Evaluation of azoxystrobin alternatives and *Rhizoctonia solani* sensitivity screening in Michigan sugar beets

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Rhizoctonia root and crown rot (RRCR) is caused by *R. solani* Kühn and continues to be a major pest of sugar beets. In Michigan, Quadris (azoxystrobin) is widely applied to manage RRCR. Azoxystrobin, a quinone outside inhibitor (QoI), targets a single site to inhibit fungal respiration and so possesses a high risk of fungicide resistance development. Continued reliance on one to two applications of this product per season has prompted the evaluation of efficacious alternatives for RRCR management and preliminary fungicide sensitivity assays. In 2018, in-furrow and banded applications (made at the 6-8 leaf stage) of Serenade (*Bacillus subtilis* QST 713), Proline (prothioconazole), and Propulse (fluopyram+prothioconazole) were evaluated in an inoculated trial at the Saginaw Valley Research and Extension Center in Frankenmuth, MI. Stand counts were collected throughout the season and total stand loss recorded. At harvest, 20 arbitrarily selected beets were rated and assigned a severity score (0-7 scale). The Rhizoctonia root rot index (DIX) was calculated by multiplying the incidence (0-100%) by the mean symptomatic root severity divided by seven. A generalized linear mixed model procedure (SAS v. 9.4) was used to conduct the ANOVA (α=0.05). Mean comparisons were determined using Fisher's Protected LSD (α=0.05).

A complementary assay of azoxystrobin sensitivity was also conducted to determine the status of Quadris efficacy in Michigan *R. solani* populations. In 2018, *R. solani* isolates were collected from five commercial fields treated with azoxystrobin in the Michigan sugar beet growing region. Two additional baseline isolates, collected prior to azoxystrobin use in sugar beet, were included for comparison. Isolates were screened on half-strength potato dextrose agar (PDA) amended with salicylhydroxamic acid (SHAM) at 10 µg ml^{-1} and azoxystrobin at concentrations: 0, 0.001, 0.01, 0.1, 1, and 10 µg ml^{-1}. After 72 hours, radial growth was measured along two transects. Percent inhibition was calculated using the equation: 100 - [(response amended / response non-amended)*100]. Significant radial growth was observed at highest concentrations, however, colony density was visibly inhibited. Methods were altered to measure colony mass in half-strength clarified V8 broth amended with SHAM at 10 µg ml^{-1} and azoxystrobin at 0, 0.01, 0.1, 1, 10, and 100 µg ml^{-1}. Effective concentrations for 50% inhibition of colony mass (EC_{50}) were determined using three-parameter logistic regression (SAS v. 9.4).

Field treatments significantly affected total stand loss (P<0.0001), DIX (P<0.01), and yield (P<0.05). Only treatments of Serenade, Proline, and Propulse used in a program with Quadris yielded significantly higher than the non-treated control. Notably, Serenade+Quadris in-furrow followed by a banded application of Proline significantly reduced root rot scores (-30%) and resulted in higher yields (+7 T A^{-1}; 15692 kg ha^{-1}) than the Quadris only program. No products tested individually performed significantly differently than the Quadris program. In the amended broth studies, mean EC_{50} values were 0.013 and 0.018 µg ml^{-1} for baseline and non-baseline isolates, respectively. Furthermore, isolates were sensitive to azoxystrobin concentrations below label rates (1.35-2.7 µg ml^{-1}). In this preliminary screen, azoxystrobin insensitivity was not observed in Michigan *R. solani* populations, however, additional testing is necessary to better represent the region.