

Improving Management Of Soybean Cyst Nematode Through Extension Demonstration And Outreach

Purpose:

Soybean cyst nematode (SCN) is the most yield limiting disease of soybean in Ontario and the northern United States. **SCN** was first detected in Ontario near Chatham (Dover Center) in 1988 and since then SCN resistant varieties in conjunction with crop rotation with non-host crops and scouting has been the cornerstone of SCN management. Unfortunately many soybean growers continue to lose yield to the disease and although effective and practical management tools are available many growers still are not properly managing SCN or are unaware of the problem. It is for these reasons SCN is often referred to as the "silent yield robber". Losses to SCN in Ontario have been estimated at 10-30 million dollars per year.

OMAFRA, AAFC (Harrow) along with funding from the Grain Farmers of Ontario (GFO) through Growing Forward "Farm Innovation Program" is participating in a multi-year project with colleagues from the North Central United States whose primary objective is to reduce losses and improve SCN management and education through extension efforts aimed at soybean producers, the soybean industry and advisors about this very destructive soybean disease.. As part of this 3 year international project, on-farm large scale SCN management demonstration plots in Ontario and 12 northern US states were established each year using resistant varieties with various SCN resistance genes. These represent the most commonly used sources of resistance to SCN in the northern soybean production areas (PI 88788, PI 548402 (Peking) and Hartwig).

Participation allows access to research, resources, communication materials, etc which would otherwise be cost prohibitive if done alone. By coordinating efforts this will help deliver a consistent message on SCN and its management across the northern soybean production areas of North America.

Methods:

1) Two large scale demonstration strip trials were established in Ontario grower fields near Highgate (Chatham-Kent) and Harrow (Essex County) in fields with known SCN infestations. Replicated strip plots of 250 ft in length were established with a minimum of four replications at each site. Each location had a minimum of five soybean varieties with similar yield potential which included at least one SCN-susceptible variety as well as varieties with SCN resistance from PI 88788 and PI 548402 (a.k.a. 'Peking'). These sources were used since unfortunately PI 437654 (CystX) derived varieties were not available for Ontario in 2012. These are the most commonly used sources of resistance to SCN in the North soybean production areas.

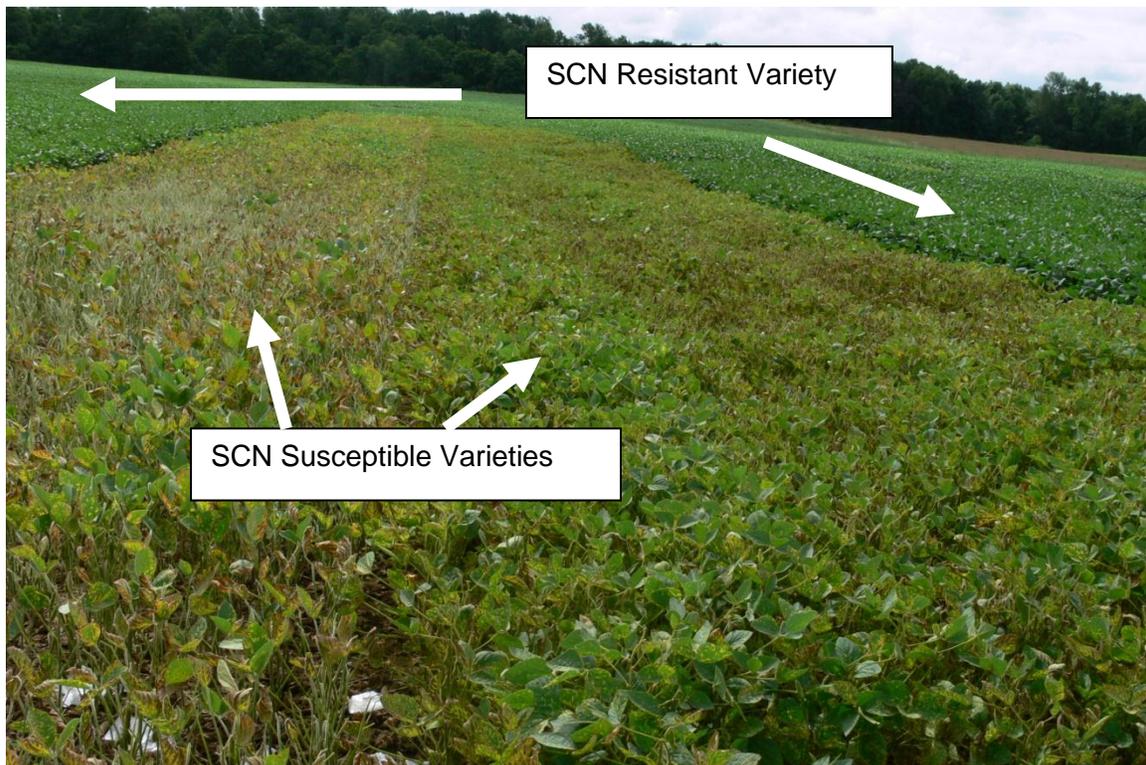


Figure1: Typical Layout of Field Demonstration Sites

2) Soil cores were collected at planting and harvest from each strip plot at both locations in each year of the study. Due to the size of the strip plots, multiple cores were collected to represent the SCN population density as best as possible. The individual plots were divided into 25 ft length sections, and 10 samples per section were collected and bulked for SCN egg density counts. A total of 640 SCN soil samples were collected from each of the four locations over the two years (spring (320) and harvest (320)) in order to determine reproduction of SCN, through egg densities from each plot.

3) Each year a modified SCN HG type test was used on both the spring and fall harvest samples. The differential lines of the SCN resistance sources used were Lee 74, PI 88788, PI 548402 (Peking), PI 437654 (Hartwig) and PI 209332. This modified SCN HG type test was used to characterize the SCN population at planting for the entire area as well as in individual plots at the end of the season. All SCN HG typing were conducted through Dr. Terry Niblack's lab (University of Illinois) and it was necessary for OMAFRA to obtain the necessary permits from the USDA to facilitate the movement of soil to Dr. Niblack's nematode lab in Illinois.

Results:

Soybean yields were consistently greater in plots where SCN-resistant varieties were grown compared to susceptible check varieties. SCN resistant varieties out yielded susceptible varieties 100% of the time for PI 88788 and Peking resistance sources in locations with medium and high SCN population densities. Hartwig resistance did not consistently increase yield unless SCN population density were high. This is not unexpected since Hartwig is just beginning to be used by breeders and often initial incorporation of resistance genes may result in a "yield drag". This does change over

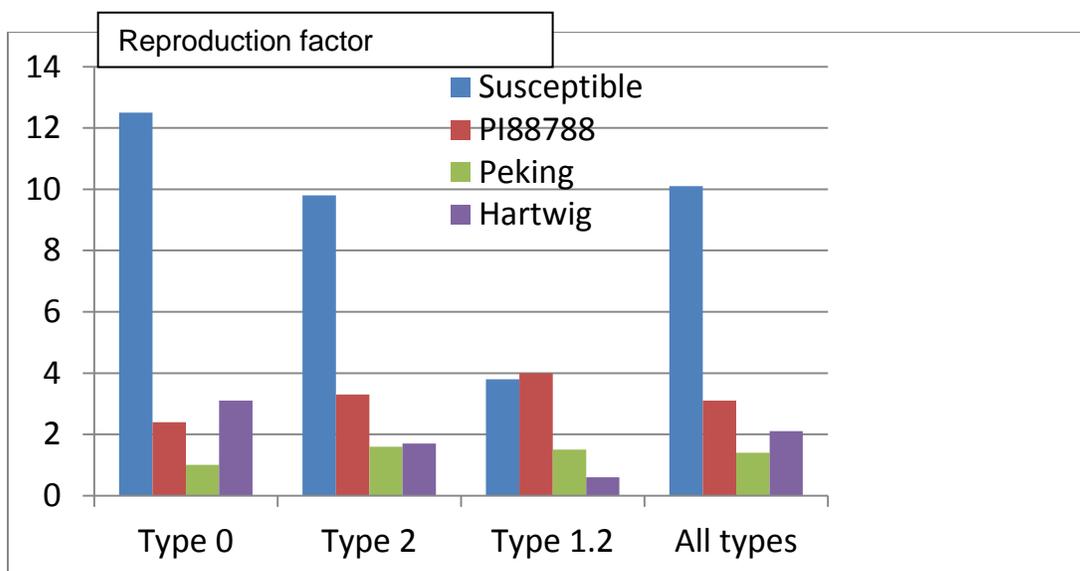
time as the new source of resistance becomes more stable. At low population density, PI88788 and Peking varieties increased yields over the susceptible varieties the majority of the time. The yields were highest for varieties with the Peking source of resistance, which had a 5.3 bu/A yield advantage over susceptible varieties averaged over all locations (US and Ontario) over the three years. In fields with high SCN population densities, the average yields of varieties with Peking, PI 88788, and Hartwig sources of resistance were 15.5, 11.8, and 6.3 bu/A higher than those of the susceptible varieties, respectively.

Effect of SCN source of resistance on SCN population levels?

A modified HG Type test was used in this research. This modified SCN HG Type test determines the ability of the nematode population to develop on three indicator lines: PI 548402 (Peking), PI 88788, and PI 437654 (Hartwig). A Type 0 cannot develop on any of the three; a Type 1 develops on Peking, a Type 2 on PI 88788, and a Type 4 on Hartwig. No Type 4 populations were identified in fields for this project.

Resistant varieties reduced the reproduction of SCN in the field trials compared with the susceptible varieties (Figure 2). Fields with HG Type 1.2 and 2 populations had slightly higher reproduction on PI 88788 than fields with SCN populations that had low (less than 10 percent) SCN reproduction on PI 88788 (Type 0). This result is expected and likely would have been greater if a greater percentage of the population was able to reproduce on PI 88788. Overall the lowest reproduction was observed on the Peking resistance source. Average reproduction on Peking was 1.2 compared to 3.0 for PI 88788 varieties versus 10 for the susceptible varieties.

Figure 2. Effects of soybean variety resistance source on SCN reproduction factors (SCN population density at harvest / initial SCN population density) in fields with varying HG Type over three years. SCN population densities decrease when the reproduction factor is less than 1.0 and conversely increase when the reproduction factor is greater than 1.0. .



Summary:

Through this project we have shown how successful management of SCN can be by not only providing economic benefits through better yields but reduce SCN populations, reduce new SCN HG-Types(races) thereby reducing future SCN risks to the producer.

These results emphasize:

1. the importance of managing SCN (yield loss potential),
2. the effectiveness of SCN-resistant varieties and new resistance sources such as Peking in lowering SCN populations,
3. the need for a long-term on farm strategy incorporating not only SCN resistant varieties but other best management practices such as crop rotation, soil sampling, etc. and;
4. the primary SCN resistance source PI88788 is still effective in most of the soybean production areas of North America and especially in Ontario.

As stated earlier, the aim of this project is to educate not only soybean producers but the soybean industry and advisors about this very destructive soybean disease. In addition, these results in combination with previous findings have led to the harmonization of regional recommendations such as:

- Always use an SCN-resistant variety in infested fields with any SCN population density.
- Field moisture (drought/excess) and other stresses demonstrate the greater importance of SCN resistance on soybean yields even at the lower SCN population densities.
- Monitor field SCN densities every 5 to 6 years to make sure your management strategy is keeping population densities low. *Even in fields with populations that could reproduce on the PI 88788 resistance source, the PI 88788 source was still effective and we did not observe a high level of SCN reproduction as with the susceptible varieties.*

Next Steps:

Numerous extension or technology transfer materials such as articles, scientific publications, videos, field days, presentations, etc were developed through this project both in Ontario (Canada) and the U.S. The data collected through this project is being combined into a new fact sheet (in final review phase) to show the overall impact of genetic resistance on yield across the northern US soybean region and Ontario as well as summarize the effects of the various resistance genes on SCN HG type during a single cropping season.

By working closely with our US colleagues we were able to remove potential duplication and this unified approach to SCN field validation has allowed us to maximize resources, deliver a consistent message on SCN and its management and has led to a unified set of SCN management guidelines for the Northern soybean production areas. In addition our participation in this project helped OMAFRA, GFO and Manitoba Pulse Growers to become part of other North Central Soybean Research Program (NCSRP) projects such as a new SCN nematicide project.

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