STROBILURIN APPLICATIONS FOR MANAGING RHIZOCTONIA ROOT AND CROWN ROT IN NEBRAKSA BASED ON SOIL TEMPERATURE MEASUREMENTS

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Abstract:

Rhizoctonia root and crown rot, caused by *Rhizoctonia solani*, is the most widespread, consistently damaging sugar beet disease in Nebraska, and causes both seedling disease and two different phases of root rot later in season. These two phases include a crown rot above the soil surface, and a tip rot of the tap root beneath the surface. Because of the occurrence of these two disease forms, making fungicide recommendations based on plant growth stage or chronological time of the season is difficult and impractical. Therefore, a two-year study was begun in 2006 with the purpose of evaluating the concept of making fungicide applications based on measurement of soil temperature. The study consisted of three treatments with eight replications: 1) untreated control; 2) fungicide applications based on soil temperatures averaging 75F (24C) for three consecutive days, 3) fungicide applications after severe symptoms appeared. Pathogen growth and activity is optimal at 78-90F (26-32C), thus 75F was chosen as the cardinal temperature for testing. Plots consisted of four 25 ft rows, and data collected included multiple disease counts, disease severity ratings assigned at harvest, and sucrose and root yield determinations. Sugar yields and numbers of diseased plants were improved with the use of azoxystrobin when soil temperature reached 75F, compared to controls and spraying after symptom development. Therefore the general concept appears to work adequately for Nebraska conditions; however improvements may still be realized with some further modifications. This concept has been continued and expanded during 2008 to test spray treatments based on varying temperatures with the purpose of determining optimal temperature for making applications.

Introduction:

Rhizoctonia root and crown rot, caused by *Rhizoctonia solani*, is an endemic soilborne disease of sugar beets wherever the crop is grown. In Nebraska, it also is the most widespread, consistently occurring and damaging disease in the state. Furthermore, the disease in Nebraska can be manifested by both a tip rot phase prior to the time when cultivations are being made and crown rot phase. Both disease phases induce the same permanent wilting and collapse of leaves and petioles.

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.

Over the last several years, studies 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. These experiments determined that 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 (2) or 18.3 and 26.6 C (3). Other studies have utilized crop growth stage as a criterion for making fungicide applications (1,3).

The previously mentioned studies have been conducted in the Northern tier of sugar beet-growing states including Montana, North Dakota, and Michigan. Because of the substantial differences between growing conditions in these states and Nebraska, a study was conducted (2006-2007) in western Nebraska to investigate the concept of basing fungicide applications timings on soil temperatures (reflecting time when the pathogen is most likely to be active) rather than the crop growth stage.

Materials and Methods:

During both years, the studies were planted in early May with plots consisting of 3 rows, 55 cm in width and 12 m long. The experiment was a completely randomized design with 3 treatments and 8 replications per treatment. Treatments consisted of an untreated control; spray applications after 10 cm soil temperatures averaged 24 C for 3 consecutive days; and spray applications after wilting symptoms had developed. All spray applications used azoxystrobin at 0.65 l/ha. Plots were irrigated with sprinkler irrigation from a linear move system (3.5-4.0 cm/wk), and combined with rainfall exceeding 20 cm during the growing season, resulted in approximately 50 cm moisture for both years.

Three separate disease counts were made in mid-June, late-July, and early September in both years. Symptomatic plants were removed and recorded from one of the two outside rows at each counting date. Harvest consisted of topping and digging all plants from the middle row by hand. During 2007, a root disease severity rating (0-4) was assigned to harvested taproots based on size and degree of root disease. Standard yield parameters were determined at the Western Sugar Cooperative factory in Scottsbluff, NE.

Results:

During both growing seasons, the number of infected plants was significantly reduced by the treatment based on measuring the soil temperature. However, the symptom spray treatment resulted in an intermediate number of diseased plants compared to the spray treatment at 24 C and the untreated control in 2006 (Table 1). Sugar yields in 2006 were significantly better for both spray treatments compared with the control, but no statistical differences existed between the two spray treatments (Table 1).

However, in 2007, a different result was observed for both diseased plants and sugar yields. The symptom spray treatment was no better than the control, and both were statistically poorer than the soil temperature treatment. The spray treatment at 24 C produced significantly superior results compared with the other two treatments for all yield variables measured except sugar loss to molasses (slm) (Table 2).

Table 1. Yield and disease parameters for 2006 azoxystrobin application study for Rhizoctonia root and crown rot management in sugar beets in Nebraska.

Treatment*	Disease Count**	Disease index ***	Sugar Percentage (%)	Root Yield (metric ton/ha)	Sugar Yield (kg/ha)	Sugar Loss to Molasses (SLM)
Control	115.4a	-----	13.5a	49.7b	6674.4a	2.0a
Soil Temperature	34.2c	-----	14.4b	61.2a	8764.7b	1.9a
Symptoms	70.4b	-----	14.7ab	60.1a	8801.4b	1.9a

*Treatments = 1) untreated control; 2) spray application made after soil temperatures reached 24 C on 3 successive days; 3) spray application made after symptom development (permanent wilting).

** Disease counts = Cumulative Rhizoctonia root disease counts made mid-June, late-July 26, and mid-September.

***Disease Index - Did not include in 2006.

Means in columns followed by the same letter are not significantly different according to LSD tests (P = 0.05).

Table 2. Yield and disease parameters evaluated for 2007 azoxystrobin application study for Rhizoctonia root and crown rot management.

Treatment*	Disease Count***	Disease index **	Sugar Percentage (%)	Root Yield (metric ton/ha)	Sugar Yield (kg/ha)	Sugar Loss to Molasses (SLM)
Control	107.5a	2. a	7.9b	36.1b	3434.1b	2.8a
Soil Temperature	44.4b	1.5c	12.9a	74.2a	9178.1a	2.7a
Symptoms	88.6a	2.4a	9.7ab	48.8b	4962.8b	2.4a

*Treatments = 1) untreated control; 2) spray application made after soil temperatures reached 24 C on 3 successive days; 3) spray application made after symptom development (permanent wilting).

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 (1-3). We wanted to test this theory in Nebraska to determine its effectiveness in a region with a very different climate and growing conditions from Montana, North Dakota, or Michigan.

Results from 2006-2007 indicate that spray applications of azoxystrobin for managing Rhizoctonia root and crown rot in Nebraska based on soil temperatures is a sound concept. We also 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 mid 60's at midnight to the high 50's in morning to the low 80s in the late afternoon. We are assuming 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.

For this concept to be ultimately successful in Nebraska, we think a more concise estimate for making applications is warranted. Furthermore, growers are reluctant to make multiple applications, hence the need to determine the optimal timing for making a single effective application in Nebraska. Thus future studies in this area will investigate a wider range of 3-day average soil temperatures for making fungicide applications for disease management, including 15, 18, 21, 24, and 27 C.

References:

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