

BREDEHOEFT, MARK* and CHRIS DUNSMORE, Southern Minnesota Beet Sugar Cooperative, 83550 County Road 21, Renville, MN 56284. **PCC for enhancement of sugarbeet production and evaluation of rhizoctonia disease suppression.**

ABSTRACT

The following report is a summarization of testing fungicides for controlling rhizoctonia solani during the growing seasons of 2009 and 2010.

Objectives:

The objective of these trials was to evaluate application of factory lime (PCC) and/or turkey manure for suppression of rhizoctonia solani (rhizoctonia root rot).

Methods:

This test was conducted at the conclusion of evaluating field corn as a host to Rhizoctonia solani Ag 2-2 IIIB and IVA. In the spring of 2007 and 2008 separate testing areas were inoculated with inoculum of Rhizoctonia solani Ag 2-2 IIIB and IVA. The inoculation was conducted in cooperation with Dr. Carol Windels, North West Research and Outreach Center. Dr. Carol Windels research staff cooperated with Southern Minnesota Beet Sugar Cooperative (SMBSC) research staff to evaluate field corn as a host to Rhizoctonia solani Ag 2-2 IIIB and IVA. Sugarbeets were planted in the testing areas in 2008 and 2009 to evaluate for rhizoctonia root rot. In 2009 and 2010 sugarbeets were planted again in the testing areas to evaluate PCC and turkey manure influence on Rhizoctonia solani Ag 2-2 IIIB and IVA in sugarbeets. Precipitated Calcium Carbonate (PCC) and Turkey manure treatments were applied in the fall of 2008 and 2009 and incorporated with a plowing disk. Table 1 shows the specifics of activities conducted at the rhizoctonia testing sites in 2008 and 2009. Plots were 11 ft. (6 rows) wide and 35 ft long. Sugarbeet stand was counted at 4 leaf sugarbeet stage and at harvest for the whole plot and factored to a 100 ft. relative stand. The test was replicated 4 times. Sugarbeets were harvested with a 4 row research harvester plow. The harvester plow lifted the sugarbeets out of the soil and places the sugarbeets on the soil surface. The sugar beets are then placed in a row for each plot for evaluation. The evaluation scale is a 1-7 scale. This scale is an industry standard used for rhizoctonia root rot evaluation. Evaluation was conducted of the roots from the middle two rows of the six row plot. Multiple evaluators were used to comprise the evaluations and a test of statistical homogeneity (combinability) was conducted and determined that the evaluators rating could be combined. The sugarbeets were collected and measured for yield and analyzed for quality. A test for homogeneity of 2009 and 2010 data was conducted and determined that the data could be combined (table

Results and Discussion:

2009 data

The data collected from the testing site is summarized in tables 3a and b. Sugarbeet stand were the lowest and root rot ratings were the highest in the presence of AG 2-2 IIIB. The AG 2-2 IIIB rhizoctonia strain is a very aggressive strain and this data indicates the persistence in the soil over time.

The sugarbeet yield and revenue presented as a percent of the mean was directly related to the sugarbeet stand and root ratings. Sugarbeet yield and revenue presented as a percent of the mean tended to be best when lime-PCC was applied to the treatment. In the absence of Rhizoctonia solani the addition of lime-PPC or lime-PCC plus manure increased the tons per acre significantly. The rate of lime-PCC did not influence the effect on sugarbeet yield or revenue. The application of manure increased tons per acre but reduced quality when compared to untreated check where soil was not inoculated and where soil was inoculated with AG 2-2 IVA. Manure appeared to have a detrimental effect on sugarbeet production in treatments innoculated with Rhizoctonia solani AG 2-2 IIIB. The influence of lime appeared to be the greatest in the presence of Rhizoctonai solani AG 2-2 IIIB.

2010 data

The 2010 data is presented in tables 4a and b. Sugar beet stand was not significantly influenced by treatments. Rhizoctonia rating tended to be higher when manure was applied to the soil. Rhizoctonia ratings did not relate to the application or the strain of Rhizoctonia.

Revenue (presented as percent of mean) tended to be lower in the presence of Rhizoctonia Solani AG 2-2 IIB. The application of lime-PCC gave the most consistent increase to sugarbeet revenue. The influence on revenue was directly related to tons per acre. Revenue increased with application of manure where soil was not inoculated or inoculated with AG 2-2 IVA but tended to be decreased where inoculated with AG 2-2 IIB. Revenue was reduced when manure was applied with lime-PCC where Rhizoctonia solani AG 2-2 IVA and IIB were applied.

2009 and 2010 combined data

Combined data of research conducted in 2009 and 2010 pertaining to lime-PCC and turkey manure influence on rhizoctonia and sugar beet production is presented in tables 5 a and b. Treatments did not consistently influence stand count or Rhizoctonia ratings. Rhizoctonia ratings tended to be higher where Rhizoctonia solani inoculum was not applied. However, tons per acre tended to be higher where Rhizoctonia solani inoculum was not applied. The application of manure alone or with lime-PCC tended to reduce tons per acre. Lime – PCC applied alone either did or tended to increase tons per acre regardless whether Rhizoctonia solani inoculum was or was not applied. Lime-PCC applied at 4 ton was as beneficial as 8 ton of lime-PCC. Revenue (presented as percent of mean) was directly related to tons per acre. Thus the relationships identified for tons per acre can also be drawn for revenue. This indicates an advantage to the application of PCC prior to sugarbeets production.

Table 1. Site Specifics for Lime and Manure Influence on Rhizoctonia Solani in Sugarbeets

Location		
Task	Gluek 2009	Gluek 2010
Sugarbeet-Variety	H4017	SV835RR
Planting-date	5/22/2009	4/27/2010
<u>Harvest</u>	9/25/2009	10/7/2010

Table 2. ANOVA Analysis of Probability of Significance for Measured Variables.

	P>F
Stand Count	0.8861
Root Rating Avg	0.2521
Tons	0.6951
% Sugar	0.6358
Purity	0.0115
Brie Nitrate	0.3291
Ext. Per Suc	0.1618
Ext. Suc Per Ton	0.1605
Ext. Suc Per Acre	0.4748
% Revenue	0.1346

* Pr > F = .05

** Greater than .05 = NS

0955 Gluek Rhizoc Influenced by Lime and Manure

Table 3 A. Lime and Manure Influence on Rhizoctonia Solani and Production in Sugarbeets, 2010

Trt No.	Rhizoctonia Strain	Treatment Description	Stand Count	Rhizoc Rating	Tons	% Sugar	Purity
1	AG 2-2 IIIB	Lime Check (A)	160	2.42	21.7	14.4	90.0
2	AG 2-2 IIIB	Lime (PCC) 4 ton	170	2.16	24.0	14.6	90.4
3	AG 2-2 IIIB	Manure 4 ton	180	2.47	19.3	14.3	89.8
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	100	2.34	14.1	14.9	90.8
5	AG 2-2 IIIB	Lime (PCC) 8 ton	140	2.97	21.6	15.1	90.5
6	AG 2-2 IIIB	Manure Check	160	2.68	17.1	14.3	89.4
7	AG 2-2 IV	Lime Check (A)	110	2.48	19.1	14.3	89.2
8	AG 2-2 IV	Lime (PCC) 4 ton	110	2.38	22.7	14.1	89.1
9	AG 2-2 IV	Manure 4 ton	130	2.66	24.6	14.1	88.8
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	130	2.57	22.9	14.3	89.3
11	AG 2-2 IV	Lime (PCC) 8 ton	80	2.63	16.3	11.8	76.3
12	AG 2-2 IV	Manure Check	120	2.84	21.7	14.7	89.6
13	Non Inoculated (1)	Lime Check (A)	100	2.94	17.8	13.1	87.8
14	Non Inoculated (1)	Lime (PCC) 4 ton	120	3.05	21.0	13.7	88.2
15	Non Inoculated (1)	Manure 4 ton	120	3.14	19.6	13.8	88.4
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	90	3.30	23.6	13.6	87.7
17	Non Inoculated (1)	Lime (PCC) 8 ton	100	2.63	20.7	14.4	89.0
18	Non Inoculated (1)	Manure Check	80	2.93	16.6	13.9	89.4

CV	46	27	24.2	7.87	1.92
LSD(.05)	70	1.02	2.2	1.57	2.43

0955 Gluek Rhizoc Influenced by Lime and Manure

Table 3 B. Lime and Manure Influence on Rhizoctonia Solani, Sugar Production and Revenue as a Percent of Means in Sugarbeets, 2010

Trt No.	Rhizoctonia Strain	Treatment Description	Rhizoc Rating	Ext. Suc Per Ton	Ext. Suc Per Acre	% Revenue
1	AG 2-2 IIIB	Lime Check (A)	2.42	239	5315	114.47
2	AG 2-2 IIIB	Lime (PCC) 4 ton	2.16	243	5882	126.47
3	AG 2-2 IIIB	Manure 4 ton	2.47	237	4617	96.84
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	2.34	250	3602	80.46
5	AG 2-2 IIIB	Lime (PCC) 8 ton	2.97	252	5457	120.75
6	AG 2-2 IIIB	Manure Check	2.68	236	4156	88.56
7	AG 2-2 IV	Lime Check (A)	2.48	235	4604	97.62
8	AG 2-2 IV	Lime (PCC) 4 ton	2.38	231	5268	106.93
9	AG 2-2 IV	Manure 4 ton	2.66	230	5484	106.25
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	2.57	235	5390	111.16
11	AG 2-2 IV	Lime (PCC) 8 ton	2.63	508	4399	103.73
12	AG 2-2 IV	Manure Check	2.84	242	5215	109.71
13	Non Inoculated (1)	Lime Check (A)	2.94	209	3882	72.99
14	Non Inoculated (1)	Lime (PCC) 4 ton	3.05	221	4763	93.93
15	Non Inoculated (1)	Manure 4 ton	3.14	224	4461	88.33
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	3.30	218	5227	100.46
17	Non Inoculated (1)	Lime (PCC) 8 ton	2.63	235	4899	101.46
18	Non Inoculated (1)	Manure Check	2.93	228	3894	79.89

CV **27 11 27 33.46**
 LSD(.05) **1.02 34 568 47.50**

1052 Gluek Rhizoc Influenced by Lime and Manure

Table 4 A. Lime and Manure Influence on Rhizoctonia Solani and Production in Sugarbeets, 2010

Trt No.	Rhizoctonia Strain	Treatment Description	Stand Count	Rhizoc Rating	Tons	% Sugar	Purity
1	AG 2-2 IIIB	Lime Check (A)	79.3	3.62	22.1	16.10	88.00
2	AG 2-2 IIIB	Lime (PCC) 4 ton	87.9	3.16	25.6	16.35	88.81
3	AG 2-2 IIIB	Manure 4 ton	93.2	3.54	20.9	16.51	89.33
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	88.9	3.01	21.1	16.36	89.40
5	AG 2-2 IIIB	Lime (PCC) 8 ton	82.1	2.89	24.8	16.35	89.93
6	AG 2-2 IIIB	Manure Check	93.9	3.21	21.9	16.46	90.50
7	AG 2-2 IV	Lime Check (A)	92.1	2.62	23.8	16.02	87.59
8	AG 2-2 IV	Lime (PCC) 4 ton	88.2	2.63	21.9	16.15	89.06
9	AG 2-2 IV	Manure 4 ton	101.4	2.62	21.7	17.08	92.68
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	97.9	3.39	24.1	15.47	85.89
11	AG 2-2 IV	Lime (PCC) 8 ton	102.1	3.12	24.0	16.43	89.42
12	AG 2-2 IV	Manure Check	102.5	2.63	24.7	16.73	90.95
13	Non Inoculated (1)	Lime Check (A)	91.1	2.97	20.9	16.80	89.67
14	Non Inoculated (1)	Lime (PCC) 4 ton	78.9	3.58	26.3	16.89	90.47
15	Non Inoculated (1)	Manure 4 ton	91.4	3.53	24.3	16.06	84.74
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	81.4	2.94	25.2	16.95	89.52
17	Non Inoculated (1)	Lime (PCC) 8 ton	95.0	3.43	24.7	16.87	89.36
18	Non Inoculated (1)	Manure Check	90.4	3.03	22.3	16.58	89.26

CV **19.0 6.8 5.1 5.69 3.71**
 LSD(.05) **NS 0.93 1.7 1.33 4.71**

1052 Gluek Rhizoc Influenced by Lime and Manure

Table 4 B. Lime and Manure Influence on Rhizoctonia Solani, Sugar Production and Revenue as a Percent of Means in Sugarbeets, 2010

Trt No.	Rhizoctonia Strain	Treatment Description	Rhizoc Rating	Ext. Suc Per Ton	Ext. Suc Per Acre	% Revenue
1	AG 2-2 IIIB	Lime Check (A)	3.62	261	5772	88.68
2	AG 2-2 IIIB	Lime (PCC) 4 ton	3.16	268	6856	107.70
3	AG 2-2 IIIB	Manure 4 ton	3.54	276	5796	93.43
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	3.01	271	5662	89.73
5	AG 2-2 IIIB	Lime (PCC) 8 ton	2.89	273	6780	108.07
6	AG 2-2 IIIB	Manure Check	3.21	281	6123	99.61
7	AG 2-2 IV	Lime Check (A)	2.62	260	6143	93.40
8	AG 2-2 IV	Lime (PCC) 4 ton	2.63	267	5819	90.69
9	AG 2-2 IV	Manure 4 ton	2.62	306	6630	114.82
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	3.39	240	5827	83.14
11	AG 2-2 IV	Lime (PCC) 8 ton	3.12	272	6509	103.32
12	AG 2-2 IV	Manure Check	2.63	283	6987	114.74
13	Non Inoculated (1)	Lime Check (A)	2.97	281	5858	95.52
14	Non Inoculated (1)	Lime (PCC) 4 ton	3.58	292	7685	129.02
15	Non Inoculated (1)	Manure 4 ton	3.53	247	5954	86.16
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	2.94	283	7128	116.86
17	Non Inoculated (1)	Lime (PCC) 8 ton	3.43	280	6901	112.26
18	Non Inoculated (1)	Manure Check	3.03	284	6357	104.77

CV 6.8 10 12 20.08
LSD(.05) 0.92 41 1061 29.01

Table 5 A. Combined Data for 2009-2010 Lime and Manure Influence on Rhizoctonia Solani and Production in Sugarbeets.

Trt No.	Rhizoctonia Strain	Treatment Description	Stand Count	Rhizoc Rating	Tons	% Sugar	Purity
1	AG 2-2 IIIB	Lime Check (A)	109	3.02	21.9	15.27	88.63
2	AG 2-2 IIIB	Lime (PCC) 4 ton	126	2.66	24.8	15.39	89.38
3	AG 2-2 IIIB	Manure 4 ton	132	3.00	20.1	15.44	89.49
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	94	2.67	17.6	15.62	90.08
5	AG 2-2 IIIB	Lime (PCC) 8 ton	111	2.93	23.2	15.73	90.24
6	AG 2-2 IIIB	Manure Check	108	2.94	19.5	15.41	90.06
7	AG 2-2 IV	Lime Check (A)	89	2.55	21.5	15.20	88.18
8	AG 2-2 IV	Lime (PCC) 4 ton	91	2.50	22.3	15.15	88.86
9	AG 2-2 IV	Manure 4 ton	101	2.64	22.8	15.72	91.06
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	99	2.98	23.5	14.89	87.39
11	AG 2-2 IV	Lime (PCC) 8 ton	83	2.87	20.2	14.83	83.66
12	AG 2-2 IV	Manure Check	92	2.73	23.2	15.71	90.45
13	Non Inoculated (1)	Lime Check (A)	83	2.96	19.4	14.95	88.65
14	Non Inoculated (1)	Lime (PCC) 4 ton	97	3.31	23.7	15.39	89.79
15	Non Inoculated (1)	Manure 4 ton	103	3.34	21.9	14.96	86.59
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	83	3.12	24.4	15.31	88.68
17	Non Inoculated (1)	Lime (PCC) 8 ton	98	3.03	22.7	15.62	89.18
18	Non Inoculated (1)	Manure Check	86	2.98	19.5	15.36	90.02

CV 55 25 17.5 10.43 5.20
LSD(.05) 54 0.73 3.8 NS 4.58

Table 5 B. Combined Data for 2009-2010 Lime and Manure Influence on Rhizoctonia Solani, Sugar Production and Revenue as a Percent of Means in Sugarbeets.

Trt No.	Rhizoctonia Strain	Treatment Description	Rhizoc Rating	Ext. Suc Per Ton	Ext. Suc Per Acre	% Revenue
1	AG 2-2 IIIB	Lime Check (A)	3.02	245	5351	97.92
2	AG 2-2 IIIB	Lime (PCC) 4 ton	2.66	253	6320	116.35
3	AG 2-2 IIIB	Manure 4 ton	3.00	251	5012	90.58
4	AG 2-2 IIIB	Lime (PCC) 4 ton + Manure (TM) 4 ton	2.67	262	4665	87.52
5	AG 2-2 IIIB	Lime (PCC) 8 ton	2.93	264	6139	117.79
6	AG 2-2 IIIB	Manure Check	2.94	257	4981	91.74
7	AG 2-2 IV	Lime Check (A)	2.55	243	5126	90.43
8	AG 2-2 IV	Lime (PCC) 4 ton	2.50	245	5433	96.55
9	AG 2-2 IV	Manure 4 ton	2.64	264	6165	111.17
10	AG 2-2 IV	Lime (PCC) 4 ton + Manure (TM) 4 ton	2.98	234	5624	97.04
11	AG 2-2 IV	Lime (PCC) 8 ton	2.87	372	5420	103.22
12	AG 2-2 IV	Manure Check	2.73	266	6115	116.39
13	Non Inoculated (1)	Lime Check (A)	2.96	243	4705	81.81
14	Non Inoculated (1)	Lime (PCC) 4 ton	3.31	256	6217	113.06
15	Non Inoculated (1)	Manure 4 ton	3.34	235	5159	87.52
16	Non Inoculated (1)	Lime (PCC) 4 ton + Manure (TM) 4 ton	3.12	250	6176	110.51
17	Non Inoculated (1)	Lime (PCC) 8 ton	3.03	257	5904	108.90
18	Non Inoculated (1)	Manure Check	2.98	256	5146	94.43

CV	25	34	28	31.65
LSD(.05)	1	87	1558	31.55

SMBSC Rhizoc soil assays, 2009

Soil root rot index

TRT	Aphanomyces	Rhizoctonia
Non inoculated	9	9
AG 2-2 IV	15	10
AG 2-2 IIIB	5	17

SMBSC Rhizoc soil assays, 2010

Soil root rot index

Trt. No	Aph	Rhizoc
AG 2-2 IIIB	28	60
AG 2-2 IV	32	44
Non inoculated	71	7