DISEASE PROGRESS OF RHIZOCTONIA CROWN AND ROOT ROT ON SUGARBEET AT SELECT SITES IN NORTH DAKOTA AND MINNESOTA

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Seedling damping-off and crown and root rot caused by *Rhizoctonia solani* AG 2-2 continue to be among the most common diseases on sugarbeet in the Red River Valley (RRV) and southern Minnesota. Control options include rotating with non-host crops (small grains), planting varieties with partial resistance, planting early to avoid favorably warm soil temperatures when young seedlings are highly susceptible, and the use of seed treatment, in-furrow, and postemergence fungicides.

Fungicides are effective in controlling Rhizoctonia in sugarbeet when applied in advance of infection, but are ineffective when applied after infections occur (11). Disease onset is therefore critical in proper timing of fungicide applications. The disease is favored by warm and wet soil conditions. Studies under controlled conditions (1) have shown the importance of soil temperature and moisture to disease development. Under field conditions, application of azoxystrobin (Quadris) at soil temperatures of 62-67 °F tended to give best results (8,9), but results varied for different years and locations (6,7,8,9,10). We have observed disease onset in our trials to vary depending on inoculum density and trial location (2,3). Soil temperature, inoculum density, and other environmental factors affected by location are all likely to influence the onset of disease and efficacy of fungicide application timings.

Sentinel plots planted to a susceptible variety can be used to detect disease, track movements of diseases, and follow progress of disease. They have been used extensively to track soybean rust (12) and have been used in sugarbeet for Cercospora fungicide resistance tracking (4) and disease management (5).

OBJECTIVES

Field trials were established using a Rhizoctonia-susceptible variety with and without seed treatment for Rhizoctonia in multiple locations on different crop residues to determine onset and progress of Rhizoctonia crown and root rot.

MATERIALS AND METHODS

The trial was established at two sites in each of three locations: northern RRV (near Cavalier, ND), central RRV (near Halstad and Ada, MN), and southern Minnesota (near Clara City and Lake Lillian, MN). The two sites at each location allowed placement of the trial on two different crop residues: wheat and corn in the northern RRV, wheat and soybean in the central RRV and corn and soybean in southern Minnesota. In the RRV, three-row by 30-ft plots were sown (4.5 inch seed spacing) in 4 replicates to a Rhizoctonia-susceptible variety (4.7 RCRR 2-year rating in American Crystal Sugar Company variety trials) treated with Apron + Thiram + Tachigaren (45g). The same Rhizoctonia-susceptible variety was sown in two-row by 30-ft plots with 6 replicates in southern Minnesota. Treatments included seed not treated with a fungicide for Rhizoctonia control (referred to as untreated in figures) and seed treated with Vibrance at 1.5 g/unit (northern RRV) or Kabina at 14g/unit (central RRV and southern Minnesota). Two sets of each treatment were included so that one set could be used for destructive sampling to follow progress of root symptoms while the other set could be kept intact for stand counts and harvest data. Stand data was collected from two weeks after planting through mid-August. Root rot ratings (0-7 scale) were collected at various intervals beginning in late June through harvest. Roots with a rating of 3 or higher (>5% of root surface rotted) were considered positive in calculating percent disease incidence. Root weights and Rhizoctonia ratings were taken at harvest. Ten roots from each plot were also randomly selected and analyzed for quality by American Crystal Sugar Company quality lab, East Grand Forks, MN (RRV sites) or Southern Minnesota Beet Sugar Cooperative, Renville, MN (southern Minnesota sites). Table 1 summarizes the dates for planting and harvest for each site.

Table 1. Location, planting and harvest dates for Rhizoctonia disease progress trial sites.

Site	Location	Planting date	Harvest date
North RRV wheat residue	North of Cavalier, ND	May 12	September 14
North RRV corn residue	East of Cavalier, ND	May 12	September 14
Central RRV wheat residue	South of Halstad, MN	May 4	September 13
Central RRV soybean residue	Northeast of Ada, MN	May 4	September 29
Southern Minnesota corn residue	Northeast of Clara City, MN	May 6	October 13
Southern Minnesota soybean residue	Southeast of Lake Lillian, MN	May 3	October 1

RESULTS AND DISCUSSION

North RRV. Soil temperatures favorable for *Rhizoctonia* infection (daily mean 4-inch bare soil temperatures ≥ 60°F) were present by May 19 (within one week after planting) at the Cavalier North Dakota Agricultural Weather Network (NDAWN) station. Emergence was excellent at both wheat and corn residue sites, with stand of at least 200 plants per 100 ft of row by June 7 (3 ½ weeks after planting). At the wheat residue site, there was a slight drop in stand for seed with and without Vibrance between June 14 and 21 (4 ½ to 5 ½ weeks after planting), but both *Aphanomyces* and *Rhizoctonia* were recovered in equal amounts from sampled seedlings (data not shown). Stands remained fairly steady until a slight decline by the middle of August (Fig. 1A) when Rhizoctonia ratings and incidence began to rise (Fig. 2A). At the corn residue site, stands declined between June 7 and 21 (3 ½ to 5 ½ weeks after planting) regardless of seed treatment, remained steady through the month of July, and declined slightly in August (Fig. 1B). Both *Pythium* and *Rhizoctonia* were recovered from seedlings collected June 21, but only *Rhizoctonia* was isolated from samples collected after that date (data not shown). Rhizoctonia root rot ratings began a slow, steady incline beginning July 26 through the middle of September (Fig. 2B). Rhizoctonia incidence jumped up for seed not treated with Vibrance on July 26, but by September 14, incidence was around 20% for both seed treatments (Fig. 2B). Due to water damage from excessive rainfall and the moderate Rhizoctonia disease pressure, root yield and quality was low at both sites. Root yields averaged 18.4 and 16.1 ton/A and recoverable sucrose per ton averaged 269 and 241 at the wheat and corn residue sites, respectively. There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

Central RRV. Soil temperatures at the Ada, MN NDAWN station were briefly above 60°F from May 5 to 9, dipped, and then returned to greater than 60°F by May 18 (2 weeks after planting). Emergence was excellent at both wheat and soybean residue sites (Fig. 1C and 1D). At the wheat residue site, stands declined for both untreated and Kabina-treated seed from June 7 to 21 (4 ½ to 6 ½ weeks after planting) (Fig. 1C). Rhizoctonia was isolated from dying seedlings collected during this time. After June 21, stand remained steady until a slight decline from July 29 to August 15 (Fig. 1C). Root rot ratings and disease incidence were very low throughout the season (Fig. 2C). At the soybean residue site, there was a slight dip in stand for both seed treatments from June 7 to 14 (Fig. 1D). No pathogens could be isolated during this time so the small stand loss may have been from wind damage. Stands remained high (over 200 plants per 100 ft of row) and steady throughout the growing season (Fig. 1D). Similarly, Rhizoctonia root rot ratings and disease incidence showed no presence of Rhizoctonia throughout the season (Fig. 1D). Root yields were high at both sites while quality was low at the wheat site and moderate at the soybean site. Root yields averaged 33.3 and 34.2 ton/A and recoverable sucrose per ton averaged 229 and 298 at the wheat and soybean residue sites, respectively. There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

Southern Minnesota. Soil temperature data collected at the University of Minnesota, Southwest Research and Outreach Center in Lamberton, MN indicated daily mean 4-inch soil temperatures ≥ 60°F from May 7 to 9 and again from May 18 (2 weeks after planting) through the rest of the growing season. Emergence was lower at both sites in southern Minnesota than in the RRV with stands reaching 170 to 180 plants per 100 ft of row (Fig. 1E and 1F). Stands at both corn and soybean residue sites remained steady throughout the growing season with no evidence of damping-off (Fig. 1E and 1F). Rhizoctonia root rot was found at very low frequency and average root rot ratings and disease incidence remained low throughout the season at both corn and soybean residue sites (Fig. 2E and 2F). Root yields were moderate at the corn residue site (mean = 27.5 ton/A) and high at the soybean residue site (mean =

33.3 ton/A) while quality was low at both sites (means = 233 and 238 lb recoverable sucrose/A at corn and soybean residue sites, respectively). There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

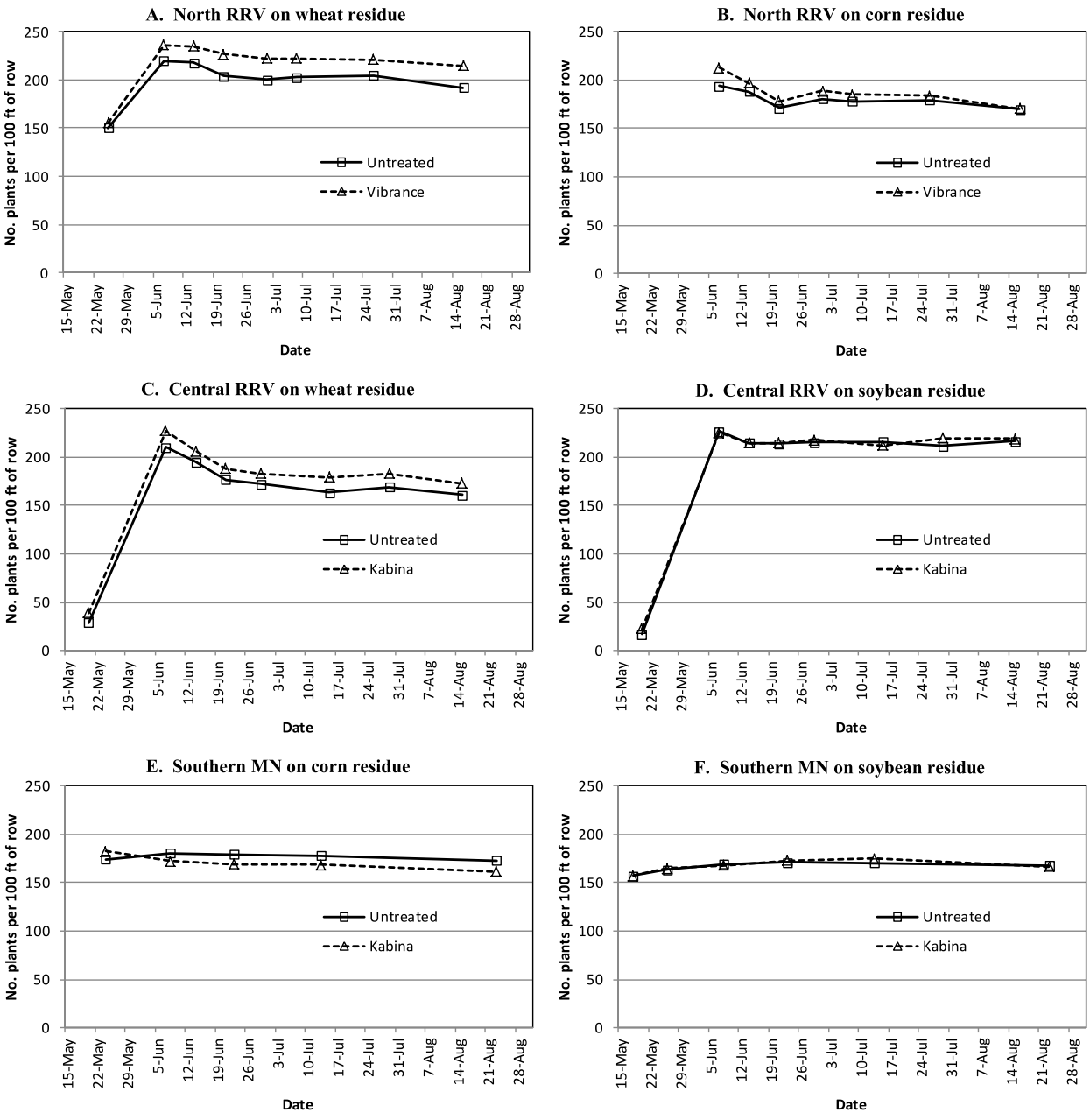

Fig. 1. Emergence and stand establishment for a Rhizoctonia-susceptible sugarbeet variety with and without Rhizoctonia seed treatment (Vibrance or Kabina) at locations across the Red River Valley (RRV) and in southern Minnesota.

Although soil temperatures were plenty high to favor infection by *Rhizoctonia* within two weeks after planting at all sites, Rhizoctonia damping-off occurred at only 3 of 6 sites, while Rhizoctonia crown and root rot occurred at a moderate level in just 2 of 6 sites. In the three sites with damping-off, timing and amount of stand loss due to Rhizoctonia damping-off was similar for both seed treatments suggesting that seed treatment efficacy had already declined prior to the onset of damping-off. In our inoculated field trials, we have seen greater efficacy of Rhizoctonia seed treatments when disease occurs very early, typically from higher pathogen populations. Onset and progress of Rhizoctonia damping-off and crown and root rot is most likely related to a combination of pathogen population and favorable environmental conditions (soil temperatures ≥ 60°F along with ample soil moisture). Significant benefits from newer seed treatments with activity against Rhizoctonia may only be realized when high pathogen populations and favorable environmental conditions conspire to cause damping-off when seedlings are young and very susceptible.

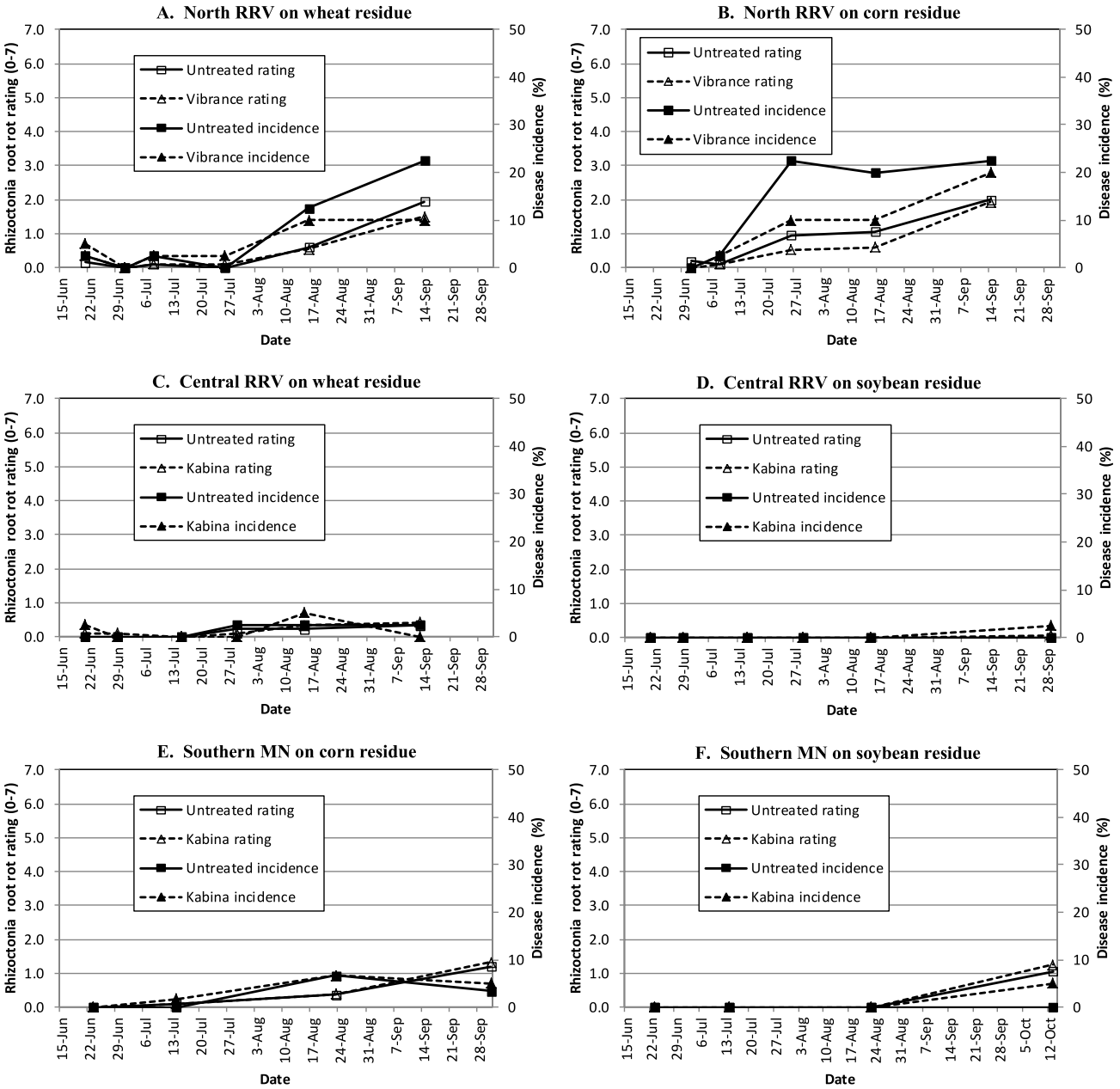

Fig. 2. Disease progress (root rot ratings on left axis and disease incidence on right axis) for a Rhizoctonia-susceptible sugarbeet variety with and without Rhizoctonia seed treatment (Vibrance or Kabina) at locations across the Red River Valley (RRV) and in southern Minnesota.

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LITERATURE CITED

1. Bolton, M.D., Panella, L., Campbell, L., and M.F.R. Khan. 2010. Temperature, moisture, and fungicide effects in managing Rhizoctonia root and crown rot of sugarbeet. Phytopathology 100:689-697.

2. Brantner, J.R. and Windels, C.E. 2013. Seed and in-furrow fungicides with and without postemergence Quadris for control of Rhizoctonia on sugarbeet. 2012 Sugarbeet Res. Ext. Rept. 43:202-207.

3. Brantner, J.R. and Windels, C.E. 2012. Seed and in-furrow fungicides with and without postemergence Quadris for control of Rhizoctonia on sugarbeet. 2011 Sugarbeet Res. Ext. Rept. 42:212-217.

4. Clark, G. 2012. Managing Cercospora resistance: an outline of the issue – and recommendations – in Michigan sugarbeets. Sugarbeet Grower 51(4):10-12.

5. Franc, G.D., Stump, W.L., Obuya, J.O., Cecil, J.T., and Moore, M.D. 2009. Pro-active crop surveys and strategic sentinel plot placement for pre-emptive cooperative extension programming efforts in Wyoming. In Abstracts, 2009 Second National Meeting, National Plant Diagnostic Network, Miami, FL. 6-10 Dec. 2009.

6. Jacobsen, B.J., Zidack, N.K., Johnston, M., Dyer, A.T., Kephart, K., and Ansley, J. 2006. Studies on optimal timing of azoxystrobin applications for Rhizoctonia crown and root rot control. 2005 Sugarbeet Res. Ext. Rept. 36:291-294.

7. Khan, M.F.R., Nelson, R., Bradley, C.A., and Khan, J. 2006. Developing a management strategy for controlling Rhizoctonia root and crown rot in sugarbeet. 2005 Sugarbeet Res. Ext. Rept. 36:295-296.

8. Khan, M.F.R., Bradley, C.A., Nelson, R. and Khan, J. 2005. Developing a management strategy for controlling Rhizoctonia root and crown rot in sugarbeet. 2004b Sugarbeet Res. Ext. Rept. 35:232-234.

9. Khan, M.F.R. and Nelson, R. 2004. Efficacy of Quadris on control of Rhizoctonia root and crown rot in 2003. 2004 Sugarbeet Res. Ext. Rept. 34:250-251.

10. Kirk, W.W., Wharton, P.S., Schafer, R.L., Tumbalam, P., Poindexter, S., Guza, C., Fogg, R., Schlatter, T., Stewart, J., Hubbell, L., and Ruppal, D. 2008. Optimizing fungicide timing for the control of Rhizoctonia crown and root rot of sugar beet using soil temperature and plant growth stages. Plant Dis. 92:1091-1098.

11. Windels, C.E. and Brantner, J.R. 2005. Early-season application of azoxystrobin to sugarbeet for control of *Rhizoctonia solani* AG 4 and AG 2-2. J. Sugar Beet Res. 42:1-17.

12. Young, H.M., Marois, J.J., Wright, D.L., Narvaez, D.F., and O'Brien, G.K. 2011. Epidemiology of soybean rust in soybean sentinel plots in Florida. Plant Dis. 95:744-750.