**MSMC Project Status**

**MSMC Project No. 387**

*Interaction of Cover Crops and Nematicides in Relation to Soybean Cyst Nematode Population Densities on Resistant and Susceptible Cultivars*

**Time Period:**

May 1, 2016-December 31, 2019

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**Layman’s Summary:**

Soybean cyst nematode (SCN) has spread to 80% of soybean fields in the US with an annual loss of $1.2 billion and is widespread in Missouri. The conventional means of controlling SCN damage is through the use of genetic resistance in soybean. The use of cover crops such as cereal rye or radish could reduce numbers by promoting premature hatch, but they could also serve as hosts for SCN. Also, recent seed treatments such as ILeVO have shown promise preventing soil borne diseases, including SCN. This study examined the interaction between SCN cultivar resistance, cover crops, and ILeVO seed treatment.

Soybean varieties were selected with SCN resistance and planted into cereal rye, radish, a cereal rye/radish blend or control plots in 2017 and 2018 at two locations in Missouri. Each soybean variety was either treated or untreated with ILeVO.

Cover crops were overseeded into soybeans prior to harvest and terminated a week before soybean planting. Plots planted with cereal rye had a higher SCN density in the spring but decreased by fall, whereas those without cover crops continued to increase throughout the year and into the next year. SCN population density was less on SCN resistant cultivars following a cover crop (Figure 1). Cereal rye may promote SCN egg hatch but since a host is not present juveniles ultimately die resulting in a reduction in the SCN population. We were able to recover a very low number of cysts (some with eggs) when SCN was inoculated to cereal rye seedlings in the greenhouse (Figure 2). This indicates that cereal rye is a poor host, but may allow for limited reproduction of SCN. Soil SCN levels were three times greater after two years following the susceptible variety Williams 82 than the SCN tolerant variety. There was no change in SCN due to ILeVO seed treatment.

Figure 2. SCN cysts recovered from cereal rye and radish in the greenhouse.

Soybean yield was slightly higher (3 bu/acre) after cover crops in 2017 when soybean yields were in the 50 bu/acre range. However, in 2018 soybean suffered from a summer long drought at both locations and soybean yield was over 10 bu/acre greater following cover crops especially the SCN susceptible Williams 82 (Figure 3). This greater yield response during drought after cover crops corresponds to the reduction in SCN counts from the previous year.

**Objectives:**

**What was the magnitude of the contribution of cover crop, soybean genetics, and seed treatment to SCN population and yield?**

The growing seasons in 2017 and 2018 were very different with very dry conditions in 2018 compared to 2017 which affected yield and response to cover crop and seed treatments.

Soybean Yield:

Cover Crop: Soybean yield was slightly higher after the cereal rye cover crop in 2017 at Bradford and significantly greater in 2018 than the control (Table 1). There was little difference in soybean yield at Hundley-Whaley. Radish and mixing radish and cereal rye has slightly less yield advantage.

Variety: The soybean SCN resistant variety Asgrow 3862N had slightly greater yield in 2017 at both locations but significantly greater, 8 bu/acre at Bradford and 13 bu/acre at Hundley-Whaley in the dry year, 2018 (Table 1). During drought soybeans are more prone to yield reductions from SCN due to reduced root biomass and having a cover crop may have increased water infiltration and water storage along with decreased SCN levels (see below).

Seed Treatment: There was no difference in soybean yield from ILeVO seed treatment in 2017 in either soybean variety. However, there was a 3 bu/acre (not statistically significant) increase in both soybean varieties at Bradford in 2018 with the ILeVO treatment.

SCN:

There were vastly different numbers of SCN eggs at Hundley-Whaley and Bradford(Tables 2 and 3). The Hundley-Whaley site had beginning values of over 10,000 eggs/cup whereas at Bradford SCN levels were below 2,000 eggs/cup.

Cover Crop: In 2017, across both locations SCN levels in early summer were 2X lower following cereal rye compared to any of the other cover crops and control (Tables 2 and 3). However, by fall SCN levels following cereal rye still remained the same whereas those following radish or a mix of cereal rye and radish increased 3X and the control plots increased 6X. This indicates that cereal rye suppressed SCN development in the soil. The following spring after cover crop termination SCN egg numbers were similar across all cover crops. However, in a greenhouse experiment when cereal rye was grown in a high SCN soil, eggs were discovered which is contradictory to other research and indicates that SCN may reproduce at low levels on cereal rye. If so, juveniles that hatch after cereal rye may not have a host and die. However, if soybeans are planted early enough then an actual increase in SCN following a cereal rye cover crop may occur. We are currently waiting on the fall/winter SCN results which may help us determine this process.

Variety: After the 2017 growing season SCN counts following the SCN susceptible Williams 82 were more than double the SCN resistant Asgrow 3862N. This also was true the following spring in 2018 indicating that continued use of SCN susceptible soybean varieties can lead to a severe loss of soybean yield.

Seed Treatment: There was little difference at both locations in SCN counts due to ILeVO seed treatment.

**Is there an interaction between cover crop, soybean genetics and seed treatment on SCN population and yield?**

Yield:

In 2017 there was little interaction with the three factors on soybean yield. However, in 2018 soybean yield was significantly greater following cover crops (especially cereal rye) in Williams 82 and the SCN resistant variety. This could be from the reduction in SCN following cover crops, which would be especially important in a dry year. There was little interaction of seed treatment with variety or cover crop.

SCN:

The primary factor determining SCN number was soybean variety with much higher levels following the SCN susceptible variety Williams 82 than the SCN resistant soybean variety Asgrow 3862N (Table 1 and Tables 2 and 3). However, cover crops significantly reduced SCN egg number in the fall when Williams 82 was planted similar to levels following the SCN resistant variety Asgrow 3862N. This research demonstrates that cover crops can be used to reduce SCN numbers when using a susceptible SCN variety.

**What is the economic cost/benefit of these three factors?**

Cover crop seed, planting and termination costs can easily approach $30/acre. During normal years when soybean yield is at or above 50 bu/acre there is a slight yield increase, 3 bu/acre. This increase in yield can cover these costs associated with including cover crops. However, in drought years such as 2018, the yield response after cover crops can be over 10 bu/acre. This response is probably twofold: the cover crop protects the soil and results in greater water infiltration and availability and a reduction in SCN. Using cover crops over a longer time period could enhance both of these effects. Using the seed treatment ILeVO did not result in an economic return under these environmental conditions.

**What are the recommendations for Missouri Farmers for SCN management based upon this research?**

Missouri farmers should use both a SCN resistant soybean variety and a cereal rye cover crop to reduce SCN populations and conserve soil water.

1. Please answer the following.
2. **How do your results benefit Missouri soybean growers?**

This research showed that there is a benefit to using cover crops in soils with a high SCN population and a low SCN population. This research also shows that a seed treatment such as ILeVO does not protect susceptible soybean varieties from SCN damage regardless if those soybean varieties are SCN resistant.

1. **Estimate financial return for the average Missouri soybean producer.**

The savings from not using a special seed treatment such as ILeVO for SCN can save Missouri soybean producers $10/acre or more. Instead, Missouri farmers should invest in using SCN resistant varieties and planting cover crops whether they are in a high SCN infested field or low SCN infested field. In the short term using a cover crop is at least breakeven and can result in returns of $60/acre ([10 bu/acre x $9/bu]-$30/acre cost).

1. **Do your results benefit the environment?**

Yes, better water infiltration and less water loss is accomplished by using a cover crop and results in less water runoff and nutrient loss.

1. **What products or processes can be commercialized from this research?**

none

1. List disclosure(s) of inventions or plant varieties submitted to the MU Tech Transfer Office.

NA

1. Identify potential disclosure(s) of inventions or plant varieties. *Please note that credit must be given to MSMC for any inventions or discoveries resulting from this research*.

NA

1. **How would you commercialize these products or processes?**

NA

1. **If no specific products or processes were produced, how do you plan to make your results available to producers or industry?**

These results will be presented at the Hundley-Whaley Field Day, Soybean Breeder’s Workshop, and Crop Management Conference at the Bradford Research Center. They will be also made available to MU Extension Plant Pathologists and Agronomists.

1. **Is additional time or research required before your results can be used by producers and industry?**

No, this research is ready to be used by producers.

1. **Where does this research go from here? What are the next steps?**

The next steps are to determine if cover crops result in less SCN numbers much like a nonhost in continuous corn.

1. **List publications by type (popular press, thesis, journals, other) written or planned.**

This project was highlighted in the Road To Discovery Magazine published by the MU College of Agriculture, Food and Natural Resources.

VIII. **List cost of original project and actual expenditures.** *The U.S. Department of Agriculture requires that we ask for budget information, including the number of hours spent on the project, the number of dollars remaining on account, as well as a breakdown of expenses. You are required to provide this information in your report.* Please also include names and titles/positions of those whose time has been charged to this project.

Budget Breakdown:

 Budgeted Actual Expenses

Labor $28,853 $29,540.96\*

Benefits $9,334 $9,888.57

Travel/Meetings $6,000 $308.26

Lab\*\* $6,000 $10,560

Field Day\*\*\* $4,000 0

Supplies/fert, chemical

Equipment repair

Seed, Fert. Chemical $7,000 $8,892.18

Total $61,187\*\*\*\* $59,189.97

Remaining: $1997.03

\*Jennifer Miller was paid from this project-868.16 hour as a research specialist through February 2018 and then 354 hours as the Superintendent at Hundley Whaley from March through December 2018

\*\*This is for four SCN analysis-spring and fall in 2017 and 2018 plus SCN HG Type Test

\*\*\* field day expenses were paid for by HW

\*\*\*\* two years of funding-$30,470 and $30,717

1. **List equipment purchased with MSMC funds, identifying inventory and serial number.**  (It is not considered equipment unless it costs $500 or more and has a life expectancy of at least 2 years.) Indicate current and future use of this equipment in support of soybean research.

none