

EFFECT OF AZOXYSTROBIN ON RHIZOCTONIA SOLANI AT DIFFERENT GROWTH STAGES OF SUGARBEET

Afsana Noor¹ and Mohamed F. R. Khan²

¹Graduate Student, Plant Pathology Department, North Dakota State University

²Extension Sugarbeet Specialist, North Dakota State University & University of Minnesota

Rhizoctonia crown and root rot (RCRR) of sugar beet (*Beta vulgaris* L.) is an important production problem for growers in North Dakota and Minnesota. The causal organism is *Rhizoctonia solani* Kühn, a soil borne fungus that is widespread around the crop growing region in the world. The fungus is composed of different populations called anastomosis groups (AGs), which attack certain crops and plant parts (Leach, 1986; Sneh et al. 1991). The anastomosis group that causes Rhizoctonia crown and root rot of sugar beet is *Rhizoctonia solani* AG 2-2 which is further divided into sub-populations (called intraspecific groups or ISGs) designated as AG 2-2 IIIB and AG 2-2 IV (Brantner and Windels, 2008). AG 2-2 IIIB is considered more aggressive and damaging than AG 2-2IV (Bolton et al., 2010). *R. solani* is ubiquitous and is most damaging in wet and warm conditions, especially in fields where sugar beet is rotated with soybean, edible beans and corn (Engelkes and Windels, 1994; Ogoshi, 1987). There is no sugar beet variety available which is completely resistant to *R. solani* and varieties with partial resistance typically yield 10 to 20% less compared to high-yielding susceptible varieties (Jacobsen et al., 2006). Fortunately there are some fungicides which provide effective control for Rhizoctonia root and crown root. Among the fungicides azoxystrobin (Quadris; Syngenta, USA) provides effective control against RCRR, but the recommendations for its use indicate that it must be applied before infection takes place (Brantner and windels, 2002; Jacobsen et al., 2002; Bolton et al., 2010; Khan and Bradley, 2010). American Crystal Sugar Company recommends azoxystrobin applications at the 4-6 leaf stages (Ag Note: 553), but infection by *R. solani* starting at the seedling stage has been observed frequently since 2009 (Stachler et al., 2009), probably as a result of higher average daily soil temperature and adequate moisture at or soon after planting. Growers will like to know whether they need to apply fungicide to plants younger than the 4-leaf stage but just before the 65 F threshold average daily soil temperature is reached or wait until sugarbeets are at the 4-6 leaf stages.

OBJECTIVES

The objective of this research was to evaluate the efficacy of control of *R. solani* by azoxystrobin, applied in-furrow or in a band, on sugarbeet seeds, and cotyledonary through 4-leaf stages.

MATERIALS AND METHODS

Research was conducted at the NDSU greenhouse facility located in Fargo, North Dakota. Sugarbeet cultivar Crystal 539RR susceptible to *R. solani* was used in this experiment. Ten seeds were planted per row in Sunshine Mix 1 peat soils (Sun Gro Horticulture Canada Ltd., Canada) into the 21 x 10.5 inch trays. Greenhouse condition was set to allow light for 12-hr photoperiod and temperature was set to 20 ± 2° C which is favorable to RCRR development. Fungicide used for this experiment was azoxystrobin applied at 0.672 L/ha either in-furrow at planting or in an 18 cm (7 inch) band application over soil covered seeds or plants at different growth stages. Fungicide applications were done using a spraying system calibrated to 40 psi with a speed of 1.3 revolutions per minute using a single flat fan nozzle (4001E). The treatments included in-furrow fungicide application to seeds; band application to soil covered planted seeds; band application to cotyledonary, 2-leaf, and 4-leaf stages sugarbeet. Inoculation was done after the fungicide treatment by placing one barley grain colonized with *R. solani* AG 2-2 IIIB 1.5 cm below the soil surface and close to the hypocotyl region of the sugar beet seed or plant. There also were inoculated and non-inoculated checks set independently for each growth stage. Sugarbeet plants were watered daily to maintain optimum soil moisture essential for plant growth and necessary for disease development. The experimental design was a Randomized Complete Block Design (RCBD) with four replicates. Two weeks later, counts of healthy, non-infected plants number were taken. The experiment was repeated twice and after a Folded F-test showed

homogeneous variances for both experiments, the data were combined. Data was analyzed with the Proc GLM procedure of SAS (version 9.3, SAS Institute Inc., Cary, NC).

RESULTS AND DISCUSSIONS

The results are shown in Table 1. Seedling emergence ranged from 88 to 93% in the non-inoculated, non-treated checks. The seeds and young plants were easily killed by *R. solani* in the non-treated inoculated checks, with a few 4-leaf stage plants surviving. The fungicide treatments resulted in significantly higher surviving plants than the non-treated checks. The numbers of survivors in the in-furrow application was lower than the band application treatments (and significantly lower than the band application to cotyledonary beets), probably because there was some phytotoxicity with direct contact of the seeds and the fungicide. The results clearly demonstrated that sugarbeet at the 4-leaf and younger stages are easily infected by *R. solani* in a favorable environment. Unpublished research also indicates that infections takes place even in varieties with good tolerance to *R. solani*. This data suggests that in fields where environmental conditions are becoming favorable - adequate moisture and daily average soil temperature at 4'' depth approaching 65 F - for disease development, plants at 4-leaf and younger should be protected from infection by *R. solani* by using an effective fungicide.

REFERENCES

- Ag Note: 553- Weeds and Rhizoctonia: "Don't Get Behind". Available at <http://www.crystalsugar.com/agronomy/agnotes/ViewArticle.aspx?id=267> (verified on Feb. 10, 2012). American Crystal Sugar Company.
- Bolton, M. D., Panella, L., Campbell, L., Khan, M. F. R. 2010. Temperature, moisture, and fungicide effects in managing Rhizoctonia root and crown rot of sugarbeet. *Phytopathology*.100:689-697.
- Branter, R. J., and Windels, C. E. 2008. Distribution of Rhizoctonia solani AG 2-2 intraspecific groups in the Red River Valley and southern Minnesota. 2007 Sugar beet Res. Ext. Reports 36:291-294.
- Brantner, J., and Windels, C. E. 2002. Band and broadcast application of Quadris for control of Rhizoctonia root and crown rot on sugar beet. 2001 Sugar beet Res. and Ext. reports. 32:282-286.
- Engelkes, C. A., and Windels, C. E. 1994. Relationship of plant age, cultivar, and isolate of *Rhizoctonia solani* AG 2-2 to sugar beet root and crown rot. *Plant Dis.* 78:685-689.
- Jacobsen, B.J., Zidack, N. K., Mickelson, J., and Ansley, J. 2002. Integrated management strategies for Rhizoctonia crown and root rot. 2001 Sugar beet Res. Ext. Report 32:293-295.
- Khan, M. F. R., and Bradley, C. A. 2010. Effect of azoxystrobin applications based on soil temperature on Rhizoctonia root and crown rot of Sugar beet. *Int. sugar J.*
- Leach, L. D. 1986. Seedling diseases. Pages 4-8 *Compendium of Beet Diseases and Insects*. E.D. Whitney and J.E. Duffus, eds. APS Press, The American Phytopathological Society, St. Paul, MN. 76pp.
- Ogoshi, A. 1987. Ecology and pathogenicity of anastomosis and intraspecific groups of *Rhizoctonia solani* Kuhn. *Annu. Rev. Phytopathol.* 25:125-143.
- Sneh, B., Burpee, L., and Ogoshi, A. 1991. Identification of *Rhizoctonia* species. American Phytopathological Society, APS Press, St. Paul, MN. 133 pp.
- Stachler, J. M., Carlson, A. L., Luecke, J. L., Boetel, M. A., Khan, M. F. R. 2009. Survey of weed control and production practices on sugarbeet in Minnesota and Eastern North Dakota. *Sugarbeet Res. Ext. Rept.* 40:39-60.

Table 1. Effect of azoxystrobin at controlling *R. solani* at different growth stages of sugarbeet in an environment favorable for infection and disease development

Treatments	Method of fungicide application	Mean number of surviving, healthy plants (from 10 seeds)
Inoculated control for in-furrow	No fungicide	0.00c
Non-inoculated control for in-furrow	No fungicide	8.75ab
Azoxystrobin 0.672 L/ha + Inoculated	In-furrow	8.63b
Inoculated control for band application on soil surface	No fungicide	0.00c
Non-inoculated control for band application on soil surface	No fungicide	9.00ab
Azoxystrobin 0.672 L/ha in a 7 inch band application on soil surface + Inoculated	18 cm band	9.00ab
Inoculated control at cotyledonary stage	No fungicide	0.00c
Non-inoculated control at cotyledonary stage	No fungicide	9.00ab
Azoxystrobin 0.672 L/ha in a 7 inch band application at cotyledonary stage + Inoculated	18 cm band	9.25a
Inoculated control at 2-leaf stage	No fungicide	0.00c
Non-inoculated control at 2-leaf stage	No fungicide	9.00ab
Azoxystrobin 0.672 L/ha in a 7 inch band application at 2-leaf stage + Inoculated	18 cm band	8.88ab
Inoculated control at 4-leaf stage	No fungicide	0.13c
Non-inoculated control at 4-leaf stage	No fungicide	9.00ab
Azoxystrobin 0.672 L/ha in a 7 inch band application at 4-leaf stage + Inoculated	18 cm band	9.00ab
LSD (0.05)		0.57