Grandevo™ - A New Biopesticide

prepared by **Marrone Bio Innovations**

Grandevo®, manufactured by Marrone Bio Innovations, is a new *biopesticide* with broad-spectrum control of various insects and mites, such as Asian Citrus Psyllids (*Diaphorina citri*), Twospotted Spider Mites (*Tetranychus urticae*), Beet Armyworms (*Spodoptera exigua*), and Sweet Potato Whiteflies (*Lycopersicon esculentum*). The active ingredient is a newly discovered *bacterium* that is effective in controlling pests by repellency, oral toxicity, reduced reproduction and egg viability. It is labeled for use on several agriculture crops, such as: Alfalfa, Cole crops, Bushberries, Citrus, Cotton, Cucurbits, Buckwheat, Fruiting Vegetables, Pome Fruits, Most Herbs.

While Grandevo has shown no effects on most beneficial insects, honey bees had yet to be tested in field conditions. Many of the labeled crops are pollinated or visited by honey bees. Therefore, a study was developed by Eurofins Agroscience Services, Inc., to determine the effects of exposure of honey bees to Grandevo. The study took place in summer 2012 and was directed by Jessica Lawrence in central North Carolina.

The study was designed with three treatment groups; Grandevo, applied as pre-flowering spray and again seven days later during full bloom and bee flight (Treatment T), a toxic reference treatment of dimethoate (Treatment R) during full bloom and bee flight, and a water application (Treatment C). The application rate was three pounds per acre of Grandevo for Treatment T and 1 Liter of product per hectare of dimethoate for Treatment R.

Each treatment was tested by spraying a plot of buckwheat (Approximately 20' x 90') that was in an enclosed mesh tunnel, with 3 plots per treatment. The buckwheat crop was grown with no other chemicals used in the field. Grandevo was applied to the treatment T plots during pre-bloom. Honey bee colonies were placed in the tunnels at beginning of flowering, four days before the second application of treatment T and the only application of treatment R (dimethoate) and treatment C (water). Mortality of the bees in front of the hives was recorded over four consecutive days inside the tunnels up to the application of Treatments C and R (second application of T). The mortality, foraging activity and behavior of the bees were checked over seven days after the start of exposure inside the tunnels. The condition of the colonies and the brood development were assessed once before and four times after set up of the colonies in the tunnels. The influence of the test item was evaluated by comparing the data from assessments of the treatment group T to the reference item group R and the control C.

Honey Bee Mortality

Mortality was observed by using dead bee traps in front of the hives, as well as a mesh layer inside the tunnel that included the first five feet inside the tunnel, a two-foot wide strip down the center of the tunnel, and a five-foot strip at the back of the tunnel. Dead bees generally accumulate at the ends of a tunnel, so the mesh strip placement would account for bee mortality. Each time bees were counted, the traps were emptied and the mesh was cleared of dead bees.

On the day of the start of exposure after the application in treatments T, C and R (corresponding to seven days after the initial application in T) the mean mortality in group R (dimethoate) was higher compared to the treatment and control groups with 30.0 bees/colony in C (water), 24.1 bees/colony in T (Grandevo) and 1808 bees/colony in R (dimethoate).

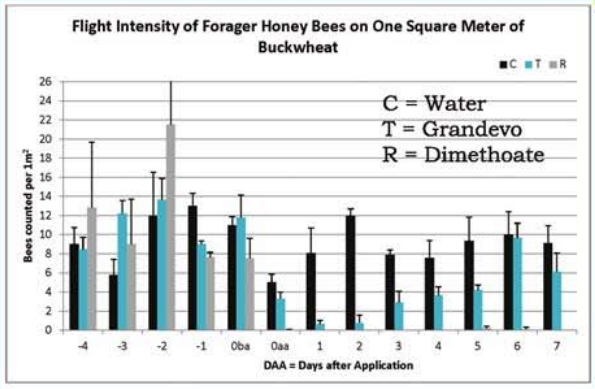
Honey Bee Flight Intensity

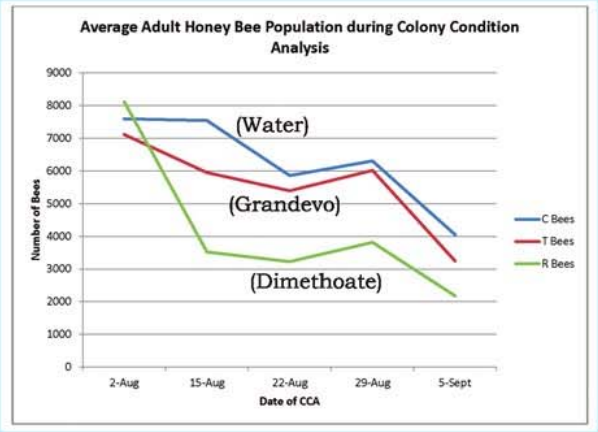
Flight intensity was recorded by monitoring a small section of buckwheat blossoms (approximately 1m²) for 30 seconds and counting the number of foragers present. During the first few days after exposure the flight intensity was temporarily reduced in the test item (T) group. On 4 (DAA = Days After Application) DAA2 flight intensity started to recover in the T group and by six DAA2 was similar to flight intensity in the C group, indicating a temporary repellency effect of bees. For comparison, the flight intensity in the reference group was significantly decreased compared to control during the entire exposure period. The mean flight intensity after the application was 9.1 bees/m² in the C (water) group, 4.0 bees/m² in the T (Grandevo) group. Flight intensity was 0.0 bees/m² in the R (dimethoate) group.

Condition of the Colonies

Colony Condition Assessments were conducted at five points in the study to monitor the overall effect on the hive. These assessments call for observations of the percentage of area covered by bees, open brood, capped brood, honey and pollen, and the presence or absence of pests and diseases in the hive. The percentage is then used to determine the overall area in the hive by calculating with one side of one frame being 100% = 860 cm². Each side of the 10 frames was observed. Overall strength was determined by the adult bee population.

The strength of the colonies in the control decreased over the course of the study. In the test item treatment group the number of bees per hive decreased during the exposure, but mirrored the patterns of the control hives throughout the study, although there was a slightly stronger impact during the exposure. In the reference item group the number of bees per colony decreased by





over half during the exposure period, but there was less than approximately 1,000 adult bees as the difference in population numbers in all three groups by the end of the study.

The number of cells containing brood decreased during the enclosure in the tunnels until DAA2 15 in all treatment groups. From 15 DAA2 onwards until end of the study at 28 DAA2 the proportion of brood increased in all treatment groups. No differences between the control and the test item treated colonies were observed.

Conclusions

The test item Grandevo was applied at pre-bloom, and again seven days later at full bloom during bee flight, at the which time the other two treatments were also applied. Grandevo was applied at a nominal rate of 3 pounds per acre to achieve the maximum label rate and usage.

The water treated control and reference item were applied during daily bee flight at full flowering of buckwheat. All applications were carried out with a spray volume of 9.35 L water/plot.

There was no effect on the bees of buckwheat pre-treatment with Grandevo three days prior to transfer of the bees to the treated tunnel. No effects on bee mortality or behavior compared to control were identified. No statistically significant increase in mortality was observed during the post application period for the test item treatment group.

A temporary decline in flight intensity was observed during the exposure period for the test item treatment group, which indicates a temporary, but non-lethal repellency effect of the test substance.

No unnatural decline of colony strength and brood development was observed in the test item and reference item groups and the control throughout the study. BC

For more information about Grandevo® bioinsecticide visit ***www.marronebioinnovations.com.***