SW MN IPM RESEARCH - 2017

STUDY: 2017 Soybean Aphid (SBA) Insecticide

INVESTIGATOR:
Bruce Potter - University of Minnesota Extension
Travis Vollmer – University of Minnesota Southwest Research and Outreach Center

OBJECTIVE:
Efficacy evaluation of multiple modes of action for the control of the soybean aphid.

CROP INFORMATION
Crop: Soybean (Glycine max)  Cultivar: Asgrow AG 2035
History:
2013: Soybean  2014: Corn  2015: Soybean  2016: Corn

PEST INFORMATION
During 2015 and 2016, areas adjacent to this study site had soybean aphid populations documented resistant to synthetic pyrethroid insecticides.

SITE INFORMATION
Location: University of Minnesota Southwest Research and Outreach Center Lamberton, Redwood County, Minnesota
This trial was placed in a portion of bulk-planted soybean field with late-season, economic threshold, soybean aphid populations.

Soil fertility (2015 sample):
Name: Normania loam
% OM: 5.3  pH: 5.8
P (bray): 32 ppm  K: 147 ppm  Zn: 1.2 ppm

PLANTING INFORMATION
Planting Date: 5/30/2017  Emergence Date: 6/5/2017
Planting Equipment: John Deere (Moline, IL) Max Emerge 2, 6-row vacuum planter.
Row Spacing: 30-inch  Seeding Rate: 160,000 seeds/acre  Seeding Depth: 1.5 inch
Soil Temperature: 64°F  Soil Moisture: Dry
Precipitation: Above-average growing season precipitation after planting

PLOT MAINTENANCE
Tillage Fall 2016: Disc Ripper  Tillage Spring 2017: Field cultivator

PRE Herbicide: 5/30/17  Dual II Magnum – 2.6 pts/A
POST Herbicide: 6/20/17  Cornerstone Plus – 32 fl. oz /A, Fusilade – 3 fl oz/A, Battlestar – 0.75 pt/A
7/06/17  Cornerstone Plus – 24 fl. oz/A, Fusilade – 3 fl oz/A
Insecticide application: Two-man CO2 plot sprayer - 15 GPA and 35 PSI

HARVEST INFORMATION
Harvest equipment: Plot combine (ALMACO, Nevada, IA). The center two rows of each four-row plot were combined. Grain yields were adjusted to 13% moisture and 60 pounds/bushel.

EXPERIMENTAL DESIGN
Study Design: Randomized Complete Block
Treatments: 13
Replications: 4
Plot Width: 15 foot (six 30-inch rows)
Treated Plot Width: 10 foot (four 30-inch rows)
Treated Plot Length: 30 foot

TREATMENTS EVALUATED
The effect of nine (9) insecticide treatments were compared to a no-insecticide control with respect to their effect on soybean aphid (SBA) populations and soybean yield. The product(s), insecticide group(s) and per acre rates are listed in Table 1.

<table>
<thead>
<tr>
<th>Product and rate</th>
<th>Compound (s)</th>
<th>Group (s)</th>
<th>Registrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Untreated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Hero®</td>
<td>5.0 fl oz/a  bifen + zeta cyperm</td>
<td>3A + 3A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>3 Hero®</td>
<td>5.0 fl oz/a  bifen + zeta cyperm</td>
<td>3A + 3A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td></td>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a dimethoate</td>
<td>1B</td>
</tr>
<tr>
<td>4 Brigadier®</td>
<td>6.1 fl oz/a  bifen + imidaci</td>
<td>3A + 4A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>5 Brigade® 2EC</td>
<td>2.1 fl oz/a  bifen</td>
<td>3A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>6 Brigade® 2EC</td>
<td>6.4 fl oz/a  bifen</td>
<td>3A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>7 Warrior II®</td>
<td>1.9 fl oz/a  lambda cyhaloth</td>
<td>3A</td>
<td>Syngenta</td>
</tr>
<tr>
<td>8 Endigo® ZC</td>
<td>4.0 fl oz/a  lambda cyhaloth + thiamex</td>
<td>3A+ 4A</td>
<td>Syngenta</td>
</tr>
<tr>
<td>9 Tundra® Supreme</td>
<td>16.8 fl oz/a bif + chlorpyri</td>
<td>3A + 1B</td>
<td>Winfield United</td>
</tr>
<tr>
<td>10 Lorsban® Advanced</td>
<td>16.0 fl oz/a chlorpyri</td>
<td>1B</td>
<td>DowAgro Sciences</td>
</tr>
</tbody>
</table>

Table 1. Insecticides and rates tested.

Insecticides were applied after SBA had reached more than 250 aphids/plant (the economic or action threshold). Alleys were cut into the most visually uniform part of the field using a tractor-mounted rotary tiller, 6-row plots were marked, and pre-treatment aphid counts were made.

Insecticide applications were made with a two-man CO2 plot sprayer, spraying the center four rows of each six row plot. This design protected against fine spray particle drift between plots and left a running check on each side of a plot. TeeJet 8001XR nozzles (TeeJet Technologies) placed on 15-inch centers applied at 15 gallons per acre water at approximately 35 PSI.
ASSESSMENT METHODS
Soybean aphid populations were assessed on five randomly selected plants per plot (four plants per plot pre-treatment). Before aphids were counted, the plants were shaken to help eliminate any dead or moribund aphids. Plants were assessed the day insecticides were applied and then at 3, 7, 13, and 20 days after application.

RESULTS
Warrior II and other formulations and isomers of cyhalothrin, bifenthrin (e.g. Brigadier, Tunda) as well as the synthetic pyrethroid insecticides (Group 3A) in general, have been widely used for insect control in many Minnesota crops. As a result, pyrethroid insecticide-resistant populations of SBA resistant to have been observed in some MN, SD, ND, and IA soybean fields. During 2015 and 2016, Lambda-cyhalothrin and bifenthrin-resistant aphid populations were documented at this study site.

Wet spring soil conditions delayed soybean planting at the study location. Rainfall was above normal early in the season and the site had good overall growing conditions. Unlike areas of northwest Minnesota, SBA populations were slow to develop at this and other 2017 southwestern Minnesota locations. Poor early season colonization rates and abundant natural enemies at this study site provided few large uniformly infested areas, limiting the number of insecticide comparisons that could be made.

Soybean aphid populations were consistently over the 250 aphid/plant economic/action threshold (ET) on August 10, averaging 266/plant through the study. Treatment means, probability and significant differences for this trial are presented in Table 2. Analysis of variance (AOV) was used to examine differences in treatment means for yield and soybean aphid population data. Mean yields did not differ by insecticide treatment. Aphid data were analyzed with Kruskal–Wallis AOV and treatment mean ranks separated based on Dunn’s pairwise comparisons.

3 days after insecticide treatment (3 DAT), all insecticides reduced SBA below ET. The two treatments containing chlorpyrifos (Lorsban Advanced and Tundra Supreme) had fewer aphids than the control. The 1pt./acre Lorsban Advanced treatment had the fewest aphids, significantly less than the 1.92 fl. oz./acre Warrior II (Table 2, Figure 1).

Populations in the untreated plots declined between 3 and 7 DAT through emigration of winged adults. By 7 DAT, the aphids surviving the Warrior II and 2.1 fl. oz. Brigade treatments were highly aggregated/over dispersed potentially suggesting biotype clones. Lorsban Advanced and Brigadier 2EC had significantly fewer aphids than the control.

The soybean aphid populations had started to increase in the Lorsban Advanced treatment by 13 DAT. By 20 DAT only the Endigo ZC plots had significantly fewer aphids than the control.

After August 18 (7 DAT), SBA populations slowly increased until August 31 (20 DAT), the untreated control ending near ET. Thereafter, all insecticide-treated plots had few aphids and, fungal diseases, present throughout the study period, greatly increased. This created pockets of very high SBA mortality and highly variable SBA infestations in the untreated plots. Additionally, SBA had begun moving to buckthorn by September 5. Because of rapidly deteriorating SBA populations, sampling was not continued beyond 20 DAT.
The untreated control accumulated 4,000 aphid-days during the 3 weeks where aphids were rated and additional aphid-days were available before and after. All insecticides reduced SBA pressure. With the exception of Lorsban Advanced, end-of-season SBA populations were correlated with initial control (Table 2, Figure 2).

As expected by the static SBA populations and low aphid day accumulations, there was no yield differences among the untreated control and any insecticide treatment (Table 2, Figure 2).

### Table 2. Yield and soybean aphid population response to insecticide treatments. UMN Southwest Research and Outreach Center, Lamberton, MN 2017.

<table>
<thead>
<tr>
<th>Rating Date</th>
<th>Soybean Stage</th>
<th>Insecticide</th>
<th>Rate</th>
<th>Group</th>
<th>Year</th>
<th>Cumulative Aphid-Days</th>
<th>Yield (Bu/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/10</td>
<td>R4</td>
<td>Untreated</td>
<td>-</td>
<td>204.7</td>
<td>a</td>
<td>0.0001 *</td>
<td>60.6 a</td>
</tr>
<tr>
<td>8/14</td>
<td>R5</td>
<td>Hero</td>
<td>5.0 fl oz/a</td>
<td>288.9</td>
<td>a</td>
<td>0.0001 *</td>
<td>61.1 a</td>
</tr>
<tr>
<td>8/18</td>
<td>R5</td>
<td>Hero</td>
<td>5.0 fl oz/a</td>
<td>102.3</td>
<td>a</td>
<td>0.0001 *</td>
<td>61.0 a</td>
</tr>
<tr>
<td>8/24</td>
<td>R5</td>
<td>Dimethoate 4E</td>
<td>9.0 fl oz/a</td>
<td>152.7</td>
<td>a</td>
<td>0.0001 *</td>
<td>674.3 a</td>
</tr>
<tr>
<td>8/31</td>
<td>R5</td>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a</td>
<td>266.3</td>
<td>a</td>
<td>0.0001 *</td>
<td>61.5</td>
</tr>
<tr>
<td>8/10-8/21</td>
<td>R5</td>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a</td>
<td>4001.0</td>
<td>a</td>
<td>0.0001 *</td>
<td>60.6 a</td>
</tr>
<tr>
<td>8/24</td>
<td>R5</td>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a</td>
<td>61.5</td>
<td>a</td>
<td>0.0001 *</td>
<td>61.5</td>
</tr>
<tr>
<td>10/18</td>
<td>R5</td>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a</td>
<td>1060.3</td>
<td>a</td>
<td>*0.9888</td>
<td>61.5</td>
</tr>
</tbody>
</table>

*Mean comparisons performed only when AOV Treatment P(F) is significant. P(F) Kruskal-Wallis non-parametric AOV. Dunn’s pairwise comparison (P<0.05) Mean rank separations.

Variety: AG 2035
Insecticide treatments applied August 11

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**Table 2.** Yield and soybean aphid population response to insecticide treatments. UMN Southwest Research and Outreach Center, Lamberton, MN 2017.
Figure 1. Insecticide effect on soybean aphid populations over time. UMN Southwest Research and Outreach Center, Lamberton, MN 2017.

Figure 2. Yield response soybean aphid response to 10 insecticides and rates. Yields were not different (p = 0.05 Tuckey’s HSD). Aphid-days (red dots) are accumulated for the 20 days the trial was rated but do not reflect total soybean aphid pressure. UMN Southwest Research and Outreach Center, Lamberton, MN 2017.
CONCLUSIONS
Unlike 2015-16, the biossayed SBA aphids collected near this 2017 study were susceptible to both lamda-cyhalothrin and bifenthrin. However, over the 21 days the aphid populations were rated in this study, a portion of the SBA in this study were not well controlled by the full labeled rate of lamda-cyhalothrin (Warrior II), the low labeled rate of bifenthrin (Brigade 2.1 fl oz.), and bifenthrin + zeta cypermethrin (Hero). This may indicate a reduced susceptibility of these SBA populations (Figure 1). These data may also illustrate the difficulty of detecting aggregated in-field insecticide resistant aphid clones before an insecticide application is made.

Insecticide pre-mixes and tank mixes can hide resistance issues associated with one of the products but they may not reduce selection pressure.

Although the economic threshold had been reached, the lack of yield response to SBA control was not surprising given the lack of population increase in the untreated plots (Figure 1-2).

Although a field may be at or near ET, weather and natural enemies can prevent population increases. It is important to preserve efficacy of remaining effective insecticide groups. Avoiding insecticide applications to non-yield-limiting stagnant, declining, or very late-season SBA populations can help reduce selection pressure on insecticides.

ACKNOWLEDGEMENTS
Matthew Wordes and Adam Hass provided valuable help in plot maintenance and aphid counts.

Always read and follow label directions! 
Brigade® 2EC, Brigadier®, Dimethoate 4E, Endigo® ZC, Hero®, Lorsban® Advanced, Tundra® Supreme, and Warrior II® with Zeon Technology are restricted use pesticides.

Products are mentioned for illustrative purposes only. Their inclusion does not mean endorsement and their absence does not imply disapproval.

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