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Foliar Feeders Management

BotaniGard® Technical Bulletin

BotaniGard ES and Bt Combinations

Foliar feeding lepidopteran pests such as diamondback moth, cabbage looper and the imported cabbage worm pose a persistent threat to producers of leafy vegetables. While light feeding pressure may be tolerable with the removal of outer leaves, heavier damage may result in complete loss of marketability and profits.

The bacterial insecticide *Bacillus thuringiensis* (Bt) has been a safe and useful tool in combating these pests. Recently increased tolerance to Bt has become more common and species such as the diamondback moth are showing resistance to field applications. USDA research has shown that BotaniGard ES, containing the insecticide *Beauveria bassiana*, provides significant control of Bt resistant diamondback moth. It has also been shown that while Bt is most effective on 1st -2nd instar larvae, Beauveria is most effective on 3rd and 4th instar larvae.

Table 1: Control of Bt resistant diamondback moth larvae on cabbage. USDA 1997.

Treatment	Larvae per seedling
BotaniGard @ 1 qt/acre	0.34
Javelin @ 1 lb/acre	1.51
Untreated check	1.42

Table 2: Percent mortality of diamondback moth larvae inoculated with BotaniGard at different instars. USDA 1997.

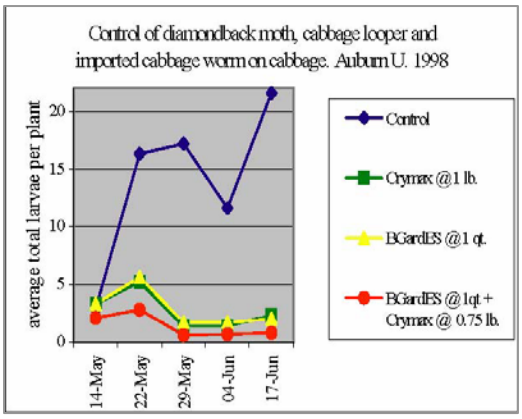
Instar	No. of larvae tested	% mortality
2nd	65	74%
3rd	87	83%
4th	83	100%

Based on the above data the addition of *Beauveria* to Bt in tank mixture or in alternation in your pest control program should:

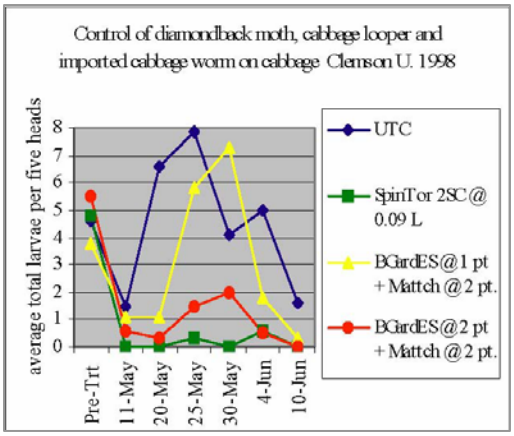
1. Increase the effective application window.
2. Enhance the level of control compared to Bt alone.
3. Provide effective control of Bt resistant populations.
4. Conserve natural enemies and valuable pollinators.
5. Provide a useful resistance management tool.

Replicated field trials conducted by Auburn University, Clemson University and the University of Florida for the control of diamondback moth, cabbage looper and imported cabbage worm larvae have shown that adding BotaniGard to Bt improved control of foliar feeding lepidopteran worms over Bt alone. In some cases this has been shown when reduced rates of Bt are used, indicating that the increased rate of Bt is not improving the control on its own.

Dr. Geoff Zehnder at Auburn University compared BotaniGard @ 1qt/a alone and in mixture with a reduced rate of Crymax, to Crymax at 1 lb./a for the control of a mixed population of larvae. His trial results shown below, indicate that BotaniGard @ 1 qt/a provided control equivalent to Crymax @ 1 lb./a and that the mixture of BotaniGard and Crymax provided the best control.



Dr. Randy Griffin at Clemson University compared tank mixtures of Mattch @ 2 pt/a + BotaniGard @ 1-2 pt/a to SpinTor for the control of a mixed population of foliar feeders. In this trial Mattch + BotaniGard at 2 pt/a provided better control than Mattch + BotaniGard at 1 pt/a. Further, the same mixture provided equivalent control to SpinTor.



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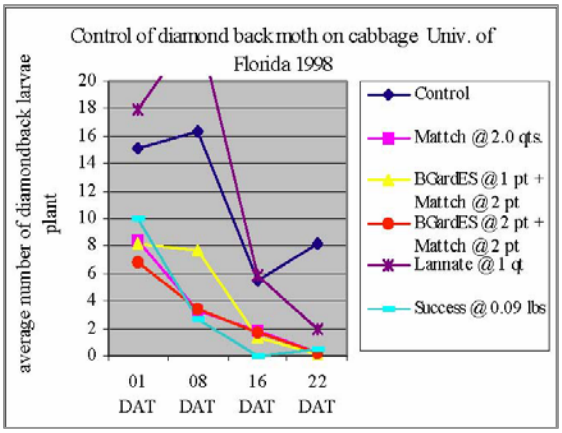
Dr. Dakshina Seal at the University of Florida at Homestead, Florida compared BotaniGard @ 1-2 pt/a in combination with half rates of Mattch (@ 2 pt/a) to Mattch @ 2 qt/a, Lannate and Success for the control of diamondback moth larvae on cabbage. In this trial, Lannate failed to provide control and larval populations soared beyond 20 larvae per plant in the Lannate plots. Mattch @ 2 qt/a, BotaniGard @ 2 pt/a + Mattch @ 2 pt/a, and Success all gave equivalent control throughout the trial period. BotaniGard @ 1 pt/a + Mattch @ 2 pt/a took longer to reduce the population but was equivalent to the other products by the third rating period.

Each of these trials demonstrates the potential for better control from a mixture of BotaniGard and Bt than from using Bt alone. Whether this improvement in control is from an additive effect of BotaniGard, or from BotaniGard overcoming increased tolerance to Bt, or from greater control of larger larvae by BotaniGard the result is all the same – a cleaner crop with higher marketability. The ability to reduce the rate of Bt will help in cost savings and the value of improved control will be realized at harvest.



An alternative strategy to tank mixing would be to alternate Bt and BotaniGard on a short interval (3-5 days). This has not been proven in the field yet and is not a practice we recommend at this time. Alternation strategies will be a subject of Mycotech sponsored research in 1999. However, considering the strength of BotaniGard in controlling 3rd and 4th instar diamondback moth larvae is seems possible that a programmed approach of timing your Bt application to hatchout followed closely by a BotaniGard application to catch escapes could extend the control window.

Further, if the escapes are actually the result of increased tolerance to Bt, rotation to a product with no known resistance is a good management strategy. In either case, increasing your ability to safely control later instar larvae would allow for better control following field delays which might limit the performance of your Bt.

The other benefit of using BotaniGard to bolster your Bt performance is that you are maintaining the safety and flexibility that you have come to appreciate with Bt products.

BotaniGard is very easy on beneficial insects, allowing them to continue to aid in your effort to produce a clean crop. BotaniGard can help you with the suppression of whiteflies, aphids and thrips, further supporting beneficial insects and helping you keep your whole control program natural.

Time and labor management for field activities such as irrigation, harvest or other hand labor is not disrupted for long when you use BotaniGard. The restricted entry interval for BotaniGard ES is a short 12 hours and since BotaniGard is exempt from tolerance the pre-harvest interval is zero (0) days.

Summary: The combination of BotaniGard and Bt, offers the following benefits.

1. **Increases your effective application window.**
2. **Enhances the level of control compared to either product used alone.**
3. **Is effective against Bt resistant populations.**
4. **Provides a useful resistance management tool**
5. **Conserves natural enemies.**

