EFFECT OF PRECIPITATED CALCIUM CARBONATE ON RHIZOCTONIA ROOT ROT IN SUGARBEET

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Rhizoctonia root and crown rot, caused by *Rhizoctonia solani* Kühn, is currently the most damaging and difficult to control disease of sugarbeet (*Beta vulgaris* L.) in the North Dakota and Minnesota. Anastomosis group (AG) 2-2, and intraspecific groups (ISGs) AG 2-2 IV and AG 2-2 IIIB are the most prevalent ISGs in this sugarbeet production area. The diseases has become more widespread and severe over the past decade, probably because of warm and wet summers favorable for disease development and a transition in cropping sequence to now including *R. solani* host crops such as soybean, edible beans and maize. Varieties with high levels of resistance typically have lower yields compared to more susceptible varieties (Panella and Ruppel, 1996). Another important soilborne disease of sugarbeet is Aphanomyces root rot caused by *Aphanomyces cochlioides*. Research showed that application of precipitated calcium carbonate (or spent lime, a by-product of the sugar purification process), applied before planting sugarbeet, resulted in significantly reduced Aphanomyces root rot and increased recoverable sucrose in the presence of *A. cohlioides* (Windels et al., 2007). The seven sugarbeet processing factories in Minnesota and North Dakota produce about 500,000 tons of precipitated calcium carbonate annually, so it is readily available.

The objective of this research was to determine whether precipitated calcium carbonate controls Rhizoctonia root and crown rot in sugarbeet.

MATERIALS AND METHODS

Field trial was conducted in Hickson, ND in 2011. Precipitated calcium carbonate (PCC) was applied at 0, 5, 10 and 15 tons/A (wet weight) and incorporated in November 2009. The Hickson site was inoculated on 19 May, 2011 with *R. solani* AG 2-2 IIIB grown on barley and applied at 15 lbs/A. The inoculum was incorporated to about two inch depth. The experimental design was a split-plot with different rates of precipitated calcium carbonate as the main plot and a Rhizoctonia susceptible and resistant variety as the sub-plots with four replicates. Precipitated calcium carbonate was applied to blocks that were 44 ft wide and 60 ft long. A glyphosate tolerant Rhizoctonia susceptible and a glyphosate tolerant Rhizoctonia resistant variety (Proprietary materials, Crystal Beet Seed) were planted in the center of each block in strips that were 11 ft wide and 30 ft long. A Rhizoctonia resistant variety was planted as a border on each side of the strips. Plots were planted to stand on 3 June with seeds treated with Tachigaren at 45 g/kg seed to provide early season protection against *Aphanomyces cochlioides*, and Poncho-Beta to provide protection against insect pests. Counter 15G was applied at 11.9 lbs/A to provide protection against insect pests. Weeds were controlled with four applications of glyphosate. The site was fertilized as recommended for sugarbeet on 5 May; the fertilizer was incorporated by the grower-cooperator on 6 May.

Stand counts were taken during the season and at harvest. The middle two-rows of plots were harvested on 21 September and weights were recorded. Samples (12-15 roots) from each plot, not including roots on the ends of plots, were analyzed for quality at American Crystal Sugar Company tare laboratory at East Grand Forks, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 8 software package (Gylling Data Management Inc., Brookings, South Dakota, 2010). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

RESULTS AND DISCUSSIONS

Warm and wet conditions resulted in good germination, emergence, and plant stand in late June. First symptoms appeared in late July and included wilting and yellowing of leaves with death of plants occurring later.

The Rhizoctonia resistant variety typically had better plant stands than the susceptible variety. The susceptible variety tended to produce roots with greater sucrose concentration than the resistant variety. Both the Rhizoctonia resistant and susceptible varieties had the greatest plant stand, yield, sugar concentration, and recoverable sucrose at the 10 ton/A rate of PCC. However there was no difference in yield or recoverable sucrose between the resistant and susceptible varieties within a PCC rate. This indicates that the addition of PCC to the soil did not adequately control Rhizoctonia root rot.

Soil conditions were favorable for disease development starting at planting time (when the soil temperature at the 4'' depth was 74F). Disease incidence and severity moderate at this site. It is possible that infection started early and the plants were either unable to utilize nutrients from the precipitated calcium carbonate to build-up defense or that infection occurred before the precipitated calcium carbonate could stimulate the plants to develop resistance to the pathogen.

This is the second year of a three-year study. Results from year one (2010) were similar to results from year two (2011) in that stand counts were generally greater for the resistant variety but there was no difference in yield or recoverable sucrose between the resistant and susceptible varieties within a PCC rate.

Table 1. Effect of Precipitated Calcium Carbonate (PCC) applied at different rates on Rhizoctonia Root Rot in sugarbeet at Hickson, ND in 2011.

	5 July	18 July	27 July	21 September			
PCC Rate in tons/A and Variety	**Stand Count**	**Stand Count**	**Stand Count**	**Stand Count**	**Yield**	**Sucrose concentration**	**Recoverable sucrose**
	beets/100'	**beets/100'**	**beets/100'**	**beets/100'**	**ton/A**	**%**	**lb/A**
0 ton Susceptible Variety A	122	125	122	100	8.3	15.9	2403
0 ton Resistant Variety B	135	153	149	137	7.9	15.6	2282
5 ton Susceptible Variety A	140	143	156	129	9.0	16.5	2760
5 ton Resistant Variety B	153	165	168	139	8.0	15.8	2350
10 ton Susceptible Variety A	174	180	178	157	10.9	17.0	3445
10 ton Resistant Variety B	179	202	203	197	12.2	16.5	3693
15 ton Susceptible Variety A	151	144	144	121	8.4	16.2	2484
15 ton Resistant Variety B	151	171	179	150	10.0	16.0	2949
LSD (P=0.05)	**29**	**25**	**28**	**26**	**2.1**	**0.56**	**687**

References

Panella, L. and E. G. Ruppel. 1996. Availability of germplasm for resistance against *Rhizoctonia* spp. Pages 515-527, *In*: *Rhizoctonia* Species: Taxonomy, molecular biology, ecology, pathology and disease control. B. Sneh, S. Jabaji-Hare, S. Neate, and G. Dijat, eds. Kluwer Academic Publishers, Dordrecht, Netherlands.

Windels, C. E., J. R. Brantner, A. L. Sims, and C. A. Bradley. 2007. Spent lime effects on sugarbeet, root rot, microorganisms, and rotation crops. In: 2007 Sugarbeet Res. Ext. Rep. Fargo, ND: NDSU Ext. Serv. 37:208-219.