# Food Crops Program – Entomology

Research Report Template for Performance & Integrated Solutions Trials

**Project #: IS00386**
**Project Title: Control of Rice Root Aphids in Hemp**
**Researcher(s) & Affiliation(s): Raul Villanueva, University of Kentucky**
**Date: 10/20/2024**

## Narrative Summary (Results/Discussion)

The objective of this study was to evaluate the efficacy and phytotoxicity of six different insecticides to control rice-root aphid (*Rhopalosiphum rufiabdominale*) on hemp. The most effective insecticides were Harvanta, Beleaf, and Senstar that were significantly different from the Control (Tukey's < 0.05). Whereas Azaguard and BoteGHA were not effective and were not significantly different than the control.
Addtionally, Compared with the first study, Harvanta and Beleaf 50 SG rates were reduced to half but, despite this both insecticides continue causing toxicit. Harvanta was the most toxic insecticide causing browning and dissecating hemp foliage immediately after the first application. As well, Beleaf also caused similar damages but toxicity symptoms were observed one week after Harvanta's.

**Table 1 Results.** Average numbers (±SEM) of visible aphids/sq. in. over time, after different insecticides applications. UKREC, Princeton, KY, **July-August** 2024.

| Treatment | Pre-spray | | 7 DAA1 | | 7 DAA2 | | 7 DAA3 | | 7 DAA4** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Control** | 0.5 ± 0.09 | a | 1.1 ± 0.24 | ab | 3.4 ± 1.33 | a | 3.7 ± 1.70 | a | 2.0 ± 0.86 | a |
| **Pyganic** | 0.9 ± 0.49 | a | 1.3 ± 0.52 | ab | 3.2 ± 1.35 | ab | 1.8 ± 0.60 | ab | 2.0 ± 0.80 | a |
| **Azaguard** | 0.6 ± 0.13 | a | 3.0 ± 1.00 | a | 3.6 ± 1.14 | a | 1.7 ± 0.56 | ab | 0.5 ± 0.13 | ab |
| **BoteGHA** | 0.9 ± 0.43 | a | 2.0 ± 0.75 | ab | 1.7 ± 0.46 | abc | 0.8 ± 0.17 | ab | 0.2 ± 0.10 | b |
| **Harvanta** | 0.6 ± 0.14 | a | 0.8 ± 0.28 | ab | 0.2 ± 0.12 | bc | 0.0 ± 0.00 | b | 0.0 ± 0.00 | b |
| **Beleaf** | 0.8 ± 0.32 | a | 0.2 ± 0.11 | b | 0.0 ± 0.00 | c | 0.0 ± 0.00 | b | 0.0 ± 0.00 | b |
| **Senstar** | 0.6 ± 0.17 | a | 0.1 ± 0.06 | b | 0.1 ± 0.06 | c | 0.0 ± 0.00 | b | 0.0 ± 0.00 | b |
| C.V. (%) | 16.81 | | 21.83 | | 24.17 | | 24.07 | | 19.64 | |

* Means followed by the same letter on columns are not statistically different between themselves by Tukey test (5%). DAA: Days After Application.

** Means based on total number of aphids/cups by the end of experiment (destructive sampling)

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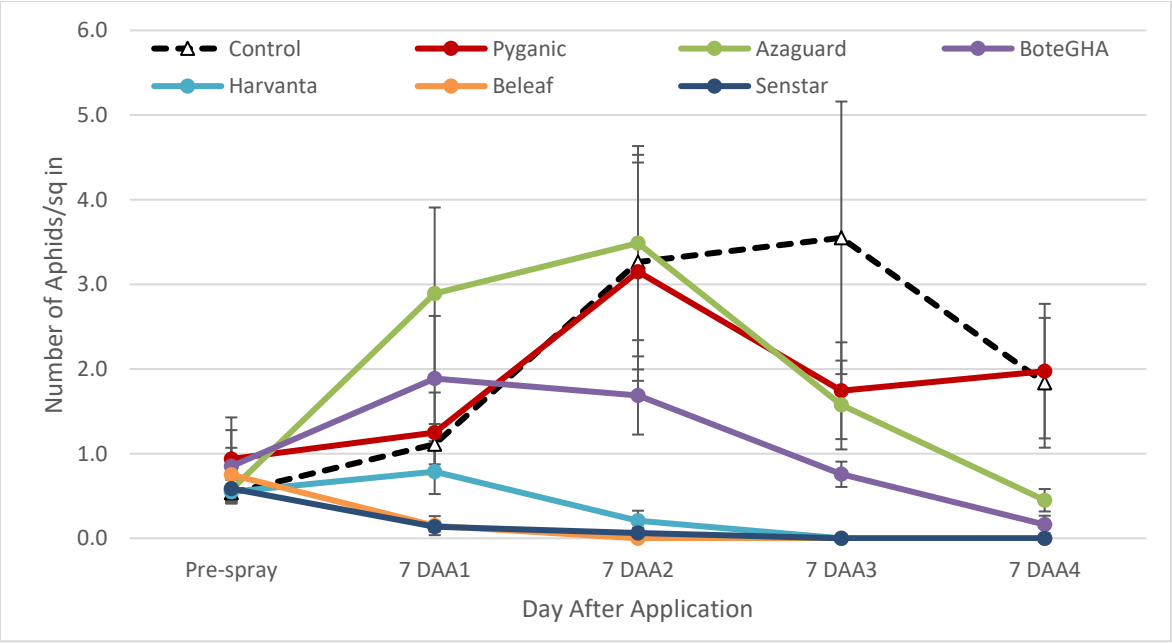


Figure. 1. Average numbers (±SEM) of visible winged aphids/sq. in. over time, after different insecticides applications. UKREC, Princeton, KY, **October-November** 2024.

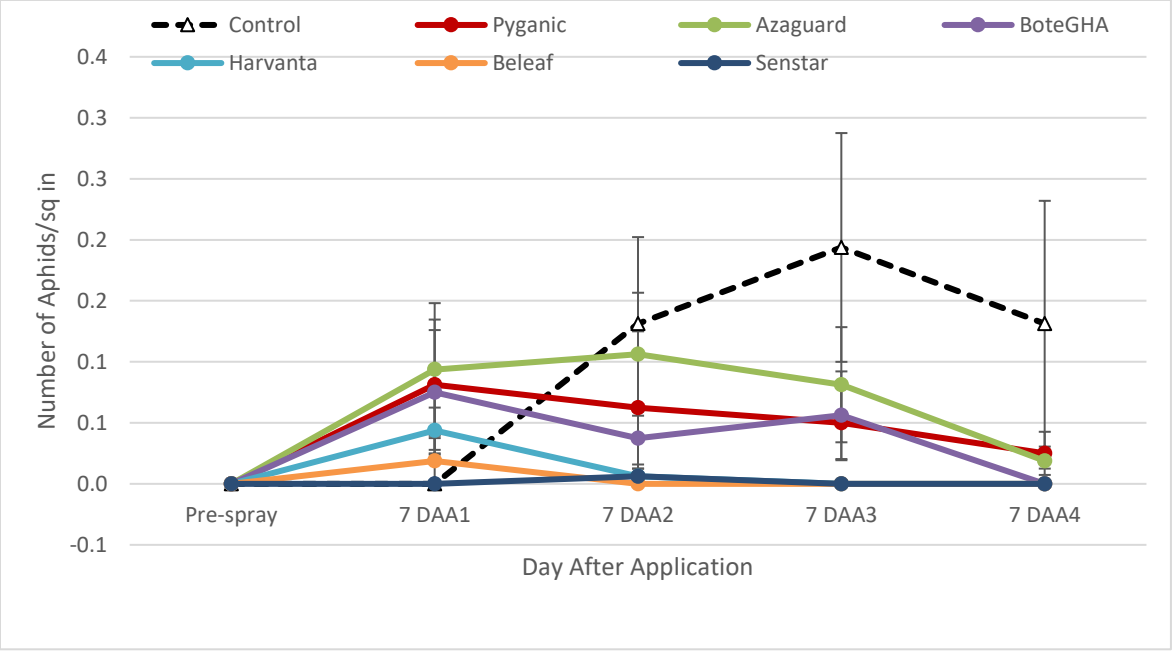


**Figure 4.** Average number (± SE) of visible winged aphids/sq. in. over time, after different insecticides applications. UKREC, Princeton, KY, **October-November** 2024.

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## Materials & Methods/Recordkeeping

A laboratory study was conducted at the UKREC, in Princeton, Caldwell Co. KY. The plants used were approximately 6 weeks old using 0.5 gal pots. The insecticides and rates tested in this trial are shown in Table 2.

Name(s) of Personnel Conducting Research: Raul T Villanueva, Zenaida Viloria and Felipe Batista
Location of Trial (city/state): Princeton, Caldwell Conty, KY
Use Site (greenhouse/shadehouse/field container/etc): Greenhouse lab

Crop History

| | |
|---|---|
| Crop Cultivar/Variety: | Study used transplanted cv. BaOx clones. |
| Date of Seeding: | 09/16/2024 |
| Date of Emergence: | 09/23/2024 |
| Date of Transplanting: | 09/30/2024 |
| Potting Mix: | Miracle-Gro® Potting Mix |
| Pot size & spacing: | ½ liter clear plastic cups separates ½ ft apart between pots |
| Row spacing: | n/a |

**Hemp seedlings**

Hemp seeds were planted on September 6th and infested with 10 adult aphids per plant on October 15 using 237-mL clear plastic cups (16 oz) containing potting soil mix. After the first month, plants were fertilized weekly (Miracle Gro All Purpose Plant Food, The Scotts Company LLC. Marysville, OH). Each cup was wrapped with aluminum foil to avoid algae growth. Two months later, plants were infested with 10 aphids: 3 adults and 7 last-instar nymphs approximately. After a week, the number of aphids per plant was recorded and some more aphids were inoculated when the numbers were below 10. The first spray was conducted on October 29 2024.

Product(s) applied prior to start of experiment: None

**Table 2.** Name, active ingredient, and rate/acre of insecticides used in the experiment to control Rice-root aphid on hemp, first test (October-November ) in 2024.

| Product | Active Ingredient | Rate | Application Type | Date of Application | Growth Stage | Application Volume |
|---|---|---|---|---|---|---|
| Pyganic EC 5.0 II | *Pyrethrin* | 0.375 fl oz/1000 sq ft | Soil Drench | Every 7 days, 4 applications were conducted. First spray was on 10/29, then 11/05, 11/12, and 11/19, 2024 | Vegetative | 100 ml |
| Azaguard | *Azadirachtin* | 0.15% v/v | Soil Drench | | Vegetative | 100 ml |
| BoteGHA | *Beauveria bassiana* | 8 fl oz/1000 sq ft | Soil Drench | | Vegetative | 100 ml |
| Harvanta 50SL | *Cyclaniliprole* | 8.2 fl oz/A | Soil Drench | | Vegetative | 100 ml |
| Beleaf 50 SG | *Flonicamid* | 1.4 oz/A | Soil Drench | | Vegetative | 100 ml |
| Senstar | *Pyriproxife* + *Spirotetramat* | 18 fl oz/A | Soil Drench | Every 14 days, 2 applications: 10/29, and | Vegetative | 100 ml |
| Control | - | - | - | - | Vegetative | - |

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A pre-count was conducted before the application of the insecticides on October 28, 2024

## Experiment Information

| | |
|---|---|
| Experimental Design: | Non-randomized repeated measures design |
| Number of Reps: | 5 |

### Materials & Methods:

The rice root aphid colony was initiated with aphids provided by the University of Ohio and University of Florida, respectively. Initially, the RRA colony was kept on wheat as a host plant, however the aphid reproduction was low. High RRA population was reached after replacing wheat with Elbon rye. Also, a layer of sand was set on the top of potting soil mix to increase aphid population (Hesler and Kindler, 2007). The colony was kept in a BugDorm insect rearing cage at 16:8 (Light:Dark) photoperiod using full spectrum grow light, and 23.33 ±0.63° C and 60.14±5.52 % relative humidity.

In early spring 2024, the aphid population was high on Elbon rye and hemp flowers. We chose Elbon rye as the best host. This colony got cross contaminated with *Tetranychus* sp. Unfortunately, an application of Kanemite (Acequinocyl) miticide killed the aphid colony. A new colony was started with a few survivals. Since the initial stages of the RRA population growth are lengthy, we requested Dr. Luis Cañas some aphids to expedite the initiation of our chemical test. It is worth noting that RRA colony can go from wingless stage to winged individuals in a unpredictable way, when this happens the number of individuals available for infestation is greatly reduced.

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The experimental design was a non-randomized repeated measures design and analyzed with repeated measures ANOVA with five replicates/ treatment and conducted from July 14 to August 12, 2024. Each insecticide was applied four times with an interval of 7 days between each application. The only insecticide applied twice every 14 days was Senstar. All these information are on Table 2.

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The numbers of aphids per square inch were evaluated 1 day before the application (Pre-application) and 7 Days After each Application (7 DAA1, 2, 3 and 4). All products were compared with the control (plots without treatment). Then counts were conducted though the clear plant for all dates except the last date that tallies were conducted in all pots removing roots from containers.

Application Equipment:__100 ml of the prepared insecticide solution were soil drenched_____

- Insecticides were prepared in 500 ml containers and only 100 ml of the prepared insecticide solution were soil drenched to each pot

Product(s) applied during experiment (including treatments, fertilizers, etc):

- Miracle-Gro® water soluble plant food (20-20-20) was used as required every week. Solution were prepared usin 1 teaspoon of Miracle-Gro and only 100 ml was used for each pot.
- Pots were water every other day.

| Product | Rate(s) | Application Type | Date of Application | Crop Growth Stage | Application Volume |
|---|---|---|---|---|---|
| Miracle-Gro® water soluble plant food (20-20-20) | 1 tea spoon of MG pe liter | Drench | 10/29, 11/05, 11/12, and 11/19, 2024 | Vegetative | 100 ml |
| | | | | | |

**Photos**

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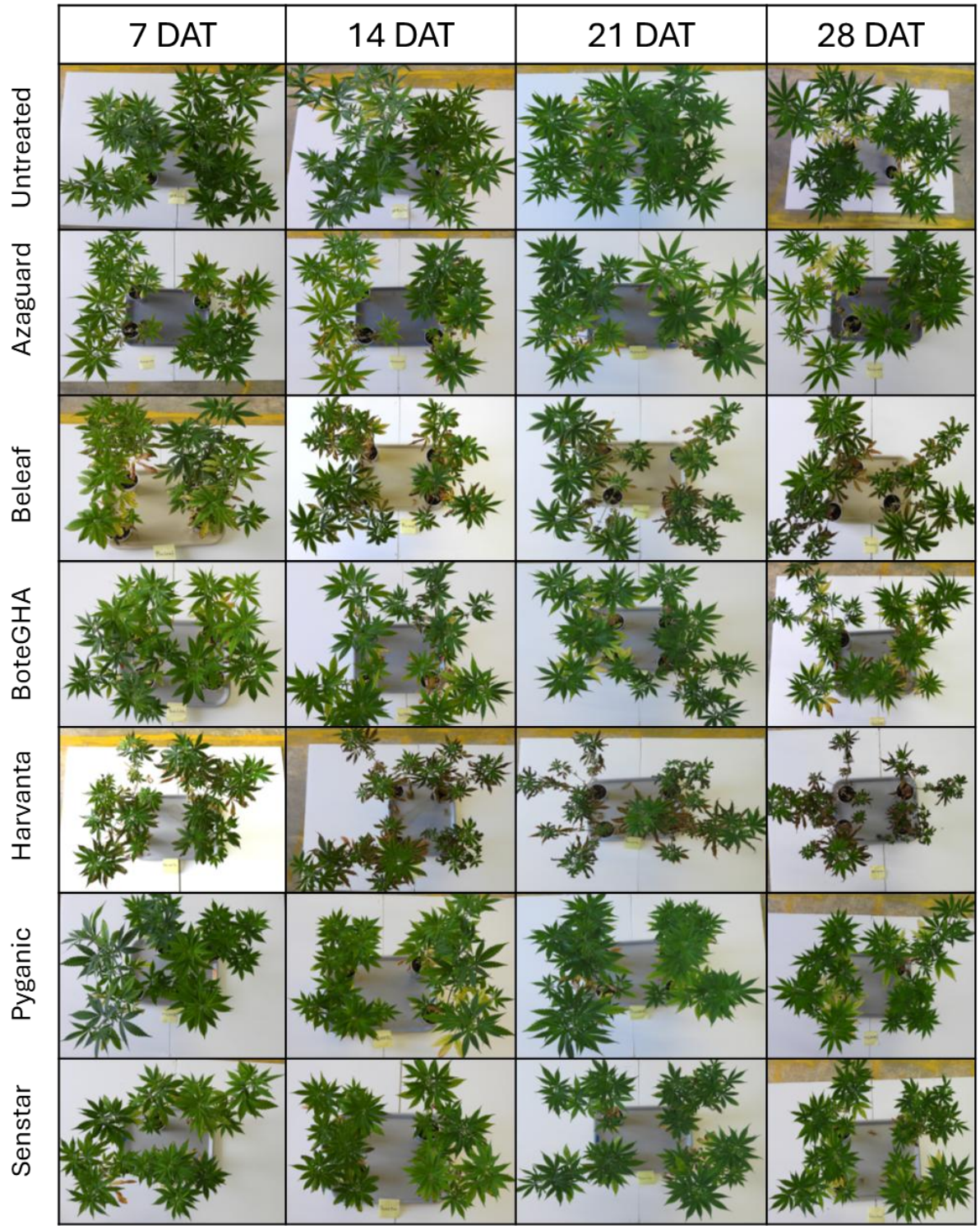


Fig. Phytotoxicity in hemp seedlings after pesticide application to control rice root aphid (*Rhopalosiphum rufiabdominalis)* in October-November experiment.

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## Data Collected

Clear plastic containers of 0.5 liter capacity were used to conduct this study. Each container was wrapped with aluminum foil to reduce aphid movement out of the containers. Rice root aphids were counted through the clear surface of the plastic containers

**Aphid counts**
Two different methods were performed to estimate the numbers of aphid per plants. In the first experiment, we followed the procedure described in IR4 protocol, this is, visible aphids were counted in six random selected spots on the periphery of each cup using a 1-inch$^2$ grid. Number of wingless and winged aphids/inch$^2$ were recorded at 7, 14, and 21 days after pesticide application (DAP). On day 28, (destructive sampling), each root ball was shaken and sieved, the potting soil mix was observed under a stereoscope to count aphids. No aphid was observed on day 14 and 21 for Pyganic, Harvanta, Beleaf and Senstar, therefore each root ball was cut lengthwise in 2 halves and observed under a stereoscope. For the second experiment, all visible aphids (winged and wingless) were counted on from the entire cup periphery, which considered as amount of aphids/plant. An additional count was completed on day 28, in this case, the rootball was divided in four quarters and only one quarter was checked under stereoscope to estimate the number of aphids per root ball by multiplying the count by four.

**Efficacy of Control**
The initial number of aphids (pre-spray) on the roots of each plant was similar in all treatments in Oct-Nov (Table 3).

**Table 3.** Average number of visible aphids/sq. in. over time, after different insecticides applications. UKREC, Princeton, KY, **July-August** 2024.

| **Treatment** | **Pre-spray** | | **7 DAA1** | | **7 DAA2** | | **7 DAA3** | | **7 DAA4** | | **7 DAA4*** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Day 0** | | **Day 7** | | **Day 14** | | **Day 21** | | **Day 28** | | **Day 35** | |
| **Control** | 0.5 | a | 1.1 | ab | 3.3 | a | 3.6 | a | 1.8 | a | 162 | a |
| **Pyganic** | 0.9 | a | 1.3 | ab | 3.2 | a | 1.7 | ab | 2.0 | a | 120 | a |
| **Azaguard** | 0.6 | a | 2.9 | a | 3.5 | a | 1.6 | ab | 0.5 | ab | 42 | ab |
| **BoteGHA** | 0.9 | a | 1.9 | ab | 1.7 | ab | 0.8 | ab | 0.2 | b | 30 | ab |
| **Harvanta** | 0.6 | a | 0.8 | ab | 0.2 | b | 0.0 | b | 0.0 | b | 0 | b |
| **Beleaf** | 0.8 | a | 0.2 | b | 0.0 | b | 0.0 | b | 0.0 | b | 0 | b |
| **Senstar** | 0.6 | a | 0.1 | b | 0.1 | b | 0.0 | b | 0.0 | b | 0 | b |
| C.V (%) | 16.98 | | 21.86 | | 24.05 | | 23.28 | | 18.86 | | 71.85 | |

* Means followed by the same letter on columns are not statistically different between themselves by Tukey test (5%).
DAA: Days After Application.
** Means based on total number of aphids/cups by the end of experiment (destructive sampling)

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**Table 5.** Efficacy of control (%) using ABOTT for winged RRA , Princeton, KY, **Oct-Nov** 2024.

| Treatment | Pre-spray | 7DAA1 | 7DAA2 | 7 DAA3 | 7 DAA4** |
|---|---|---|---|---|---|
| **Pyganic** | - | 0 | 3 | 51 | 0 |
| **Azaguard** | - | 0 | 0 | 56 | 76 |
| **BoteGHA** | - | 0 | 48 | 79 | 91 |
| **Harvanta** | - | 29 | 94 | 100 | 100 |
| **Beleaf** | - | 87 | 100 | 100 | 100 |
| **Senstar** | - | 88 | 98 | 100 | 100 |

**Table 6.** Toxicity of insecticides to hemp plants 7 days after each application on study conducted from July to August

| Toxicity Oct-Nov | 7 | 14 | 21 | 28 |
|---|---|---|---|---|
| **Treatment** | **7 DAA1** | **7 DAA2** | **7 DAA3** | **7 DAA4** |
| **Control** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Pyganic** | 0.0 | 0.0 | 0.3 | 0.3 |
| **Azaguard** | 2.0 | 0.8 | 1.0 | 1.0 |
| **BoteGHA** | 0.5 | 0.5 | 0.5 | 0.8 |
| **Harvanta** | 2.8 | 4.0 | 4.0 | 4.0 |
| **Beleaf** | 2.8 | 2.8 | 2.5 | 4.0 |
| **Senstar** | 0.3 | 0.3 | 0.3 | 0.5 |

**Toxicity**
Pesticide toxicity was assessed weekly before aphid counting based on the following categories:
0 = no damage seen
1 = damage seen in ≤10% of the plant
2 = damage seen in 11-25% of the plant
3 = damage seen in 26-50% of the plant
4 = damage seen in >50% of the plant

Environmental conditions during the experiment:

Temperatures were between 70 to 75 F on plants grown in indoor conditions.