NEW FUNGICIDE TREATMENTS FOR PINK ROOT MANAGEMENT AND PLANT HEALTH IN ONIONS

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Introduction

There are several new types of fungicide products being developed to manage fungal pathogens that affect onions, including soil-borne pathogens such as pink root. These fungicides could be a valuable addition to onion management because they have different modes of action from traditional fungicides and they may promote overall plant health and vigor through systemically acquired resistance (SAR)-like properties. This trial was conducted to evaluate a new biological product, Serenade® (made by Bayer) for the management of pink root when it is applied through drip irrigation.

Materials and Methods

Onions were grown in 2014 on an Owyhee silt loam. The field had been planted to wheat in 2013. In the fall of 2013, the wheat stubble was shredded and the field was irrigated. The field was then disked, moldboard plowed, and groundhogged. A soil analysis taken in the fall of 2013 showed a pH of 7.9, 1.27% organic matter, 181% base saturation, 21 ppm of phosphorus, 418 ppm of potassium, and less than 1.5% lime. Based on the soil analysis, 500 lb of sulfur/acre, 3 lb of manganese/acre, and 1 lb of boron/acre were broadcast before plowing. Phosphorus was intentionally not added in the fall. After plowing, the field was fumigated with Vapam® at 15 gal/acre and bedded at 22 inches.

Seed was planted on March 18 in double rows spaced 3 inches apart at 9 seeds/ft of single row. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onions received a narrow band of Lorsban® 15G at 3.7 oz/1,000 ft of row (0.82 lb ai/acre) over the planted rows, and the soil surface was rolled. Onion emergence started on April 7.

All onions in these trials were grown under drip irrigation. The field had drip tape laid at 4-inch depth between 2 onion beds during planting. Drip tape (Toro Aqua-Traxx, Toro Co., El Cajon, CA) with emitters spaced 12 inches apart and an emitter flow rate of 0.22 gal/minute/100 ft was laid at 4-inch depth between 2 onion beds at the time of planting. The distance between the tape and the center of each bed was 11 inches. The water application rate was 0.06 inch/hour.

The field was irrigated as necessary to maintain soil water tension at 20 cb at 8-inch depth. Soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture

Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA).

The experiment was designed as a randomized complete block with four replications each of the Serenade treatments and the untreated control. Serenade is a biological fungicide formulation composed of the bacterium *Bacillus subtilis.* There were three different treatments with Serenade soil fungicide applied through the drip system (Table 1). One of the treatments included Serenade and an experimental fungicide (BCS- AR83685), also manufactured by Bayer. Applications were made four times during the growing season (Application A: May 16, B: June 16, C: July 16, D: August 8). Drip applications were made by injecting treatment solutions over a 2-hour period starting 0.5 hours after the initiation of irrigation. Irrigation continued for 6 hours after the injection was completed.

On four dates during the growing season, 10 onion bulbs from each plot were evaluated for size and pink root incidence. For each bulb, diameter was measured with calipers, and then the total number of roots and number of pink roots were counted. Evaluation dates were June 3, July 2, August 5, and August 26.

The onions were lifted on September 10 to field cure. Onions from the middle two double rows in each plot were topped by hand and bagged on September 18. The onions from each plot were graded on January 8, 2015 so that storage quality could be evaluated. During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small, medium, jumbo, colossal, and supercolossal. Bulb counts per 50 lb of supercolossal onions were determined for each plot by weighing and counting all supercolossal bulbs during grading. Marketable yield consisted of No.1 bulbs larger than 2¼ inches.

Data on the severity of pink root, bulb diameter, and yield were analyzed by ANOVA using the SAS statistical program.

Table 1. Treatment applications for each application date of fungicides for pink root management at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.

Treatment	Dates			
	May 16 Application A	June 16 Application B	July 16 Application C	August 8 Application D
1 Control	None	None	None	None
2 SERENADE	Serenade 4 qt/acre	None	None	None
3 SERENADE	Serenade 2 qt/acre	Serenade 2 qt/acre	Serenade 2 qt/acre	None
4 SERENADE + BCS-AR83685	Serenade 2 qt/acre	Serenade 2 qt/acre BCS-AR83685 6.84 oz/acre	Serenade 2 qt/acre	BCS-AR83685 6.84 oz/a

Results and Discussion

On the first sample date of June 3, onions that had received one of the Serenade treatments had significantly fewer pink roots than the untreated onions (Table 2). There was no difference in total number of roots, so the treated onions also had a significantly lower proportion of pink roots.

After the first sample date, there were no other differences among the Serenade treatments and the untreated control in the severity of pink root detected during the season (Fig. 1). These data are highly variable, because roots infected with the pink root pathogen are prone to sloughing off, so accurate determinations of severity can be difficult. The increase in proportion of pink roots between the third and fourth evaluation was lower for treatment 4, in which the final application contained the BCS- AR83685 fungicide. However, there were no significant differences in the bulb size, so there did not appear to be an overall increase in plant health with this or the other Serenade treatments.

Marketable yield was approximately 3-9% higher in the Serenade treatments than in the untreated control (Table 3); however, these differences were not significant. There was no difference in the storage quality between Serenade-treated onions and the untreated controls. The incidence of rot ranged from 2 to 4% across all of the treatments.

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Table 2. Fungicide effects on bulb size and root health of onions as measured on four dates over the growing season at the Malheur Experiment Station, Oregon State University, Ontario, OR, in 2014. Means with the same lower case letter are not significantly different ($p > 0.05$.)

Treatment	Bulb diameter (mean inches)	Pink roots (mean number)	Total roots (mean number)	Proportion pink roots
		June 3		
1 Control	0.925 a	3.2 a	68.0 a	0.04699 a
2 SERENADE 4 qt/acre A *	0.863 a	0.6 b	62.7 a	0.00966 b
3 SERENADE 2 qt/acre ABC	0.800 a	0.6 b	62.5 a	0.00887 b
4 SERENADE 2 qt/acre ABC	0.869 a	1.6 b	64.9 a	0.02386 b
BCS-AR83685 6.84 fl oz/acre BD				
		July 2		
1 Control	1.538 a	7.6 a	81.5 a	0.09417 a
2 SERENADE 4 qt/acre A	1.544 a	4.2 a	82.9 a	0.05093 a
3 SERENADE 2 qt/acre ABC	1.500 a	4.6 a	82.8 a	0.05482 a
4 SERENADE 2 qt/acre ABC	1.613 a	6.3 a	79.6 a	0.07838 a
BCS-AR83685 6.84 fl oz/acre BD				
		Aug 5		
1 Control	3.406 a	13.4 a	71.9 a	0.19402 a
2 SERENADE 4 qt/acre A	3.381 a	16.5 a	79.7 a	0.20889 a
3 SERENADE 2 qt/acre ABC	3.331 a	14.1 a	69.3 a	0.20650 a
4 SERENADE 2 qt/acre ABC	3.481 a	15.2 a	70.0 a	0.21719 a
BCS-AR83685 6.84 fl oz/acre BD				
		Aug 26		
1 Control	3.856 a	25.2 a	61.7 a	0.40166 a
2 SERENADE 4 qt/acre A	3.700 a	34.4 a	64.4 a	0.53532 a
3 SERENADE 2 qt/acre ABC	3.719 a	26.3 a	55.9 a	0.47998 a
4 SERENADE 2 qt/acre ABC	3.919 a	18.3 a	54.5 a	0.26021 a
BCS-AR83685 6.84 fl oz/acre BD				

* Application dates: A: May 16, B: June 16, C: July 16, D: August 8.

Table 3. Effect of fungicide treatments for pink root management on amount of rot and yield of onions in 2014 at the Malheur Experiment Station, Oregon State University, Ontario, OR. Means with the same lower case letter are not significantly different ($p > 0.05$.)

Treatment	Total Rot	Small	Medium	Jumbo	Colossal	Supercolossal	Total marketable
	---------- cwt/acre ----------						
1 Control	28.697 a	8.705 a	25.258 a	549.738 a	254.103 a	7.637 a	843.355 a
2 SERENADE 4 qt/acre A *	20.476 a	7.000 a	23.813 a	589.895 a	251.263 a	6.601 a	876.438 a
3 SERENADE 2 qt/acre ABC	42.416 a	5.060 a	26.810 a	667.478 a	216.190 a	6.478 a	921.530 a
4 SERENADE 2 qt/acre ABC BCS-AR83685 6.84 fl oz/acre BD	14.611 a	8.213 a	29.378 a	670.628 a	199.945 a	7.149 a	917.075 a

* Application dates: A: May 16, B: June 16, C: July 16, D: August 8.

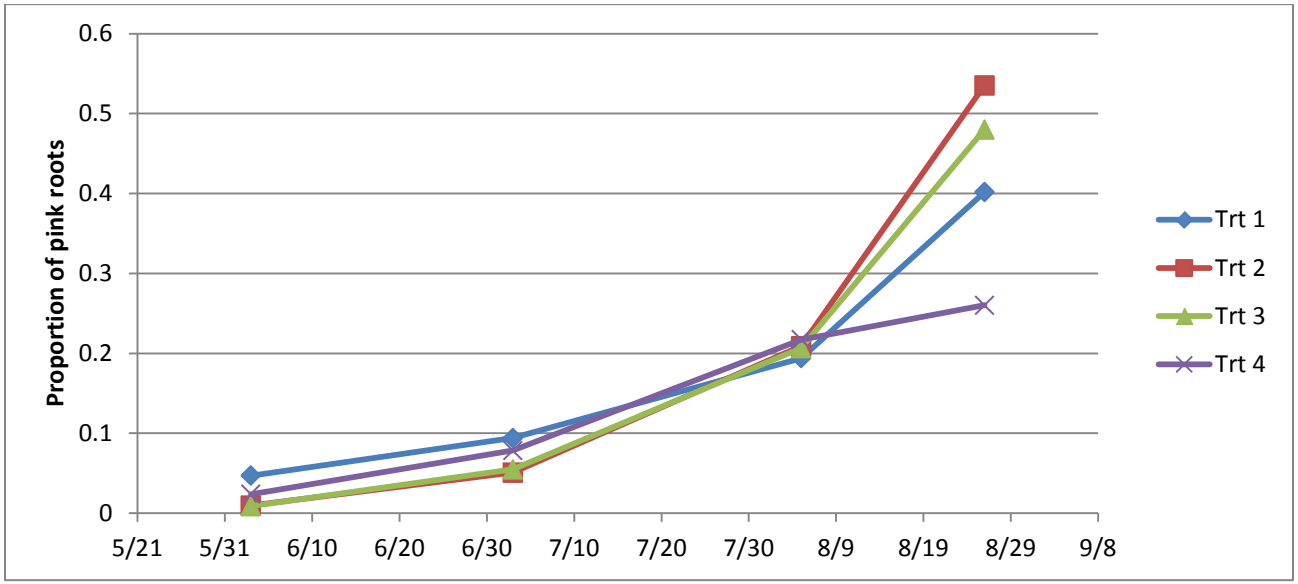

Figure 1. Increase in proportion of pink roots per onion bulb. The increase in proportion of pink roots was lower after the final fungicide application for Treatment 4 compared with the other 3 treatments. Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.