unfavorably affected. So far, our results have been inconsistent, which may be a reflection of the differential effects of one season vs. another on factors that influence flower-bud induction and formation. This lack of predictable results, along with the increasingly severe effects of higher GA concentrations on fruit maturation, do not encourage further work at this time.