Soybean entomology in the North Central region:
Management and outreach for new and existing pests

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Project Objectives

I. Extension and Outreach

II. Insect Monitoring and Management
1. Stink bug monitoring and management
2. Pollinator diversity and soybean yield
3. Soybean aphid insecticide resistance
4. Monitoring for aphids, thrips, and soybean vein necrosis
5. Technology development

III. Resistant Varieties and Biotypes
1. Breeding for resistant varieties
2. Aphid virulence genotyping and mapping
3. Aphid virulence management for resistant varieties
4. Economic returns on resistant varieties

IV. Biological Control

Progress Report (Year 2, through March 2017)

I. Extension and Outreach

We wrote 5 journal publications and gave 69 extension and scientific presentations. The publication on stink bugs of the North Central Region is in final editing. Progress towards publication has been delayed by the 3-month maternity leave of the outreach coordinator responsible for the guide.

II. Insect Monitoring and Management

1. Stink bug monitoring and management: Participants sampled stink bugs in a total of 59 fields last summer, to develop recommendations tailored to the region. We devised a preliminary sampling plans for field edges and interiors, which will be refined by a repeat of the study.

2. Pollinator diversity and soybean yield: Participants in ND, SD, IA, OH, MN, NE, IN, MO, WI collected pollinators in soybean fields last summer. Samples processing/ID by ND is 75% complete.

3. Soybean aphid insecticide resistance: We are working on a DIY assay kit to test aphids for resistance to thiamethoxam insecticide. Optimizations to the kit include more specific instructions on handling and classifying aphids, inclusion of a video demonstrating aphid handling technique, and a discriminating dose in the kits to reduce variability and sources of error.

4. Monitoring for aphids, thrips, and soybean vein necrosis: Soybean vein necrosis virus is transmitted by thrips. We sampled thrips from suction traps in 6 states. We identified thrips samples (still in progress). In IN, IL, IA thrips populations started to rise in June, but later in northern states. Populations of thrips vectors of SVNV are high during August in Iowa and Indiana which coincides with appearance of the disease in these states (primetime for monitoring). We are preparing the the suction trap network for summer.

5. Technology development: The goal is to develop an aphid-counting app. Images collected during the summer of 2016 are still being counted and cataloged. The Windows application is now able to automatically cut out all backgrounds from imported images, which leaves just the leaflet with aphids to scan. This reduces processing time and false positives, which will provide the user with quicker aphid counts.

III. Resistant Varieties and Biotypes

1. Breeding for resistant varieties: The Diers program is developing and releasing soybean varieties with aphid resistance. The backcrossing of the aphid resistance genes Rag4 and Rag6 into Rag1,2,3 cultivars is continuing. Rag4 backcrossing is complete and this summer we will select plants with all combination of Rag1-4. The backcrossing will continue this summer and into next year until we have sets of lines developed with all combinations of Rag1-4 and Rag6. The University of Illinois is commercializing 4 varieties with Rag2, 1 with Rag1 and 3 with Rag1+2. In 2013, we showed that the resistance gene Rag2 was associated with reduced yield. We have followed that research with a study to determine whether the reduced yield was the result of linkage between Rag2 and a second yield reducing gene or because the resistance gene directly reduced yield (pleiotropy). This research was just completed and we found that the yield reduction was the result of a second yield reducing gene and breaking the linkage between these genes should not be very difficult.

2. Aphid virulence genotyping and mapping: Our goal is to map aphid virulence. We are phenotyping the F1 reciprocal crosses of soybean aphid biotypes 1 and 4 (in progress). This will determine the virulence of these F1 types on soybean breeding lines with Rag1, Rag2, Rag1 + Rag2, and checks. A preliminary linkage map has been created from the biotype 1 and biotype 2 cross. A major QTL was detected on linkage group 2, but more data is necessary to confirm.

3. Aphid virulence management for resistant varieties: Modeling is ongoing. We are adding parasitoids to the microcosms to see how that may influence virulence management. In 2017 we will focus on how integrated refuge fields (resistant plants with a small percentage of susceptible plants), impact immigration into fields.

4. Economic returns on resistant varieties: This is a three-summer study designed to assess the economic returns on herbicide tolerant and aphid resistant traits. Preliminary results are that there were significant differences in yield between treatments at both locations. In general, the early-planted treatments had higher yield than late-planted treatments. There were also significant differences among varieties, but an inconsistent pattern between early- and late-planted treatments.

IV. Biological Control

We analyzed data to see impact of thiamethoxam seed treatments on parasitoids: it appears not to affect them. We conducted 3 overwintering experiments for soybean aphid parasitoids; emergence will be measured this spring. Dissections of a subsample of these mummies indicated that most *A. certus* and *A. glycinis* survived the winter while most *A. rhamni* had not.