DETERMINING OPTIMAL FUNGICIDE TIMING FOR RHIZOCTONIA ROOT ROT OF SUGAR BEET IN NEBRASKA BASED ON SOIL TEMPERATURES

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ABSTRACT

Rhizoctonia root and crown rot, caused by *Rhizoctonia solani*, is the most widespread, consistently found, and damaging sugar beet disease in Nebraska. It is capable of causing both a seedling disease and two different phases of root rot later in season. These two phases include a crown rot, and a tip rot of the tap root originating beneath the soil surface. Since there are several diverse forms (root rot phases) of the disease observed in Nebraska, it has been difficult to make fungicide recommendations based only on plant growth stage or chronological time of the season. In the attempt to determine more efficient application timings, a study was begun in 2009 with the purpose of making fungicide applications based on measurement of soil temperature. Spray treatments were applied when 10 cm soil temperatures averaged 15°, 18°, 21°, and 24°C for 3 sequential days, with two additional treatments consisting of untreated checks and spraying at symptom expression. Data collected included root disease incidence counts, sucrose and root yield, and sugar loss to molasses determinations. Sugar yields and numbers of diseased plants were significantly improved with the use of azoxystrobin when soil temperature reached 15°, 18° and 21°C, compared to controls and spraying after

Introduction:

Rhizoctonia root and crown rot, caused by *Rhizoctonia solani*, is an endemic soilborne disease of sugar beets wherever the crop is grown. *R. solani* is long-lived in soils and attacks plants in many different families. Even if the pathogen is known to be present in fields, disease severity and incidence are still dependent upon soil populations and environmental conditions, all of which make it very difficult to manage.

In Nebraska, it also is the most widespread, consistently occurring, and damaging disease in the state (Figure 1). Furthermore, the disease additionally manifests itself as both a seedling disease (Figure 2) and two different phases of root rot later in season (Figures 3 and 4), with both phases inducing the same permanent wilting and collapse of leaves and petioles (Figure 5).

Experiments in other sugar beet-growing regions of the United States have concluded that spraying the strobilurin fungicide Quadris (azoxystrobin) was beneficial for managing this disease. Higher sucrose yields and lower numbers of diseased plants were realized when applications were made at soil temperatures ranging between 9.9 and 25.9 C (3) or 18.3 and 26.6 C (4). This concept of spraying fungicides based on specific soil temperatures has proven to be effective in Nebraska when using 23.9° C for the cardinal temperature and comparing that to a treatment based on symptom development (1,2). Thus, we expanded this concept and began a study in 2009 to test the idea of spraying azoxystrobin at a range of soil temperatures, including 15.5°, 18.3°, 21.1°, 23.9°, and 26.6° C to better determine those conditions enhancing disease management in the Central High Plains.

Materials and Methods:

The study was planted in early May with plots consisting of 4 rows, 55 cm in width and 12 m long. The experiment was a randomized complete block design with 7 treatments and 6 replications per treatment. Plots were irrigated with sprinkler irrigation (3.5-4.0 cm/wk), and combined with rainfall exceeding 20 cm, resulted in approximately 50 cm moisture for both seasons. Treatments consisted of 1) untreated control, 2-6) spray applications based on 10 cm soil temperature average of 15.5°,18.3°,21.1°,23.9°, and 26.6° C for 3 consecutive days, and 7) applications after severe symptoms have become evident. All spray applications used azoxystrobin at 0.65 l/ha. Four separate disease counts were made in mid-June, late-July, mid-August, and early September. Lastly, standard yield parameters - root and sugar yields, sugar percentages, and sugar loss to molasses (SLM) - were determined from plots after harvest at the Western Sugar Cooperative factory in Scottsbluff, NE.

Results:

Sugar and root yields and numbers of diseased plants were substantially improved with the use of fungicide sprays based on soil temperatures averaging 15.5°, 21.1°, and 70° (Table 1). Although not significantly different from each other, the best results were achieved with spraying at 18.3° and 21.1° rather than 15.5° and 23.9° C (Figures 6 and 7). However, the 15.5, 18.3 and 21.1 spray treatments were significantly better than the checks or spraying at symptom treatments, resulting in sugar yield increases of almost 4000 kg/ha compared to untreated checks (Table 1). Only the 18.3° and 21.1° spray treatments produced significantly lower levels of root disease over the control and symptom treatments. Few differences were observed involving other yield parameter such as sugar percentage and sugar loss to molasses (SLM).

Conclusions:

Other sugar beet-growing states have attempted to optimize the timing for making applications of azoxystrobin for disease management, with varying recommendations resulting as a consequence (3,4). We chose to use an average temperature over three successive days to attempt to account for the radical soil temperature fluctuations occurring between day and night. These 10 cm soil temperature values have been closely monitored and routinely vary from the high 50's in the morning to the low 80s in the late afternoon. We hypothesize that this will better estimate the potential for disease development by the pathogen, based on its biology and life cycle, rather than on crop growth stage, which can vary substantially by location and year. Results from Nebraska in 2009 indicates that spray applications of azoxystrobin based on soil temperatures averaging 18.3 or 21.1 over three successive days results in maximum benefits for managing the disease. However, this study is being repeated in 2010 in order to further estimate the most effective time for treating fields, or whether an application would even be necessary if environmental conditions being measured were unfavorable for disease development.

References:

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Table 1. Yield and disease parameters for 2009 azoxystrobin application study for Rhizoctonia root and crown rot management.

Treatment*	Disease Count**	Sugar Percentage (%)	Root Yield (metric ton/ha)	Sugar Yield (kg/ha)	Sugar Loss to Molasses (SLM)
Control	29a	12.5a	14.6c	1768.5c	2.4ab
15.5	12bc	12.9a	36.7ab	4820.4ab	2.4ab
18.3	13.8bc	12.9a	45.3a	5828.3a	2.3ab
21.1	8.2c	13.1a	41.4a	5507.4a	2.3ab
23.9	17.7ab	13.2a	26.9bc	3466.3bc	2.2b
26.6	19.8ab	12.7a	23.9bc	3110.7bc	2.3ab
Symptoms	26a	11.8a	15.0c	1792.0c	2.5a
LSD	9.1	1.5	6.3	1668.9	0.25

*Treatments = untreated control; spray application made after soil temperatures averaged 15.5º, 18.3º, 21.1º, 23.9º, and 26.6º C on 3 successive days; and application made after symptom development (permanent wilting).
** Disease counts = Cumulative Rhizoctonia root disease counts made mid-June, late-July 26, and early-September.
Means in columns followed by the same letter are not significantly different according to LSD tests (P = 0.05).