

# MISSISSIPPI SOYBEAN PROMOTION BOARD

## Management of Soybean Insect Pests, 01-2022 Annual Report

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### RATIONALE/JUSTIFICATION FOR RESEARCH:

Up to date non-biased information is critical for making any agricultural management decision, including insect management decisions. As production practices change, the impact of pests can change also. An example of this is greater risk from early season/soil insects as a result of reduced tillage and increased plant residue from the previous crop, native winter vegetation, and/or cover crops. Also, uncommon and unexpected insect pest issues can occur. For example, redbanded stink bug infestations were much more widespread during 2017 and 2022, and soybean looper during 2022. As a result, many studies were conducted with regard to management, damage potential, and treatment thresholds. Also, many current management tools are under reregistration review. It is possible that some of the older insecticides, which growers rely on, may have uses either restricted or revoked in the near future. With a limited number of insecticides already, this would make insect management in soybeans, and all crops more challenging. Insecticide resistance can be a major issue for insect management, and new insecticides are not being brought to market regularly anymore. “Routine” studies to evaluate current insecticides, along with reports from growers and consultants provide the first indications of pending insecticide resistance issues. Current market conditions have reduced profit margins considerably. The most informed and economical insect management decision is always important, but may be even more important when profit margins are small. To keep information current, studies must be regularly conducted to evaluate management strategies and tools and to provide information on unexpected insect issues.

### Objectives:

To provide up to date information on insect management strategies/tools for soybean insect pests.

### Summary

During 2022 experiments were conducted to evaluate the performance of selected insecticides against a range of soybean insect pests including, seedling/soil insects (corn rootworm, wireworm, pea leaf weevil), bean leaf beetle, soybean looper, and stink bugs (including redbanded stink bug).

Two experiments were conducted to evaluate the performance of at-planting insecticides against seedling/soil pests. In the first trial, selected insecticide seed treatments and seed treatment packages were evaluated. At 23 DAE all of the insecticide seed treatments resulted in greater plant population than Evergol Energy Soybean (Fungicide Only) (Table 1). No differences in yield were observed. In the second experiment, there were no differences among treatments for plant density or yield (Table 2).

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One experiment was conducted to evaluate the performance of selected insecticides against bean leaf beetle infesting soybeans (Table 3). At 2 DAT only Acephate, Acephate plus Sniper, and Sevin reduced bean leaf beetle densities compared to the non-treated. At 6 DAT only Acephate plus Sniper and Sevin reduced bean leaf beetle densities compared to the non-treated. There were no differences among treatments at 13 DAT.

Four experiments were conducted to evaluate the performance of selected insecticides against soybean looper. In the first experiment, all of the insecticides reduced looper numbers compared to the non-treated at 5 DAT (Table 4). Also, plots treated with Intrepid Edge (either rate) had fewer larvae than plots treated with Intrepid, Besiege, or Vantacor (regardless of rate). At 7 DAT all of the insecticides, except Besiege (both rates) and Vantacor (1.2 oz), reduce looper densities compared to the non-treated. Differences in looper numbers were observed among treatments at 11 DAT, but overall densities had declined substantially (>8 / 25 sweeps in non-treated plots). In the second experiment all of the insecticides reduced looper densities compared to the non-treated at 2, 4, 7 and 11 DAT (Table 5). Also, all of the insecticide resulted in greater yield than the non-treated. In this trial two formulations of methoxyfenozide were evaluated. There were no difference between the two methoxyfenozide products (Intrepid and Troubadour) at any rating date or for yield. In the third trial, only Intrepid Edge, Besiege, Steward, and Vantacor reduced looper densities compared to the non-treated at 5 and 7 DAT (Table 6). At 11 DAT only Steward and Vantacor reduced soybean looper numbers compared to the non-treated, but looper numbers had declined substantially since 7 DAT. In the fourth trial, all of the insecticides reduced soybean looper larval densities compared to the non-treated at 5 and 10 DAT (Table 7). Steward resulted in fewer larvae compared to the other insecticides 5 DAT. At 10 DAT Intrepid Edge and Steward resulted in fewer loopers than Acephate plus Warrior and Besiege. At 12 DAT all of the insecticides, except Besiege, reduced larval densities compared to the non-treated. Vantacor, Intrepid Edge, and Steward resulted in fewer larvae than Acephate plus Warrior and Besiege. At 19 DAT all of the insecticides resulted in less defoliation compared to the non-treated. Vantacor and Steward resulted in less defoliation than Acephate plus Warrior.

Five experiments were conducted to evaluate the performance of selected insecticides against redbanded stink bug. In the first trial, all of the insecticides reduced redbanded stink bugs compared to the non-treated (Table 8). At 7 DAT all of the insecticides, except Wrangler, resulted in fewer redbanded stink bugs than the non-treated control. Leverage 360 plus Acephate reduced stink bug densities compared to Sniper, Wrangler, and Sniper plus Wrangler. All of the insecticides, except Wrangler, maintained stink bug densities below threshold (4 / 25 sweeps). At 14 DAT none of the insecticides maintained stink bug densities below threshold. Also none of the insecticides reduced stink bug densities below that in the non-treated control. In the second trial, redbanded stink bug densities were relatively low at 2 and 7 DAT (Table 9). All of the insecticides reduced stink bug densities at 2 DAT compared to the non-treated. There were no differences among treatments for stink bug densities at 7 or 14 DAT. By 14 DAT redbanded stink bug densities had greatly exceeded threshold in all plots. In the third trial, all of the insecticides, except Warrior, Sniper (5.12 oz/acre) and Wrangler, reduced redbanded stink bugs below that observed in the non-treated plots at 3 DAT (Figure 10). At 6 DAT, all of the insecticides, except Sniper (5.12 oz /acre), Wrangler, and Baythroid reduced stink bug densities compared to the non-treated. Endigo reduced stink bug numbers compared to all other treatments. At 10 DAT, only Acephate (0.75 lb AI/acre), Leverage 360, and Endigo reduced stink bug densities compared to the non-treated. Also these were the only treatments that reduced stink bug densities below threshold. At 14 DAT, all of the insecticides, except Wrangler, reduced stink bug densities compared to the non-treated. In the fourth trial, all of the insecticides reduced redbanded stink bugs compared to the non-treated at 3 DAT (Figure 11). At 6 DAT only Sniper,

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Endigo, and Sniper plus Acephate reduced stink bug densities compared to the non-treated. At 10 DAT all of the insecticides reduced stink bug densities compared to the non-treated. However, none reduced stink bug densities below threshold at 10 DAT. In the fifth experiment, all of the insecticides reduced stink bug densities compared to the non-treated at 3 DAT (Table 12.) At 6 DAT, all of the insecticides, except Wrangler, reduced stink bug densities compared to the non-treated. All of the insecticides, except Wrangler and Sniper plus Wrangler maintained stink bug numbers below threshold at 6 DAT. At 10 DAT, all of the insecticides reduced stink bug numbers compared to the non-treated. Endigo resulted in fewer stink bugs than all other insecticides. Only Endigo and Leverage 360 plus Acephate maintained stink bugs below threshold. At 14 DAT all of the insecticides resulted in fewer stink bugs than the non-treated. However, none of the insecticides maintained stink bugs below threshold.

Two trial were conducted to evaluate the impact of termination timing of insecticides for redbanded stink bugs on yield and seed quality. In both trials, termination timing (R6 or later) did not impact yield or 100 seed weight (Figures 13 and 14). However, both trials were non-irrigated and soil conditions were very dry. Plant in both trial matured rapidly, progressing from ca. R5.5 to ca. R7.5 in ca. 14 days. Under conditions of higher soil moisture, maturation would have taken longer. This longer period to maturity possibly would have contributed to different results.

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Table 1. Impact of selected soybean seed treatment packages on stand establishment and yield.

| Treatment                                             | Rate<br>fl oz/cwt  | Insecticide<br>component                        | Plants per acre<br>23 DAE <sup>e</sup> | Yield<br>bu/acre |
|-------------------------------------------------------|--------------------|-------------------------------------------------|----------------------------------------|------------------|
| Evergol Energy Soybean                                | 1.0                | -                                               | 69,587c                                | 33.7             |
| Evergol Energy Soybean +<br>Poncho/Votivo             | 1.0 +<br>3.28      | Poncho <sup>a</sup>                             | 94,743ab                               | 39.9             |
| CruiserMaxx Vibrance                                  | 3.2                | Cruiser <sup>b</sup>                            | 97,847a                                | 43.4             |
| CruiserMaxx Vibrance +<br>Avicta                      | 3.2<br>3.0         | Cruiser <sup>b</sup>                            | 92,620ab                               | 41.4             |
| Intego Suite                                          | 3.37               | Nipsit <sup>a</sup>                             | 97,357a                                | 42.3             |
| Evergol Energy Soybean +<br>Gaucho                    | 1.0 +<br>2.5       | Gaucho <sup>c</sup>                             | 99,154a                                | 45.6             |
| Evergol Energy Soybean +<br>Poncho/Votivo +<br>Gaucho | 1.0<br>3.28<br>2.5 | Poncho <sup>a</sup> +<br>Gaucho <sup>c</sup>    | 83,309b                                | 43.0             |
| Vibrance Trio +<br>Fortenza                           | 1.55<br>1.084      | Fortenza <sup>d</sup>                           | 86,379ab                               | 38.8             |
| CruiserMaxx Vibrance +<br>Fortenza                    | 3.2<br>1.084       | Cruiser <sup>b</sup> +<br>Fortenza <sup>d</sup> | 100,134a                               | 41.4             |
| <i>P&gt;F</i>                                         |                    |                                                 | <0.01                                  | 0.37             |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Active ingredient – Clothianidin, Class - Neonicotinoid.

<sup>b</sup>Active ingredient – Thiamethoxam, Class - Neonicotinoid.

<sup>c</sup>Active ingredient – Imidacloprid, Class - Neonicotinoid.

<sup>d</sup>Active ingredient – Cyantraniliprole, Class - Diamide.

<sup>e</sup>DAE=Days after emergence.

Table 2. Impact of selected insecticide seed treatments on stand establishment and yield.

| Treatment                    | Rate                | Plants/acre 18 DAE <sup>h</sup> | Yield (bu/acre) |
|------------------------------|---------------------|---------------------------------|-----------------|
| Non-Treated                  | -                   | 65,503                          | 34.7            |
| Gaucho 5FS <sup>a</sup>      | 2.5 <sup>e</sup>    | 68,934                          | 33.8            |
| Poncho 5FS <sup>b</sup>      | 0.11 <sup>f</sup>   | 61,583                          | 32.6            |
| Dermacor 5.21FS <sup>c</sup> | 0.0057 <sup>f</sup> | 78,898                          | 34.1            |
| Fortenza 5.21FS <sup>d</sup> | 0.0057 <sup>f</sup> | 63,707                          | 35.2            |
| Brigade 2EC                  | 3.9 <sup>g</sup>    | 70,241                          | 34.7            |
| <i>P&gt;F</i>                |                     | 0.12                            | 0.94            |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ). All seed received a fungicide seed treatment.

<sup>a</sup>Active ingredient – Imidacloprid, Class - Neonicotinoid.

<sup>b</sup>Active ingredient – Clothianidin, Class - Neonicotinoid.

<sup>c</sup>Active ingredient – Chlorantraniliprole, Class - Diamide.

<sup>d</sup>Active ingredient – Cyantraniliprole, Class - Diamide.

<sup>e</sup>fl oz/cwt seed. Seed treatment application.

<sup>f</sup>mg AI/seed. Seed treatment application.

<sup>g</sup>fl oz/acre. In-furrow spray application.

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<sup>h</sup>DAE=Days after emergence.

Table 3. Performance of selected insecticides against bean leaf beetle infesting soybeans.

| Treatment                                           | Rate/acre<br>(fl oz product) | Bean Leaf Beetle / 25 Sweeps |         |        |
|-----------------------------------------------------|------------------------------|------------------------------|---------|--------|
|                                                     |                              | 2 DAT <sup>g</sup>           | 6 DAT   | 13 DAT |
| Acephate 90S <sup>a</sup>                           | 0.75 <sup>f</sup>            | 9.6c                         | 21.7abc | 10.0   |
| Warrior 2.08CS <sup>b</sup>                         | 1.6                          | 21.4a                        | 21.2bc  | 8.5    |
| Baythroid XL 1EC <sup>c</sup>                       | 2.8                          | 15.7abc                      | 21.6abc | 8.5    |
| Sevin 4F <sup>d</sup>                               | 24.0                         | 2.4d                         | 13.5d   | 13.1   |
| Sniper 2EC <sup>e</sup>                             | 5.12                         | 20.2ab                       | 29.9a   | 9.4    |
| Acephate 90S <sup>a</sup> + Sniper 2EC <sup>e</sup> | 0.5 <sup>f</sup> + 5.12      | 12.1bc                       | 18.4cd  | 6.6    |
| Non-Treated                                         | -                            | 23.6a                        | 25.8ab  | 10.3   |
| <i>P&gt;F</i>                                       |                              | <0.01                        | <0.01   | 0.81   |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredients – Acephate, Class – Organophosphate.

<sup>b</sup>Active ingredient –  $\lambda$  Cyhalothrin, Class – Pyrethroid.

<sup>c</sup>Active ingredient –  $\beta$  Cyfluthrin, Class – Pyrethroid.

<sup>d</sup>Active ingredient – Carbaryl, Class – Carbamate.

<sup>e</sup>Active ingredients – Bifenthrin, Class – Pyrethroid.

<sup>f</sup>lb (wt) AI per acre.

<sup>g</sup>DAT=Days after treatment.

Table 4. Evaluation of selected insecticides against soybean looper, I.

| Treatment                      | Rate/acre<br>(fl oz product) | Soybean Looper / 25 Sweeps |         |        |
|--------------------------------|------------------------------|----------------------------|---------|--------|
|                                |                              | 5 DAT <sup>g</sup>         | 7 DAT   | 11 DAT |
| Intrepid Edge 3SC <sup>a</sup> | 4.0                          | 4.9e                       | 2.3d    | 2.0bcd |
| Intrepid Edge 3SC <sup>a</sup> | 5.0                          | 5.9de                      | 3.7cd   | 1.4bcd |
| Intrepid 2F <sup>b</sup>       | 4.0                          | 16.3bc                     | 6.9bcd  | 3.9ab  |
| Intrepid 2F <sup>b</sup>       | 6.0                          | 14.4bcd                    | 8.4bc   | 2.7bc  |
| Steward 1.25EC <sup>c</sup>    | 9.0                          | 6.0de                      | 2.1d    | 0.7d   |
| Besiege 1.252CS <sup>d</sup>   | 7.0                          | 24.6b                      | 11.3ab  | 2.7d   |
| Besiege 1.252CS <sup>d</sup>   | 10.0                         | 19.8bc                     | 10.2abc | 1.8bcd |
| Vanticor 5SC <sup>e</sup>      | 1.2                          | 20.4bc                     | 11.0ab  | 3.5abc |
| Vanticor 5SC <sup>e</sup>      | 1.71                         | 17.8bc                     | 5.8bcd  | 1.2cd  |
| Denim 0.16EC <sup>f</sup>      | 6.0                          | 10.0cde                    | 4.3bcd  | 7.8a   |
| Non-Treated                    | -                            | 52.5a                      | 18.6a   | 7.8a   |
| <i>P&gt;F</i>                  |                              | <0.01                      | <0.01   | <0.01  |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredients – Spinetoram plus Methoxyfenozide, Classes – Spinosyn and IGR.

<sup>b</sup>Active ingredient – Methoxyfenozide, Class – IGR.

<sup>c</sup>Active ingredient – Indoxacarb, Class – Oxydiazine.

<sup>d</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Chlorantraniliprole, Classes – Pyrethroid and Diamide.

<sup>e</sup>Active ingredient – Chlorantraniliprole, Class - Diamide.

<sup>f</sup>Active ingredient – Emamectin Benzoate, Class - Avermectin.

<sup>g</sup>DAE=Days after emergence.

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Table 5. Evaluation of methoxyfenozide formulations against soybean looper.

| Treatment                      | Rate/acre<br>(fl oz product) | Soybean Looper / 25 Sweeps |       |        | Yield<br>bu/acre |
|--------------------------------|------------------------------|----------------------------|-------|--------|------------------|
|                                |                              | 2 DAT <sup>c</sup>         | 7 DAT | 11 DAT |                  |
| Intrepid Edge 3SC <sup>a</sup> | 4.0                          | 4.4c                       | 1.9c  | 0.9b   | 36.9a            |
| Intrepid 2F <sup>b</sup>       | 4.0                          | 10.4bc                     | 5.8b  | 2.0b   | 34.7a            |
| Intrepid 2F <sup>b</sup>       | 6.0                          | 15.2b                      | 8.9b  | 1.7b   | 35.7a            |
| Intrepid 2F <sup>b</sup>       | 8.0                          | 9.4bc                      | 6.4b  | 2.3b   | 36.0a            |
| Troubadour 2F <sup>b</sup>     | 4.0                          | 15.6b                      | 7.0b  | 2.5b   | 35.2a            |
| Troubadour 2F <sup>b</sup>     | 6.0                          | 14.6b                      | 5.2b  | 1.4b   | 35.3a            |
| Troubadour 2F <sup>b</sup>     | 8.0                          | 9.0bc                      | 7.4b  | 2.2b   | 36.2a            |
| Non-Treated                    | -                            | 35.1a                      | 20.9a | 6.6a   | 21.9b            |
| <i>P&gt;F</i>                  |                              | <0.01                      | <0.01 | 0.04   | <0.01            |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Active ingredients – Spinetoram plus Methoxyfenozide, Classes – Spinosyn and IGR.

<sup>b</sup>Active ingredient – Methoxyfenozide, Class – IGR.

<sup>c</sup>DAE=Days after emergence.

Table 6. Evaluation of selected insecticides against soybean looper, II.

| Treatment                                             | Rate/acre<br>(fl oz product) | Soybean Looper / 25 Sweeps |        |        |
|-------------------------------------------------------|------------------------------|----------------------------|--------|--------|
|                                                       |                              | 5 DAT <sup>h</sup>         | 7 DAT  | 11 DAT |
| Intrepid Edge 3SC <sup>a</sup>                        | 4.0                          | 6.0d                       | 6.0cd  | 3.6cde |
| Besiege 1.252CS <sup>b</sup>                          | 7.0                          | 12.8cd                     | 4.3cd  | 3.1de  |
| Steward 1.25EC <sup>c</sup>                           | 9.0                          | 5.5d                       | 2.6d   | 1.7e   |
| Sniper 2EC <sup>d</sup>                               | 6.4                          | 57.0a                      | 27.1ab | 9.3abc |
| Sniper 2EC <sup>d</sup> + Acephate 90S <sup>e</sup>   | 6.4 +0.75                    | 39.0b                      | 19.9b  | 13.0ab |
| Sniper 2EC <sup>d</sup> + Diamond 0.43EC <sup>f</sup> | 6.4 +6.0                     | 59.5a                      | 31.5a  | 15.7a  |
| Diamond 0.43EC <sup>f</sup>                           | 6.0                          | 25.8bc                     | 19.6b  | 9.2abc |
| Diamond 0.43EC <sup>f</sup>                           | 9.0                          | 35.6b                      | 18.7b  | 10.7ab |
| Vanticor 5SC <sup>g</sup>                             | 1.7                          | 9.5cd                      | 8.6c   | 1.1e   |
| Non-Treated                                           | -                            | 40.5b                      | 25.6ab | 7.5bcd |
| <i>P&gt;F</i>                                         |                              | <0.01                      | <0.01  | <0.01  |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Active ingredients – Spinetoram plus Methoxyfenozide, Classes – Spinosyn and IGR.

<sup>b</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Chlorantraniliprole, Classes – Pyrethroid and Diamide.

<sup>c</sup>Active ingredient – indoxacarb, Class - Oxydiazine.

<sup>d</sup>Active ingredient – bifenthrin, Class - Pyrethroid.

<sup>e</sup>Active ingredient – acephate, Class - Organophosphate.

<sup>f</sup>Active ingredient – novaluron, Class – Insect Growth Regulator.

<sup>g</sup>Active ingredient – Chlorantraniliprole, Class – Diamide.

<sup>h</sup>DAE=Days after emergence.

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Table 7. Evaluation of selected insecticides against soybean looper, III.

| Treatment                                                  | Rate/acre<br>(fl oz product) | Soybean Looper / 25 Sweeps |        |        | % defoliation<br>19 DAT |
|------------------------------------------------------------|------------------------------|----------------------------|--------|--------|-------------------------|
|                                                            |                              | 5 DAT <sup>g</sup>         | 10 DAT | 12 DAT |                         |
| Vantacor 5SC <sup>a</sup>                                  | 6.7                          | 16.8b                      | 25.8cd | 12.5c  | 3.9c                    |
| Intrepid Edge 3SC <sup>b</sup>                             | 5.0                          | 2.9d                       | 8.0de  | 9.5c   | 7.1bc                   |
| Acephate 90S <sup>c</sup> +<br>Warrior 2.08CS <sup>d</sup> | 0.75+<br>1.92                | 7.3c                       | 37.5bc | 26.3b  | 11.2b                   |
| Steward 1.25EC <sup>e</sup>                                | 9.0                          | 0.0e                       | 1.8d   | 3.5c   | 3.4c                    |
| Besiege 1.252CS <sup>f</sup>                               | 7.0                          | 27.4b                      | 49.8b  | 35.5ab | 6.7bc                   |
| Non-Treated                                                | -                            | 58.3a                      | 78.5a  | 45.0a  | 63.0a                   |
| <i>P&gt;F</i>                                              |                              | <0.01                      | <0.01  | <0.01  | <0.01                   |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Active ingredient – Chlorantraniliprole, Class – Diamide.

<sup>b</sup>Active ingredients – Spinetoram plus Methoxyfenozide, Classes – Spinosyn and IGR.

<sup>c</sup>Active ingredient – acephate, Class - organophosphate.

<sup>d</sup>Active ingredient –  $\lambda$  Cyhalothrin, Class – Pyrethroid.

<sup>e</sup>Active ingredient – indoxacarb, Class - oxydiazine.

<sup>f</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Chlorantraniliprole, Classes – Pyrethroid and Diamide.

<sup>g</sup>DAE=Days after emergence.

Table 8. Evaluation of selected insecticides against redbanded stink bug, I.

| Treatment                                                 | Rate/acre<br>(fl oz product) | Redbanded Stink Bugs / 25 Sweeps <sup>g</sup> |        |         |
|-----------------------------------------------------------|------------------------------|-----------------------------------------------|--------|---------|
|                                                           |                              | 2 DAT <sup>h</sup>                            | 7 DAT  | 14 DAT  |
| Acephate 90S <sup>a</sup>                                 | 0.75 <sup>f</sup>            | 0.3b                                          | 1.6cd  | 13.9bcd |
| Endigo ZCX 2.7CS <sup>b</sup>                             | 4.5                          | 0.0b                                          | 1.9bcd | 20.2bc  |
| Sniper 2EC <sup>c</sup>                                   | 6.4                          | 0.3b                                          | 3.0bc  | 15.4bcd |
| Wrangler 4F <sup>d</sup>                                  | 1.5                          | 0.8b                                          | 4.3ab  | 10.7cd  |
| Leverage 360 3SC <sup>e</sup>                             | 2.8                          | 0.0b                                          | 1.2cd  | 24.4ab  |
| Belay 2.13SC <sup>f</sup>                                 | 4.0                          | 0.0b                                          | 2.3bcd | 11.9cd  |
| Sniper 2EC <sup>c</sup> + Acephate 90S <sup>a</sup>       | 6.4 + 0.75 <sup>f</sup>      | 0.0b                                          | 0.6cd  | 8.8d    |
| Sniper 2EC <sup>c</sup> + Wrangler 4F <sup>d</sup>        | 6.4 + 1.5                    | 0.3b                                          | 2.8bc  | 34.9a   |
| Leverage 360 3SC <sup>e</sup> + Acephate 90S <sup>a</sup> | 2.8 + 0.75 <sup>f</sup>      | 0.0b                                          | 0.3d   | 18.4bc  |
| Sniper 2EC <sup>c</sup> + Belay 2.13SC <sup>f</sup>       | 6.4 + 4.0                    | 0.0b                                          | 1.0cd  | 18.2bc  |
| Non-Treated                                               | -                            | 3.3a                                          | 8.1a   | 17.0bcd |
| <i>P&gt;F</i>                                             |                              | 0.04                                          | <0.01  | 0.01    |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Active ingredient – Acephate, Class – Organophosphate.

<sup>b</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Thiamethoxam, Classes – Pyrethroid and Neonicotinoid.

<sup>c</sup>Active ingredient – Bifenthrin, Class – Pyrethroid.

<sup>d</sup>Active ingredient – Imidacloprid, Class – Neonicotinoid.

<sup>e</sup>Active ingredient – Clothianidin, Class – Neonicotinoid.

<sup>f</sup>lb AI per acre.

<sup>g</sup>adults plus nymphs.

<sup>h</sup>DAT=Days after treatment.

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Table 9. Evaluation of selected insecticides against redbanded stink bug, II.

| Treatment                     | Rate/acre<br>(fl oz product) | Redbanded Stink Bugs / 25 Sweeps <sup>i</sup> |       |        |
|-------------------------------|------------------------------|-----------------------------------------------|-------|--------|
|                               |                              | 2 DAT <sup>j</sup>                            | 7 DAT | 14 DAT |
| Warrior 2.08CS <sup>a</sup>   | 1.92                         | 0.8b                                          | 2.0   | 33.3   |
| Sniper 2EC <sup>b</sup>       | 5.12                         | 1.0b                                          | 2.0   | 31.0   |
| Sniper 2EC <sup>b</sup>       | 6.4                          | 0.8b                                          | 1.3   | 34.4   |
| Endigo ZCX 2.7CS <sup>c</sup> | 4.5                          | 0.3b                                          | 1.9   | 35.2   |
| Acephate 90S <sup>d</sup>     | 0.5 <sup>h</sup>             | 0.3b                                          | 3.2   | 32.8   |
| Acephate 90S <sup>d</sup>     | 0.75 <sup>h</sup>            | 0.0b                                          | 1.4   | 34.5   |
| Leverage 360 3SC <sup>e</sup> | 2.8                          | 0.5b                                          | 1.7   | 31.6   |
| Wrangler 4F <sup>f</sup>      | 1.5                          | 0.5b                                          | 3.6   | 32.3   |
| Baythroid XL 1EC <sup>g</sup> | 2.8                          | 0.3b                                          | 0.3   | 34.1   |
| Non-Treated                   | -                            | 3.3a                                          | 5.2   | 32.0   |
| <i>P&gt;F</i>                 |                              | 0.03                                          | 0.06  | 0.50   |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredient –  $\lambda$  Cyhalothrin, Class – Pyrethroid.

<sup>b</sup>Active ingredient – Bifenthrin, Class – Pyrethroid.

<sup>c</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Thiamethoxam, Classes – Pyrethroid and Neonicotinoid.

<sup>d</sup>Active ingredient – Acephate, Class – Organophosphate.

<sup>e</sup>Active ingredients –  $\beta$  Cyfluthrin plus Imidacloprid, Classes – Pyrethroid and Neonicotinoid.

<sup>f</sup>Active ingredient – Imidacloprid, Class – Neonicotinoid.

<sup>g</sup>Active ingredient –  $\beta$  Cyfluthrin, Class – Pyrethroid.

<sup>h</sup>lb AI per acre.

<sup>i</sup>adults plus nymphs.

<sup>j</sup>DAT=Days after treatment.

Table 10. Evaluation of selected insecticides against redbanded stink bug, III.

| Treatment                     | Rate/acre<br>(fl oz product) | Redbanded Stink Bug / 25 Sweeps <sup>i</sup> |        |        |         |
|-------------------------------|------------------------------|----------------------------------------------|--------|--------|---------|
|                               |                              | 3 DAT <sup>j</sup>                           | 6 DAT  | 10 DAT | 14 DAT  |
| Warrior 2.08CS <sup>a</sup>   | 1.92                         | 3.9ab                                        | 3.1c   | 10.2ab | 8.7bc   |
| Sniper 2EC <sup>b</sup>       | 5.12                         | 1.6abc                                       | 8.1ab  | 11.8a  | 8.6bc   |
| Sniper 2EC <sup>b</sup>       | 6.4                          | 0.0d                                         | 3.4c   | 7.6abc | 7.9bc   |
| Endigo ZCX 2.7CS <sup>c</sup> | 4.5                          | 0.3cd                                        | 0.9d   | 3.4cd  | 4.9c    |
| Acephate 90S <sup>d</sup>     | 0.5 <sup>h</sup>             | 0.3cd                                        | 3.8c   | 4.6bcd | 10.9abc |
| Acephate 90S <sup>d</sup>     | 0.75 <sup>h</sup>            | 0.9bcd                                       | 4.2bc  | 2.9d   | 9.6bc   |
| Leverage 360 3SC <sup>e</sup> | 2.8                          | 0.7bcd                                       | 3.5c   | 1.8d   | 3.8c    |
| Wrangler 4F <sup>f</sup>      | 1.5                          | 1.7abc                                       | 8.6ab  | 8.0abc | 14.0ab  |
| Baythroid XL 1EC <sup>g</sup> | 2.8                          | 0.3cd                                        | 4.3abc | 8.1abc | 6.9bc   |
| Non-Treated                   | -                            | 4.9a                                         | 9.6a   | 10.9ab | 21.0a   |
| <i>P&gt;F</i>                 |                              | 0.02                                         | <0.01  | <0.01  | 0.03    |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredient –  $\lambda$  Cyhalothrin, Class – Pyrethroid.

<sup>b</sup>Active ingredient – Bifenthrin, Class – Pyrethroid.

<sup>c</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Thiamethoxam, Classes – Pyrethroid and Neonicotinoid.

<sup>d</sup>Active ingredient – Acephate, Class – Organophosphate.

<sup>e</sup>Active ingredients –  $\beta$  Cyfluthrin plus Imidacloprid, Classes – Pyrethroid and Neonicotinoid.

<sup>f</sup>Active ingredient – Imidacloprid, Class – Neonicotinoid.

<sup>g</sup>Active ingredient –  $\beta$  Cyfluthrin, Class – Pyrethroid.

<sup>h</sup>lb AI per acre.

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<sup>i</sup>adults plus nymphs.

<sup>j</sup>DAT=Days after treatment.

Table 11. Evaluation of selected insecticides against redbanded stink bug, IV.

| Treatment                                           | Rate/acre<br>(fl oz product) | Redbanded Stink Bugs / 25 Sweeps <sup>f</sup> |       |        |
|-----------------------------------------------------|------------------------------|-----------------------------------------------|-------|--------|
|                                                     |                              | 3 DAT <sup>g</sup>                            | 6 DAT | 10 DAT |
| Sniper 2EC <sup>a</sup>                             | 6.4                          | 0.9bcd                                        | 1.9bc | 10.9b  |
| Acephate 90S <sup>b</sup>                           | 0.75 <sup>e</sup>            | 1.4b                                          | 2.7ab | 6.9b   |
| Sevin 4F <sup>c</sup>                               | 16.0                         | 1.2bc                                         | 4.6ab | 11.2b  |
| Endigo ZCX 2.7CS <sup>d</sup>                       | 4.5                          | 0.2cd                                         | 1.2bc | 7.3b   |
| Sniper 2EC <sup>a</sup> + Sevin 4F <sup>c</sup>     | 6.4 + 16.0                   | 0.0d                                          | 2.6ab | 9.3b   |
| Sniper 2EC <sup>a</sup> + Acephate 90S <sup>b</sup> | 6.4 + 0.75 <sup>e</sup>      | 0.2cd                                         | 0.2c  | 7.0b   |
| Non-Treated                                         | -                            | 6.5a                                          | 8.2a  | 19.7a  |
| <i>P&gt;F</i>                                       |                              | <0.01                                         | 0.02  | <0.01  |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredient – Bifenthrin, Class – Pyrethroid.

<sup>b</sup>Active ingredient – Acephate, Class – Organophosphate.

<sup>c</sup>Active ingredient – Carbaryl, Class – Carbamate.

<sup>d</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Thiamethoxam, Classes – Pyrethroid and Neonicotinoid.

<sup>e</sup>lb AI per acre.

<sup>f</sup>adults plus nymphs.

<sup>g</sup>DAT=Days after treatment.

Table 12. Evaluation of selected insecticides against redbanded stink bug, V.

| Treatment                                                    | Rate/acre<br>(fl oz product) | Redbanded Stink Bug / 25 Sweeps <sup>g</sup> |       |        |        |
|--------------------------------------------------------------|------------------------------|----------------------------------------------|-------|--------|--------|
|                                                              |                              | 3 DAT <sup>h</sup>                           | 6 DAT | 10 DAT | 14 DAT |
| Acephate 90S <sup>a</sup>                                    | 0.75 <sup>f</sup>            | 0.9b                                         | 2.5bc | 13.2b  | 33.8b  |
| Endigo ZCX 2.7CS <sup>b</sup>                                | 4.5                          | 0.4b                                         | 1.2c  | 1.2e   | 8.5cd  |
| Sniper 2EC <sup>c</sup>                                      | 6.4                          | 0.2b                                         | 3.3bc | 9.1bcd | 9.5cd  |
| Wrangler 4F <sup>d</sup>                                     | 1.5                          | 4.1b                                         | 13.1a | 11.9bc | 19.3c  |
| Leverage 360 3SC <sup>e</sup>                                | 2.8                          | 0.3b                                         | 2.0bc | 4.2d   | 6.5cd  |
| Belay 2.13SC <sup>f</sup>                                    | 4.0                          | 0.8b                                         | 2.5bc | 5.8bcd | 10.0cd |
| Sniper 2EC <sup>c</sup> +<br>Acephate 90S <sup>a</sup>       | 6.4 + 0.75 <sup>f</sup>      | 1.0b                                         | 3.4bc | 4.8cd  | 9.3cd  |
| Sniper 2EC <sup>c</sup> +<br>Wrangler 4F <sup>d</sup>        | 6.4 + 1.5                    | 1.4b                                         | 4.8b  | 5.6bcd | 15.0cd |
| Leverage 360 3SC <sup>e</sup><br>+ Acephate 90S <sup>a</sup> | 2.8 + 0.75 <sup>f</sup>      | 0.4b                                         | 3.2bc | 3.7de  | 4.5d   |
| Sniper 2EC <sup>c</sup> +<br>Belay 2.13SC <sup>f</sup>       | 6.4 + 4.0                    | 0.6b                                         | 3.8bc | 4.2d   | 14.5cd |
| Non-Treated                                                  | -                            | 9.1b                                         | 20.2a | 53.0a  | 52.5a  |
| <i>P&gt;F</i>                                                |                              | <0.01                                        | <0.01 | <0.01  | <0.01  |

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

<sup>a</sup>Active ingredient – Acephate, Class – Organophosphate.

<sup>b</sup>Active ingredients –  $\lambda$  Cyhalothrin plus Thiamethoxam, Classes – Pyrethroid and Neonicotinoid.

<sup>c</sup>Active ingredient – Bifenthrin, Class – Pyrethroid.

<sup>d</sup>Active ingredient – Imidacloprid, Class – Neonicotinoid.

<sup>e</sup>Active ingredient – Clothianidin, Class – Neonicotinoid.

<sup>f</sup>lb AI per acre.

<sup>g</sup>adults plus nymphs.

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<sup>h</sup>DAT=Days after treatment.

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Table 13. Evaluation of insecticide termination timings for redbanded stink bug, I.

| Treatment <sup>a</sup>                            | Redbanded Stink Bugs / 25 Sweeps |              |                |               | Yield<br>bu/acre | 100 seed<br>wt (grams) |
|---------------------------------------------------|----------------------------------|--------------|----------------|---------------|------------------|------------------------|
|                                                   | 14-Sep<br>R 5.8                  | 22-Sep<br>R6 | 29-Sep<br>R6.8 | 5-Oct<br>R7.5 |                  |                        |
| Terminate at R6 <sup>bc</sup><br>Threshold = 4    | 0.8                              | 9.0bc        | 21.3a          | 16.0a         | 31.2             | 14.3                   |
| Terminate at R6.5 <sup>bde</sup><br>Threshold = 4 | 1.3                              | 5.8c         | 0.4b           | 2.3b          | 32.6             | 14.2                   |
| Terminate at R7 <sup>bdf</sup><br>Threshold = 10  | 1.1                              | 9.8bc        | 0.9b           | 5.5b          | 29.5             | 14.4                   |
| Terminate at R8 <sup>bdf</sup><br>Threshold = 10  | 0.7                              | 13.8b        | 0.4b           | 4.3b          | 33.3             | 14.2                   |
| Non-Treated                                       | 3.0                              | 24.8a        | 25.2a          | 17.0a         | 27.3             | 13.3                   |
| P>F                                               | 0.33                             | <0.01        | <0.01          | <0.01         | 0.15             | 0.13                   |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Growth stage when insecticide applications for redbanded stink bugs terminated and treatment threshold for redbanded stink bugs up to that growth stage (no./ 25 sweeps).

<sup>b</sup>Plots treated with Sniper 2EC 6.4 oz. acre plus acephate 0.75 lb AI / acre on 8-Sep, R5.5.

<sup>c</sup>Insecticide applications terminated on 22-Sep, no applications after 8-Sep.

<sup>d</sup>Plots treated with Sniper 2EC 6.4 oz. acre plus acephate 0.75 lb AI / acre on 22-Sep.

<sup>e</sup>Insecticide applications terminated on 29-Sep, no applications after 22-Sep.

<sup>f</sup>Stink bug densities in these plots did not exceed threshold (10 / 25 sweeps) after the R6 (22-Sep) application through R8.

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Table 14. Evaluation of insecticide termination timings for redbanded stink bug, II.

| Treatment <sup>a</sup>                            | Redbanded Stink Bugs / 25 Sweeps |              |               |                | Yield<br>bu/acre | 100 seed<br>wt (grams) |
|---------------------------------------------------|----------------------------------|--------------|---------------|----------------|------------------|------------------------|
|                                                   | 22-Sep<br>R 5.7                  | 29-Sep<br>R6 | 5-Oct<br>R6.5 | 13-Oct<br>R7.6 |                  |                        |
| Terminate at R6 <sup>bcd</sup><br>Threshold = 4   | 2.0b                             | 8.6b         | 1.3b          | 1.0            | 28.0a            | 16.6a                  |
| Terminate at R6.5 <sup>bde</sup><br>Threshold = 4 | 1.2b                             | 12.7b        | 0.6b          | 0.7            | 29.5a            | 13.4a                  |
| Terminate at R7 <sup>bdf</sup><br>Threshold = 10  | 1.4b                             | 13.5b        | 1.1b          | 0.6            | 29.0a            | 13.1a                  |
| Terminate at R8 <sup>bdf</sup><br>Threshold = 10  | 2.0b                             | 10.8b        | 1.0b          | 1.2            | 26.7a            | 16.6a                  |
| Non-Treated                                       | 39.7a                            | 72.8a        | 38.8a         | 10.9           | 14.5b            | 9.6b                   |
| P>F                                               | <0.01                            | <0.01        | <0.01         | 0.06           | 0.01             | 0.01                   |

Means within columns followed by a common letter are not significantly different (FPLSD,  $P=0.05$ ).

<sup>a</sup>Growth stage when insecticide applications for redbanded stink bugs terminated and treatment threshold for redbanded stink bugs up to that growth stage (no./ 25 sweeps).

<sup>b</sup>Plots treated with Sniper 2EC 6.4 oz. acre plus acephate 0.75 lb AI / acre on 14-Sep, R5.5.

<sup>c</sup>Insecticide applications terminated after 29-Sep application.

<sup>d</sup>Plots treated with Sniper 2EC 6.4 oz. acre plus acephate 0.75 lb AI / acre on 29-Sep.

<sup>e</sup>Insecticide applications terminated on 5-Oct, no applications after 29-Sep.

<sup>f</sup>Stink bug densities in these plots did not exceed threshold (10 / 25 sweeps) after the R6 (29-Sep) application through R8.