NEW FUNGICIDE TREATMENTS FOR DISEASE MANAGEMENT AND PLANT HEALTH IN ONIONS

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Introduction

There are several new types of fungicide products that are being developed to manage fungal pathogens that affect onions. Some of these new products work through uptake into the plant rather than relying on contact with the pathogen on the foliage surface. These fungicides could be a valuable addition to onion management for three reasons: 1) they have different modes of action from traditional fungicides; 2) they have translaminar and systemic properties so they can be applied either as foliar sprays or through drip irrigation; and 3) they may promote overall plant health and vigor through systemically acquired resistance (SAR)-like properties. In addition to these types of products, new biological products have been developed for the management of soil-borne pathogens, such as pink root.

We sought to evaluate two new fungicides for management of botrytis leaf blight: Fontelis®, which was applied as a foliar spray, and Luna® Tranquility, which was applied through drip irrigation. These fungicides were integrated with other standard fungicides into season-long management programs. Certain treatment programs with these materials called for applications to be made when an infection event occurs (e.g., hail, sandstorm) or 14 days before neck collapse to determine if such applications would mitigate bulb rot losses.

A second trial was conducted to evaluate a new biological product, Serenade® for the management of pink root when it is applied through drip irrigation.

Materials and Methods

Onions were grown on an Owyhee silt loam with a pH of 7.3 and 1.6% organic matter, that was previously planted to wheat. In the fall of 2012, the wheat stubble was shredded and the field was irrigated. Based on a soil analysis done in the fall of 2012, 49 lb of phosphorus/acre, 200 lbs of sulfur/acre, and 1 lb of boron/acre were broadcast before plowing. The field was then disked, moldboard plowed, and groundhogged. On September 24, the field was fumigated with Vapam® at 15 gal/acre and bedded at 22 inches.

Onion seed (‘Vaquero’; Nunhems, Parma, ID) was planted on March 15 in double rows, spaced 3 inches apart at 9 seeds/ft of each single row, giving 150,000 seeds/acre. 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, Lorsban® 15G insecticide

was banded at 3.7 oz per 1,000 ft of row (0.82 lbs ai/acre), and the soil surface was rolled. Onion emergence began on 8 April.

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/min/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).

Trial 1. Evaluation of Fontelis and Luna Tranquility for Foliar Disease Management and Onion Bulb Rot

All fungicides (Table 1) except Luna Tranquility were applied by a CO_2-powered backpack sprayer with a 4-nozzle boom with 11004 nozzles at 30 psi and 35 gal/acre. Luna Tranquility was injected through the drip system. Drip applications were made by injecting the Luna Tranquility mixture at 5 gal/hour over a 2-hour period starting 2 hours after the initiation of irrigation. After the injection, irrigation continued for 4 hours after the injection was completed.

Plots were inspected weekly for foliar disease symptoms, in particular botrytis onion leaf blight caused by *Botrytis squamosa*. Fifteen consecutive plants in one of the middle two rows of each plot were visually inspected for symptoms and disease severity rated.

The onions were lifted on September 13 to field cure. Onions from the middle two double rows in each plot were topped by hand and bagged on September 24. The onions from each plot were graded on January 14, 2014 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 (caused by the fungus *Botrytis allii* in the neck or side of the bulb), plate rot (caused by the fungus *Fusarium oxysporum*), and black mold (caused by 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 of every variety by weighing and counting all supercolossal bulbs during grading. Marketable yield consisted of No. 1 bulbs larger than 2¼ inches.

Data were analyzed by ANOVA using the SAS statistical program.

Results and Discussion: Trial 1

Botrytis onion leaf blight was not observed in the field during the 2013 growing season. The lack of disease was likely a result of the hot, dry summer that kept leaf blight from developing. Botrytis leaf blight is favored by high rainfall, extended periods of leaf wetness, high relative humidity, and moderate temperatures (50-75^{o}F).

The amount of bulb rot did not differ significantly among the treatments (Table 2). The amount of rot ranged from 8% in the untreated control to just over 2% in the straight Fontelis treatment (4 applications of Fontelis over the season).

There were significant differences in marketable yields among the treatments (Table 2). The highest total marketable yields were the conventional standard programs where Quadris® was rotated with Rovral®. The late-season application of Luna Tranquility that followed the Quadris – Rovral rotation in treatment 3 did not lead to an increase in marketable yield compared with treatment 2 where only Quadris and Rovral were used.

The treatment that utilized a rotation of Luna Tranquility and Bravo Weather Stik plus Scala® produced intermediate yields.

Foliar applications of Fontelis, either by itself or when rotated with ManKocide® and Tanos® did not increase yields relative to the untreated control.

Although the amount of foliar or bulb rot disease was minimal in this trial, marketable yields and the yield of colossal bulbs was high in the treatment where Luna Tranquility was used (treatment 3 and 4). These results suggest that Luna Tranquility helps promote overall plant health and vigor, which leads to production of larger bulbs.

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Table 1. Sequences of fungicide treatments and application dates for efficacy against onion foliar and bulb pathogens. Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

Treatment	June 6	June 20	July 4	July 18	August 15
1	Untreated control				
2	Quadris 2F 12 oz	Rovral 4F 1.5 pt	Quadris 2F 12 oz	Rovral 4F 1.5 pt	
3	Quadris 2F 12 oz	Rovral 4F 1.5 pt	Quadris 2F 12 oz	Rovral 4F 1.5 pt	Luna Tranquility* 6.84 oz (drip application)
4	Luna Tranquility 6.84 oz (drip application)	Bravo Weather Stik 1.5 pt Scala 9 oz	Luna Tranquility 6.84 oz (drip application)	Bravo Weather Stik 1.5 pt Scala9 oz	
5	Fontelis SC 1.5 pt (MSO 1% vol:vol)	Fontelis SC 1.5 pt (MSO 1% vol:vol)	Fontelis SC 1.5 pt (MSO 1% vol:vol)	Fontelis SC 1.5 pt (MSO 1% vol:vol)	
6	Fontelis SC 1.5 pt (MSO 1% vol:vol)		Fontelis SC 1.5 pt (MSO 1% vol:vol)		
7	Mankocide 1.5 lb Tanos 10 oz	Fontelis SC 1.5 pt (MSO 1% vol:vol)	ManKocide 1.5 lb Tanos 10 oz	Fontelis SC 1.5 pt (MSO 1% vol:vol)	

* Application applied

Table 2. Effect of fungicide treatments on onion yield. Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

	Cwt/acre					
Treatment[a]	**Supercolossal**	**Colossal**	**Jumbo**	**Medium**	**Total marketable**	**Rot (% of total)**
1	95	461	578	23	1157	8.3%
2	110	570	590	21	1290	2.9%
3	111	650	511	13	1285	5.1%
4	67	469	648	16	1200	3.3%
5	66	470	621	11	1168	2.2%
6	67	439	630	12	1147	5.0%
7	109	442	507	17	1074	2.9%
LSD	NS	120	NS	NS	122	NS
F-Test Probability Value	0.44	0.01	0.11	0.24	0.02	0.20

[a]See Table 1 for fungicide treatment descriptions.

Trial 2: Evaluation of Serenade for Pink Root Management

The experiment was arranged as a randomized complete block with four replications each of the Serenade treatment and the untreated control. Serenade soil fungicide was applied at 2 qt/acre through the drip system. Applications were made three times during the growing season (June 6, July 3, August 1). Drip applications were made by injecting a Serenade solution over a 2 hour period starting 2 hours after the initiation of irrigation. After the injection, irrigation continued for 4 hours after the injection was completed.

On three 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.

The onions were lifted on September 13 to field cure. Onions from the middle two double rows in each plot were topped by hand and bagged on September 24. The onions from each plot were graded on January 14, 2014 for storage quality. 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 of every variety 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.

Results and Discussion: Trial 2

There were no differences between the Serenade treatment and the untreated control in the severity of pink root detected during the season (Fig. 1). On two of the three evaluations, the Serenade treatment had lower levels of pink root but these were not statistically different. In part, this may reflect the variable nature of the data. Roots infected with the pink root pathogen are prone to sloughing off so accurate determinations of severity can be difficult. However, no significant differences in the bulb size occurred so there did not appear to be an overall increase in plant health with the Serenade treatment.

Marketable yield was approximately 7% higher in the Serenade treatment (1,241 cwt/acre) than in the untreated control (1,157 cwt/acre) (Fig. 2), but this was not a statistically significant difference. There were more bulbs in the colossal size range for the Serenade treatment (44.8%) than for the untreated control (39.8%). There was no difference in the storage quality between Serenade-treated onions and the untreated controls. The incidence of rot was 5.8% of the total yield in the Serenade treatment versus 8.3% in the untreated control.

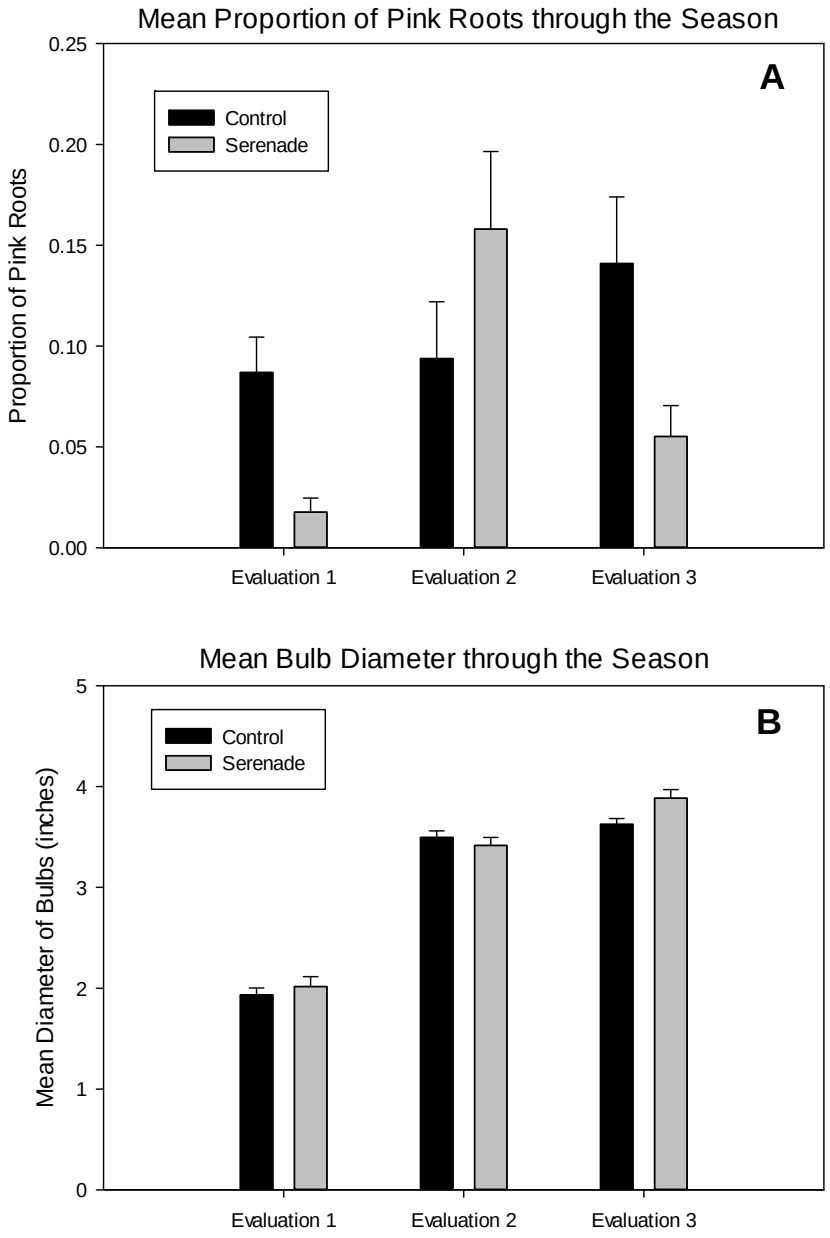

Figure 1. The effect of Serenade soil fungicide on the severity of pink root (A) and onion bulb size (B) as determined in three evaluations over the season. Evaluations were done on 11 July, 12 August, and 5 September. Severity of pink root was determined by the proportion of pink roots per onion bulb. Bulb size was determined by measuring diameter. There were no statistically significant differences in proportion of pink roots or bulb size between the treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

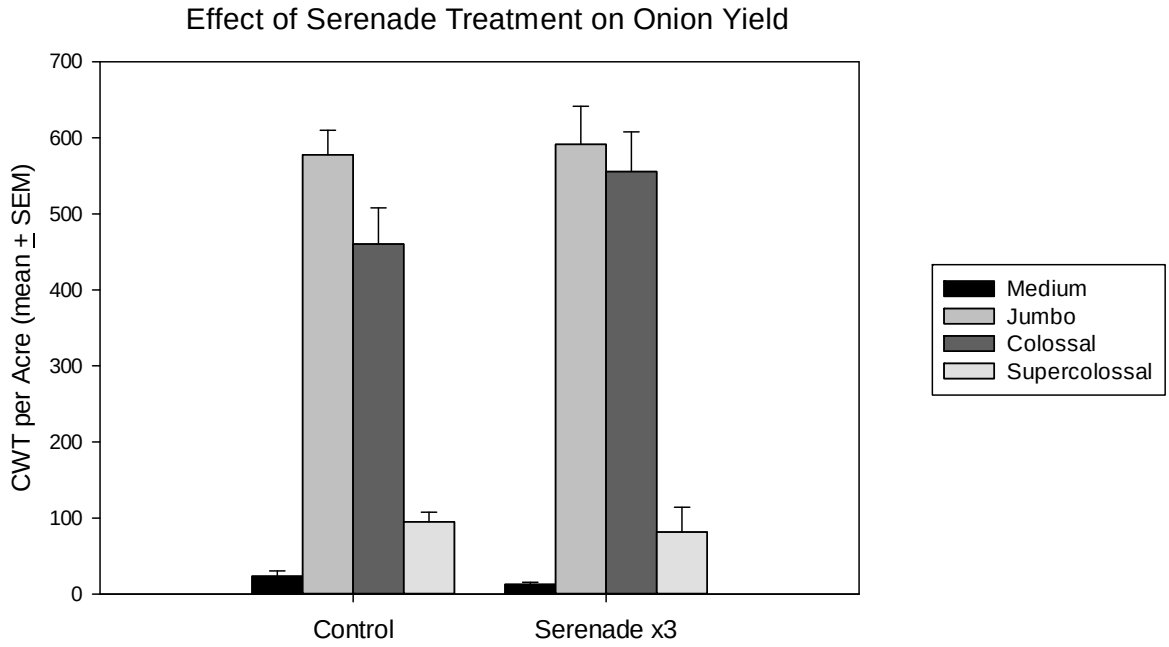

Figure 2. The effect of Serenade soil fungicide treatments on onion yield in comparison with untreated controls. The total marketable yield for the Serenade treatment was 1,241 cwt/acre, which was not statistically greater than that for the untreated control (1,157 cwt/acre). Malheur Experiment Station, Oregon State University, Ontario, OR.