EFFECT OF PENTHIOPYRAD ON *RHIZOCTONIA SOLANI* ON SUGARBEET

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Rhizoctonia solani is a soilborne fungus that causes damping-off, crown and root rot of sugar beet (Beta Vulgaris L.), and is considered the most important pathogen of sugarbeet production in North Dakota and Minnesota (4). It is difficult to develop sugarbeet varieties with complete resistance to *R. solani* that are also high producer of recoverable sucrose. Cultural practices including early planting, crop rotation with non-host plants such as wheat, and the use of resistant varieties can provide some levels of protection against *R. solani* in older plants. Also, timely applications of effective fungicides are necessary to manage *R. solani*. Azoxystrobin, a systemic fungicide and a quinone outside inhibitor, is the most effective and widely used fungicide for controlling *R. solani* (2,3). However, field resistance against azoxystrobin has been reported in *R. solani* on rice in United States (1). As a result it would be useful to have other fungicides with different modes of action that will effectively control *R. solani* and can be used in rotation with azoxystrobin.

OBJECTIVE

The objective of this research was to evaluate penthiopyrad for its efficacy at controlling *R. solani* under greenhouse conditions. Penthiopyrad, a systemic fungicide, employs the succinate dehydrogenase inhibition (SDHI) mode of action to suppress pathogens.

MATERIALS AND METHODS

Trials were conducted at the AES greenhouse located in Fargo, North Dakota. Greenhouse temperature was set at 21±2℃. Plants were watered daily to maintain adequate soil moisture (75%-100%). Sugarbeet cultivar (Crystal 539RR) used in all the trials is very susceptible to *R. solani*. Inoculation was with *R. solani* AG-IIIB grown on barley. Sunshine Mix 1 peat soil (Sun Gro Horticulture) was filled in trays and pots. Fungicide applications were conducted using a spraying system calibrated to spray the fungicides at 20 psi with a speed of 3.91 miles per hour using a single flat fan nozzle (4001E).

Ten seeds were planted in the tray of 11 x 5 inch. Penthiopyrad at 38, 30, 20, 15 fl oz/A was applied in-furrow at planting, followed by inoculum (one grain each) placed near each seed. The experimental design was a randomized complete block with four replicates. Stand counts were taken during the growing season. Roots were harvested after 5 weeks and washed cleanly to check for any infection. This experiment was repeated three times and the data were combined after data was shown to be homogenous using Bartlett's test for homogeneity.

Three seeds were planted in the small pot of 4 x 4 inches. Plants were thinned at 2 leaf stage to allow one vigorous plant per pot. In this trial, penthiopyrad at 38, 30, 20, 15 fl oz/A was used as 7 inch band foliar application on four leaf stage sugarbeet as soon as they were inoculated with R. *solani*. Experimental design was CRD with no sampling with six replicates. Under the same experimental set, Penthiopyrad was directly added to the soil at 38, 30, 20, 15 fl oz/A to four leaf stage sugarbeet, followed by inoculation with *R. solani*. Sugarbeet plants were taken out from the pots and root were washed carefully and evaluated using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted). These two experiments were repeated two times and Scales were analyzed via non-parametric method to figure out the relative effects and its lower and upper limits.

For all the trials, controls were inoculated check and non-inoculated check without any fungicide application.

RESULTS AND DISCUSSION

In the experiment where penthiopyrad was applied in-furrow (Table 1), all the rates of fungicide resulted in more than 70% of plant stands in average compared with only 4.2% in the inoculated check. The rates from 20 to 38 fl oz/A were not significantly different from non-inoculated check (P=0.95), among which 20 fl oz/A had the highest average percentage of survivors (80.8%). Washed roots were clean without any infection and there were no phytotoxic visual symptoms observed on the plants treated with penthiopyrad. However, when penthiopyrad was used as foliar application (Table 2), all the rates had the relative effects that were not significantly different from the inoculated check and all treated plants had some leaf scorching. The reason why the 7-inch band foliar application

failed to control the disease is not clear so far. In this trial, plants were watered 24 hr after inoculation and fungicide application. It may be possible that the fungus may initiate growth and start the infection process before the fungicide gets into contact with the pathogen. More experiments where the treated plants are watered immediately after treatments and using a narrower band to concentrate the fungicide were initiated to determine how best to provide control with a foliar but soil directed application of penthiopyrad. All rates of penthiopyrad used as a drench provided control similar to the non-inoculated check because they had shared relative effects with the non-inoculated check as a strong comparison with inoculated check (Table 3). These trials demonstrated that penthiopyrad provides effective control of *R. solani* when in direct contact with the pathogen before infection takes place. It may be possible to use penthiopyrad in an alternation program with azoxystrobin to help in delaying the development of fungicide resistant isolates of *R. solani*.

REFERENCES

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Table 1: Effect of Vertisan applied in-furrow on *R. solani* in sugarbeet

Application Method	Fungicide Rate	Average Percent of Survivors	LSD(0.05)=11.8%
In-furrow application (Vertisan[1])	38 fl oz/A	77%	ab
	30 fl oz/A	75%	ab
	20 fl oz/A	81%	ab
	15 fl oz/A	73%	b
	Non- inoculated check	86%	a
	Inoculated check	4%	c

1: One gallon of Vertisan contains 1.67 pounds of penthiopyrad.

Table 2: Effect of Vertisan applied foliarly on *R. solani* in sugarbeet

Treatment	Median disease rating	Mean rank	Estimated relative effect	Confidence internal (95%) for relative treatment effect	
				Lower limit	Upper limit
38 fl oz/A	7	21.9164	0.5949	0.4544	0.7158
30 fl oz/A	7	20.9156	0.5671	0.4087	0.7078
20 fl oz/A	7	20.3324	0.5509	0.3817	0.7047
15 fl oz/A	7	20.5808	0.5578	0.3917	0.7072
Non-Ino check	0	30.4988	0.0833		
Ino-check	7	23.7488	0.6458	0.5150	0.7505

Table 3: Effect of Vertisan applied as a soil drench on *R. solani* in sugarbeet

Treatment	Median disease rating	Mean rank	Estimated relative effect	Confidence internal (95%) for relative treatment effect	
				Lower limit	Upper limit
38 fl oz/A	0	14.9972	0.4027	0.3760	0.4304
30 fl oz/A	0	14.9972	0.4027	0.3760	0.4304
20 fl oz/A	0	14.9972	0.4027	0.3760	0.4304
15 fl oz/A	0	17.4999	0.4722	0.3675	0.5805
Non-Ino check	0	14.9972	0.4027	0.3760	0.4304
Ino-check	7	33.4976	0.9166		