EFFECT OF PRECIPITATED CALCIUM CARBONATE ON FUSARIUM YELLOWS IN SUGARBEET

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Fusarium yellows is caused by *Fusarium oxysporum* f. sp. *betae* and other as yet uncharacterized novel Fusarium species (Khan et al., 2003; Rivera et al., 2008). The disease has become a serious problem for sugarbeet growers in the Glyndon, Sabin and Moorhead areas and has been positively identified in some areas of southern Minnesota and in the Minn-Dak factory districts. Fusarium yellows causes severe reduction in yield and recoverable sucrose. Currently there are no fungicides which effectively control the disease. Growers should use Fusarium yellows resistant varieties for fields with a known history of the disease. *Aphanomyces cochlioides* is another important soilborne pathogen is which causes Aphanomyces root rot in sugarbeet. Research showed that application of precipitated calcium carbonate (or spent lime, a by-product of the sugar purification process), applied before planting sugarbeet, significantly reduced Aphanomyces root rot and increased recoverable sucrose in *A. cohlioides* infected soil (Windels et al., 2007).

The objective of this research was to determine whether precipitated calcium carbonate (PCC) controls Fusarium yellows in sugarbeet.

MATERIALS AND METHODS

Field trial was conducted in Moorhead, MN. Precipitated calcium carbonate was applied at 0, 5, 10 and 15 tons/A (wet weight) and incorporated on April 22, 2010. Sugarbeet samples collected from this site in 2009 were infected with several Fusarium species including *F. oxysporum* and *F*. nov. spp. The experimental design was a split-plot with different rates of precipitated calcium carbonate as the main plot and a Fusarium yellows 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 Fusarium yellows susceptible and a glyphosate tolerant glyphosate tolerant Fusarium yellows resistant variety (Proprietary materials, Crystal Beet Seed, and Syngenta Seeds) were planted in the center of each block in strips that were 11 ft wide and 30 ft long. A Fusarium yellows resistant variety was planted as a border on each side of the strips. Plots were planted to stand on 18 May. Seeds were 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 at 11.9 lbs/A was also applied to provide protection against insect pests. Weeds were controlled with four applications of glyphosate. The site was fertilized as recommended for sugarbeet.

Stand counts were taken during the season and at harvest. Ten feet of the middle two-rows of plots were hand harvested on 1 September and weights were recorded. Only plots with Fusarium yellows resistant plants were harvested; there was not an adequate population of susceptible plants. Harvested roots from each plot 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 emergence and plant stand in early June. First symptoms appeared in mid-June and included wilting and death of young plants, chlorosis of older leaves, distinct yellowing and necrosis of half a leaf along the midrib, and death of older plants as the season progressed. There was over 95% mortality of the Fusarium yellows susceptible plants by late July resulting in none being harvested for yield and quality analysis. Some resistant plants also had typical Fusarium yellows symptoms and their population was reduced at harvest time. There was no significant difference in stand count at harvest, tonnage, sucrose concentration or recoverable sucrose per acre between the non-treated check (0 PCC) and the precipitated calcium carbonate treatments. Since infection started early, it is likely that that the plants were unable to utilize nutrients from the PCC to help in structural defense. Soils treated with PCC and planted one to two years later to sugarbeet tend to have higher populations of useful microorganisms such as fluorescent pseudomonad bacteria (Windels et al., 2007). Since planting was done less than one month after PCC application, there was probably not enough time for the useful microorganisms' population to increase so that they will become antagonistic to soilborne pathogens such as *F. oxysporum*.

Table 1. Effect of Precipitated Calcium Carbonate Applied (PCC) at Different Rates on Fusarium Yellows at Moorhead, MN in 2010.

	1 September			
PCC rate in tons/A & Variety	**Stand Count beets/60'**	**Yield tons/A**	**Sucrose concentration %**	**Recoverable sucrose lb/A**
0 ton Resistant Variety B	36	18.4	13.4	4465
5 ton Resistant Variety B	33	19.2	12.9	4497
10 ton Resistant Variety B	38	19.2	13.6	4772
15 ton Resistant Variety B	36	20.0	13.2	4827
LSD	NS	NS	NS	NS
Prob (F)	(p=0.3152)	(p=0.6134)	(p=0.1562)	(p=0.6204)

References

Khan, M. F. R., C. A. Bradley, and C. E. Windels. 2003. Fusarium yellows of sugarbeet. North Dakota State University and University of Minnesota bulletin, PP-1247.

Rivera, V., J. Rengifo, M. Khan, D. M. Geiser, M. Mansfield and G. Secor. 2008. First report of a novel *Fusarium* species causing yellowing decline of sugar beet in Minnesota. Plant Dis. 92:1589.

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.