Interactions of Glyphosate and Cercospora Leaf Spot (DS01-08)

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Glyphosate applications have been reported to reduce foliar diseases. There have also been reports that glyphosate combinations with fungicides may result in synergistic responses that could reduce foliar diseases. Cercospora leaf spot is a major foliar disease that Michigan sugarbeet growers need to manage yearly. With the recent commercialization of Roundup Ready (glyphosate-resistant) sugarbeets, applications of glyphosate may help reduce the disease severity of Cercospora leaf spot in Roundup Ready sugarbeets. A field trial was initiated at the Saginaw Valley Bean and Beet Research farm in 2008 to test this hypothesis. This research was a cooperative effort between MSU Weed Science and USDA-ARS and MSU Plant Pathology. The study was designed to evaluate the response of sugarbeet variety, weed management treatment, and fungicide application. The entire study was inoculated for Cercospora leaf spot in early July. Four different Roundup Ready sugarbeet varieties, ACH 827RR, Hilleshog 9027, Hilleshog 9028, and Hilleshog 9029 were evaluated. The weed management treatments included: three applications of glyphosate, four applications of glyphosate, two standard-split herbicide applications (Betamix + Upbeet + Stinger), and a no herbicide control that was kept weed-free throughout the season by hand-weeding. Each of these weed management treatments was evaluated for Cercospora leaf spot disease severity with and without fungicide applications. The fungicide treatment included: three separate applications Headline followed by Eminent followed by Gem at 55 DSV according to BeetCAST.

There was not a 3-way interaction between sugarbeet variety, herbicide treatment, and fungicide treatment. Herbicide treatment did not have a significant effect on Cercospora disease severity or sugarbeet yield. However, the main effects of sugarbeet variety and fungicide application were significant. ACH 827RR was the most susceptible variety to Cercospora leaf spot. Fungicide applications reduced the disease severity of all varieties, ultimately leading to greater sugarbeet yields. This study will be repeated in 2009.

Interactions of Glyphosate and Rhizoctonia Root Rot (DS02-08)

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Previous greenhouse research with an experimental Roundup Ready (glyphosate-resistant) sugarbeet variety indicated that host resistance to Rhizoctonia crown and root rot could be compromised when plants were exposed to glyphosate. In order to improve disease management recommendations, field research was initiated in Michigan to investigate the interaction between weed and disease management strategies on the severity of Rhizoctonia crown and root rot in four commercial Roundup Ready sugarbeet varieties. The Roundup Ready sugarbeet varieties investigated were ACH 827RR, Hilleshog 9027, Hilleshog 9028, and Hilleshog 9029. Each of these varieties were treated with three different weed management programs: 1) no herbicide (hand-weeded control), 2) a standard-split herbicide program (two applications of Betamix + UpBeet + Stinger), and 3) three applications of glyphosate. Uninoculated and plots inoculated with *Rhizoctonia solani* AG-2-2 IIIB were compared for each variety by weed management combination. Additional treatments included inoculated plots treated with the fungicide Quadris (azoxystrobin) in-furrow or postemergence to 6-leaf sugarbeets. Significant main effects included the presence of the disease, fungicide treatment, and variety. Herbicides and interactions with herbicide programs were not significant. Rhizoctonia disease severity was greatest with the sugarbeet varieties ACH 827RR and Hilleshog 9028. Foliar Quadris applications also provided the greatest protection against Rhizoctonia crown and root rot compared with in-furrow applications. Results from this first year of field research indicate that weed management strategy had little impact on Rhizoctonia disease severity. However, a combination of host plant resistance and fungicide applications were important in reducing Rhizoctonia disease severity.

Comparing yield and weed management in wide- and narrow-row Roundup Ready sugarbeet

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With the support of the Michigan Sugar Company and Project GREEEN, we conducted multiple field trials to evaluate Roundup Ready (glyphosate-resistant) sugarbeet planted in 15-, 20-, and 30-inch rows to determine if there were any advantages for yield, quality, and weed management by planting in narrow rows. Trials were conducted at the MSU Saginaw Valley Bean and Beet Research Farm and on growers' fields in 2007 and 2008.

Row width and plant population effects on yield and quality

The first study evaluated sugar beet yield and quality in 15-, 20-, and 30-inch rows and stands of 22,000; 31,000; 41,000; or 50,000 beets/acre. All plots were thinned to the desired stands when beets were in four-leaf growth stages and were maintained weed-free during the growing season. Populations were held constant across the three row widths to evaluate the effect of row width.

Root yields were similar among all plant populations, regardless of row width. However, recoverable white sugar per ton (RWST) increased from 231 pounds per ton at stands of 22,000 beets per acre to 240 pounds per ton at stands of 50,000 beets per acre. Though the differences were not statistically significant, there was also a slight trend toward increased RWST as row width narrowed from 30-inches to 15-inches at all locations. When averaged over all populations, sugarbeet planted in 20-inch rows provided a 6% increase in root yield (38.9 tons per acre) over 15-inch (36.5 tons) and 30-inch rows (36.4 tons). As a result of the increased root yield with 20-inch rows, the highest recoverable white sugar per acre (RWSA) was also observed in 20-inch rows.

We also collected measurements throughout the growing season to compare crop canopy development among the various row width and plant population combinations. Sugarbeet planted in 15- and 20-inch rows provided earlier and denser canopy cover than beets planted in 30-inch rows at all populations. Earlier canopy cover is advantageous because it allows for maximum sunlight interception and can aid in weed control by shading out late-season weed emergence.

Glyphosate timing and weed control in narrow rows

The second question we addressed is the effect of row width on weed control in Roundup Ready sugarbeet. Three row widths, 15-, 20-, and 30-inches, were investigated at a uniform stand of 31,000 plants/acre. Treatments included Roundup WeatherMax (22 fl oz) + ammonium sulfate (17 lbs/100 gal) when weeds averaged 2- and 4-inches in height, with follow-up treatments when weeds were 4-inches in height; single glyphosate applications when weeds averaged 4- and 6-inches; conventional sugar beet herbicide programs (Betamix + Stinger + UpBeet) of either a standard-split program applied twice (non-ionic surfactant included in the second application) or micro-rate program applied four times (methylated seed oil included in all applications); and weed-free and untreated control plots. When averaged over all herbicide treatments, sugar beet root yields were highest in 15- and 20-inch rows. When averaged over row widths, yields were lowest when glyphosate applications were delayed until weeds were 6-inches in height. In treatments which received only a single glyphosate application when weeds

were 4-inches tall, subsequent weed biomass accumulation was reduced by at least 70% in 15-in rows and 65% in 20-in rows, compared with 30-in rows. Results from this study indicate that planting glyphosate-resistant sugar beet in narrow rows may result in higher yields and provide some suppression of late-season weed growth.

Time of Weed Removal in Roundup Ready Sugarbeet (SB04-08)

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Early-season weed competition can reduce sugarbeet yields. This field study was conducted to demonstrate the optimum time for weed removal or POST glyphosate applications in Roundup Ready (glyphosate-resistant) sugarbeets. Glyphosate formulated as Roundup PowerMax was applied at 22 fl oz/A and 33 fl oz/A when weeds were 1-inch, 2-inches, 3-inches, 4-inches, and 6-inches tall. Initial and sequential timings of glyphosate were applied according to weed size. Three applications were made in the 1-inch weed plots, two applications were made in plots where weeds were 2-, 3- or 4-inches tall, and only one application was made in the plots where weeds were 6-inches tall. Weed control (common lambsquarters and pigweed) was lowest when glyphosate applications were made to weeds that were 4-inches tall. When averaged over glyphosate rates, sugarbeet yield and recoverable white sugar per acre was lower as glyphosate applications timings were made to taller weeds. In fact, recoverable white sugar per acre was significantly ($P = 0.1$) lower when weeds were not controlled until they were 4- or 6-inches tall. The optimum time for the first application of glyphosate in Roundup Ready sugarbeets would be when weeds are 2-inches tall. Control of weeds early in sugarbeets is important to maximizing sugarbeet yield.

Weed Control and Crop Tolerance with Sequence and Roundup Ready Sugarbeet (SB05-08)

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As Roundup Ready sugarbeets become more prevalent in Michigan sugarbeet production, additional products may be commercialized to help with weed management. Some of these products may include premixtures of products that can be currently used in sugarbeets. For example, glyphosate and Dual Magnum (s-metolachlor) are two products that can be used POST in Roundup Ready sugarbeets. Sequence is a premixture of these two products and is currently being marketed in Roundup Ready soybean by Syngenta Crop Protection. A field study was initiated to evaluate weed control and crop tolerance of Roundup Ready sugarbeet to Sequence herbicide. Sequence was applied to sugarbeets at the 2-leaf stage at 2, 3, 4, 6, and 8 pints per acre, these treatments were compared with tank-mixtures of Touchdown Total (1.2 pt/A) and Dual Magnum (1.5 pt/A) was applied; the equivalent of Sequence at the 3 pt per acre rate. Additional treatments included Sequence applied at 3 pt/A at 2-leaf sugarbeets and then followed by Touchdown Total 1.5 pt/A (glyphosate) or Sequence when weeds regrew to 2-inches tall or the initial application of Touchdown Total followed by Sequence. Injury to sugarbeet from Sequence at rates greater than 4 pt/A ranged between 6 and 12%. This injury did not seem to have any significant affect on sugarbeet yield. However, when only one herbicide application was made common lambsquarters control was less than satisfactory by then end of the growing season. Two applications either Sequence, Sequence followed by Touchdown, Touchdown followed by Sequence or even two applications of Touchdown provided season-long weed control. Sugarbeet yield was the highest, 37 and 36.9 tons/A when Sequence was applied in the first application followed by Sequence or Touchdown Total, respectively. The results of this study indicate that, if labeled, Sequence may be a useful herbicide for weed control in Roundup Ready sugarbeet, although more than one herbicide application will be needed for season-long weed control.

Tank-Mixes with Glyphosate for use Roundup Ready Sugarbeet (SB06-08)

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Glyphosate-resistant weeds will likely become an issue in Roundup Ready sugarbeets with the exclusive use of glyphosate for weed control. Because this may become an issue in the future a study was initiated to evaluate compatible tank-mix partners with postemergence applications of Roundup PowerMax (glyphosate) in Roundup Ready sugarbeet. Tank-mix partners evaluated with 22 fl oz/A of Roundup PowerMax included: Nortron, Upbeet, Stinger, Dual Magnum, and Outlook. The first application was made when weeds were 2-inches tall. The second herbicide application was made in each treatment when weeds were 4inches tall. Some treatments were scheduled to be treated a third time when weeds were again 4-inches tall. All treatments resulted in excellent weed control (>96%) late in the season, and sugarbeet injury throughout the growing season from herbicides was less than 12% in all treatments. Initial common lambsquarters control was lower when crop oil concentrate was added to the glyphosate + UpBeet tank-mixture. It appears if UpBeet is applied with glyphosate AMS should only be added. Highest yields (tons/acre and recoverable white sugar/acre) were from Roundup PowerMax alone, or Roundup PowerMax tank-mixed with Dual Magnum in the second application. Roundup PowerMax tank-mixed with Upbeet in the first application; or tank-mixed with Nortron, Stinger, or Outlook in the second application resulted in lower sugar yields.

Evaluation of Cover Crops and Reduced Tillage with Roundup Ready Sugarbeets (SB07-08)

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The recent commercialization of Roundup Ready sugarbeets may allow for changes in current sugarbeet production practices. A field study was conducted to investigate the effects of cover crops and strip tillage on weed management, stand establishment, and crop yield in Roundup Ready (glyphosate-resistant) sugarbeet. Cover crops included in this study were oilseed radish, oriental mustard, oats, winter wheat and no cover as a control. These crops were planted the previous fall and all winter killed except for wheat. Two weeks before planting, half of the plots were strip-tilled. Roundup WeatherMax at 22 oz/A plus ammonium sulfate at 2% v/v was applied two weeks prior to planting in the winter wheat plots and applied at planting and two weeks after planting in all other plots. Weed populations were counted 15, 30, and 50 days after planting. Sugarbeet stand was evaluated mid-season and at harvest and were harvested for yield. There was a significant interaction between cover crop and glyphosate application timing for sugarbeet stand and yield. The highest yielding treatments were plots that were planted in the no cover crop control (29.6 tons/A to 31.5 tons/A). The lowest yielding treatment was where wheat was controlled two weeks after planting (11.9 tons/A). Tillage also had a significant effect on sugarbeet yield. Average yields were significantly higher in the no-till system (25 tons/A) compared with the strip-till system (23 tons/A). Recoverable white sucrose per ton was highest in the treatments with radish as a cover crop 309 lb. Treatments with oriental mustard, oat, and no cover crop were similar with recoverable white sucrose per ton ranging from 244-246 lb. Winter wheat had the lowest recoverable white sucrose per ton (232 lb). Tillage did not have a significant effect on sugar quality. Overall results showed that treatments with no cover crop and no tillage had significantly higher yields than strip-till or cover crop treatments from the first year of this trial. This trial is being repeated in 2009.