PENTHIOPYRAD SEED TREATMENT ON SUGARBEET FOR CONTROL OF *RHIZOCTONIA SOLANI*

Carol E. Windels and Jason R. Brantner

Professor of Plant Pathology and Research Fellow, respectively
University of Minnesota, Northwest Research and Outreach Center, Crookston

Seedling diseases caused by *Rhizoctonia solani* AG 4, AG 2-2 IV and AG 2-2 IIIB occur on sugarbeet when soil is > 65^0F and moist to wet. Disease management strategies include early planting, partially resistant varieties, seed treatment fungicides, and rotation of non-host crops. Currently, metalaxyl (Apron) and Thiram (a dithiocarbamate) are standard seed treatment fungicides on sugarbeet in the USA to control of species of *Pythium* and *R. solani*, respectively. Unfortunately, Thiram is inadequate in protecting sugarbeet from Rhizoctonia seed rot and damping-off when inoculum densities are high and environmental conditions are favorable for disease. Thus, alternative effective seed treatment fungicides with activity against *R. solani* AG 4 and AG 2-2 are being explored.

OBJECTIVE

A controlled environment experiment was conducted to determine efficacy of penthiopyrad seed treatment in controlling damping-off and root rot of sugarbeet caused by *R. solani* AG 4, AG 2-2 IIIB, and AG 2-2 IV.

MATERIALS AND METHODS

Seed of a commercial sugarbeet variety treated with Apron + Thiram (A + T, at standard rates) also were treated with penthiopyrad at five rates (7, 14, 28, 56, 84 g/100,000 [unit] seed). There were four controls: untreated seed, A + T, A + T + azoxystrobin (5 g/unit, commercial fungicide to control *R. solani*), and A + T + penthiopyrad (14g) + hymexazol (14 g, commercial fungicide to control *Aphanomyces*).

Soil collected from a field at the University of Minnesota, Northwest Research and Outreach Center, Crookston was inoculated with a mixture of cultures of *R. solani* AG 4, AG 2-2 IIIB, and AG 2-2 IV at rates of 13 mg inoculum of each isolate per Liter of soil (based on preliminary trials). Inoculum of *R. solani* was grown on sterilized barley grain for 3 weeks, dried, and ground in a Wiley mill (#3 round-hole screen, 1/8-inch mesh). Seed was sown in 4 x 4 x 4-inch pots (16 seed/pot), six replicates per seed treatment. Pots were placed in a growth chamber (75 +/- 4 °F and a 14-hour photoperiod) in a randomized block design for 4 weeks.

Stand counts began at emergence and continued every 1 to 3 days until 4 weeks after planting. Dying seedlings were removed at each stand count and cultured in the laboratory for verification of infection by *R. solani.* After 4 weeks, remaining seedlings were removed from soil, gently washed, and rated on a 0 to 3 scale (0 = plant healthy, 1 = slight necrosis at or below soil line, 2 = necrosis and constriction of the hypocotyl, 3 = hypocotyl completely constricted, plant dead). Disease ratings plus counts of dead seedlings over 4 weeks were used to calculate a root rot index (RRI) value (0 to 100 scale, 0 = no disease, 100 = all seedlings dead or severely rotted).

Total emergence, final stand (plants living after 4 weeks), and RRI values were subjected to analysis of variance and if significant ($P = 0.05$), means were separated by least significant difference.

RESULTS

At 5 days after planting, emergence was the same for all seed treatments (Fig. 1) and averaged 51%. Stands from untreated and A + T-treated seed started to decline at 10 days after planting and 4 days later, both of these controls had significantly lower stands compared to the equally higher stands from seed treated with all rates of penthiopyrad, penthiopyrad + hymexazol, and azoxystrobin (Fig. 1).

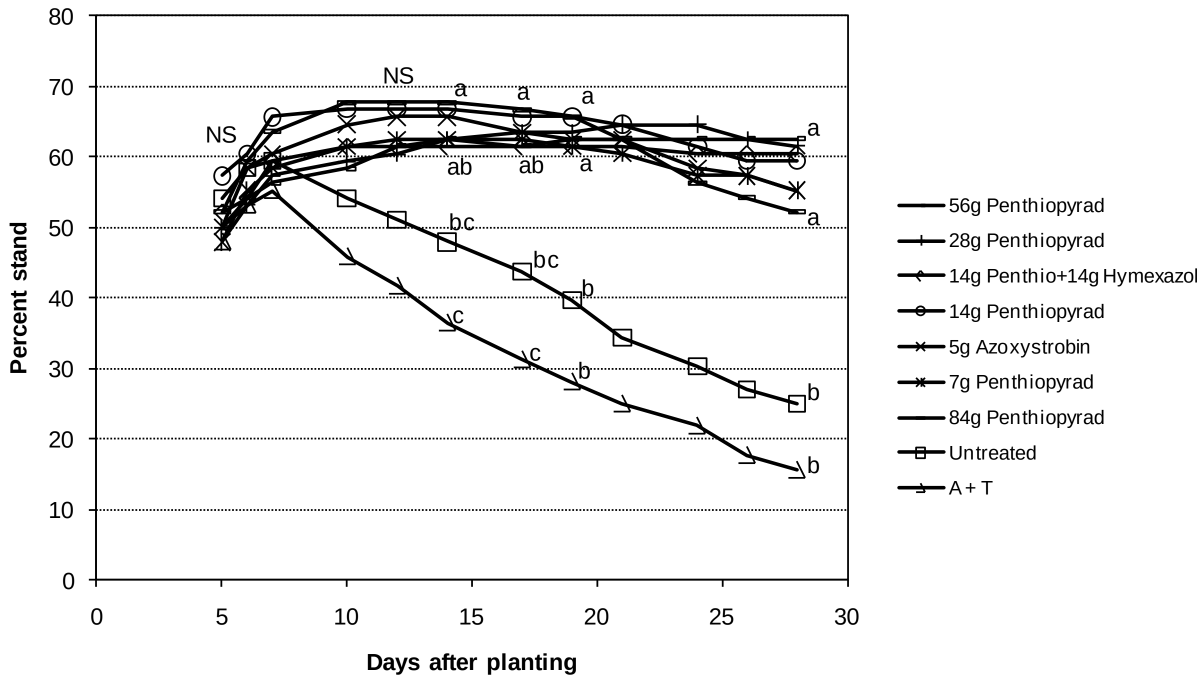

Fig. 1. Percent stand of sugarbeet from seeds treated with five rates of penthiopyrad compared to treatment with azoxystrobin, penthiopyrad + hymexazol, no fungicide (untreated), and a standard treatment with Apron (A) + Thiram (T). Field soil was inoculated with a mixture of *Rhizoctonia solani* AG 4, AG 2-2 IV, and AG 2-2 IIIB (13 mg of each isolate/Liter soil). For each selected date, values followed by the same letter are not significantly different (P = 0.05); NS = not significantly different. Each value is based on an average of six pots, 16 seed sown per pot. Experiments were conducted in a controlled environment chamber to favor infection by *R. solani*.

================================

Table 1. Percent total emergence, stand at 4 weeks after planting (final stand), and root rot index (RRI) values of sugarbeet when seeds were treated with five rates of penthiopyrad compared to treatment with azoxystrobin, penthiopyrad + hymexazol, no fungicide (untreated), and a standard treatment with Apron + Thiram. Field soil was inoculated with a mixture of *Rhizoctonia solani* AG 4, AG 2-2 IV and AG 2-2 IIIB (13 mg of each isolate/Liter soil) before seed was sown.

Treatment	Description	% Total emergence	% Final stand	RRI[Z]
1	Untreated	64	25 a	68.4 a
2	Apron + Thiram	63	16 a	79.4 a
3	5g Azoxystrobin	67	55 b	20.1 b
4	7g Penthiopyrad	63	55 b	23.4 b
5	14g Penthiopyrad	67	59 b	19.8 b
6	28g Penthiopyrad	65	62 b	12.2 b
7	56g Penthiopyrad	65	63 b	11.9 b
8	84g Penthiopyrad	68	52 b	36.2 b
9	14g Penthio + 14g Hymexazol	62	60 b	14.9 b
	ANOVA *P*-value[y]	0.997	0.0002	<0.0001
	LSD (P = 0.05)[y]	NS	21.4	26.0

Y In each column, values followed by the same letter are not significantly different and are separated by Least Significant Difference (LSD, P = 0.05); NS = not significantly different. Each value is based on an average of six pots, 16 seed sown per pot; experiments were conducted in a controlled environment chamber to favor infection by *R. solani*.

Z RRI = root rot index; values 0 to 100, 0 = no disease, 100 = all seedlings dead or dying.

By 4 weeks after planting, percent total emergence was the same for all seed treatments and the untreated control (Table 1). Rhizoctonia damping-off occurred in all seed treatments and differed with seed treatment. Final sugarbeet stands were significantly higher and equal for all rates of penthiopyrad, penthiopyrad + hymexazol, and azoxystrobin (averaged 58%) compared to untreated seed (25%) and A + T (16%) (Fig. 1, Table 1). Root rot index values also were significantly lower and equal for all rates of penthiopyrad, penthiopyrad + hymexazol, and azoxystrobin (averaged RRI = 19.8) compared to untreated seed (= 68.4) and A + T (= 79.4) (Table 1) Among the penthiopyrad seed treatments, rates of 7, 14, 28, 56, and 84g resulted in final stands of 55, 59, 62, 63 and 52%, respectively, and root rot indices of 23.4, 19.8, 12.2, 11.9, and 36.2, respectively (Fig. 1, Table 1). Of 115 dying seedlings collected throughout the trial, 92% were infected by *R. solani*; 7% yielded no fungus (likely were infected by *R. solani* based on symptoms), and <1% were infected by *Pythium* and *Aphanomyces cochlioides*.

DISCUSSION

Seed treatment with all rates of penthiopyrad was as effective as azoxystrobin in controlling a mixed soil population of *R. solani* AG 4, AG 2-2 IV, and AG 2-2 IIIB. It is unknown why the highest rate of penthiopyrad (84 g/unit) tended to have a slightly lower final stand than other rates of the product. In the United States, commercial sugarbeet is treated with Apron and Thiram to control *Pythium* and *R. solani*, respectively. Thiram, however, only provides fair control of seed rot and post-emergence damping-off. Azoxystrobin is registered for control of *R. solani* on sugarbeet and application is made as an in-furrow and/or a post-emergence band treatment. In some fields in Michigan, an in-furrow application of azoxystrobin is warranted because of high soil population densities of the pathogen. An affordable, alternative seed treatment fungicide, such as penthiopyrad, is needed for effective control of this increasingly important soilborne pathogen.

ACKNOWLEDGEMENTS

We thank Mitsui Chemical Inc., Sankyo Agro Co. Ltd., Sumitomo Corporation, and Betaseed for materials and/or a grant-in-aid; and Jeff Nielsen and student workers Fiyori Gebrehiwot and Nathan Whalen, University of Minnesota, Northwest Research and Outreach Center, Crookston, for technical assistance.