PEAR (*Pyrus communis* 'Comice')
Fire blight; *Erwinia amylovora*

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Assess the efficacy of ProBlad and Cinnerate against fire blight on pear under field conditions

We tested the efficacy of three treatments (Table 1) on reducing fire blight on pears at a research block in Southern Oregon Research and Extension Center near Medford, OR. The treatments were arranged in randomized complete block design and each treatment was replicated three times with one tree in each replication. Total flower clusters per tree were predetermined during the pink stage and the treatment trees were blocked based on cluster numbers. The treatments were applied at 70-80% bloom, full bloom, and petal fall on April 14, April 17, and April 24, 2020 respectively using air blast sprayer equipped with handgun and calibrated to deliver 100 gallons per acre. An untreated control included water sprayed trees. Tank-mixed antibiotic sprays, Agri-mycin-17 and Mycoshield were applied as commercial standard. A day before 70-80% bloom application, the treatment trees were inoculated with *Erwinia amylovora* strain 153 N (streptomycin- and oxytetracycline-sensitive pathogen strain), applied at 1 x 10^6 CFU per mL to near runoff (~ 1 L /tree) on the evening of April 13, using a backpack sprayer.

Table 1: Treatment number, products, rates, and timings for evaluation of ProBlad and Cinnerate against fire blight on pear.

Treatment #	Product	Rate	Timing[x]
1	Non-treated control	-	A, B, C
2	ProBlad	40 fl oz/A	A, B, C
3	Cinnerate	32 fl oz/100 gal	A, B, C
4	Agrimycin	227 gm/A	A, B
	Mycoshield	227 gm/A	A, B
	Previsto	2.8 L/A	C

[x]Number of Applications: 3 Total; 70-80% bloom (A), full bloom (B), and petal fall (C).

Cluster blight was counted (blighted clusters were removed right away) at two days interval starting April 27th to June 10th. Fire blight incidence per replicate tree was calculated as ratio of total number of blighted cluster and total number of flower clusters expressed as percentage. The disease incidence was then subjected to analysis of variance using PROC GLIMIX in SAS 9.4. Incidence of shoot blight was monitored every week from early May to late-July. Phytotoxicity was evaluated on leaves and flower petals, and fruit toxicity was evaluated as fruit russet at commercial harvest. Fruits were harvested at commercial maturity on August 23, 2020. Forty fruits from each replication were evaluated for fruit russet using a modified Horsfall-Barratt rating scale to estimate the proportion of the fruit surface exhibiting russet symptoms: '0' = no russeting, '1' = > 0 to 1%, '2' = > 1 to 3%, '3' = 3 to 6%, '4' = 6 to 11%, and '5' = 18 to 25%, and '6' = 25 to 30%. The mid-point value of each russet category was calculated and subjected to analysis of variance to compare the treatment effects.

The flower clusters on treatment trees ranged from 95 to 361. The commercial standard, Agri-Mycin, Mycoshield, applied at 70-80% bloom and full bloom followed by Previsto at petal fall provided the best cluster blight control. This treatment reduced the incidence by 86% compared to non-treated control (Table 2). The other two treatments that included, ProBlad and Cinnerate applied at 70-80% bloom, full bloom, and petal fall resulted numerically lower cluster blight incidence compared to non-treated control; however, the differences were not statistically significant (Table 2). These treatments reduced the cluster blight incidence by 57, and 41% respectively compared to non-treated control. The efficacy of ProBlad and Cinnerate as a rotational product in conventional and organic program could be worth testing and may provide a valuable alternative for resistance management.

The average number of shoot blights in treatment trees ranged from 2.3 to 9.3. Higher variations on numbers of shoot blight within a treatment were observed that resulted no significant differences among treatment means.

Numerically, the highest shoot blight was observed on trees treated with Cinnerate and the lowest on antibiotics commercial standard. The larger number of cluster blight generally results higher shoot blight, as the clusters are the primary sources of infection that extend to the shoots as season progress. As higher numbers of cluster blight were observed on ProBlad and Cinnerate treatments, this may have resulted higher number of shoot blights. However, on the non-treated control, the higher percentage of cluster blight but lower shoot blight on these trees indicate possible effect of inadequate shoot blight cutting in the former treatments. We cut the shoot blight after we record them and we follow general practice of cutting eight inches beyond the brown tissues. We have observed reoccurring of shoot blight on the same shoot that was cut earlier indicating a possible movement of bacteria beyond the cut tissues.

Table 2: Comparative efficacy of the bactericides on reducing fire blight cluster and shoot blight incidence.

Treatment	Rate per 100 gallons water	Dates treatments applied			Percent blighted clusters*		Number of shoot blight	
		14 Apr 70-80% bloom	17 Apr Full bloom	24 Apr Petal fall				
Non-treated control	-	x	x	x	24.35	a#	3.3	a#
ProBlad	40 fl oz	x	x	x	10.60	b	5.4	a
Cinnerate	32 fl oz	x	x	x	14.46	ab	9.3	a
Agri-Mycin	227 gm	x	x		3.37	c	2.3	a
Mycoshield	227 gm	x	x					
Previsto	2.8 L			x				

* Log Transformed prior to analysis of variance; non-transformed means are shown. Data includes foliar symptoms averaged across three trees (three replications and one tree per replication)

Means within a column followed by same letter do not differ significantly ($p < 0.05$) based on Fischer's protected least significance difference.

The foliar toxicity were observed as burnt margin and tip of new leaves and flower petals. Except for treatments with antibiotics combined with Previsto, no significant phytotoxicity was observed in any of the treatments. On the antibiotics and Previsto treatment, 3-5% phytotoxicity was observed few days after application. The toxicity was not as concerning as the season progressed.

No significant differences on fruit russet were observed among ProBlad, Cinnerate, and non-treated control fruits indicating the safer use of ProBlad and Cinnerate on russet susceptible cultivars such as Comice. The percent fruit russet ranged from 3 to 6% on these treatments. The treatment that included the commercial standard, Agri-Mycin, Mycoshield, applied at 70-80% bloom and full bloom followed by Previsto at petal fall resulted the highest percentage russet on fruits (Figure 1). This treatment provided the best cluster and shoot blight control, however were also more phytotoxic on fruit surfaces. The copper formulation applied towards petal fall results higher russet fruits and possibly attributed to higher russet percentage on antibiotic commercial standard (Figure 1).

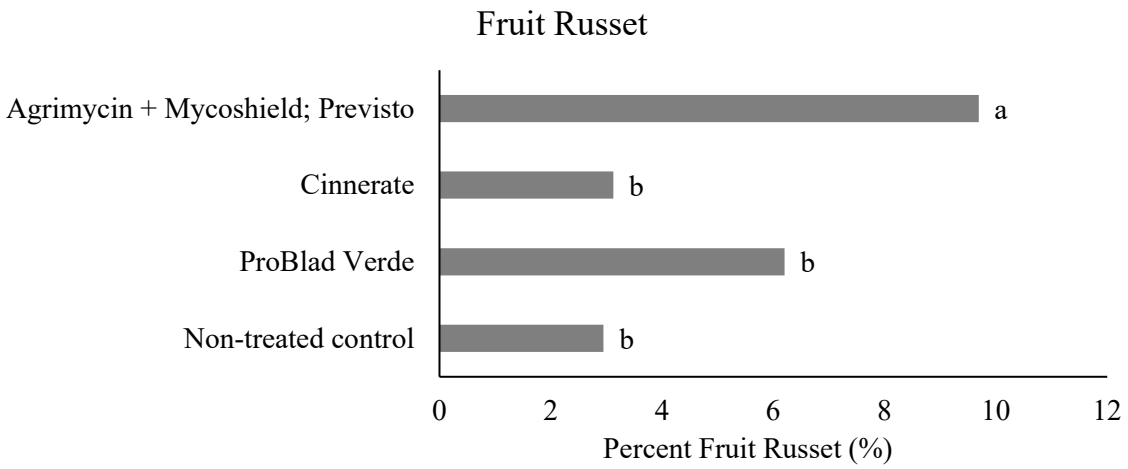

Figure 1: Treatments effect on fruit russet (fruit finish). At harvest, 40 fruits from individual treatment tree were harvested and rated using the modified Horsfall-Barratt rating scale: '0' = no russet, '1' = > 0 to 1%, '2' = > 1 to 3%, '3' = 3 to 6%, '4' = 6 to 11%, and '5' = 18 to 25%, and '6' = 25 to 30%. The mid-point value of each russet category was calculated and subjected to analysis of variance to compare the treatment effects. Means with bars followed by same letter do not differ significantly ($p < 0.05$) based on Fischer's protected least significance difference.