CHERRY (*Prunus avium* 'Bing')
Powdery Mildew; *Podosphaera cerasi*
Leaf Spot; *Blumeriella jaapii*
Shothole; *Wilsonomyces carpophilus*

J. W. Pscheidt, B. Warneke, N. DiManno
and J. A. Whitney
Dept. of Botany and Plant Pathology
Oregon State University
Corvallis, OR 97331

Evaluation of soil injected fungicide for management of cherry diseases, 2022-2024.

This trial was conducted at the Botany and Plant Pathology Field Laboratory in a cherry orchard planted on a Camas gravelly sandy loam soil type. Treatments were arranged in a randomized complete block design in a 'Bing' sweet cherry orchard on Mazzard F12-1 rootstock planted in 1995 on 20 x 20 ft spacing and grafted in 1998. Each treatment consisted of 5 single tree replicates. The diameter of trees 8 inches above ground was determined 25 Oct 2022. The fungicide RTSA 505 was injected into the soil around trees using an HTI 2000 Soil Injector connected to a Maruyama MS75 backpack power sprayer. The nozzle end of the injector was inserted 4 inches into the soil prior to horizontal injection of the fungicide solution. The amount of fungicide solution injected was based on the diameter of each tree where 250 ml of solution was injected per inch diameter. For example, 14 separate injection sites were evenly distributed within the drip zone of a tree 14 inches in diameter.

Soil Injections 2022 to 2023

Fall injections occurred on 8 Nov 2022 and spring injections occurred 11 Apr 2023 (bud break) and 25 Apr 2023 (full bloom). Fungicide solution emerged from about half the injection sites (through cracks and earthworm middens) during application and puddled on the ground before subsequently absorbing. The fungicide Banner Maxx II was foliar applied using a hydraulic handgun sprayer at 100 psi, such that 4 to 6 gal of a spray suspension was applied per 5 trees (109 to 163 gal water/A), depending on the amount of foliage present. Foliar sprays were applied on 13 Apr 2023 (bud break), 27 Apr 2023 (full bloom), 11 May 2023 (petal fall to shuck split), 25 May 2023 (1st cover), 8 Jun 2023 (color change) and 23 Jun 2023 (preharvest). Assail 70 WP (2.3 oz/A) was applied 22 May 2023 for aphid and western cherry fruit fly management. Insecticide sprays were applied to the entire block using a Rear's air blast sprayer. GlyStar Plus (5.23 oz/gal) and Galligan 2e (2 pts/A) were applied on 1 May 2023 for weed control using a Rear's 100g boom sprayer. Fertilizer was not applied this growing season. Trees were pruned from 16 to 17 Feb 2023. Fungal infection periods were monitored using a Meter Atmos 41 weather station equipped with standard sensors including one for leaf wetness. Only 1 cherry leaf spot infection period was detected from bud break through mid-Jun: 1 medium risk infection period on 20 Apr 2023. Incidence of cherry leaf spot and shothole was evaluated on 15 Jun 2023 by examining all leaves on each of 10 vigorous shoots from around the tree (average of 248 leaves per 10 shoots ranging from 218 to 277 leaves). Incidence of cherry leaf spot on fruit stems was evaluated on 20 Jun 2023 by examining 100 to 155 fruit stems arbitrarily selected from around each tree. Incidence of powdery mildew was evaluated on 17 Jun 2023 by examining the last (distal) five (5) fully expanded leaves on each of 20 shoots from around the tree. To compensate for variations in tree vigor, only shoots showing high vigor and strong growth were selected for disease evaluation. Powdery mildew on fruit was not assessed. Defoliation was assessed on 13 Nov 2023.

Rainfall during the dormant season (Oct 2022 to March 2023) was 3.18 inches below normal. Spring weather conditions were normal to dry in April and first week of May but then became very dry with little rainfall for the remainder of the season. Soil moisture was measured at 30% water content (29-32%) during the fall and spring injections. Conditions for cherry leaf spot or shothole development were considered low risk but considered high risk for powdery mildew. Cherry leaf spot was first observed 24 May 2023 on widely scattered leaves while shothole was first found 8 May 2023 as widely scattered leaf spots. Powdery mildew was first observed on 15 May 2023.

The incidence of cherry leaf spot on fruit stems of non-treated trees was not significantly different from the incidence found on trees treated with RTSA 505 (Table 1). The incidence of cherry leaf spot on leaves from trees treated with RTSA 505, however, was significantly different from the incidence found on non-treated trees. Lowest incidence of cherry leaf spot was found on trees treated with Banner Maxx II. Incidence of shothole was not significantly different among all the various treatments (Table 2). The amount of powdery mildew found on non-treated trees was not significantly different from powdery mildew found on any of the trees treated with soil injection (Table 2). Lowest amount of powdery mildew was found on trees treated with Banner Maxx II which was significantly lower than powdery mildew found on all other trees except when treated with 10 ml RTSA 505 in the

fall. There was no difference in defoliation in 2023 among the various treatments (Table 3). Phytotoxicity was not observed on any treated trees. This includes any PGR effects or necrosis of the serrations on the leaf margins as has been seen with foliar applications of the same chemical (see Corum report from 2011).

Soil Injections 2023 to 2024

A similar trial was conducted on the same set of trees from 2023 to 2024. Fall injections occurred on 14 Dec 2023 and spring injections occurred 26 Mar 2024 (popcorn) and 11 Apr 2024 (full bloom to petal fall). Foliar sprays were applied on 26 Mar 2024 (popcorn), 11 Apr 2024 (full bloom to petal fall), 24 Apr 2024 (shuck split), 9 May 2024 (1st cover), 23 May 2024 (2nd cover), 6 Jun 2024 (color change) and 20 Jun 2024 (preharvest). Omni Supreme Spray Oil (2.6 qt/A) was applied to the entire block on 9 Apr for Aphid management. Assail 70 WP (2.3 oz/A) was applied on 16 May to manage western cherry fruit fly and aphids. Insecticides were applied using a Rear's air blast speed sprayer. GlyStar Plus (5.7 pt/A) was applied on 18 Mar for management of weeds. Fertilizer was not applied this growing season. Trees were pruned 6 to 7 Feb 2024. A total of 6 cherry leaf spot infection periods were detected from bud break through mid-Jun in 2024: 2 high infection periods (25 Apr and 2 Jun), 2 medium infection periods (22 Mar and 3 May) and 2 light infection periods (2 Apr and 2 Jun). Incidence of cherry leaf spot and shothole was evaluated on 21 May 2024 by examining all leaves on each of 10 vigorous shoots from around the tree (average of 211 leaves per 10 shoots ranging from 201 to 224 leaves). Incidence of powdery mildew was evaluated on 3 Jul by examining the last (distal) five (5) fully expanded leaves on each of 20 shoots from around the tree. To compensate for variations in tree vigor, only shoots showing high vigor and strong growth were selected for disease evaluation. Powdery mildew on fruit was not assessed. Defoliation was assessed on 24 Jul 2024 using a 0 to 5 scale where 0 = no defoliation, 1 = 1 to 10% defoliation, 2 = 10 to 20% defoliation, 3 = 20 to 30% defoliation, 4 = 40 to 50% defoliation, 5 = > 50% defoliation.

Rainfall during the dormant season 2023-24 was 4.1 inches above normal, spring weather conditions were close to long-term norms while summer was accented by a few high heat events. Cherry leaf spot, shothole and powdery mildew were all first observed on 13 May.

Highest incidence of cherry leaf spot on fruit stems or leaves was found on non-treated trees and was significantly higher than all fungicide treated trees (Table 1). Lowest incidence of cherry leaf spot on fruit stems or leaves was found on trees treated with Banner Maxx II but was not significantly different from the incidence found on trees treated with RTSA 505 only in the fall of 2022. Lowest incidence of shothole was found on trees treated with RTSA 505 in the fall and spring both years but was not significantly different from the incidence found on trees treated with RTSA 505 once at bud break both years or Banner Maxx II (Table 2). The amount of powdery mildew found on non-treated trees was significantly higher than the powdery mildew found on any of the trees treated by soil injection or with Banner Maxx II. Lowest amount of powdery mildew was found on trees treated with Banner Maxx II, which was significantly lower than powdery mildew found on all other trees. Lowest defoliation rating was assessed on trees treated with Banner Maxx II but was not significantly different from the defoliation assessed on trees treated with RTSA 505 only in the fall of 2022 (Table 3). Once again, phytotoxicity was not observed on any treated trees in 2024.

Table 1. Cherry leaf spot incidence on fruit stems and leaves.

Treatment & Rate/injection or /100 gal as indicated below	Time of Application [X]	Ave. Tree Diameter (inches) [Y]	Cherry Leaf Spot			
			Fruit Stems (%)[Y]		Leaves (%)[Y]	
			2023	2024	2023	2024
Non-treated……..	None……	14.1	13.4 ab	50.2 a	15.0 a	53.2 a
RTSA 505 at 10 ml/injection……	Fall 22 only……	13.1	9.8 ab	8.8 de	7.6 b	10.7 ef
RTSA 505 at 5 ml/injection……..	Fall 22 and 23and Bud Break 22 and 23	14.1	7.4 bc	11.8 d	7.0 b	15.4 de
RTSA 505 at 5 ml/injection……..	Bud Break 22 and 23	13.5	15.4 a	27.2 b	9.7 b	24.0 bc
RTSA 505 at 10 ml/injection……	Bud Break 23 only…	14.8	8.3 bc	18.0 c	8.1 b	20.4 cd
RTSA 505 at 5 ml/injection……..	Bud Break 22 & 23 plus 2 weeks later 22 and 23	14.1	9.1 b	23.8 bc	9.0 b	27.5 b
Banner Maxx II at 4 fl oz/100 gal.	Foliar apps 23 and 24	13.6	2.9 c	3.8 e	1.4 c	5.8 f

[X] Injections occurred on 8 Nov 2022 and 11 Apr 2023 (bud break) and 25 Apr 2023 (full bloom); then again on 14 Dec 2023 and 26 Mar 2024 (popcorn) and 11 Apr 2024 (full bloom to petal fall). The fungicide Banner Maxx II was foliar applied on 13 Apr 2023 (bud break), 27 Apr (full bloom), 11 May (petal fall to shuck split), 25 May (1st cover), 8 Jun (color change) and 23 Jun (preharvest); then again on applied on 26 Mar 2024 (popcorn), 11 Apr 2024 (full bloom to petal fall), 24 Apr 2024 (shuck split), 9 May 2024 (1st cover), 23 May 2024 (2nd cover), 6 Jun 2024 (color change) and 20 Jun 2024 (preharvest).

[Y] Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P \leq 0.05$). Means without letters were not significantly different.

Table 2. Incidence of leaves with shothole and/or powdery mildew.

Treatment & Rate/injection or /100 gal as indicated below	Time of Application[X]	Shothole (% leaves) [Y]		Powdery Mildew (% leaves) [Y]	
		2023	2024	2023	2024
Non-treated……..	None……	29.2	27.5 ab	82.2 ab	98.4 a
RTSA 505 at 10 ml/injection……	Fall 22 only……	28.2	29.1 a	71.8 bc	62.8 d
RTSA 505 at 5 ml/injection……..	Fall 22 and 23and Bud Break 22 and 23	26.2	21.6 c	85.0 a	86.2 b
RTSA 505 at 5 ml/injection……..	Bud Break 22 and 23	29.1	26.1 abc	88.4 a	75.2 c
RTSA 505 at 10 ml/injection……	Bud Break 23 only…	29.3	31.4 a	79.6 ab	67.6 d
RTSA 505 at 5 ml/injection……..	Bud Break 22 & 23 plus 2 weeks later 22 and 23	27.2	27.6 ab	79.6 ab	79.4 c
Banner Maxx II at 4 fl oz/100 gal.	Foliar apps 23 and 24	26.5	22.6 bc	59.2 c	50.8 e

[X] Injections occurred on 8 Nov 2022 and 11 Apr 2023 (bud break) and 25 Apr 2023 (full bloom); then again on 14 Dec 2023 and 26 Mar 2024 (popcorn) and 11 Apr 2024 (full bloom to petal fall). The fungicide Banner Maxx II was foliar applied on 13 Apr 2023 (bud break), 27 Apr (full bloom), 11 May (petal fall to shuck split), 25 May (1st cover), 8 Jun (color change) and 23 Jun (preharvest); then again on applied on 26 Mar 2024 (popcorn), 11 Apr 2024 (full bloom to petal fall), 24 Apr 2024 (shuck split), 9 May 2024 (1st cover), 23 May 2024 (2nd cover), 6 Jun 2024 (color change) and 20 Jun 2024 (preharvest).

[Y] Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P \leq 0.05$). Means without letters were not significantly different.

Table 3. Tree defoliation evaluations in 2023 and 2024.

Treatment & Rate/injection or /100 gal as indicated below	Time of Application [X]	Defoliation	
		2023 (%)[Y]	2024 (rating) [Z]
Non-treated……..	None……	29	4.8 a
RTSA 505 at 10 ml/injection…….	Fall 22 only……	26	2.2 cd
RTSA 505 at 5 ml/injection……...	Fall 22 and 23and Bud Break 22 and 23	24	3.6 b
RTSA 505 at 5 ml/injection……...	Bud Break 22 and 23	25	3.4 b
RTSA 505 at 10 ml/injection…….	Bud Break 23 only…	30	2.8 bc
RTSA 505 at 5 ml/injection……...	Bud Break 22 & 23 plus 2 weeks later 22 and 23	22	3.2 b
Banner Maxx II at 4 fl oz/100 gal.....	Foliar apps 23 and 24	31	1.8 d

[X] Injections occurred on 8 Nov 2022 and 11 Apr 2023 (bud break) and 25 Apr 2023 (full bloom); then again on 14 Dec 2023 and 26 Mar 2024 (popcorn) and 11 Apr 2024 (full bloom to petal fall). The fungicide Banner Maxx II was foliar applied on 13 Apr 2023 (bud break), 27 Apr (full bloom), 11 May (petal fall to shuck split), 25 May (1st cover), 8 Jun (color change) and 23 Jun (preharvest); then again on applied on 26 Mar 2024 (popcorn), 11 Apr 2024 (full bloom to petal fall), 24 Apr 2024 (shuck split), 9 May 2024 (1st cover), 23 May 2024 (2nd cover), 6 Jun 2024 (color change) and 20 Jun 2024 (preharvest).

[Y] Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P \leq 0.05$). Means without letters were not significantly different.

[Z] Defoliation was assessed on 24 Jul 2024 using a 0 to 5 scale where 0 = no defoliation, 1 = 1 to 10% defoliation, 2 = 10 to 20% defoliation, 3 = 20 to 30% defoliation, 4 = 40 to 50% defoliation, 5 = > 50% defoliation. Analysis of variance is based on log (x+1) transformation. Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P=0.05$).