INTEGRATION OF BACILLUS SP. BIOLOGICAL SEED TREATMENTS WITH APRON-THIRAM AND APRON-THIRAM-TACHIGAREN SEED TREATMENTS FOR BIOLOGICAL CONTROL OF PYTHIUM AND APHANOMYCES SEEDLING DISEASES

Barry Jacobsen[1],, Nina Zidack[1], J.L.A Eckhoff[2], J. Bergman[2], and K. Kephart[3]
1. Professor and Extension Specialist in Plant Pathology and Assistant Research Professor respectively, Department of Plant Sciences, Montana State Univerity, Bozeman, MT. 2. Associate Professor and Professor/Superintendent, Eastern Agricultural Research Center, Montana Agricultural Experiment Station, Sidney, MT. 3. Associate Professor and Superintendent, Southern Agricultural Research Center, Montana Agricultural Experiment Station, Huntley, MT.

Introduction

Damping- off and root rots caused by several species of *Pythium, Rhizoctonia solani, Phoma betae, and Aphanomyces cochlioides* commonly reduce stands and yields wherever sugarbeets are grown. Establishment of uniform vigorous stands is critical to achieving maximum economic returns and controlling weeds. In Montana, stand losses from Aphanomyces of 10-50% are common throughout the Yellowstone River Valley. It is interesting that in Montana, Aphanomyces damping-off at the 2-8 leaf stage is common while root rot is rare compared to MN and eastern ND where root rot is common. Currently, damping-off is controlled by using the seed treatment fungicides Apron, Thiram and Tachigaren. Tachigaren is used only on pelleted seeds and where Aphanomyces is a proven problem. These fungicides provide protection from seed rots and damping-off for 1-3 weeks folowing which these products breakdown. We have experimented with these fungicides combined with several different Bacillus spp. selected in our laboratory for control of *Pythium ultimum*, *Rhizoctonia solani* AG 3 and 2-2, and *Aphanomyces cochioides*. The concept is that when the fungicides degrade, the biologicals will colonize the root system for the remainder of the production year, thus providing season long protection. We have shown in growth chamber experiments that both LS 201 and LS 202 colonize the top, middle and lower third of sugarbeet roots at both 15 and 24^0C with LS 202 providing approximately 10 fold higher populations at either temperatures. Best colonization was at 15^0C. The presence of the fungicides did not influence bacterial colonization for either bacteria. In the tests reported here we have continued to evaluate two elite strains in combination with either Apron-Thiram or Apron-Thiram-Tachigaren seed treatment in fields known to have either Pythium alone or Pythium and Aphanomyces damping-off problems.

Methods and Materials

1997 research was done in a grower field in Forsyth, MT with a history of Aphanomyces damping-off. 1998-1999 research trials were planted at the Eastern Agricultural Research Station at Sidney, MT and in growers fields in Laurel, Fallon and Forsyth, MT. 2000 research trials were planted at the Eastern Agricultural Research Station at Sidney, MT, the Southern Agricultural Research Station at Huntley, MT and in a grower field that had to be replanted due to severe Aphanomyces damping-off near Ballantine, MT. A single seed lot of the variety Beta 8754 was pelleted and treated each year by Seed Systems (1997-1999) and ASTEC (2000) using seed treatments formulated by Gustafson Inc. Apron was applied at 0.98 ml/kg seed, Thiram 42 S at 5.2 ml/kg seed , Tachigaren at 45 gm/kg seed and bacteria were applied at 1 x 10^{6-7} cfu (colony forming units)/seed except in 2000 when only 1 x 10^{5-6} cfu/seed were recovered from seed after treatment. Trials were planted in early May using a cone planter at Sidney and with air planters in the growers fields. At Sidney, a randomized complete block design with six replications of 3 row plots, 30 ft long was used. Grower field plots used a completely randomized design with 4 replications . At Laurel, single rows 1350 ft long were used at 10 subplots of 30 ft were harvested from each plot. At Forsyth, plots were 6 rows,1350 ft long and the whole plot was harvested with a commercial beet digger. All plots were harvested in the last week of September. The 2000 trials at Sidney were done as above. The trial at Huntley was planted in early May with a precision planter (Alloway) using the same plot design as Sidney. The trial at Ballantine was planted June 4 with an air planter with a 4 replication completely randomized design with 30 ft of row harvested.

Results

Results summarizing sucrose yields in lbs./acre for all locations for the years 1997-2000 are given in Table 1. This data shows that only in 1998 and 1999 did ATT (Tachigaren @ 45 grams/kg seed) yield more than

seed treated only with Apron-Thiram, the standard seed treatment. However, if one excludes the Sidney location where Aphanomyces damping-off has not been observed until 2000, ATT provided higher yield in every year but 1997 when phyotoxicity caused yield reductions. In 1997, 2000 and average of 10 location years there was no significant difference between ATT and AT. In every year and over 10 location years AT+LS 201 significantly yield more sugar per acre than either of the standard seed treatments, AT, ATT or combinations of these seed treatments with LS202. Seed treatment with AT + LS 202 showed significant yield increases in all years but 2000. Based on 10 location years of research it appears that there is no benefit in using either LS 201 or LS 202 in combination with Tachigaren.

Data individual locations for the years 1997-1999 have been published previously (Jacobsen et.al. 1997,1998, 1999). Data for individual location for 2000 are given in Table 2.

Table 1. Sugar Yields in Lbs. per acre as affected by Apron-Thiram, Apron-Thiram-Tachigaren and combinations with Bacillus-based biological seed treatments LS 201 and LS 202 over 10 location years of field research .

Treatment	1997-1 location (Forsyth)	1998-3 locations (Sidney, Forsyth, Fallon)	1999-3 locations (Sidney, Forsyth, Laurel)	2000-3 locations (Sidney, Huntley, Ballantine)	Average for 10 location years
Apron-Thiram	3820	8250	8496	6321	7302 BC
Apron-Thiram-LS201	5240	9414	9093	7070	7975 A
Apron-Thiram -LS 202	4400	8938	9121	6301	7748 AB
Apron-Thiram-Tachigaren (ATT)	2660	8616	8766	6158	7328 BC
ATT-LS 201	3680	9277	8797	5527	7448 BC
ATT-LS 202	3040	9512	8723	4180	7029 C

Numbers followed by the same letter do not differ significantly at P=0.1

Table 2. Final harvest stands and sugar yields in Lbs. per acre as affected by Apron-Thiram, Apron-Thiram-Tachigaren and combinations with Bacillus-based biological seed treatments LS 201 and LS 202 in 2000.

Treatment	Sidney		Huntley		Ballantine	
	stand at harvest/A	sugar yield lb/A	stand at harvest/A	sugar yield lb/A	stand at harvest/A	sugar yield lb/A
Apron-Thiram	19,118 A	4862 A	21,054 A	7797 AB	16,517 B	6304 A
Apron-Thiram-LS201	21,054 A	5323 A	19,602 A	8848 A	17,969 B	7040 A
Apron-Thiram - LS 202	19,602 A	5138 A	19,116 A	7109 B	20,147 AB	6656 A
Apron-Thiram-Tachigaren (ATT)	20,473 A	5018 A	19,723 A	7696 AB	23,050 A	5760 AB
ATT-LS 201	19,723 A	5321 A	22,259 A	4347 C	15,065 B	6912 A
ATT-LS 202	22,264 A	5069 A	20,473 A	2544 D	11,798 C	4928 B

Numbers followed by the same letter do not differ significantly at P=0.05

Literature Cited:

Jacobsen, B.J., S. Kienwick, J. Bergman, and J. Eckhoff. 1997. Integrated Control of Soilborne Diseases on Sugar Beet with Antagonistic Bacteria and Fungicides. 1997 Sugarbeet Research and Extension Reports 28: 334-349

Jacobsen, B.J., J. Eckhoff and J. Bergman. 1998. Seed treatments for Control of Pythium and Aphanomyces Black Root Rot. 1998 Sugarbeet Research and Extension Reports 29: 281-282.

Jacobsen, B.J., D. Collins, N. Zidack, J. Eckhoff, and J. Bergman. 1999. Fungicide and fungicide plus Bacillus spp. seed treatments for control of Pythium and Aphanomyces root rots. Sugarbeet Research and Extension Reports 30: 277-278.