Determination of *Heterodera Glycines* types for improved Soybean Cyst Nematode management

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Summary:

In the FY2015, 1,313 producer soil samples were analyzed for SCN and results and recommendations provided to the submitters. This number is slightly higher than last year submissions, indicating continued awareness of SCN in the state. We have determined the *Heterodera glycines* types for 73 SCN populations collected from SD. Results indicate 25% of the SCN populations tested can reproduce on PI 88788, a common source of resistance used in SD. Of the HG types tested, 29% were HG type 0 (these populations had <10% female index on all SCN differential lines). The majority of SCN populations tested could only reproduce on a single PI line. These results indicate that use of resistance genes available in commercial cultivars is still viable, but should be combined with other management practices to avoid adapted SCN populations increasing.

Introduction:

The soybean cyst nematode (SCN) continues to be a soybean production constraint in South Dakota and in the United States. In South Dakota, more soybean fields are increasingly being detected with SCN. One of the challenges in the management of SCN is the absence of obvious above ground symptoms on plants infected with the SCN. This makes it difficult to visually assess whether a field has SCN or not and whether yield loss is occurring. Several reports indicate that up to 30% yield loss by SCN can occur without any obvious symptoms on soybean. This means that a grower could be losing potentially 30% of the yield before SCN management practices can be applied. Because once detected, SCN cannot be practically eradicated in soil, SCN then has to be managed to keep the SCN population under check to avoid yield losses. Detection and monitoring, therefore, become very crucial steps in SCN management.

Detection and monitoring SCN population changes in soybean fields are important in SCN management in two ways; first, once detection of SCN is confirmed, deployment of SCN management early before the SCN population builds up is necessary. Secondly, monitoring changes in SCN populations enables evaluation of the management practices being used. For insistence, an increase in SCN when a SCN resistant cultivar was planted may indicate the existence of SCN population that can overcome the resistance gene in this particular cultivar and would therefore require a change in the cultivar. Therefore continued monitoring of SCN in soybean fields is crucial for effective SCN management.

Heterodera glycine (HG) types (formerly called races) determination is important in understanding the diversity of the SCN in South Dakota. Knowing the relative occurrence of HG types in SD is important in the management of SCN specifically in deploying and rotating soybean cultivars that have the varying SCN resistance genes.

The objectives of this grant were to:

1. *Monitor the occurrence of SCN in South Dakota*
2. *Determine HG types that occur in South Dakota*
3. *Screen major soybean cultivars for resistance against HG types prevalent in SD*

Description of achievements:

Objective 1: Monitoring the occurrence of SCN in SD.

During the FY15, 1,313 soil samples were submitted to the Plant Diagnostic Clinic for SCN testing. Of these, 40 % were positive for SCN. This is higher SCN prevalence than 2014 samples, indicating continued spread of SCN in the state. Detection of SCN was confirmed for the first time in Campbell County. This implies SCN is continuing to spread further north and west of the state. The results of SCN testing were communicated back to the submitters with recommendations for management for those that were positive. Although these samples were voluntary submissions and therefore not truly random samples, still 40% prevalence indicates the risk of SCN to be increasing in South Dakota.

Objective 2: Determination of HG types that occur in South Dakota.

To determine HG types, 250 soil samples were collected from 7-8 arbitrarily selected fields in each of the 28 counties. The soil samples were tested for SCN in the lab. Of these, 33% were positive for SCN with eggs and juveniles count ranging from 50 to 65,200 per 100cm^3 of soil. Soil samples that had sufficient SCN egg count had SCN extracted and infested to 7 SCN differential lines in constant temperature water bath (Fig. 1.). The SCN differential lines used were: 1(Peking), 2 (PI88788), 3 (PI90736), 4 (PI 437654), 5 (PI209332), 6 (PI89722), and 7 (Cloud). Soybean cv. Willium 82 was included as a susceptible check and each of the differential lines and susceptible check were replicated four times. For soil samples with insufficient SCN numbers, SCN was first increased on a susceptible cultivar and then infested to the SCN differential lines.

Fig. 1. *Water bath* with *Soybean differential lines that were infested with different SCN populations extracted from soil samples. The soil samples were collected from soybean fields in South Dakota. The water bath was kept at 80 F to provide conducive environment for SCN to develop (Photo credit: Krishna Acharya).*

After 35 days, the differential lines and the susceptible check were removed from the water bath and SCN female cysts on the roots extracted and counted. A female index (FI) was calculated based on the number of female cysts found on each differential line relative to the susceptible check (William 82) as follows:

$$\frac{\text{Average no. of female cysts on a differential line}}{\text{Average no. of female cysts on William 82}} \times 100\ \%$$

Female indices equal to or greater than 10% in any line was assigned as that HG type. A total of 73 HG type tests have been completed. Of these, HG type 7 and HG type 0 were the most predominant (47 out of 73 samples tested) HG type detected (Fig. 2). This indicates that a 64% chance that HG type in South Dakota will be HG type 7 or 0. HG type 0 means that the SCN population could not reproduce beyond 10% relative to the susceptible check on any differential lines. HG type 7 means that the SCN population tested could reproduce > 10% on differential line 7 ((Cloud).

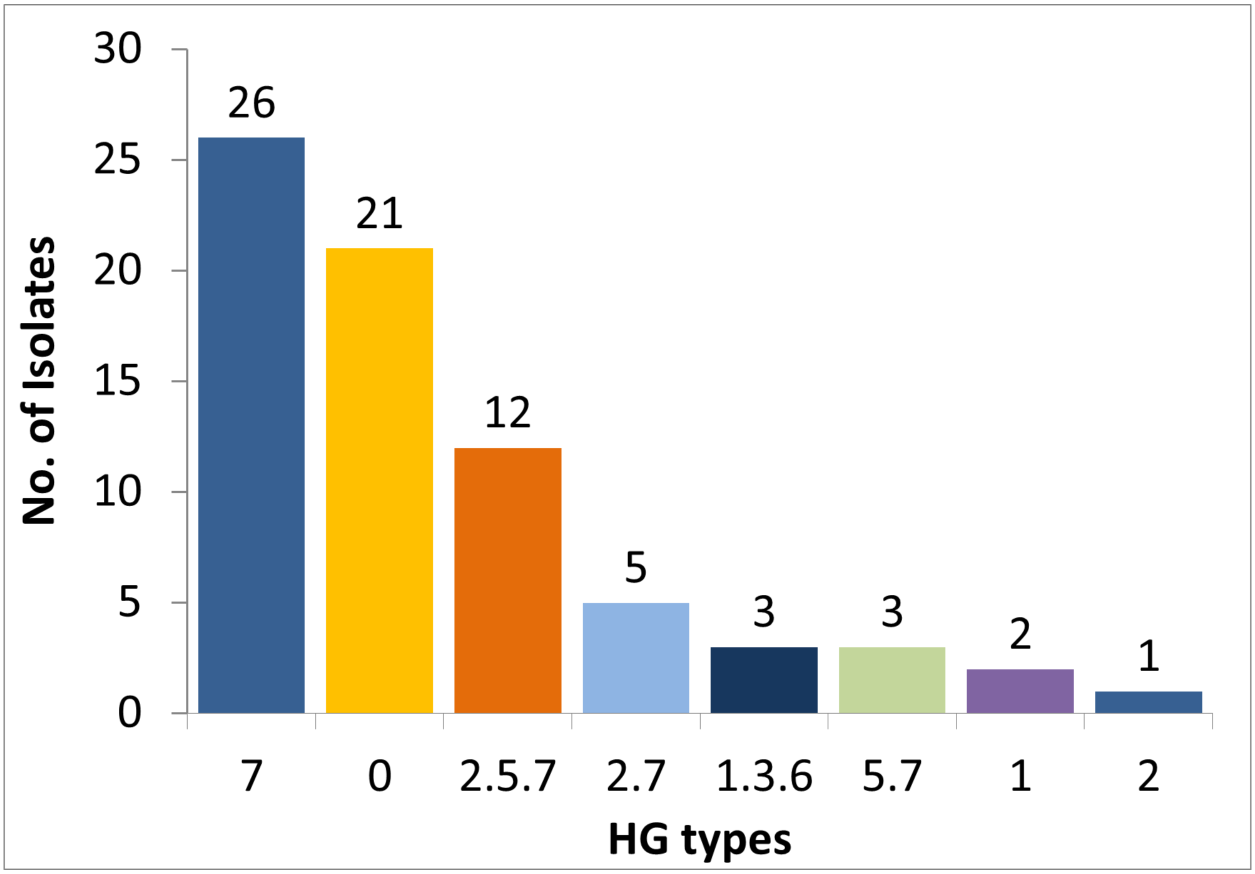

Fig. 2. Heterodera glycines types detected in 73 SCN positive soils samples from various counties in South Dakota.

Twenty five percent of the SCN population had a reproductive index >10% on PI88788, a common source of SCN resistance used in most commercial soybean cultivars. This indicates the need to rotate within soybean cultivars to avoid further adaptation of SCN populations to this source of resistance. The SCN population that had FI > 10% on PI88788 had also FI>10% on PI 5 and 7. Only five (7%) of SCN populations tested had Female Index >10% on differential line

1 (Peking). Peking is the second most common source of SCN resistance genes used in commercial soybean lines.

Objective 3: Screen major soybean cultivars for resistance against HG types prevalent in SD

Host resistance, when available, is the most effective, economical, and sustainable plant disease management practice. Although SCN resistance has been developed, most of the available resistant soybean cultivars have been mainly from one source, PI88788. No information is available how these commercial soybean cultivars with resistance to SCN are adapted to South Dakota SCN populations.

We have acquired 34 commercial soybean cultivars from seed companies. These will be screened against the common HG types, namely HG type 0, 2.5.7, and 7 in the second year of this grant.

Outreach component

Creating grower awareness of SCN and its detriments to soybean production is important in the management of SCN. Because of the lack of obvious visual symptoms, growers tend to ignore the importance of testing soils for SCN, hence the need for outreach. Outreach efforts were made through various channels including iGrow articles, articles in Soybean Leader Magazine, radio interviews, extension talks, and field days. SCN sampling bags were handed out on several occasions including Dakotafest, Soy100, Ag Outlook, State fair, Research field days, and pesticide applicator trainings. A SCN field day was held at the Hurley, SD. Growers who participated learned how to identify SCN on roots and how to take a soil sample to be tested for SCN, among several other topics discussed.

Projections

This project achieved the objectives proposed in the first year. Over 1,300 samples were tested in FY15. The free testing (thanks to the funding provided by this grant) is also an incentive to encourage growers to submit soil samples to monitor SCN in their fields. This project determined the HG types predominant in SD. The diversity of SCN at this time indicate that the available resistance is effective in the management of SCN. This may change over time as SCN continues to spread and same source of resistance is used.

Publications:

Abstracts:

Byamukama, E., Acharya, K. and Tande. C. 2014. The status of soybean cyst nematode, *Heterodera glycines*, in South Dakota. Phytopathology S14

Acharya, K., Byamukama, E. and G. L.Tylka . 2015. Determining *Heterodera glycines* HG Types to Improve Soybean Cyst Nematode Management in South Dakota. Phytopathology xx.

Extension Publications:

Byamukama, E. and Strunk, C. Scout for the soybean cyst nematode. Published 8/7/2014. Online http://igrow.org/agronomy/soybeans/scout-for-the-soybean-cyst-nematode/

Byamukama, E. and Tande C. Did flooding drown soybean cyst nematode? Published 7/3/2014. Online http://igrow.org/agronomy/soybeans/did-flooding-drown-soybean-cyst-nematode/

Byamukama, E. and Strunk, C. Is your SCN management intervention working? Published 10/20/2014. Online http://igrow.org/agronomy/soybeans/is-your-scn-management-intervention-working/