INTEGRATED MANAGEMENT STRATEGIES FOR RHIZOCTONIA CROWN AND ROOT ROT

Barry Jacobsen[1], Nina Zidack[1], Marieka Johnston[1], Ken Kephart[2], and John Ansley[1]
1. Department of Plant Sciences and Plant Pathology, Montana State Univerity, Bozeman, MT. 2. Montana Agricultural Experiment Station -Southern Agricultural Research Center, Huntley, MT.

Introduction

Rhizoctonia crown and root rot caused by the fungus, *Rhizoctonia solani* AG 2-2 is one of the most damaging sugarbeet diseases worldwide. This *R. solani* strain can also cause damping-off. Losses are highest in warm, irrigated, production areas where sugarbeets are cropped intensively. Once soil populations of this fungus are built up, rotation is of little value and growers are dependent on relatively ineffective cultural controls such as avoiding cultivating soil into the row, maintaining adequate, balanced fertility for good crop growth and maintaining adequate soil drainage. However, maintaining rotations with non-host crops such as corn, small grains or alfalfa and avoiding beans or soybeans before beets will help keep soil populations of this strain of Rhizoctonia low. The R. solani AG 4 strain causes damping-off can attack some of these non hosts and literature suggests that damping-off may be more severe on beets following alfalfa.

Where disease pressure is high, growers can plant specialty varieties with resistance. Available resistance is incomplete and these varieties typically have yield potentials 10-15% less than the best approved varieties, although some varieties such as Beta 4546 and HM RH5 are 0-10% lower yielding than the best approved varieties. However, these varieties may not have other important disease resistant characteristics such as resistance to curly top, rhizomania, Aphanomyces, or Cercospora. Because predicting disease development and loss is difficult, growers have long wanted a control where yield potential is not compromised. Since 1995, we have explored the potential for chemical control by preventing crown infections of young plants. Our research and that of others clearly shows that most infections occur through the crown from sclerotia deposited there primarily during cultivation and that application of effective fungicides to the crown prior to cultivation will provide good control. Research from 1995-2000 served as the basis for a full EPA label for Quadris in 2000. Data summarizing Quadris data from 1998-2003 are shown in Table 1. 2002 and 2001 were years of high disease severity while 2000 and 2003 were of moderate disease severity and 1998 and 1999 were years of low disease severity based on the effects of inoculation. Disease severity in 2002 was the highest seen in our research on this topic. Two factors favored disease development, severe curly top virus infection and very warm conditions following inoculation. Recent research has shown the importance of temperatures > 70-75^{0}F for infection and disease development.

Materials and Methods

The effect of temperature on infection and disease development was done by growing plants in growth chambers at 50, 60 and 75 ^{0} F and inoculating plants at the 4 leaf stage with ground barley inoculum (Rupple et. al., 1979) followed by placing soil over the crown of the plant. Plants were grown for 60 days and roots rated for percent root decay.

Field research was done at the Eastern Agricultural Research Center at Sidney, MT on a Savage silty-clay loam soil in 1997-1999 and at the Southern Agricultural Research Center at Huntley, MT in 2000, 2001, 2002 and 2003. The plot design was a randomized complete block with six replications. Plots were single rows 30 ft long and all plots except the uninoculated controls were inoculated with 14 grams / plot of ground barley infected with *R. solani* AG 2-2 at the 4 leaf stage. Fungicide applications were made at emergence, just prior to application of inoculum at the 4 leaf stage or at the 8, 10, 12-14 leaf stage using a 6 inch band applied over the row with a single Spraying Systems 8002 VS nozzle @30psi= 18 gallons/acre. In 2003, 3 and 6 inch band applications were compared using a split plot design comparing Beta 8636 and Hilleshog Rh5. The RH 5 varieties is reportedly resistant to Rhizoctonia crown and root rot. Following application plots at the 4 leaf stage plots were cultivated and irrigated. Plots were harvested in late September and rated for Rhizoctonia root rot on the 0-7 scale (Rupple et. al., 1979) and samples sent to Holly Sugar (1997-1999) or Western Sugar (2000, 2001,2002,2003) for determination of tare, % sugar and sugar loss to molasses.

Results: Effect of temperature on disease development is shown in Table 1. At 50 ^{0} F very little disease developed while at 60^0 F only 8% of roots had > 50% decay compared to 68% for plants grown at 75^0 F.

Table 1. Effect of temperature on Rhizoctonia root decay.

Temperature	Percent roots with decay			
	0	<10	10-49	> 50
50^0 F	81	19	0	0
60 ^{0} F	53	37	2	8
75^0 F	0	0	32	68

Results for Quadris(1998-2003) are presented are presented in Table 2. Overall the Quadris 0.075 oz.ai./1000 row ft. treatment applied at the 4 plus 8 leaf stage appears to be the best treatment although the 0.15 oz. ai./1000 row ft. rate applied at the 4 leaf stage treatment provided equally significant returns in 2002 and 2003. In 2000 and 2001, the 0.15 oz ai./1000 row ft applied at the 8 leaf stage provided statistically equal yields to applied at the 4 leaf stage. In 2003 application of 0.4 oz ai /1000 row ft. provided a significant yield increase although significantly less than the band applications applied at the 4 or 4 plus 8 leaf stages.

Table 2. Effect of various rates and timing of Quadris on extractable sugar yield per acre in 1998- 2003 through control of Rhizoctonia crown and root rot.

Treatment oz. ai. /1000row ft.-timing	Extractable Sucrose/Acre					
	1998	1999	2000	2001	2002	2003
non inoculated check	6981	9725	9783	9758 *	4375 *	9701*
inoculated check	6236	8843	8650	7313	65	7956
Quadris 0.075-4+ 8 leaf	7673	9396	10706*	10048*	3347 *	10779*
Quadris 0.15-4 leaf	7176	9282	8893	9254	3315* (0.4 oz)	10861*
Quadris 0.15-8 leaf	Nd	nd	10308*	9809*	0	Nd
Quadris 0.15-4+8 leaf	Nd	nd	10168*	nd	3394 *	10034*
@planting or @emergence	nd	nd	nd	7813	nd	8929*
FLSD P=0.1	1474	956	1376	2140	834	719

*=significantly different from inoculated check

Results of the 2003 fungicide trials are found in Table 3. In this trial, the Amistar and Quadris formulations performed similarly in both disease control and resultant yield improvement. Headline, another strobilurin type fungicide also gave good performance. Where application of Quadris at two rates application band widths of 3 and 6 inches were compared there was no difference in either disease control or yield. Neither, MSU 207 a Bacillus that induces plant resistance nor Muscoder albus a fungus that produces volatile antimicrobial gases gave any control or yield increase. Analysis of the data comparing the susceptible Beta 8636 and resistant Hilleshog RH 5 showed that the varieties responded similarly to the treatments in Table 3.

Table 3. Results of 2003 Rhizoctonia Crown and Root Rot Fungicide Trial

Treatment oz ai/1000 ft-6" band unless noted	**Timing-# leaf**	**Sucrose/A (lbs)**	**Disease Index 0-100**
Uninoculated		**9701 abcde**	**22.3 cde**
Inoculated		**7956 f**	**36.6 ab**
Amistar 0.075 + MSU 127	**4**	**10641 ab**	**13.5 e**
Amistar 0.075	**4+8**	**9854 abcde**	**23.5 cde**
Amistar 0.15	**4+8**	**9952 abcde**	**24.5 dc**
Amistar 0.15	**@ emergence**	**10065 abcd**	**19.7 de**
Quadris 0.075-3" band	**4+8**	**10779 a**	**22.4 cde**
Quadris 0.075-3" band	**4**	**10251 abc**	**20.2 de**
Quadris 0.15	**4+8**	**10034 abcd**	**16.6 e**
Quadris 0.15	**4**	**10861 a**	**19.7 de**
Quadris 0.4	**@ emergence**	**8929 bcdef**	**26.1 cd**
Headline 0.2	**4+8**	**10113 abcd**	**21.8 cde**
Headline 0.2	**4**	**10189 abc**	**23.2 cde**
Headline 0.2	**8**	**9425 abcdef**	**31.6 bc**
Headline 0.2 + MSU 127	**4+8**	**9911 abcde**	**20.8 de**
Headline 0.1 + MSU 127	**4+8**	**9613 abcdef**	**23.9 cd**
MSU 203-7	**2+4+8**	**8523 cdef**	**43.1 a**
Muscoder 620-80lb/A	**2**	**8229 ef**	**44.7 a**

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