METHODS

Bactericides were evaluated for control of bacterial canker (caused by *Pseudomonas syringae pv. syringae*) of sweet cherry in two commercial orchards in Parkdale, Oregon. Bactericide application began at budswell in spring and ended at leaf drop in autumn.

**Orchard A.** Sweetheart trees on Mazzard rootstock were planted on 19 April, 2006. During the week between planting and the first bactericide application, heading cuts were made on all trees in which the terminal sections of the main trunk and scaffold limbs were removed, resulting in trees of about one meter height. Starting one week after planting, 20 replicate trees per treatment in a completely random design were sprayed to runoff with a trombone sprayer. Five applications were made in 2006 (26 April, 11 May, 24 May, 7 June, and 1 November), five in 2007 (6 April, 20 April, 4 May, 18 May, and November 1, and three in 2008 (10 April, 24 April, and 9 May). About 0.9 (spring) to 1.5 (fall) gallons were applied per 20 trees in 2006 and 2007. In 2008, 1.3 to 1.75 gallons were applied per 20 trees. Control trees were not sprayed. In mid-April, 2008 (between the first and second bactericide applications) the grower made scoring cuts on major scaffold limbs to induce bud break and shoot growth. Two to four limbs per tree were scored, and most limbs received three cuts.

All heading cuts were evaluated visually for cankers on 7 June, 2007, and canker lengths were recorded. Heading cut canker incidence (percent heading cuts infected) and severity (length of heading cut cankers) data were transformed to square root values before performing analysis of variance and protected least significant difference tests. All scoring cut cankers and other shoot cankers (excluding heading cut cankers) were evaluated on 16 June, 2008, and canker lengths were recorded. Data on scoring cut and nonscoring cut cankers were analyzed with analysis of variance and protected least significant difference tests on nontransformed data.

**Orchard B.** Lapins trees on Gisela 6 were planted on 21 May, 2007. On 24 May, 17 replicate trees per treatment in a completely random design were sprayed to runoff with a trombone sprayer. Three applications were made in 2007 (24 May, 7 June, and 1 November), and four in 2008 (1 April, 24 April, 12 May, and 22 May). About 1.0 gallon
was applied per 17 trees. Control trees were not sprayed. Incidence and severity of cankers at heading cuts and shoot cuts were determined on 17 June, 2008.

RESULTS

Orchard A (Table 1). Trees each had 1 to 4 heading cuts, and percent cuts with cankers were recorded as well as canker length per tree for each of the 20 replicate trees per treatment. No bacterial canker was observed at the end of the first growing season (fall 2006) but appeared during the spring in 2007. Most cankers originated at heading cuts (94.6%) made when trees were planted in 2006 or where limbs were pruned in spring 2007. Occasionally, cankers were observed on the trunk (4.3%) or at nodes (1.1%).

Only Kasumin significantly reduced heading cut canker incidence and severity. Famoxate was not significantly different from the Kasumin treatment but also was not different from the control at $P = 0.05$. Tanos applied alone and Cuprofix Ultra Disperss were not different from the unsprayed control. Both treatments containing Kocide had significantly greater canker incidence and severity than the unsprayed control.

Only 4.7% of unsprayed scoring cuts were infected. Several treatments were not significantly different from the control, but no treatments reduced the incidence of scoring cut cankers. However, all treatments significantly reduced the size of cankers at scoring cuts.

The number of cankers per tree that were not related to heading or scoring cuts was significantly reduced by Kasumin, Cuprofix UltraDisperss, and Tanos. None of the treatments reduced the size of these cankers.

No phytotoxicity was observed with any of the bactericide treatments. Trees in Orchard A will be in production in 2009, and this trial has been completed.

Orchard B (Table 2). No treatments reduced incidence or severity of heading cut or shoot cut cankers in the first evaluation of this trial. Treatments will be continued at leaf drop in 2008 and in spring, 2009, and cankers will be evaluated again in June, 2009.

DISCUSSION

On unsprayed trees, over 51% of heading cuts in Orchard A were infected, and average canker length was over 6 mm. Although Kasumin application was not started until spring 2007, trees sprayed with this bactericide had significantly lower canker incidence and severity than unsprayed controls. Famoxate also appeared to reduce canker incidence and severity, but reductions were not significant at $P = 0.05$. All treatments reduced the severity of cankers at scoring cuts, and three treatments (Kasumin, Cuprofix UltraDisperss, and Tanos) reduced the number of cankers per tree that were not related to heading or scoring cuts.

Trees sprayed in 2006 and 2007 with Kocide had increased canker incidence and severity compared with unsprayed controls. A high level of copper resistance has been observed in the *Pseudomonas syringae* population in the Hood River Valley and is likely related to prolonged, heavy copper use for control of blossom blast of pear (Spotts, R. A., and Cervantes, L. A. 1995. Copper, oxytetracycline, and streptomycin resistance of *Pseudomonas syringae* pv. *syringae* strains from pear orchards in Oregon and Washington. Plant Disease 79:1132-1135).
Bacterial canker is the most important disease of sweet cherry in the Mid-Columbia and Willamette Valley districts and perhaps in all growing areas of the Pacific Northwest. Currently, an integrated control program is recommended (see Appendix A), but tree losses are still unacceptable. These trials have demonstrated that Kasumin, Cuprofix UltraDisperss, Famoxate, and Tanos have potential for control of bacterial canker. This evaluation of bactericides will continue during 2008-2009 and hopefully will result in registration of new, effective bactericides for the Pacific Northwest sweet cherry industry.

Table 1. Orchard A. Evaluation of bactericides for control of bacterial canker of sweet cherry, Parkdale, Oregon in 2006-2008

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate product per acre¹</th>
<th>Rate product per gal</th>
<th>Heading cuts²</th>
<th>Scoring cuts²</th>
<th>Nonscoring cuts²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent infected</td>
<td>Length (mm)</td>
<td>Percent infected</td>
<td>Length (mm)</td>
<td>Number per tree</td>
</tr>
<tr>
<td>Famoxate 25SE</td>
<td>11.4 oz</td>
<td>6.7 ml</td>
<td>40.8ab</td>
<td>4.1ab</td>
<td>8.5ab</td>
</tr>
<tr>
<td>Tanos 50WG</td>
<td>12.0 oz</td>
<td>6.8 g</td>
<td>62.0bc</td>
<td>6.3b</td>
<td>10.7ab</td>
</tr>
<tr>
<td>Tanos 50WG +Kocide 2000³</td>
<td>6.0 lb</td>
<td>54.4 g</td>
<td>79.6c</td>
<td>11.9c</td>
<td>26.8cd</td>
</tr>
<tr>
<td>Kocide 2000³</td>
<td>6.0 lb</td>
<td>54.4 g</td>
<td>80.7c</td>
<td>12.0c</td>
<td>16.3abc</td>
</tr>
<tr>
<td>Cuprofix Ultra Disperss 40DF⁴</td>
<td>8.0 lb</td>
<td>72.5 g</td>
<td>56.1b</td>
<td>6.9b</td>
<td>35.2d</td>
</tr>
<tr>
<td>Kasumin 2L⁴</td>
<td>32 oz</td>
<td>18.9 ml</td>
<td>30.0a</td>
<td>3.1a</td>
<td>18.4be</td>
</tr>
<tr>
<td>Unsprayed</td>
<td>---</td>
<td>---</td>
<td>51.4b</td>
<td>6.2b</td>
<td>4.7a</td>
</tr>
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</table>

¹Based on 50 gallons per acre.
²Numbers followed by the same letter are not significantly different at P = 0.05 according to protected LSD test.
⁴Treatments begun 6 April, 2007.

Table 2. Orchard B. Evaluation of bactericides for control of bacterial canker of sweet cherry, Parkdale, Oregon in 2007-2008

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate product per acre¹</th>
<th>Rate product per gal</th>
<th>Heading cuts²</th>
<th>Shoot cuts²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent infected</td>
<td>Length (mm)</td>
<td>Percent infected</td>
<td>Length (mm)</td>
</tr>
<tr>
<td>Famoxate 25SE</td>
<td>11.4 oz +</td>
<td>6.7 ml +</td>
<td>100a</td>
<td>21.2a</td>
</tr>
<tr>
<td>+ManKocide³</td>
<td>6.0 lb</td>
<td>54.4 g</td>
<td>93.7a</td>
<td>19.3a</td>
</tr>
<tr>
<td>Kasumin 2L</td>
<td>32 oz</td>
<td>18.9 ml</td>
<td>100a</td>
<td>15.3a</td>
</tr>
<tr>
<td>Unsprayed</td>
<td>---</td>
<td>---</td>
<td>100a</td>
<td>15.3a</td>
</tr>
</tbody>
</table>

¹Based on 50 gallons per acre.
²Numbers followed by the same letter are not significantly different at P = 0.20 according to protected LSD test.
³Tanos 50WG used in place of Famoxate on 7 June, 2007. Kocide 3000 used in place of ManKocide on 24 May and 7 June, 2007.
12 Steps to Manage Bacterial Canker of Sweet Cherry

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*Pseudomonas syringae*, which causes bacterial canker, is a major bacterial pathogen of young sweet cherry trees. Often, 10 to 20% of the trees in new orchards are killed by *P. syringae* within five years of planting. Control must integrate several techniques including the following:

1. Do not interplant new trees with old trees, which are major sources of *P. syringae*.

2. Keep irrigation water off the part of the trees above ground as much as possible for the first 2 or 3 years after planting. Consider withholding water in late summer so trees will “harden off” and not be as susceptible to low temperature injury in early winter.

3. Avoid all types of injury – mechanical, insect, frost. Paint all trunks white with latex paint to prevent winter injury. Adding copper to the paint is probably of little benefit.

4. Some studies show less bacterial canker when pruning is delayed until spring, even as late as after flowering in May. Less disease also occurs when summer pruning is used. Prune only during dry weather if possible.

5. Remove and destroy branches and trees killed by *P. syringae* from the orchard.

6. Mazzard F12-1 is one of the most resistant rootstocks. Resistance of new rootstocks is unknown at this time, but trees on Mazzard may have an advantage over trees on size-controlling rootstocks. Sweet cherry scion cultivars generally are susceptible.

7. Locate the orchard in an area less likely to be affected by frost and slow drying conditions.

8. Provide optimal soil conditions for growth of cherries, including attention to pH and nutrition. Application of excess nitrogen, especially late in the growing season, will promote late season growth that is susceptible to low temperature injury in early winter, followed by bacterial infection.

9. Control weeds. They often support large populations of *P. syringae*, especially grasses. Clover and vetch ground covers support lower populations. Consider clean cultivation of row middles for the first 3 years.

10. Fixed copper products or Bordeaux 12-12-100, applied in October and January may help, but strains of *P. syringae* resistant to copper are widespread in the Mid-Columbia area.

11. Test for and control plant pathogenic nematodes before planting if needed. High populations of ring nematode have been associated with more bacterial canker.

12. In the Parkdale area, plant trees in May rather than April.