

APPLICATION OF BASF F500 AT THE FOUR- OR EIGHT-LEAF STAGE FOR CONTROL OF RHIZOCTONIA ROOT AND CROWN ROT ON SUGARBEET

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Rhizoctonia solani AG-2-2 (= *R. solani*) is a soilborne fungus that has been increasing in prevalence and severity on sugarbeet grown throughout Minnesota and North Dakota in recent years. This trend is attributed to unusually wet weather and build up of inoculum by close rotations of sugarbeet and bean crops (*R. solani* AG-2-2 also causes stem rot and root rot on soybean and edible beans). Strobilurin fungicides are registered on sugarbeet to control *R. solani* (Quadris) and Cercospora leaf spot (Gem, Headline). There is interest in knowing if application of strobilurin fungicides that protect against early-season Cercospora leafspot also provide “kick back” activity against Rhizoctonia root and crown rot.

OBJECTIVE

Our objective was to evaluate efficacy of a band treatment of F500, applied at the four- or eight-leaf stage, for control of *R. solani* AG-2-2 on sugarbeet. F500 is the same fungicide as Headline, but is referred to as a numbered product in this report because it is not registered for control of *R. solani*.

MATERIALS AND METHODS

The trial was established at the University of Minnesota, Northwest Research and Outreach Center, Crookston. Plots were fertilized for maximum sugar beet yield and quality on May 16, 2003 and planted with VDH 66240 on May 21. Seeds were sown at a 1.25-inch spacing in six-row plots (30 ft long, rows 22 inches apart), with four replicates per treatment in a randomized block design. Counter (1.8 lb/A) was applied at planting to control root maggot. Microrates of herbicides were applied on June 2, 9, and 13 and included Betamix, UpBeet, Stinger, Select, and MSO (0.5 pint, 0.125 oz, 40 ml, 60 ml, and at least 1.5 pint/A, respectively) per application. Cercospora leaf spot was controlled by application of Eminent on July 23, Super Tin on August 6, Eminent on August 22, and Super Tin on September 5 (13, 5, 13, and 5 oz/A, respectively).

Treatments in the trial included: 1) inoculation with *R. solani* and application of F500 (0.5 fl. oz. product/1000 ft row) at the four-leaf stage, 2) a *R. solani*-inoculated control (applied at the four-leaf stage), 3) an untreated control, 4) inoculation with *R. solani* and application of F500 (0.5 fl. oz. product/1000 ft row) at the eight-leaf stage, 5) a *R. solani*-inoculated control (applied at the eight-leaf stage), and 6) an untreated control. Treatments 1-3 were handled as one subtrial because treatments were applied before plots were thinned; treatments 3-6 were handled as another subtrial because they were applied after thinning.

Inoculum of *R. solani* was grown on sterile barley grains for 3 weeks and air-dried; 16 g of inoculum were sprinkled along the 30-ft length of each of two middle rows per plot. Soil was lightly raked into the row to prevent drying of inoculum. Applications of F500 were made in a 7-inch band at the four-leaf stage on June 17 with a three-nozzle row applicator at 30 psi (one center nozzle was directly over the row and two side nozzles were angled at 45 degrees toward the crown). Stand data were collected on June 17 and July 1, 15, and July 23 (before plots were thinned later in the day). Plots were thinned to the equivalent of 150 plants/100 ft of row and “baseline” stands were counted. Stand counts continued to be made on August 1, 12, and 19.

For plants treated at the eight-leaf stage, plots were thinned and baseline stand counts were made on July 1. Then, plants were inoculated with *R. solani* and treated with F500, as previously described for the four-leaf stage treatments. Stand counts were made on July 15 and 23 and August 1, 12, and 19.

Subtrials were harvested on September 30. Data were collected for number of roots harvested, severity of Rhizoctonia root and crown rot on surviving plants (0 to 7 scale, 0 = root healthy, 7 = root completely rotted and foliage dead), root yield, and sucrose yield. For each subtrial, data were subjected to analysis of variance and if significant ($P = 0.05$), means were separated by Least Significant Difference.

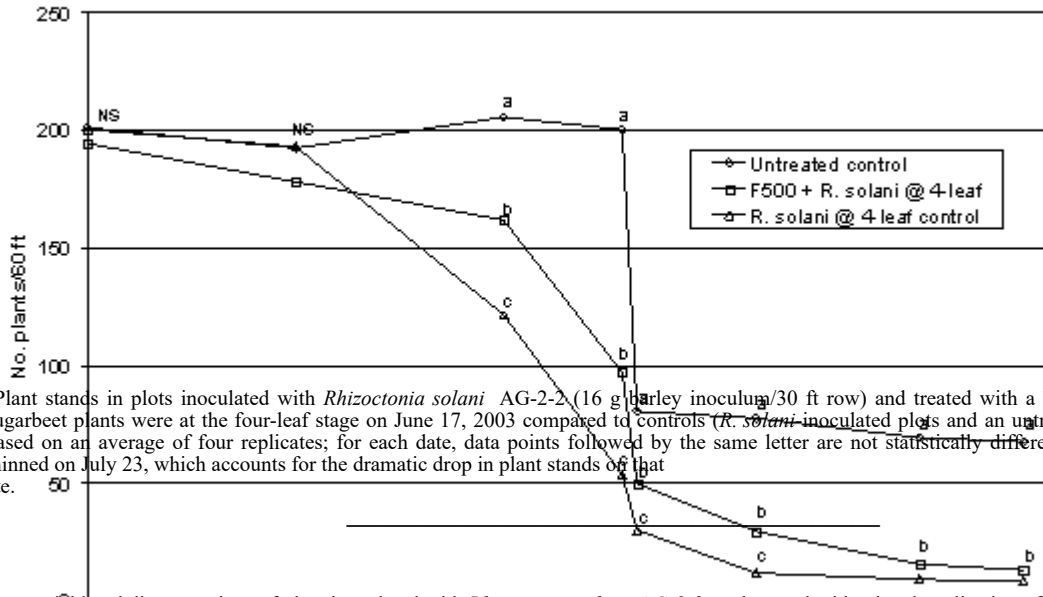


Fig. 1. Plant stands in plots inoculated with *Rhizoctonia solani* AG-2-2 (16 g barley inoculum/30 ft row) and treated with a band application of F500 when sugarbeet plants were at the four-leaf stage on June 17, 2003 compared to controls (*R. solani*-inoculated plots and an untreated control). Each data point is based on an average of four replicates; for each date, data points followed by the same letter are not statistically different, $P = 0.05$. NOTE: plots were thinned on July 23, which accounts for the dramatic drop in plant stands of that date.

Table 1. Harvest yield and disease ratings of plots inoculated with *Rhizoctonia solani* AG-2-2 and treated with a band application of F500 when sugarbeet plants were at the four-leaf stage on June 17, 2003 compared to controls (*R. solani*-inoculated plots and an untreated control).

| Treatment ^W | Number harvested/60 ft row | Root rot rating (0-7 scale) ^Y | Root yield (T/A) | Sucrose yield | | | |
|---------------------------------|----------------------------|--|------------------|---------------|-----|------|------|
| | | | | Percent | LTM | lb/T | lb/A |
| Untreated control | 72 | 1.7 | 23.8 | 16.1 | 1.5 | 293 | 6954 |
| <i>R. solani</i> + F500 | 14 | 5.1 | 3.7 | 14.2 | 1.6 | 251 | 939 |
| <i>R. solani</i> control | 10 | 5.4 | 1.9 | 13.7 | 1.7 | 239 | 443 |
| LSD ($P = 0.05$) ^Z | 10 | 0.9 | 3.1 | 1.2 | NS | 26 | 852 |

- W Each value based on four replicates.
- X *R. solani* was applied along the row (16 g barley inoculum/30 ft row) and then soil was lightly raked in the row to cover it.
- Y Root rot rating on a 0 – 7 scale, 0 = root healthy, 7 = root completely rotted and foliage dead.
- Z LSD = Least Significant Difference if significant, LSD value provided for mean separations; NS = not significant.

RESULTS AND DISCUSSION

For plots inoculated with *R. solani* and treated with F500 at the four-leaf stage, there were no statistical differences in stand among treatments 2 weeks later, on July 1 (Fig. 1). By July 15, there were statistically higher stands in the untreated control compared to the *R. solani*-inoculated control; stands in plots inoculated with *R. solani* and treated with F500 were intermediate and statistically different from both controls (Fig. 1). This trend continued, despite

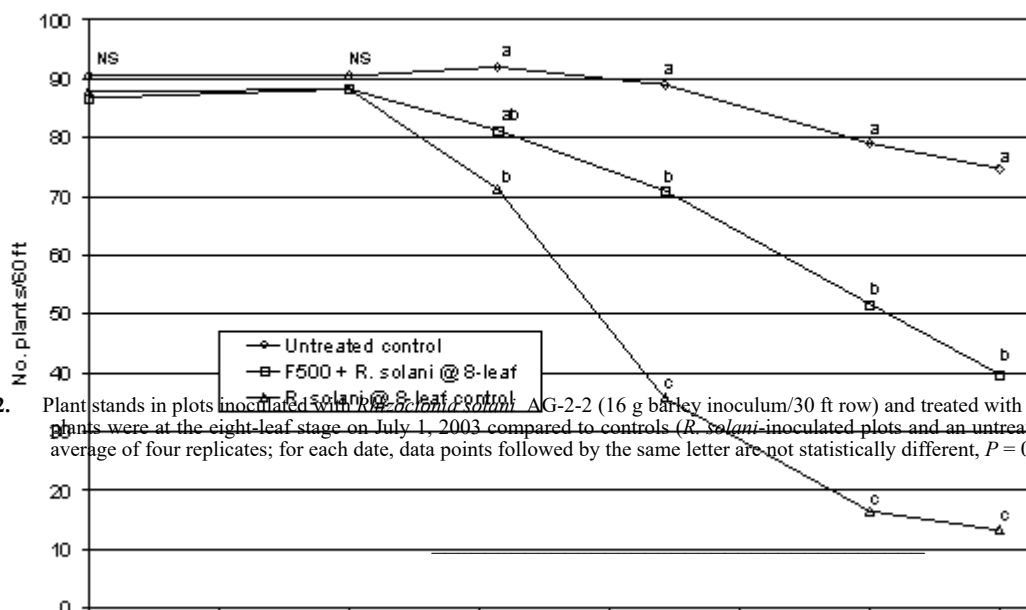


Fig. 2. Plant stands in plots inoculated with *Rhizoctonia solani* AG-2-2 (16 g barley inoculum/30 ft row) and treated with a band application of F500 when sugarbeet plants were at the eight-leaf stage on July 1, 2003 compared to controls (*R. solani*-inoculated plots and an untreated control). Each data point is based on an average of four replicates; for each date, data points followed by the same letter are not statistically different, $P = 0.05$.

continuing stand losses (naturally occurring *R. solani* also reduced stands slightly in the untreated control). When plots were thinned on July 23, stands in the *R. solani*-inoculated plots (with and without F500) were so low the untreated control still had significantly more plants than the other treatments (Fig. 1). Stands continued to decline, although at a relatively reduced rate, for the remainder of the season. On August 19, the untreated control resulted in statistically higher stands than plots inoculated with *R. solani* and treated with F500 and in the inoculated control, which were equally low. At harvest, the untreated control resulted in the lowest root rot ratings and the highest number of harvested roots, root yields, percent sucrose, pounds of sucrose/ton, and pounds of recoverable sucrose/acre compared to plots inoculated with *R. solani* and treated with F500 and in the inoculated control, which were equal (Table 1). Loss to molasses was equal across all treatments.

For plots inoculated with *R. solani* and treated with F500 at the eight-leaf stage, there were no significant differences in stand compared to untreated and inoculated controls 2 weeks later (Fig. 2). Stands then declined across all treatments (naturally occurring *R. solani* also reduced stand slightly in the untreated control). By August 19, the untreated control had the highest stand; the *R. solani*-inoculated control had the lowest stand; and plots inoculated with *R. solani* and treated with F500 had an intermediate stand that was statistically different from both controls. At harvest, the untreated control resulted in the highest number of harvested roots, root yields, percent sucrose, pounds of sucrose/ton, and pounds of recoverable sucrose/A and the lowest root rot and loss to molasses compared to the *R. solani*-inoculated control (Table 2). Plots inoculated with *R. solani* and treated with F500 resulted in intermediate root rot ratings, number of harvested roots, root yields, percent sucrose, and pounds of sucrose/A that were statistically different from both controls; it also resulted in loss to molasses and pounds of recoverable sucrose/ton that were statistically the same as the untreated control and statistically better than the *R. solani*-inoculated control (Table 2).

Table 2. Harvest yield and disease ratings of plots inoculated with *Rhizoctonia solani* AG-2-2 and treated with a band application of F500 when sugarbeet plants were at the eight-leaf stage on July 1, 2003 compared to controls (*R. solani*-inoculated plots and an untreated control).

| Treatment ^{WX} | Number harvested/60 ft row | Root rot rating (0-7 scale) ^Y | Root yield (T/A) | Sucrose yield | | | |
|---------------------------------|----------------------------|--|------------------|---------------|-----|------|------|
| | | | | Percent | LTM | lb/T | lb/A |
| Untreated control | 80 | 1.7 | 24.4 | 16.7 | 1.4 | 307 | 7455 |
| <i>R. solani</i> + F500 | 30 | 3.7 | 10.0 | 15.6 | 1.5 | 282 | 2910 |
| <i>R. solani</i> control | 12 | 5.5 | 3.9 | 12.9 | 1.9 | 220 | 910 |
| LSD ($P = 0.05$) ^Z | 14 | 1.8 | 5.6 | 2.4 | 0.3 | 53 | 1558 |

^W Each value based on four replicates.

^X *R. solani* was applied along the row (16 g barley inoculum/30 ft row) and then soil was lightly raked in the row to cover it.

- Y Root rot rating on a 0 – 7 scale, 0 = root healthy, 7 = root completely rotted and foliage dead.
- Z LSD = Least Significant Difference; if significant, LSD value provided for mean separations.
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This trial had severe disease pressure, so the positive response (reduction in root rot and increased yields) with application of F500 at the eight-leaf stage looks promising. If F500 were applied to sugarbeet a few days before infection by *R. solani* (i.e., before the last cultivation and shortly before row closure), control of this disease could be enhanced. The challenge, however, will be to integrate this strategy with control of *Cercospora* leaf spot.

CONCLUSION

Application of F500 was more effective in reducing *Rhizoctonia* root and crown rot and increasing sugarbeet yield and quality when applied at the eight-leaf stage compared to the four-leaf stage, which was ineffective.

ACKNOWLEDGEMENTS

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