Impact of Winter Weed Management and Crop Rotation on Winter Weed and SCN Population Density

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PURDUE WEED SCIENCE

Introduction

Soybean cyst nematode (SCN) is found throughout soybean growing regions of the U.S and can devastate soybean yields. Certain winter annual weed species (including henbit and purple deadnettle) were identified as alternative hosts to SCN in the greenhouse (Venkatesh et al. 2000). A 2004 survey of 55 SCN infested fields in Indiana revealed that winter annual weed hosts of SCN were present in 93% of fields and occurred at an average density of ~100 plants/m^2 (Creech and Johnson 2006). Current management recommendations for SCN include rotation to a non-host crop and use of SCN resistant soybean cultivars. However, the importance of winter annual weed control as an SCN management tactic is unknown.

Objectives

To determine the effect of various winter weed management tactics and crop rotation on SCN populations, the weed seedbank, and crop yield.

Materials and Methods

Experiments were established in September 2003 at the Agronomy Center for Research and Education (ACRE) near West Lafayette and the Southwest Purdue Agricultural Center (SWPAC) near Vincennes. The ACRE site has a silty clay loam soil with low weed pressure and low SCN. In contrast, SWPAC has high SCN and winter weed pressure and contained a silt loam soil.

Treatments

The experiment was arranged in a split-plot design with 6 reps

Crop Rotations (whole-plot factor)

1) Soybean-Soybean
2) Soybean-Corn

Winter Weed Management Tactics (split-plot factor)

1) No herbicide application
2) Fall + spring herbicide applications
3) Spring herbicide application
4) Fall herbicide application
5) Annual ryegrass cover crop
6) Winter wheat cover crop

Data Collection

- SCN egg counts were determined at harvest and planting
- Weed seedling emergence technique to determine the weed seed in the soil seedbank
- Soybean was harvested and yields were adjusted for 13% moisture

Data Analysis

RCBD with 12 reps since soybean was present in all plots in 2004. SCN and seedbank data were analyzed with covariate analysis and mean separated with t-tests. Yield data were subjected to ANOVA and means separated with Fisher's Protected LSD.

Results and Discussion

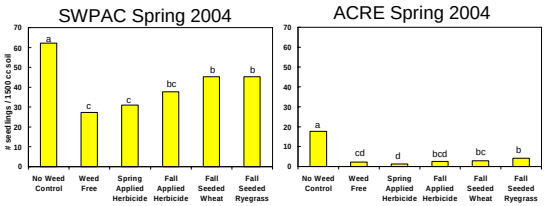

Figure 1. Influence of winter weed management tactics on weed seedling emergence from the soil seedbank in spring 2004. Treatments with the same letter are not significantly different at $P = 0.05$. Both sites showed similar treatment responses. All weed management treatments resulted in significantly less seedling emergence than the untreated control. The herbicide treatments generally resulted in less seedling emergence than the cover crops.

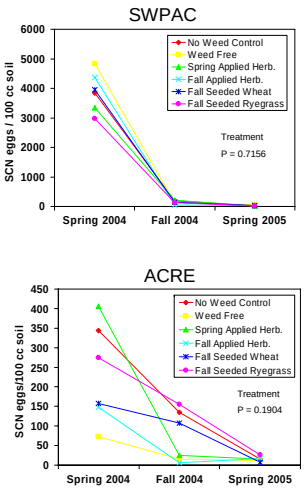

Figure 2. Influence of various winter weed management tactics on SCN population density in the soil. The fall 2003 SCN counts were used as the covariate to adjust the means of subsequent sampling timings. Treatment was not significant at either site. The large amount of noise in the data was probably the result of both large plot size and the highly variable spatial distribution characteristic of SCN in the soil. The fact that SCN count was not significant is probably due to the low weed pressure present at each of the field sites. Winter annual weed hosts of SCN (henbit and purple deadnettle) were present at ~12 plants/m^2 at SWPAC and at ~1 plants/m^2 at ACRE. Apparently this low weed population is not sufficient to influence overall SCN population levels. Thus, growers with this level of weed infestation would probably not be justified in controlling winter annual weeds as an SCN management tactic. Another interesting trend in the figures is the tremendous drop in SCN eggs during the 2004 growing season due to the presence of an SCN-resistant soybean cultivar. This research confirms that this practice is very important for managing the nematode.

References

Creech, J. E. and W. G. Johnson. 2006. Survey of broadleaf winter weeds in Indiana production fields infested with soybean cyst nematode (*Heterodera glycines*). Weed Technol. (In press).

Venkatesh, R., S. K. Harrison, and R. M. Riedel. 2000. Weed hosts of soybean cyst nematode (*Heterodera glycines*) in Ohio. Weed Technol. 14:156-160.

Results and Discussion (cont.)

December 2003 December 2005

Figure 3. Comparison of winter weed pressure in the same plot at SWPAC in 2003 and 2005. In December 2003, purple deadnettle (the strongest known winter annual weed host of SCN) was present at less than 12 plants/m^2. By December 2005, the purple deadnettle population in the plots had increased to form a dense mat of vegetation. Years 1 and 2 of this experiment have allowed us to determine that managing winter weeds at low weed densities fails to impact SCN population levels. As we complete year 3 (the winter of 2005-06) and move into years 4 and 5 of this experiment, our data collection will enable us to determine the influence of high weed densities on SCN egg counts.

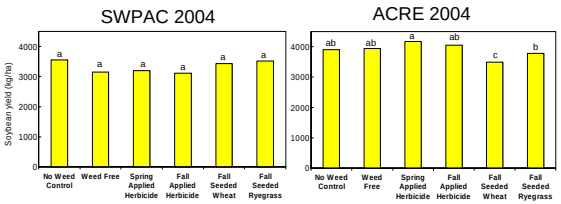

Figure 4. Influence of winter weed management tactics on soybean yield in 2004. Treatments with the same letter are not significantly different at $P = 0.05$. No significant yield differences were detected at SWPAC. At ACRE, the winter wheat cover crop resulted in significantly lower soybean yield than any of the other weed management treatments. The ACRE soil is heavier than that of SWPAC. Consequently, the lower wheat yields at ACRE could be due to the release of phenolic compounds from the wheat into the soil and/or compaction from the moist conditions in these plots at planting.

Conclusions

1. Herbicides were more effective than cover crops in reducing the weed seedbank
2. Winter wheat negatively influenced soybean yield on heavier soils
3. At low weed populations, winter annual weed management does not appear to impact SCN egg density

Acknowledgments

This research was funded by the North Central Region Integrated Pest Management Program and the Indiana Soybean Board.