**FINAL REPORT**

~~**WTFRC Project Number:** Internal program~~

**Project Title:** WTFRC internal pear projects


| | |
|---|---|
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**Cooperators:** Jim McFerson, Tom Auvil, Felipe Castillo, Tory Schmidt, WTFRC, Wenatchee, WA; Jonathan Toye, Extenday, NZ


**Budget:**

**Organization Name:** WTFRC **Contract Administrator:** Kathy Schmidt

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| Item | Year 1: 2008 |
|---|---|
| **Salaries** | 21,176 |
| **Benefits (32%)** | 9,965 |
| **Wages** | 7,914 |
| **Benefits (32%)** | 3,724 |
| **Equipment + supplies** | 1,500 |
| **RCA rental** | 640 |
| **Travel** | 500 |
| | |
| | |
| **Reimbursements** | 2,000 |
| | |
| **Total** | **43,419** |

Salaries: include proportional time spent on pear projects for Hanrahan, Castillo, Schmidt, Auvil

Wages: covers timeslip expenses, based on fiscal year (July 2007-June 2008)

RCA rental: 10% of one room to hold maturity samples (current rate approx. $6,400/room/year)

Travel: fuel costs to travel to and from trial sites

Reimbursements: monetary contribution by Extenday ($1,000 per trial)

Other: all chemicals were donated by industry suppliers

Comment: initial amount approved at 2008 Pear Review was $59,515.


Special thanks to our cooperating growers: Steve Hull, Don Weippert, Paul Strutzel, Hansen Fruit, Don Gibson, Dave Olson, Geoff Thornton, Andrew Sundquist, Rudy Bossart, Ray Schmitten, Jack Anderson, and John Verbrugge.

**OBJECTIVES:**

1. Investigate the effects of chemical thinners on pear crop load and fruit quality.

2. Determine the effects of Daybright reflective groundcover on horticultural performance of pear orchards.

**SIGNIFICANT FINDINGS:**

*Chemical thinning*: The most consistent performers in Washington pear chemical thinning trials are ammonium thiosulfate (ATS) applied during bloom and benzyladenine (BA) applied postbloom. Increases in individual fruit weight are often observed after benzyladenine application, even without significant fruitlet thinning.

*Reflective groundcovers*: Daybright reflective groundcovers improve yields in Bartlett by increasing fruit set and/or size.

**METHODS**

*Chemical thinning:* Within a set of 6 trials in 2008 we evaluated ammonium thiosulfate (ATS), and urea as bloom thinners, as well as BA (Exilis Plus, MaxCel, 6-BA) and NAA as postbloom thinners. ATS (4%) and urea (5%) were applied at 20 and 80% bloom (only 80% at grower-applied sites, both timings at PropTec sites), BA (1%) and NAA (3.6oz/100gal) at 10 mm fruitlet size. All experiments employed randomized complete block designs with 4 replicates. Two of last years trials were small plot trials sprayed with a Proptec tower sprayer operated by WTFRC staff. The remaining four trials were applied by grower-cooperators with their own commercial spray rigs, typically airblast sprayers.

Initial bloom counts were taken prior to treatment and compared to actual fruit set counts taken after June drop. From these data, we calculated the number of fruit set per 100 blossom clusters. We also recorded the quantity of fruit set in each cluster initially counted, allowing us to calculate how many clusters were blanked, thinned to single fruits, two fruits, etc. Return bloom counts of the same experimental units are recorded in the spring following treatment. Standard fruit quality parameters are assessed at commercial harvest, including: fruit size, soluble solids content, titratable acidity and firmness. Sampled fruit was visually graded for defects including: sunburn and russet.

*Reflective groundcovers:* Trials were conducted in two locations over three seasons (2006 - 2008). The first site (Sunnyside) was a mature Bartlett/seedling block with 4 x 13 ft. spacing, and trained to a v-trellis structure. The second site (Cashmere) was a young 'Bartlett' block, on an OH x F 87 rootstock, with 7 x 14 ft. spacing, and trained to a central leader structure. Daybright was applied from early bloom until harvest in both experiments. The general layout consisted of variable length strips of reflective ground cover applied in four or six plots across several orchard rows alternating with untreated control plots of approximately equal dimensions. Daybright reflective groundcover was placed in orchard alleyways and attached to the tree trunks with elastic bands (ca. 4 inches above ground), covering approximately 80% of intra-row space.

All samples were taken from trees in the middle row. For each experiment, yields and fruit maturity were determined from several individual trees per plot at harvest (4 in Cashmere, 8 in Sunnyside); the Cashmere block was strip-picked at harvest, while the Sunnyside block was picked twice, once for fresh market, and again for cannery pears. Fresh market pears were chosen based on fruit size (minimum 2.55 inches diameter). The remaining pears (cannery) were harvested immediately following the first pick. Fruit maturity parameters were assessed from 10

fruit per tree for each pick, including: fruit weight, firmness, starch, titratable acidity, soluble solids concentration, russet incidence, degree of sunburn.

**RESULTS AND DISCUSSION**

*Chemical thinning:* The Mt. Adams, Buena and Tonasket trials were sprayed by grower-cooperators, while those at Sawyer and Cashmere were applied with the WTFRC Proptec tower sprayer (Table 1).

Table 1. Crop load and fruit quality effects of WTFRC pear thinning trials. 2008.

| Treatment | Fruitlets/ LCSA $cm^2$ | Fruitlets/ 100 blsm clusters | Fruit diameter (in) | Fruit weight (g) | Box size | Sugars (% brix) | Acids (% m. acid) | Firmness (lbs) |
|---|---|---|---|---|---|---|---|---|
| **Bartlett / Seedling – Sawyer** | | | | | | | | |
| ATS | 2.3 ns | 52 ns | 2.6 ns | 200 b | 100 | 10.2 b | 0.316 a | 17.6 a |
| 6-BA | 1.4 | 48 | 2.7 | 212 a | 94 | 10.2 b | 0.270 c | 16.7 b |
| NAA | 1.8 | 64 | 2.6 | 198 b | 101 | 10.7 ab | 0.280 bc | 17.1 b |
| Urea | 2.1 | 49 | 2.6 | 203 ab | 98 | 11.4 a | 0.307 ab | 17.7 a |
| Control | 2.2 | 61 | 2.6 | 202 ab | 99 | 10.6 ab | 0.279 bc | 17.0 b |
| **Bartlett / OHxF.87 – Cashmere** | | | | | | | | |
| ATS | 2.3 ab | 34 a | 2.7 b | 211 b | 95 | 13.1 ns | 0.354 ns | 18.4 ns |
| 6-BA | 1.6 b | 21 b | 2.8 a | 232 a | 86 | 13.1 | 0.352 | 18.0 |
| NAA | 1.8 b | 28 ab | 2.7 b | 206 b | 97 | 13.1 | 0.359 | 17.6 |
| Urea | 1.8 b | 29 ab | 2.7 ab | 214 ab | 93 | 13.0 | 0.359 | 18.1 |
| Control | 2.9 a | 36 a | 2.6 b | 201 b | 99 | 13.3 | 0.356 | 17.8 |
| **Bartlett / OHxF.87 - Mt. Adams** | | | | | | | | |
| ATS | 6.1 ns | 73 ns | 2.6 c | 160 b | 125 | 11.0 ns | 0.243 ns | 18.0 a |
| 6-BA | 4.6 | 73 | 2.6 a | 171 a | 117 | 11.1 | 0.249 | 17.0 c |
| Urea | 5.0 | 76 | 2.6 b | 167 ab | 120 | 11.2 | 0.249 | 17.2 bc |
| Control | 4.9 | 80 | 2.6 b | 166 ab | 120 | 10.9 | 0.237 | 17.6 ab |
| **Bartlett / OHxF.97 - Mt. Adams** | | | | | | | | |
| ATS | 3.6 ns | 76 ns | 2.6 b | 171 ab | 117 | 11.2 ns | 0.311 a | 17.1 ns |
| 6-BA | 3.4 | 67 | 2.7 a | 178 a | 112 | 11.1 | 0.286 ab | 17.0 |
| Urea | 3.4 | 75 | 2.6 b | 170 b | 118 | 10.8 | 0.259 bc | 17.2 |
| Control | 4.5 | 84 | 2.6 ab | 170 b | 118 | 10.7 | 0.243 c | 16.9 |
| **Bartlett / Seedling – Buena** | | | | | | | | |
| ATS | 0.7 ab | 44 ns | 2.7 ns | 214 ns | 93 | 11.4 ns | 0.305 ab | 17.4 ns |
| Exilis Plus | 0.7 ab | 48 | 2.7 | 213 | 94 | 11.4 | 0.334 a | 17.1 |
| Urea | 0.5 b | 39 | 2.7 | 212 | 94 | 11.2 | 0.265 b | 17.3 |
| Control | 1.0 a | 52 | 2.7 | 206 | 97 | 11.5 | 0.292 b | 17.3 |
| **Bosc / OHxF.97 - Tonasket** | | | | | | | | |
| ATS | 1.3 ns | 85 b | no data | 251 a | 80 | 11.3 ns | 0.159 ns | 14.0 b |
| MaxCel | 1.5 | 97 a | no data | 219 c | 91 | 11.5 | 0.151 | 14.8 a |
| Urea | 1.5 | 79 b | no data | 237 b | 84 | 11.0 | 0.150 | 14.5 ab |
| Control | 1.7 | 98 a | no data | 211 c | 95 | 12.4 | 0.142 | 14.8 a |

Fruit set (fruitlets/100 clusters) was significantly reduced once with urea or ATS (Tonasket) and 6-BA (Cashmere), translating into higher individual fruit weight at harvest (Table 1). Although

BA did not thin fruitlets effectively, it generally improved final fruit size. Soluble solids, titratable acidity and fruit finish were not affected by any treatment. Chemical thinning effects on fruit firmness are inconsistent: firmness was increased once with ATS and urea, and decreased once with 6-BA and ATS.

Since 2003 we have conducted 25 pear thinning trials, testing an array of bloom (ATS, urea, CFO+LS, LS) and postbloom (BA, NAA) thinners. Table 2 summarizes our results. The overall goals when using crop load adjustment methods are: reduction of fruit set (indicated by fruitlets/100 blossom clusters); increase in mean fruit weight; and consistent annual bearing (indicated by return bloom). ATS and BA products have shown utility in pear blossom and fruitlet thinning. More importantly, BA typically improves final fruit size even in the absence of fruitlet thinning (Table 2).

Table 2. Incidence of statistically significant results for three key crop load parameters. WTFRC pear chemical thinning trials 2003-2008.

| *THINNING AGENT* | *FRUITLETS/100 BLSM CLUSTERS* | *MEAN FRUIT WEIGHT* | *RETURN BLOOM* |
|---|---|---|---|
| NAA | 0/6 (0%) | 0/6 (0%) | 0/2 (0%) |
| ATS | 7/25 (28%) | 5/24 (21%) | 2/17 (12%) |
| Urea | 1/17 (6%) | 3/17 (18%) | 0/11 (0%) |
| CFO + LS | 0/3 (0%) | 1/13 (8%) | 1/2 (50%) |
| LS | 1/13 (8%) | 3/13 (23%) | 0/13 (0%) |
| BA | 3/12 (25%) | 6/10 (60%) | 2/5 (40%) |

*Reflective groundcovers:* Daybright, a reflective groundcover manufactured by Extenday, was applied for the third consecutive year in 2008 in an established Bartlett block on a V-trellis (Sunnyside) and a young Bartlett block (Cashmere) from early bloom to harvest. Each year of the trial, fruit was harvested in two picks at Sunnyside and a single pick in Cashmere. Timing and duration of commercial harvest was not affected by Daybright at either site in 2008. Significant results include (Table 3, 4):

- Overall yield was increased by 10.5% in Cashmere, due to increased fruit set.
- Daybright decreased individual fruit size by 1.5% in Cashmere.
- Sugar content was decreased and acidity increased in Cashmere.
- Daybright-treated fruit from the first pick in Sunnyside was larger.
- In Sunnyside, firmness and sugar content increased, while acidity decreased.

Table 3. Yield effects of WTFRC pear reflective groundcover trials. 2008.

| Treatment | Total yield kg/tree | Total fruit ct fruit/tree | Yield efficiency fruit/TCSA | Yield efficiency kg/TCSA | 1st pick kg % of total | 2nd pick kg % of total |
|---|---|---|---|---|---|---|
| **Bartlett / Domestic - Sunnyside** | | | | | | |
| Daybright | 25.1 ns | 128 ns | 1.1 ns | 0.21 ns | 92 ns | 8 ns |
| Control | 25.6 | 136 | 1.1 | 0.21 | 89 | 11 |
| **Bartlett /OHxF.87 - Cashmere** | | | | | | |
| Daybright | 71.3 a | 383 a | 4.6 ns | 0.85 ns | no data | no data |
| Control | 64.5 b | 342 b | 4.4 | 0.83 | no data | no data |

Table 4. Fruit quality effects of WTFRC pear reflective groundcover trials 2008.

| Treatment | Sugars (% brix) | Acids (% malic acid) | Firmness (lbs) | Weight (g) | Diameter (in) |
|---|---|---|---|---|---|
| **Bartlett / OHxF.87 - Cashmere** | | | | | |
| Daybright | 11.4 b | 0.329 a | 17.3 ns | 203 b | 2.66 b |
| Control | 11.9 a | 0.313 b | 17.0 | 217 a | 2.70 a |
| **Bartlett / Domestic – Sunnyside (Fresh pick)** | | | | | |
| Daybright | 10.8 a | 0.256 b | 17.6 a | 199 a | 2.64 a |
| Control | 10.2 b | 0.279 a | 17.4 b | 190 b | 2.57 b |
| **Bartlett / Domestic – Sunnyside (Cannery pick)** | | | | | |
| Daybright | 10.5 ns | 0.255 b | 17.9 ns | 123 ns | 2.26 ns |
| Control | 10.3 | 0.273 a | 17.7 | 122 | 2.25 |

During the three year trial period, Daybright application resulted in consistently higher yields in two years at both sites (Figure 1). 2008 results suggest that Cashmere fruit set gains were offset by smaller fruit size (10% higher yields with loss of ½ box size). In Sunnyside, yields were comparable, but fruit was ½ box size larger (Table 4).

Reflective groundcovers have shown utility in modern pear plantings and young orchards. Trials with Daybright reflective groundcover demonstrate yield gains in Bartlett due to increased fruit set and/or size. Better light distribution spurred renewed fruiting in lower portions of tree canopies, allowing more of the crop to be managed from the ground.

Figure 1: Percent change in yield (kg/tree) after Daybright application in two pear orchards over a three year period.

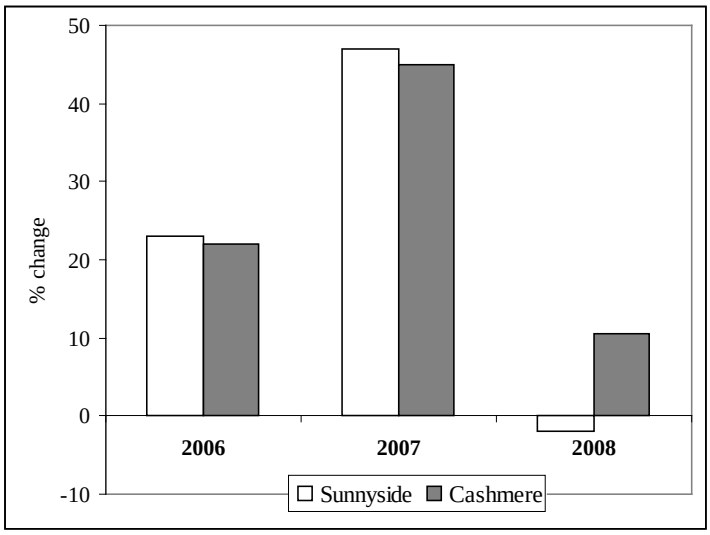
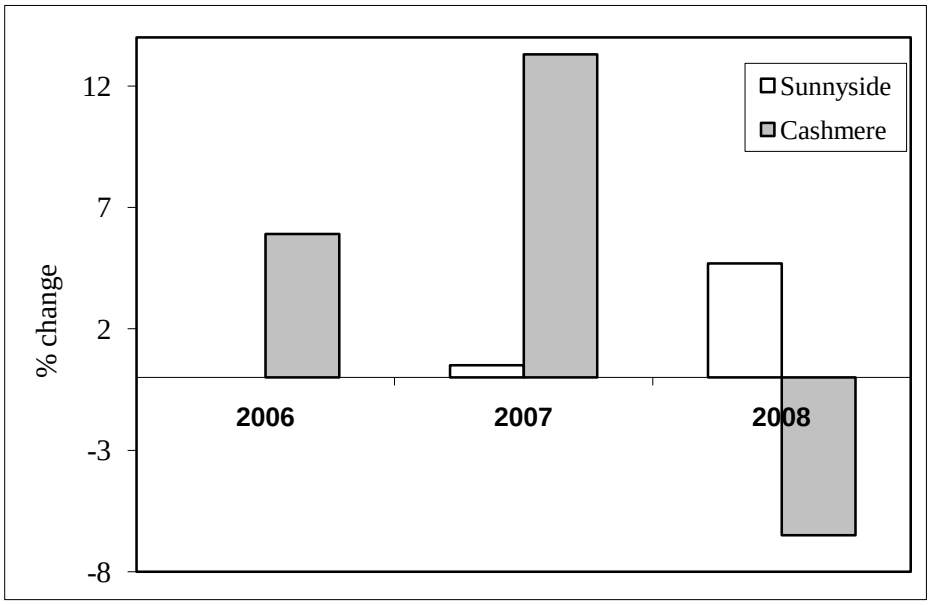



Figure 2: Percent change in individual fruit weight (gram) after Daybright application in two pear orchards over a three year period.



## OUTREACH

### Posters

Schmidt, T. 2006-2008. Crop load management. Posters at WSHA annual meeting.

Castillo, F. 2006-2008. Update on reflective groundcover evaluation in Washington. Posters at WSHA annual meeting.

### Talks at industry meetings

Castillo, F. 2007. Reflective groundcovers in tree fruit. GS Long Grower Meeting.

Castillo, F. 2007-08. Reflective groundcovers. Okanogan Field Day.

Hanrahan, I. 2008. Crop load management in pears. Presentation at Wenatchee Pear Day.

Schmidt, T. 2007. WTFRC Research Programs. Presentation at D & M Growers' Annual Meeting, Yakima, WA.

Schmidt, T. 2008. WTFRC Research Programs. Presentation at D & M Growers' Annual Meeting, Yakima, WA.

Schmidt, T. 2008. Horticultural benefits of reflective materials. Presentation at Cascade Ag Services Growers' Annual Meeting, Chelan, WA.

### Scientific publications

Hanrahan, I., Schmidt, T. R., Castillo, F., McFerson, J.R.. 2008. Reflective Ground Covers Increase Yields of Target Fruit. Poster and paper at ISHS in Geneva, NY, August 2008.

### Other

Hanrahan, I. 2009. Increasing yields of target fruit with reflective ground covers in pear. Presentation at IFTA conference, Potsdam, Germany.

Schmidt, T. 2007. Improving fruit quality with reflective fabrics and sunburn suppression. Presentation at British Columbia Fruit Growers' Association Hort Forum, Penticton, Canada.

## EXECUTIVE SUMMARY

### 1. Pear crop load management

Since 2003 we have set-up 25 pear thinning trials, testing an array of bloom (ATS, urea, CFO+LS, LS) and postbloom (BA, NAA) thinners. Our overall goals were:

- reduction of fruit set (indicated by fruitlets/100 blossom clusters);
- increase in mean fruit weight;
- consistent annual bearing (indicated by return bloom).

The most consistent performers in Washington pear chemical thinning trials are ammonium thiosulfate (ATS) applied during bloom and benzyladenine (BA) applied postbloom. Increases in individual fruit weight are often observed after benzyladenine application, even without significant fruitlet thinning.

### 2. Reflective groundcovers in pear

Daybright, a reflective groundcover manufactured by Extenday, was applied for three consecutive years in an established Bartlett block on a V-trellis (Sunnyside) and a young Bartlett block (Cashmere) from early bloom to harvest. Daybright results demonstrate yield gains in Bartlett due to increased fruit set and/or size. Better light distribution spurred renewed fruiting in lower portions of tree canopies, allowing more of the crop to be managed from the ground.