Toward integrated management of the soybean cyst nematode and soybean aphid.

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Introduction

The soybean cyst nematode (SCN), Heterodera glycines, is currently the most damaging pest of soybean in the US. When present at high population densities, SCN can reduce soybean yields by 50% or more. Successful, long-term management of SCN is based primarily on the use of SCN-resistant soybean varieties. Since 2000, the soybean aphid (SBA), Aphis glycines, has become a pest in the US. Soybean yields can be reduced by 30% or more when damaging population densities develop. Since SCN and soybean aphid are widespread, knowledge of how these two pests affect each other and interact to affect the soybean crop is needed.

Objectives

1) Determine how SCN infection affects SBA population growth in growth chambers and field (microplot) conditions
2) Quantify the interaction of SCN infection and aphid herbivory on the quantity and quality of soybean yield

Materials and Methods

We estimated population growth rates (r) of SBA within a growth chamber (25°C, 16:8 [L:D]) on soybean varieties... (r) or more when damaging population densities develop. Since SCN and soybean aphid are widespread, knowledge of how these two pests affect each other and interact to affect the soybean crop is needed.

Table 1. Soybean varieties used within growth chamber and microplot studies

<table>
<thead>
<tr>
<th>Variety</th>
<th>SCN Resistance</th>
<th>SBA Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenwood 4</td>
<td>Susceptible</td>
<td>Susceptible</td>
</tr>
<tr>
<td>L2450R</td>
<td>Susceptible</td>
<td>Susceptible</td>
</tr>
<tr>
<td>Jack</td>
<td>PI97878</td>
<td>Susceptible</td>
</tr>
<tr>
<td>L2468R</td>
<td>PI97878</td>
<td>Susceptible</td>
</tr>
<tr>
<td>L2620RX</td>
<td>CystX</td>
<td>Susceptible</td>
</tr>
</tbody>
</table>

Separation of the means was achieved using the Student-Newman-Keuls least significant difference test.

Fields

Microplot experiments were conducted at the Iowa State University Horticulture Station. Eight replicates of four treatments were established: control (without SCN, and without soybean aphid), SCN (SCN-infested, without soybean aphid), SBA (soybean aphid only), and SCN/SBA (both pests present). Each treatment was applied to varieties that represented varying levels of SCN resistance and susceptibility (Table 1). SCN population were estimated in the SCN and SCN/SBA plots by adding eggs to the soil at planting and growing a SCN-susceptible variety the previous year. Plants were covered with a mesh cage to keep out insects in each microplot. An initial population of 10 soybean aphids was introduced into a cage in the SBA and SCN/SBA plots at the V4 stage (June 27).

Aphid reproduction, nematode reproduction, and soybean growth, development, and yield were assessed in each cage and microplot. The aphid population density was assessed by counting all aphids on caged plants; the soybean cyst nematode population densities were determined by extracting cysts from soil samples collected from each microplot. Periodically throughout the growing season, plant height and developmental stage were assessed, and at the end of the season, the soybean grain was collected, moisture content determined, and the quantity weighed. This field research was conducted for the first time in 2006, and it will be repeated in 2007.

Aphid reproduction was estimated by the slopes of log-linear relationships of aphid abundance on caged plants. Treatment impacts on aphid exposure and yield were determined using analysis of variance. Separation of the means was achieved using the Student-Newman-Keuls least significant difference test.

Figure 1. Rate of population growth for soybean aphid on varying soybean varieties infected and uninfected with SCN from plants grown within growth chambers.

Figure 2. Rate of population growth for soybean aphid on varying soybean varieties infected and uninfected with SCN from plants grown within microplots.

Figure 3. Soybean exposure to aphids across the four treatments (with or without SCN, and with or without SBA) for the five varieties tested within microplots.

Figure 4. Impact of SCN and SBA on soybean plant height with unique letters labeling the means for significance (F=13.9, df=11,43; P=0.0001). For each variety means were calculated by dividing each treatment to the no SBA, no SCN control. Heights were measured at seed harvest. LSD were made for all four treatments, although the no SBA, no SCN treatment was not reported as it would appear as a 1 throughout.

Figure 5. Impact of SCN and SBA on soybean seed weight with unique letters indicating significant differences (F=13.9, df=11,43; P=0.0001). For each variety means were calculated by dividing each treatment to the no SBA, no SCN control. Seed weights were measured at seed harvest. LSD were made for all four treatments, although the no SBA, no SCN treatment was not reported as it would appear as a 1 throughout.

Conclusions

Although aphid population growth (Fig. 1, 2) and abundance (Fig. 3) did not vary with soybean variety or SCN presence, plants were smaller when infected with SCN (Fig. 4). Thus the density of aphids was significantly greater on SCN infected soybeans (analysis not shown).

The combination of SCN and SBA reduce soybean height (Fig. 4) and seed weight (Fig. 5) more than when plants were infested by either pest alone. Interestingly, this was observed on varieties that are considered resistant to the SCN (Jack and L2468R) and had low to no SCN present on their roots (data not shown).

Acknowledgements

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