OBJECTIVE:
Evaluate efficacy of insecticide compounds and modes of action for control of the soybean aphid, *Aphis glycines*.

SUMMARY OF RESULTS: Seven foliar applied insecticide treatments containing eight individual compounds were compared against an untreated control in a RCB design. All insecticides significantly (α=.05) reduced soybean aphid populations and maintained them below economic injury levels during the 21 day study rating period. At 3 DAT only flonicamid (Carbine) had similar aphid populations to the untreated control. After 7 DAT all insecticides provided similar control. See also Tables 1-2.

CROP INFORMATION
Crop: Soybean (*Glycine max*) 
Cultivar: Asgrow AG15X9


PEST INFORMATION
Soybean aphid (SBA) populations resistant to synthetic pyrethroid insecticides were documented during 2015, 2016, 2018 and 2019 from soybeans near this study.

In the study area as well as other area soybeans, 2019 SBA populations established poorly. Low soybean colonization rates were likely due to late soybean planting and emergence and high spring rainfall across much of SW MN. Immigrating winged aphids colonized the late-planted study in early August. Few predators and parasites allowed populations to increase rapidly.

This study was placed within an area of bulk fill that was planted very late to soybeans. This field was selected after severe lodging of the planned study site. This study area was attractive to late season winged soybean aphids and heavily, but not uniformly, infested.

SITE INFORMATION
Location: University of Minnesota Southwest Research and Outreach Center near Lamberton, Redwood County, Minnesota. Warrior II and other formulations and isomers of cyhalothrin, bifenthrin, (e.g. Brigadier, Tundra) as well as the synthetic pyrethroid insecticide group (3A) in general, had been widely used for insect control in many Minnesota crops. The site and surrounding area had a history of pyrethroid resistant soybean aphid populations since 2015.
An agricultural research experimental area that had been in a corn soybean rotation for many years and bulk planted to soybean in 2019. Severe lodging of soybeans in the planned location for this study caused this late-planted area to be selected. The smaller size of this site limited the number of treatments that could be compared.

**Soil fertility (October 2017 sample):**
- **Name:** Normania loam
- **% OM:** 4.0
- **pH:** 5.8
- **P (bray):** 15 ppm  
  **K:** 114 ppm  
  **Zn:** 0.7 ppm

**PLANTING INFORMATION**
- **Planting Date:** 7/08/2019  
  **Emergence Date:** ~ 7/15/2019
- **Planting Equipment:** Kinze (Williamsburg, IA) Model 3110 6-row vacuum planter.
- **Row Spacing:** 30-inch  
  **Seeding Rate:** 160,000 seeds/acre  
  **Seeding Depth:** 1.5 inch
- **Soil Temperature:** 76°F  
  **Soil Moisture:** Moist, wet below seedbed
- **Precipitation:** Well above-average growing season precipitation before and after planting.

**SITE MAINTENANCE**
- **Tillage Fall 2018:** Disc Ripper  
  **Tillage Spring 2019:** Field cultivator
- **PRE Herbicide:** None
- **POST Herbicide:** 7/12/19  
  Cornerstone Plus – 48 fl. oz /A
- **Insecticide:** *Treatments part of study*
- **Insecticide application:** 15 GPA and 35 PSI with 8001 VS nozzles 14 inches on center  
  8/23/2019 Tractor mounted compressed air sprayer

**HARVEST INFORMATION**
- **Harvest equipment:** Soybeans did not reach maturity and study was not harvested

**EXPERIMENTAL DESIGN**
- **Study Design:** Randomized Complete Block  
  **Treatments:** 8  
  **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 seven (7) insecticide formulations were compared to a no-insecticide control with respect to their effect on soybean aphid (SBA) populations. The product(s), insecticide group(s) and per acre rates are listed in *Table 1.*

Spring SBA populations were slow to develop at this location due to few early-planted soybeans and subsequent high rainfall. Additionally, this site was planted well after soybeans had left buckthorn. In August, large numbers of alate aphids found these late planted soybean attractive, and by mid-August the study area and other nearby soybeans began to reach economic levels. Rainfall was well above normal both early in the season and after insecticide application (Figure 1).

Insecticide treatments were applied after SBA populations were near the 250 aphids/plant action threshold. An area was selected that was as uniform as possible with respect to soybean canopy and soybean aphid density. Alleys were cut into the field in using a tractor-mounted rotary tiller, 6-row plots were marked, and pre-treatment aphid counts were made on August 23.
The insecticides were applied August 23 with a tractor mounted compressed air 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 8001VS nozzles (TeeJet Technologies) placed on 14-inch centers applied 15 gallons per acre water at approximately 35 PSI.

<table>
<thead>
<tr>
<th>Product and rate</th>
<th>Compound(s)</th>
<th>Group(s)</th>
<th>Registrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hero®</td>
<td>5.0 fl oz/a bifenthrin + zeta cypermethrin</td>
<td>3A + 3A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>Dimethoate 4E</td>
<td>16.0 fl oz/a dimethoate</td>
<td>1B</td>
<td>Cheminova</td>
</tr>
<tr>
<td>* Carbine® 50 WG</td>
<td>2.8 oz/a flinicamid</td>
<td>29</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>Brigadier®</td>
<td>6.1 fl oz/a bifenthrin + imidacloprid</td>
<td>3A + 4A</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>Endigo® ZCX</td>
<td>3.5 fl oz/a lambda cyhalothrin + thiamethoxam</td>
<td>3A+ 4A</td>
<td>Syngenta</td>
</tr>
<tr>
<td>Sefina® (Inscolis®)</td>
<td>3.0 fl oz/a afidopyropen</td>
<td>9D</td>
<td>BASF</td>
</tr>
<tr>
<td>Sivanto™ Prime</td>
<td>5.0 fl oz/a flupyradifurone</td>
<td>4D</td>
<td>Bayer CropScience</td>
</tr>
<tr>
<td>Sivanto™ HL</td>
<td>2.5, 3.5 fl oz/a flupyradifurone</td>
<td>4D</td>
<td>Bayer CropScience</td>
</tr>
</tbody>
</table>

* Not currently(10/15/19)registered on soybean in MN

| Synthetic pyrethroid(3A), Organophosphate(1B), Neonicitinoid(4A), Butenolide(4D), Pyropene(9D), Pyridine(29)

Table 1. Insecticides, insecticide groups and rates tested.

ASSESSMENT METHODS
Whole-plant counts of five randomly selected plants per plot (two plants per plot pre-treatment) were used to estimate soybean aphid populations. The sampled plants were shaken to help eliminate any dead or insecticide stupefied, dying aphids before counting. Aphids were assessed the day of insecticide application and then at 3, 7, 14, and 21 days after application.

These plots had not matured when a killing freeze occurred on October 14 and the study was not harvested.

RESULTS
Rapidly increasing soybean aphid populations averaged 214 per plant by August 23 on R2-stage soybeans. Treatment means, probability and significant differences (Tukey’s HSD p= 0.05) for SBA populations and cumulative aphid-days (CADs) for the evaluation period of this study and yields are shown in Table 2, Figure 2, Figure 3.

Three days after insecticide treatment (3 DAT), SBA populations in all insecticides treatments were below ET. Soybean aphid populations in the Carbine treatment, while numerically lower, were not significantly different from the untreated check (α= 0.05) and had more aphids than Hero + Dimethoate. All other insecticides performed similarly. The Hero + Dimethoate treatment still had fewer SBA than Carbine at 7 DAT. Numerically, the Carbine treatment had higher but sub-economic aphid populations through 21 DAT. From 14-21 DAT, all insecticides had fewer aphids than the untreated check and provided similar control. Aphid populations in the untreated control accumulated more than 9,500 cumulative aphid-days and were above the economic injury level (EIL). All insecticides maintained aphid population densities well below the EIL.
ACKNOWLEDGEMENTS
Noah Stavnes and Ian Kellog provided valuable help in plot maintenance and the aphid counting process.

Always read and follow label directions!
*Hero®, Brigadier®, Endigo®ZCX, and Hero® 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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### Table 2. Soybean aphid response to insecticide treatments. UMN Southwest Research and Outreach Center, Lamberton, MN 2019. Not all of the insecticide formulations tested have current (10/15/19) MN labels for soybean.

<table>
<thead>
<tr>
<th>Rating Date</th>
<th>Soybean aphid populations (Aphids /Plant)</th>
<th>Cumulative Aphid-Days 8/23 - 9/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop Stage</td>
<td>R2</td>
<td>R2</td>
</tr>
<tr>
<td>UNTREATED</td>
<td>360 -</td>
<td>207.5 a</td>
</tr>
<tr>
<td>HERO</td>
<td>5 fl oz/a</td>
<td>3A</td>
</tr>
<tr>
<td>DIMETHOATE 4E</td>
<td>16 fl oz/a</td>
<td>1A</td>
</tr>
<tr>
<td>CARBINE 50 WG*</td>
<td>2.8 oz wt/a</td>
<td>29</td>
</tr>
<tr>
<td>BRIGADIER</td>
<td>5 fl oz/a</td>
<td>3A + 4A</td>
</tr>
<tr>
<td>ENDIGO ZCX</td>
<td>3.5 fl oz/a</td>
<td>3A+4A</td>
</tr>
<tr>
<td>SEFINA (INSCALIS)</td>
<td>3 fl oz/a</td>
<td>1A</td>
</tr>
<tr>
<td>SIVANTO PRIME NIS</td>
<td>5 fl oz/a</td>
<td>4D</td>
</tr>
<tr>
<td>SIVANTO HL NIS</td>
<td>0.125 % v/v</td>
<td>4D</td>
</tr>
</tbody>
</table>

Mean sepaeratoin based on log tranformed data
Means followed by same letter or symbol do not significantly differ (P=.05, Tukey’s HSD).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

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See also: https://swroc.cfans.umn.edu/weather
Figure 2. Insecticide effects on SBA populations over time. Aphid populations are shown as aphids/plant in log-transformed units.
Figure 3. Insecticide effect on cumulative aphid-days (CADs). Aphid populations are shown as aphids/plant in log-transformed units. Economic injury level is greater than 5000 CADs shown as a red line.