

BACTERIAL CANKER

Project No.: 97-BK-o0 Bacterial Canker: Disease Mechanisms, Pathogen Characterization and Control- Proceedings Report

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Objectives

1. Develop a laboratory/growth chamber /field model system which allows the consistent production of bacterial canker (BC) disease in stone fruit crops at UC Davis.
2. Determine the genetic fingerprints of *Pseudomonas syringae* pv. *syringae* (Pss) strains isolated from stone fruit cankers and blasted flowers, buds and shoots. Determine if genetically similar Pss strains can be found on the surface of trees and orchard weeds.
3. Determine if prematurely defoliating stone fruit trees with zinc sulfate and subsequent applications of copper bactericides during the dormant period can reduce the incidence of BC. Determine if several novel bactericides can reduce the incidence of almond blast in northern California orchards.
4. Identify metabolites in BC-predisposed, "stressed" trees that can activate virulence determinants of Pss.
5. Determine the almond compatibility and relative BC-resistance of peach rootstocks which show resistance to peach short life disease.
6. Determine if Pss is involved with premature bud drop in almonds growing on sandy soils.

Results

Bacterial canker (BC) and blast diseases are caused by a pathogenic interaction between the bacterium *Pseudomonas syringae* pv. *syringae* (Pss) and stone fruit trees that are "stressed" by a number of factors such as high ring nematode populations, shallow or hard pan soils, low soil fertility, drought, and other parameters. In order to gain a better understanding of the way Pss causes BC disease in stone fruit trees we

need to develop experimental systems that allow the production of BC under defined parameters we can experimentally manipulate. In 1995 we established a large field plot containing several stone fruit/nut varieties at UC Davis which had a simulated hardpan soil constructed from a clay mixture used to line irrigation ditches. One year old trees were inoculated with several Pss strains in the fall and winter of 1996. Small gumming cankers were observed in some of the apricot trees that were grown over the hard pan soil plot, however no evidence of BC was observed in the other stone fruit varieties. Because trees often become more susceptible to BC in the second or third years following planting we will repeat these inoculations during the next two years. A pathogenicity assay using peach shoots was developed to assess the relative pathogenicity of Pss isolates from stone fruits and other plants. We are also evaluating a growth chamber procedure, which briefly exposes potted trees to freezing temperatures as another model system to experimentally express BC.

We previously determined that the genetic fingerprints of Pss isolates obtained from BC cankers which developed on several different stone fruit varieties were all very similar. In 1997, we found that nearly all of the Pss strains we isolated from the surface and buds of stone fruit trees were genetically dissimilar to the canker strains. Although we need to repeat these isolations to confirm these results, these initial observations suggest that the Pss strains that actually cause BC represent a very small percentage of Pss strains in an orchard. If this is confirmed, it will be important to determine where these canker-inducing strains are located in the tree and in the orchard in order to most effectively target those strains that are actually causing BC.

It has been postulated, but not conclusively shown, that leaf scars, which are produced when trees defoliate in the fall, serve as natural wounds which allow the bacteria to enter into the tree. If this is true, then prematurely defoliating trees with materials such as zinc sulfate or urea should allow the leaf scar to heal before winter rains facilitate the dispersal of Pss. Research in New Zealand and South Africa has also shown that copper bactericide applications can reduce the incidence and severity of BC in apricot and sweet cherry. Work conducted by Steve Southwick's group at UC Davis also implicated low nitrogen fertilization as a BC-predisposing factor in french prune, so we decided to evaluate the impact of late summer/fall nitrogen applications on the incidence of BC. In 1996 and 1997 we evaluated the effectiveness of zinc sulfate defoliation and dormant applications of copper on french prune, and in 1997, in collaboration with Roger Duncan the effectiveness of zinc sulfate or urea mediated defoliation and copper applications for BC control in cling peach. Four applications were made on an approximate monthly basis from November through February. Disease incidence and severity was rated on a 1 to 4 scale with 0=healthy, 1= a few new, small cankers, 2= numerous small cankers, 3=large expanding cankers causing limb death or trunk necrosis, 4=tree death. All trials were conducted in orchards with a previously high incidence of BC and involved 20 trees for each treatment. In the two french prune orchards that developed new BC strikes we obtained the following results:

Orchard	Copper + N	N only	Copper only	Zinc + Copper	Control
A	0.47	1.1	0.55	0.7	1.3
B	0.15	0.1	0.22	0.1	0.2

Thus it appeared that nitrogen application in combination with copper had some benefit in one of the prune orchards while there was no significant differences in the treatments at the orchard that developed less disease. In both of the peach orchard trials we observed no difference in the incidence or severity of BC in any of the treatments as compared to the control trees. Although we plan to evaluate the merits of these treatments in almond in 1997/98, these initial results suggest the benefits of bactericide applications for decreasing BC are small at best. Bactericide applications for reducing almond blossom blast are planned for 1998 in collaboration with Joe Connell.

In collaboration with Ted DeJong we evaluated the relative BC-resistance of some peach rootstocks which showed resistance to peach short life disease, a disease which is similar in some respects to BC in California. Although these rootstocks looked very promising for the first two years they were planted in BC "hotspots", the incidence and severity of BC of peach grafted on these peach short life rootstocks was the same as standard Lovell rootstocks in the third year following planting. Although these results are clearly disappointing, it is still worth evaluating the compatibility and relative BC-resistance of almond grafted on these short life rootstocks, task which Warren Micke is undertaking for 1998.

In 1997 several mature Carmel orchards, typically located in sandy soils in Merced and Stanislaus counties, had severe bud drop problems. Premature bud drop can be caused by several factors including low chilling, however many of these trees were growing in sites that had previously experienced some problems with BC. In order to determine whether Pss was involved in the bud drop phenomena, we made several isolations from samples that were sent to us by Loni Hendricks and Roger Duncan. High Pss populations were isolated from all bud samples obtained from diseased trees, while very low populations were obtained from healthy trees. These initial results suggest that Pss may be involved with the bud drop problem, however it is not clear whether high Pss caused buds to drop in normally healthy trees or whether the buds were stressed and dying from some other factor(s) and Pss simply multiplied to high numbers as a saprophyte in these weakened buds. Inoculation experiments planned for 1998 should clarify this question.