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Update on the soybean aphid efficacy program

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The confirmation of soybean aphid, *Aphis glycines* (Hemiptera: Aphididae), in 2000 has drastically changed soybean pest management in the United States. Outbreak populations (i.e., 1,000's per plant) can significantly reduce yield by 40 percent, and reduce seed size, seed coat quality, pod number and plant height (Ragsdale et al. 2007). As a result of the yield loss potential, soybean aphid quickly became the primary soybean pest in Iowa and the north central region. A soybean efficacy evaluation was started at ISU in 2005 and continues to grow with the availability of new products and management tools.

Scan this code to get a copy of the 2011 Yellow Book for Soybean Insects, view a copy of the slides presented today, and to learn more about the Hodgson Lab!

Insecticides have been the primary control strategy for soybean aphid during the first decade. Two major classes of insecticides, organophosphates and pyrethroids, are the most common types of foliar insecticides for soybean aphid, but foliar neonicotinoids have also been recently released. Although most labeled products are effective now, we have concerns with managing a persistent pest like soybean aphid solely with insecticides. Aphids can develop genetic resistance to major classes but growers can help delay these events in soybean by minimizing exposure to aphid populations and only treating when populations exceed the economic threshold. Also, rotating modes of action (e.g., pyrethroids, organophosphates, neonicotinoids) will prolong the effectiveness of available products.

Host plant resistance is the newest soybean aphid management tool, and is complementary to existing chemical control. Aphid-resistant varieties have the potential to simultaneously reduce insecticide usage and associated production costs, and preserve natural enemies in soybean (Tilmon et al. 2011). To date, host plant resistant genes for soybean aphid are prefixed with "*Rag*," which is an abbreviation for "Resistant *Aphis glycines*." The *Rag1* gene expresses antibiosis and has been commercially available since 2010. Antibiosis is type of resistance where exposed insects do not live as long or produce as many offspring as they could on susceptible plants.

The objective of the efficacy program is to evaluate labeled and proprietary foliar insecticides alone and in combination with seed treatments and host plant resistance. We assessed knockdown and residual of foliar insecticides and monitored for potential genetic resistance to insecticidal chemistries.

Comparison of soybean aphid treatments

In 2011, soybean aphid efficacy evaluations were established at three ISU Research Farms (Northwest, Northeast, and Johnson). Each location had plots (15 x 45-50 feet) in a randomized complete block design with four replications per treatment. The number of treatments varied between locations, but included at least the same seven controls: untreated, *Rag1*, seed treatment (ST), ST + *Rag1*, ST + *Rag1* + threshold spray, aphid-free spray, and threshold spray. Two types of seed were used (Rag1 and susceptible). See the 2011 Yellow Book for a complete list of treatments and application rates; this summary only includes data from the Northwest Farm (Table 1).

Soybean aphids were counted in plots weekly from June to early September. To estimate the total exposure of soybean plants to soybean aphid, we calculated cumulative aphid days (CAD) based on the number of aphids per plant counted on each sampling date. Yield was determined by weighing grain with a grain hopper and corrected to 13% moisture. One way analysis of variance (ANOVA) was used to determine treatment effects within each experiment. Means separation for all studies was achieved using a general linear mixed model and a least significant difference (LSD) test ($\alpha < 0.10$) using SAS software (2011).

Table 1. List of treatments, rates, and application timings for the Northwest Farm in 2011

Treatment	Active Ingredient	Rate	Timing
Untreated Control	-----	-----	-----
Rag1	-----	-----	-----
CruiserMaxx Beans	thiamethoxam + mefenoxam + fludioxonil	56g/100 kg seed	ST
CruiserMaxx Beans + *Rag1*	thiamethoxam + mefenoxam + fludioxonil -----	56g/100 kg seed + -----	ST -----
CruiserMaxx Beans + *Rag1* + Warrior II	thiamethoxam + mefenoxam + fludioxonil ----- lambda-cyhalothrin	56g/100 kg seed + ----- + 1.6 fl oz	ST ----- 10 Aug
Warrior II	lambda-cyhalothrin	1.6 fl oz	10 Aug
Warrior II + Lorsban Advanced	lambda-cyhalothrin + chlorpyrifos	1.6 fl oz + 16.0 fl oz	29 Jul + 10 Aug
Cobalt Advanced	lambda-cyhalothrin + chlorpyrifos	13 fl oz	10 Aug
Endigo ZC	thiamethoxam + lambda-cyhalothrin	4.5 fl oz	10 Aug

Results

Aphid colonization at all three locations was low in June, but gradually increased in July and August. Overall seasonal aphid pressure varied between locations, but the Northwest Farm had the highest abundance. We would expect to see economic loss when the CAD value exceeds 5,000-6,000 (Ragsdale et al. 2007). There were significant differences in CAD between foliar treatments (F=32.335; df=3,8; P<0.0001) (Fig. 1a). CAD were significantly higher in the untreated control (18,896 ± 4,420 SEM) and seed treatment (19,739 ± 3,786 SEM) plots. The *Rag1* treatment had significantly fewer CAD than Endigo or Cobalt. There were also significant differences between treatments and yield (LSD=2.63; F=9.10; df=3,8; P<0.0001) (Fig. 1b). Yield was highest in the Warrior II treatment (65.3 ± 1.4 SEM) and *Rag1* (65.0 ± 2.8 SEM) plots. The insecticidal seed treatment did not reduce CAD or prevent yield loss compared to the untreated control, but did complement *Rag1* and foliar insecticide treatments.

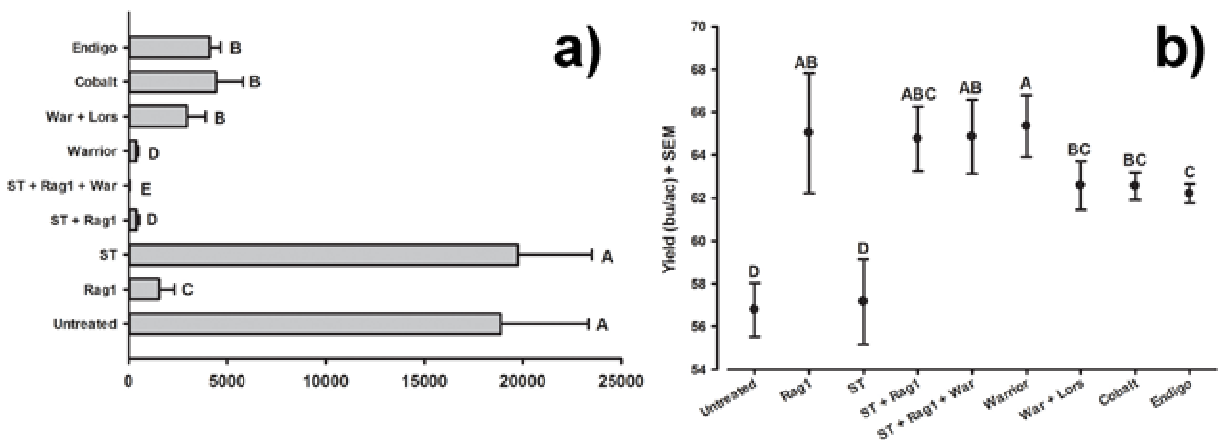

Figure 1. Soybean aphid efficacy evaluation at the Northwest Farm for 2011 showing a) comparison of cumulative aphid days and soybean aphid density, and b) comparison of treatments and soybean yield. Different letters represent a significant difference between treatments.

Management Summary

- The severity and abundance of soybean aphid in Iowa has fluctuated over the last decade. Scout fields even if using host plant resistance or a seed treatment.
- Bloom (R1-R2) and pod development (R3-R4) are the most critical growth stages to protect for obtaining optimal yields.
- Use the full rate of an insecticide instead of tank-mixing several products with reduced rates. Reduced rates of insecticides do not always provide adequate soybean aphid control, and can lead to increased risk of insecticide resistance.
- Consider alternating modes of action if more than one application, including seed treatments, is made during a single growing season.
- To optimize foliar coverage, increase pressure (40 psi), increase carrier (20 gpa of water) and use small droplet-size nozzles. Complete coverage is important for optimum aphid control (Hodgson and O'Neal 2011).

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