Non-target effects of GS2 to control Colorado Potato Beetles

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Abstract

Pesticides are commonly used to prevent insect damage in agriculture. However, continuous pesticide application eventually leads to the development of pesticide resistant insects such as the Colorado Potato Beetle (*Leptinotarsa decemlineata*). A bio pesticide developed by GreenLight Biosciences called GS2 uses double-stranded RNA to target and destroy a specific sequence in *L. decemlineata*'s DNA. To test for potential non-target effects, fields were given seven different treatments including untreated, GS2, broad-spectrum insecticides, and GS2 + insect specific pesticides. Both ground insects from pitfall traps and canopy insects from the potato foliage were collected, sorted, and categorized as beneficial, harmful, or neutral. The average numbers from the four replicate blocks of each treatment were then taken and compared by date. The results indicated that GS2 had no non-target effects except on beneficial ground insects where treatments with GS2 had reduced numbers even compared a treatment which utilized two broad-spectrum insecticides (Agri-mek and Asana).

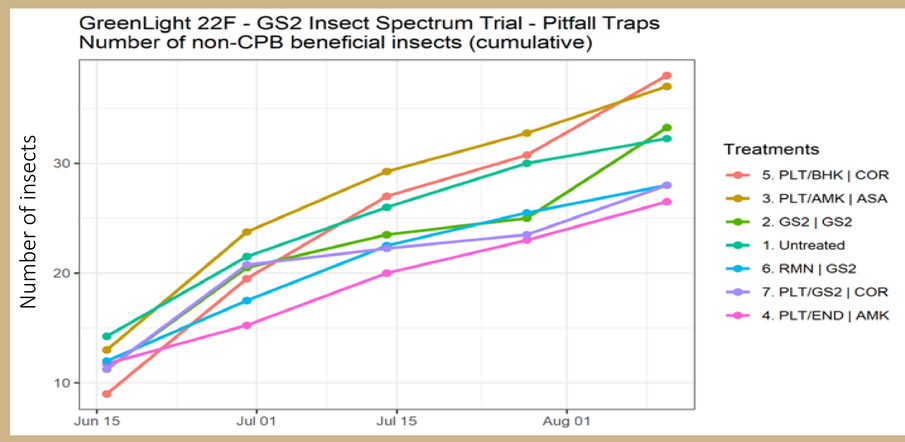
Introduction

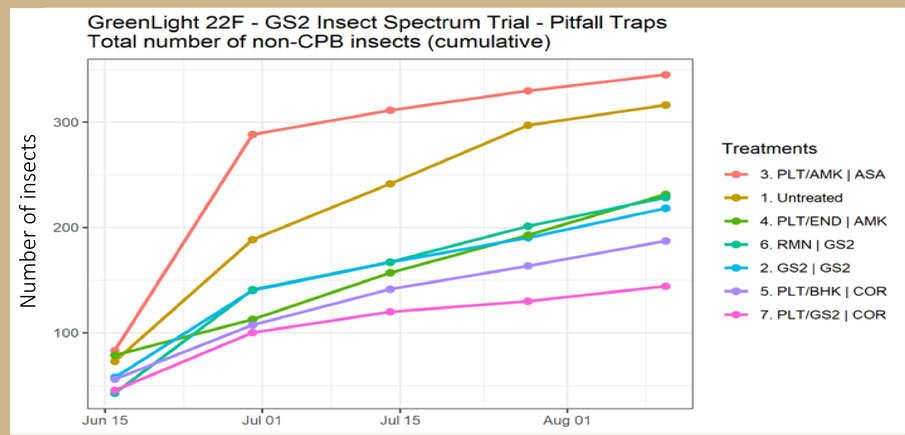
- Colorado Potato Beetles (*Leptinotarsa decemlineata*) are a pesticide resistant potato defoliator
- GS2 uses double-stranded RNA (dsRNA) developed from a unique segment of the beetle's DNA to inhibit the the synthesis of an essential protein
- GS2 should be taxa specific and only target *L. decemlineata*.
- Seven treatments were made to compare GS2 to other conventional pesticides
- GS2 should display similar insect abundance to untreated plots, indicating no non-target effects.

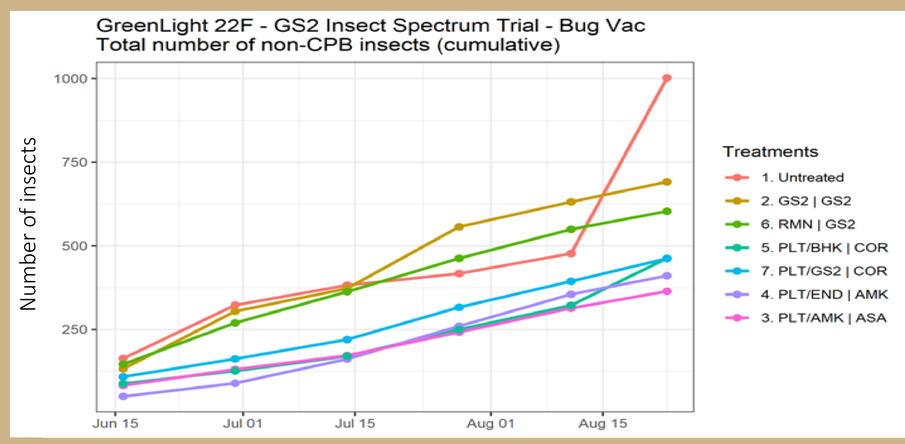
Methods

1. Untreated: no pesticide applications, natural insect spectrum
2. GS2: Only GS2, should preserve insect spectrum
3. PLT/AMK (ASA): Platinum (insecticide taken into plant tissues), Agri-Mek and Asana (foliar broad-spectrum insecticides), expected to greatly reduce insect spectrum
4. PLT/END (AMK): Platinum (insecticide taken into plant tissues), Endigo and Asana (foliar broad-spectrum insecticides), expected to greatly reduce inspect spectrum
5. PLT/BHK: Platinum (insecticide taken into plant tissues) and Blackhawk (foliar medium-spectrum), expected to reduce insect spectrum
6. RMN (GS2): Uses Rimon (specific insect growth inhibitor) and GS2, expected to slightly reduce insect spectrum
7. PLT/GS2 (COR): Uses Platinum (insecticide taken into plant tissues), GS2, and Coragen (narrow-spectrum insecticide), expected to slightly reduce insect spectrum.

Ground insects (pitfall traps) and canopy insects (Bug Vac) from potato foliage were collected, identified, and categorized as beneficial, harmful, or neutral in respect to potato plants.







(Top) Compares the number of beneficial ground insects by treatment number for each date and distinguishes insect abundance by color. (Middle) Compares the cumulative number of ground insects (beneficial, harmful, and neutral) by treatment number for each date and distinguishes insect abundance by color. (bottom) Compares the cumulative number of canopy insects (Beneficial, harmful, and neutral) by treatment number for each date and distinguishes insect abundance by color.

Results

• Treatments with GS2 displayed smaller numbers of beneficial ground insects

•Treatments with GS2 displayed smaller cumulative numbers of non-Colorado Potato Beetle ground insects (beneficial, harmful and neutral)

•Treatments with GS2 displayed larger cumulative numbers of non-Colorado Potato Beetle canopy insects (beneficial, harmful and neutral)

Discussion/Conclusions

- The lowered numerical trend of beneficial ground insects in GS2 treated plots possibly indicate a potential non-target effect, but the p-value indicated that this evidence was insufficient for all but the last date
- The lowered cumulative number of non-Colorado Potato Beetle ground insects in GS2 treated plots indicate a potential non-target effect on ground insects, but all the p-values indicate that this evidence is insufficient
- The increased cumulative number of non-Colorado Potato Beetle canopy insects indicates no non-target affect, and all the p-values indicated at least moderate evidence for this except one (August 11)
- There is moderate evidence that GS2 has no non-target effects on canopy insects, but the non-target effects on ground insects is inconclusive
- It will be important for future GS2 insect spectrum surveys to reassess for potentially significant non-target effects on ground insects

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