PR # 9619

Annual Report - 2004

Prepared for the California Pear Board

Project Title:	Evaluation of new bactericides for control of fire blight of pears caused by *Erwinia amylovora*
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Cooperators:	L. Wade (formerly Naumes Packing), D. Thompson, and H. Förster
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SUMMARY

1. In two field trials, blossom and foliar spray treatments with the antibiotic kasugamycin (Kasumin) effectively reduced fire blight to similar levels as terramycin. No phytotoxicity was observed.
2. A new fatty acid product (M-Pede) and the acidified hydrogen peroxide product Zerotol had little effect and will no longer be included in future tests.

INTRODUCTION

Fire blight, caused by the bacterium *Erwinia amylovora,* is a very destructive disease of pome fruit trees, especially pears, worldwide. In addition to cankers, the pathogen overwinters in flower buds, diseased fruit, small twigs, and branches left on the ground after pruning. In the spring, blossoms are infected through natural openings in nectaries, and pistils. After destroying the blossoms, the bacteria spread into the peduncles and spurs. During warm, humid weather ooze droplets consisting of new inoculum are exuded from the peduncles. Young fruitlets often become infected, and they also turn black, dry, shrivel, but usually remain attached to the tree. The disease spreads rapidly and the bacteria invade adjacent leaves through stomata, trichomes, hydathodes, but more frequently through wounds caused by hail or wind whipping. Succulent twigs, suckers, sprouts, and shoots are the next tissues infected. Secondary infections may occur throughout the growing season. Inoculum is spread by wind, rain, insects, birds, or by man, e.g. by means of contaminated pruning tools. Primary and secondary infections may spread into the branch. At this time the infection, if walled off, produces a canker or it penetrates further into the branch and then into the trunk. From here the bacteria may move into other branches and finally the trunk. Trunk cankers will eventually girdle the tree and the whole tree will die. The disease can be very severe in some years, causing repeated infections during warm and wet weather.

Control measures. Fire blight is very difficult to control. Even with an integrated program of chemical control combined with sanitation and orchard management this serious disease is almost impossible to eliminate with the current methods available. Thus, every effort should be made to keep the disease out of the orchard. If the disease is in its early stage and only a few twigs are blighted it often can be eliminated by pruning. Current chemical control programs for fire blight control are based on protective schedules, because available compounds are contact treatments and are not systemic. Copper compounds have been used since the early 1900s, mostly in the form of copper sulfate plus lime (Bordeaux mixture). Control with copper compounds is only satisfactory when disease severity is low to moderate. On Bartlett (summer) pears, copper treatments are widely used only during dormant and bloom periods because phytotoxic effects commonly occur on fruit as russeting. Streptomycin, an antibiotic for fire blight control, came into general commercial use during the late 1950s, followed by the less effective oxytetracycline (Terramycin). Because of the lack of alternative control materials, antibiotics are still being used commercially, although pathogen resistance against the antibiotic streptomycin is widespread and concerns are growing regarding using antibiotics in agriculture that are also used in human medicine.

New, more effective materials for fire blight control have to be developed to combat this destructive disease. These materials should be locally systemic and not phytotoxic and should target multiple sites of action within the bacterial pathogen and have a mode of action different from currently used bactericides. Materials with different modes of action could then be incorporated into a resistance management program. During the past years we have identified a broad-spectrum biocide from Dow Chemicals that is registered as a water treatment and the antibiotic Starner. In field trials both materials had a similar efficacy to the industry standard terramycin. Phytotoxicity that has been observed with the use of the DOW material could be correlated to the formulation of the chemical. Because of registration costs, however, DOW will not proceed with registration. The antibiotic Starner (Valent Biosciences) is not being developed for agricultural use because the class of antibiotics that Starner belongs to is important in medicine. The acidified hydrogen peroxide Zerotol showed efficacy in our 2003 trials and was evaluated again in 2004.

Thus, in 2004 we conducted additional field experiments for the evaluation of new potential fire blight control chemicals. The antibiotic kasugamycin (Kasumin) was made available to us for evaluation by Arvesta Corp. This antibiotic is known to have activity against bacteria, including species of *Erwinia* and *Xanthomonas*, as well as against several fungal diseases. Members of the kasugamycin antibiotic class are not being used in human and animal medicine. Kasugamycin has a different mode of action from streptomycin or terramycin and there is no cross-resistance known to occur. The fatty acid product M-Pede is registered as an insecticide and fungicide, but is also thought to have antibacterial activity. Thus our in field studies we evaluated the efficacy of Zerotol, kasugamycin, and M-Pede against fire blight. Zerotol and kasugamycin were also evaluated using different adjuvants.

OBJECTIVES

1. Evaluate the toxicity of new agriculturally registered acidified peroxide formulations (e.g., Zerotol, Oxidate) as compared to terramycin (Mycoshield) in cooperation with UCCE.
   a. Laboratory in vitro tests to evaluate the bactericidal activity with and without adjuvants: Direct contact assays, filter disk assays, amended agar assays.
   b. Field studies with protective spray treatments will be done in large-scale field trials. Adjuvants and product rates will be evaluated. Applications will be made based on existing Fireblight forecasting models starting at bloom.

MATERIALS AND METHODS

Field studies using protective treatments during the growing season. In small-scale field studies, the relative efficacy of the protective treatments Zerotol (an acidified, hydrogen peroxide material), kasugamycin (an antibiotic), and M-Pede (a fatty acid product) was compared to terramycin (e.g., Mycoshield) or streptomycin (e.g., Agrimycin). Concentrations that were evaluated were based on current product registration rates for other uses. Adjuvants used with Zerotol and Kasumin included Breakthru and Topfilm. Topfilm is known to reduce phytotoxic effects of agricultural chemicals and to improve efficacy. Trials were established at UC Davis and in a commercial orchard in Marysville where fire blight caused crop losses in previous years. In the Marysville plot, treatments were applied on 3/24, 3/30, 4/7, 4/14, 4/27, and 5/6/04 and disease was evaluated on May 11, 2004. In the Davis plot, treatments were applied on 3/23, 4/3, 4/9, and 4/15/04 and disease was evaluated April 20, 2004. In both plots treatments were applied using an air-blast sprayer at 100 gal/A. Incidence of new blight infections on blossoms and leaves in addition to potential phytotoxic effects of the treatments on foliage and fruit were evaluated. Data for were analyzed using analysis of variance and LSD mean separation procedures of SAS 6.12.

RESULTS AND DISCUSSION

Two field trials on Bartlett pear were conducted using bactericides and antibiotics as protective spray treatments, one in a commercial orchard in Marysville and one in an experimental orchard in Davis, CA. Six

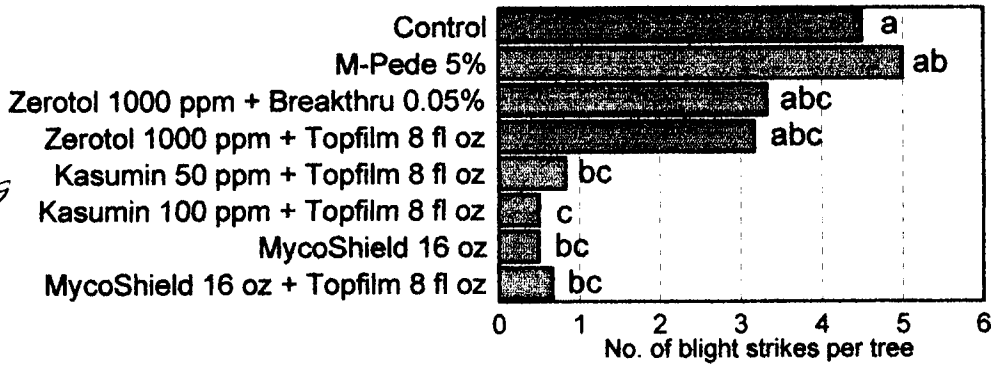
treatments between the end of March to early May were applied in the Marysville orchard based on a temperature-threshold model. In the Davis orchard four treatments were applied based on forecasted rains between the end of March and mid-April.

Fireblight incidence in the Marysville trial was low in 2004. At the end of the experimental period, there were an average of 4.5 fire blight strikes per control tree. M-Pede had no effect on fire blight incidence and Zerotol only numerically, but not statistically, reduced the incidence of disease. Kasumin was highly effective, reducing the disease to less than 0.8 strikes/tree, similar to MycoShield. The adjuvant Topfilm had no effect on efficacy of Kasumin and PlantShield. In addition, no phytotoxicity on foliage or fruit was observed in any of the treatments.

Disease incidence in the Davis trial was very high with an average of 60 fire blight strikes per control tree. Many trees in this orchard are now dying due to years of experimental use. This orchard will not be used anymore for our field in the future because a fair evaluation of materials is no longer possible at this stage of the disease. Similar to the Marysville trial, M-Pede and Zerotol had no effect on disease. Significant reductions in disease were found with Kasumin and Agrimycin, with no significant differences between the two antibiotics. The best treatment (Agrimycin) had an average of 22.5 blight strikes per tree.

Because under the high-disease pressure conditions at the UC Davis plot the new antibiotic Kasumin was still effective and at the Marysville plot with low disease pressure disease by this antibiotic was reduced to low levels similar to Mycoshield, Kasumin is a promising new treatment for fire blight. Kasugamycin is registered for agricultural use on other crops in other countries. The registrant for Kasumin, Arvesta Corp., is very supportive in registering the material for agricultural use. Thus, additional field trials need to be conducted with Kasumin, using different rates and adjuvants.

Fig. 1. Evaluation of new bactericides for fireblight management on Bartlett pear
Field trial in Marysville, CA - 2004



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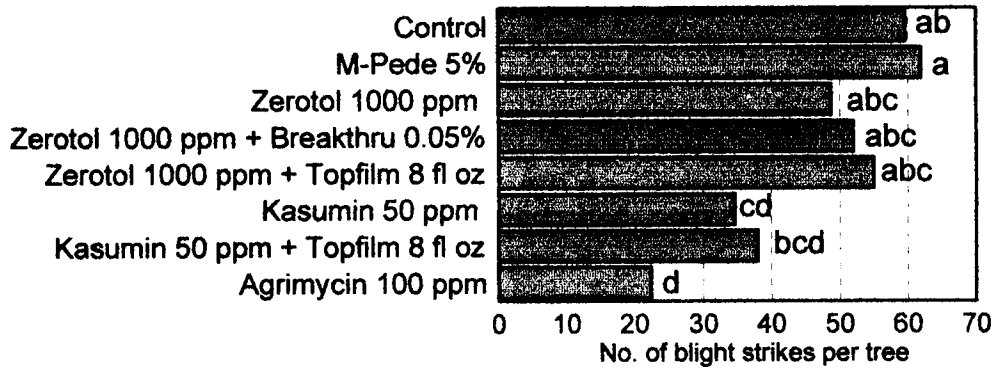
Treatments were applied on: 3/24, 3/30, 4/7, 4/14, 4/27, and 5/6/04 using an air-blast sprayer at 100 gal/A. Disease was evaluated on May 11, 2004. The number of fire blight strikes was counted on each of four single-tree replications and disease incidence determined for each tree.

Fig. 2. Evaluation of new bactericides for fireblight management on Bartlett pear
Field trial in Davis, CA - 2004



Treatments were applied on: 3/23, 4/3, 4/9, and 4/15/04 using an air-blast sprayer at 100 gal/A. Disease was evaluated on April 20, 2004 and the number of fire blight strikes was counted on each of six single-tree replications.

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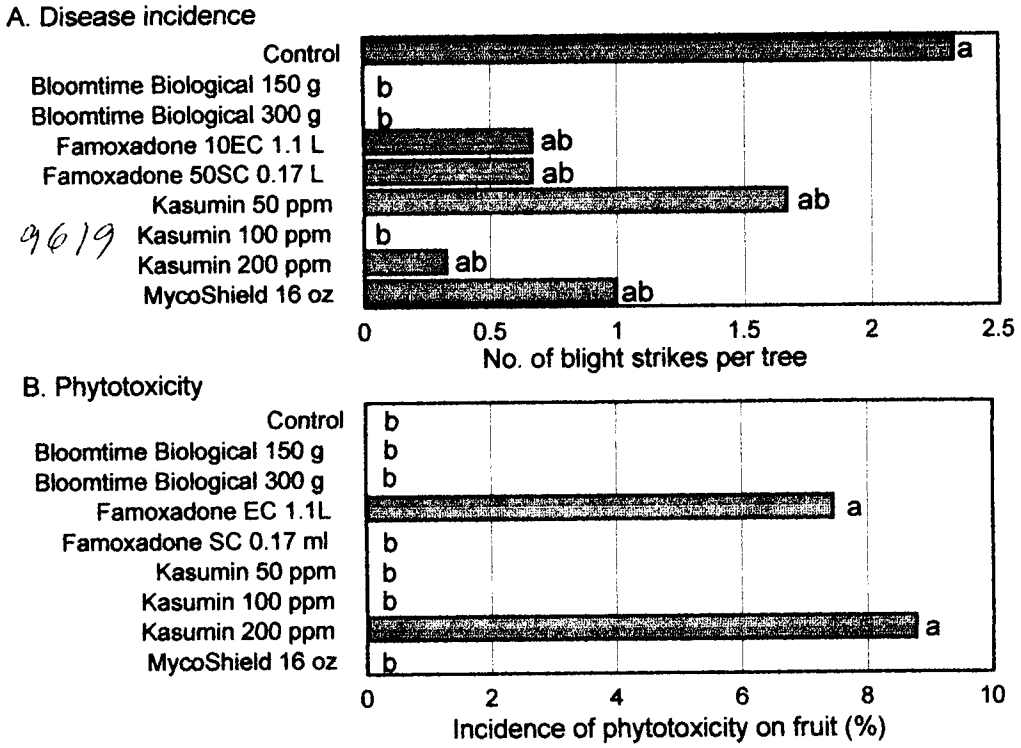
Fig. 1. Evaluation of new bactericides for fireblight management on Bartlett pear
Field trial in Marysville, CA - 2005



Treatments were applied on: 3/11, 3/17, 3/23, 3/30, 4/14, and 4/25/05 using an air-blast sprayer at 100 gal/A. Disease was evaluated on May 5, 2005. The number of fire blight strikes was counted on each of four single-tree replications. Phytotoxicity on fruit was evaluated on August 23 after 4 weeks of cold storage. Phytotoxicity was evident as circular lesions. In the Kasumin 200 ppm treatment phytotoxicity was also observed on the leaves.