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PRELIMINARY STUDIES FOR CONTROLLING BACTERIAL SPOT IN LOW-CHILL PEACHES

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Abstract. **Florida's subtropical climate allows peach trees to retain their leaves for most of the year. Vegetative growth begins in late January or early February and trees can retain their leaves until December. Symptoms of bacterial spot (*Xanthomonas arboricola pv. pruni* (= *X. campestris pv. pruni*)) often occur on foliage and fruit in May. The disease persists and develops rapidly under warm weather, and complete defoliation can occur by October on susceptible cultivars. Copper-based bactericides can be used during dormancy and early in the growing season. However, the risk of phytotoxcity from copper sprays increases as the season progresses. A spray program was developed during the summer of 2004 and repeated in the summer of 2005 in an attempt to control bacterial spot. Basic copper sulfate (Cuprofix Disperss®) at a rate of 0.08 oz (23 g) /200gal H_2O applied at 400 gpa, was used in the experiment along with a soy-based non-ionic surfactant and a pH reducing agent. The spray program began in early June just prior to summer pruning and just after final fruit harvest had been completed. Trees were sprayed on a three week schedule until early October. Preliminary observations indicate the copper sprays delayed and significantly reduced defoliation. This spray program may help alleviate the condition of "fall bloom" which can occur in some trees when they defoliate too early. Overall health and tree vigor may also be increased from a longer photosynthetic period.**

Bacterial spot of peach is a common disease in many peach producing areas. It was first reported in north-central Florida in 1979 (Sherman and Lyrene, 1981). The disease is well established in Florida and proliferates rapidly during the long warm and humid growing season. Many cultivars show some susceptibility to the disease, and there are none that are immune (Werner et al., 1986). The cultivars which are most susceptible may defoliate early in the growing season, and can be completely defoliated by late summer or early fall. This may lead to a condition called "off-season bloom" or "fall bloom" in which dormancy in some floral buds is overcome during the period of defoliation (Sherman and Lyrene, 1984). Some of these buds will flower during October or November, and set fruit. The fruit will either be removed by freezing temperatures or their quality will be low from lack of photosynthates.

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It has been established that temperatures around 86°F (30°C) and high humidity levels can greatly increase the incidence of this disease (Zehr et al., 1996). Generally, day time temperatures during the summer months in north-central Florida are around 90°F (32°C) and relative humidity's are high. Other factors which can influence disease development include soil type (Matthee and Daines, 1968) and plant nutrition (Matthee and Daines, 1969).

Materials and Methods

Ten 'TropicBeauty' peach trees were selected. The trees were planted at a spacing of 140 trees/ac (346 trees/ha) in February of 2002 in Archer, Florida (Lake fine sand, 29.52N-82.53W). The trees were grafted on a green leaf nematode resistant rootstock (a 'Flordaguard' type), and were standard field-grown, bare-root, trees when planted. There were two blocks of trees, a control block and a sprayed block. Each block contained five trees with each tree being one replication. During early January the trees were pruned to a standard open vase form, and were summer pruned in early June. Trees received frost protection by overhead irrigation as needed during early spring of 2004 and 2005.

All trees were sprayed with paraffinic hydrocarbon oil for control of white peach scale (*Pseudaulacaspis pentagona* (Targioni Tozzetti)) while dormant in January and twice with Imidan® (phosmet) and Captan® (captan) in March for control of plum curculio (*Conotrachelus nenuphar* (Herbst)) and brown rot (*Cladosporium carpophilum* (Thum.)). The total rate of nitrogen applied each year was, 247.3 lbs/ac (276 $kg \cdot ha^{-1}$) for 2004 and 279.7 lbs/ac (312 $kg \cdot ha^{-1}$) for 2005.

The spray program consisted of 0.08 oz (23 g) of Cuprofix® Disperss (basic copper sulfate, 20% metallic Cu equivalent), 16 fl oz (473 mL) Preference® (alkylphenol etozylate, sodium salts of soya fatty acids, and isopropyl alcohol), and 6.7 fl oz (200 mL) Takedown® (phosphoric acid), to achieve a pH of 6.0, mixed into 200 gal of water. Coverage of the spray mix was 400 gpa. Trees were sprayed early in the morning after condensation (dew) had dried on the leaves. Spray was applied to run-off using a hydraulic sprayer (John Bean sprayers, Modular Hydraulic Sprayer, Model DM10E200FERH, Hogansville, Ga.), from the back of a pickup truck or from the ground with a handgun at 500 psi.

During 2004 applications of the spray mixture began in early August and occurred every three weeks until the middle of October. During 2005, spray applications began in early June just after harvest and just prior to summer pruning. Trees were sprayed every three weeks until the middle of October.

Bravo Weather Stick® (chlorothalonil) or Pristine® (pyraclostroblin and boscalid) was applied during 2004 as needed, and Pristine® during late 2005, to control peach leaf rust (*Tranzschelia discolor* (Fuckel) Tranzschel and Litvinov). Pristine® was applied in the tank mix with the Cuprofix®, Preference®, and Takedown®; Bravo Weather Stick® was not compatible to with the above chemicals and was applied separately.

Table 1. Mean percentage of defoliation for five sprayed and unsprayed 'TropicBeauty' peach trees at seven different observation times.

Date	Sprayed %	Control %	Significance
07 October 2005	0	30	0.0028
14 October 2005	1	48	0.0006
21 October 2005	2	52	0.0010
28 October 2005	2	60	0.0002
04 November 2005	8	74	<0.0001
11 November 2005	18	82	<0.0001
18 November 2005	22	90	<0.0001

Starting on 7 Oct. 2005, trees were rated on a 10 to 100% visual scale for the total amount of canopy leaf drop. This rating was done every week until 18 Nov., 2005. Data were analyzed using PROC ANOVA and means were separated according to LSD.

Results

Slight defoliation on the control trees had already begun in late September. By the first observation date in October, the control trees had 30% defoliation compared to the sprayed trees which had no detectable defoliation (Table 1). Defoliation progressed steadily on the control trees on a weekly basis until mid November, at which time the trees were 90% defoliated. Sprayed trees did not defoliate as quickly as the controls, and for the same date in November, the sprayed trees were only 22% defoliated. Observations were completed on all trees in mid-November. A significant amount of leaves remained on the trees in early December, at which time the trees were chemically defoliated with a 2.0% zinc sulfate spray.

Discussion

Bacterial spot can infect leaves and fruit and often results in early fall defoliation of peach trees grown in areas that have warm and humid weather conditions during the growing season. The severity of disease infection is more pronounced at temperatures around 86°F (30°C) and at exposure of inoculated leaves to high humidity for 24 or 48 h (Zehr et al., 1996). Laboratory tests indicate that the optimum temperature for the disease is 88°F (31°C) (Young et al., 1977). Daytime temperatures around 86°F (30°C) are common in Florida from May through October. During the summer months, sea breezes interact with warm air over the north-central and central parts of the state, often producing daily rains. Daily maximum temperatures, around 90°F (32°C) along with frequent rains, caused high levels of humidity. During early evening, condensation (dew) forms on leaves and remains there until mid-morning. Moisture present on the foliage, along with warm weather conditions aids in disease development.

Early defoliation in the fall from stresses imposed on trees can result in a condition where dormancy of some flower buds is suppressed and they bloom; this condition is commonly called "fall bloom". The timing of this defoliation is important. A response to photoperiod regulates the cessation of growth of vegetative buds (Sherman and Lyrene, 1984). The defoliation must occur after the cessation of vegetative growth, but before the onset of cooler weather when deeper dormancy occurs (Sherman and Lyrene, 1984). Leaf retention until cooler weather naturally defoliates trees can help alleviate the condition of "fall bloom" where it is unfavorable.

Early defoliation may affect other aspects of growth. Flower bud survival and fruit set of sour cherry was reported to be adversely affected by early defoliation (Howell and Stackhouse, 1973). Spring bloom can also be affected by keeping the leaves on the tree longer. The longer that leaves remain on the tree in the fall; the later bloom will occur the following spring (Lloyd and Firth, 1990). This can be beneficial for genotypes that have chilling requirements too low for a given area (Sherman, personal communication). The delay in bloom can protect the trees from freeze damage.

Our results indicate that a spray program consisting of low levels of a copper-based bactericide such as Cuprofix Disperss®, combined with a soy-based non-ionic surfactant and a pH reducing agent such as phosphoric acid beginning after harvest, can reduce the infection rate of bacterial spot and increase leaf retention by nearly 1.5 months. Early scouting is essential, and postharvest sprays should begin as soon as the disease is detected within the orchard. This spray program combined with peach genotypes which have low susceptibility to the disease may show promise in areas with a high rate of disease pressure. Further testing should also be done on other copper based formulations and additional bactericides.

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