Development of alternative carriers for use of Beauveria Bassiana in Ostrinia nubilalis suppression on corn

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Development of alternative carriers for use of Beauveria Bassiana in Ostrinia nubilalis suppression on corn

Abstract
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Keywords
Entomology, Biocontrol and Integrated Pest Management, Organic production practices and comparisons, Soils and agronomy

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**Development of alternative carriers for use of Beauveria bassiana in Ostrinia nubilalis suppression on corn**

**Abstract:** The European corn borer (ECB) is a serious pest of corn causing significant yield losses in the Midwest. In continuous work on innovative control of the ECB via an entomopathogenic fungus, this project evaluated alternative carriers for delivery of Beauveria bassiana without increasing indigenous mycotoxins.

**Background**

The European corn borer (ECB) was first discovered in the United States in 1917 and in Iowa in 1942. Losses incurred from corn borer are estimated to rank second annually to the corn rootworm complex in Iowa. Estimated yield losses from ECB can range from $20 to $50 per acre in the Midwest.

The corn borer has varying numbers of generations per growing season with range depending on day length, temperature, and genetic composition of the population. Iowa usually sees two generations of corn borers, with the first generation causing the characteristic “shot-hole” damage on the whorl tissue.

*Beauveria bassiana*, an entomopathogenic fungus, occurs naturally in soil and plant residue and colonizes corn plant tissue. The term “endophyte” is used to describe a relationship between a fungus and a plant in which both organisms benefit from the relationship. *B. bassiana* is a unique fungus in that it is not only an effective pathogen of a wide variety of insect pests, but also able to form an endophytic relationship with a wide variety of plants, the most economically important of which is corn.

Because of its endophytic relationship, *B. bassiana* has been used experimentally as a plant protectant. The corn plant experiences reduced insect attack and *B. bassiana* is able to propagate well in the moist, humid environment inside the corn plant.

*B. bassiana*, applied in granular formulation during the whorl-stage of corn development, provides season-long control of corn borer populations. In addition, several liquid formulations of *B. bassiana* are being experimentally evaluated for their effectiveness in protecting corn plants from corn borer. Further advances in strain identification, production, and formulation will increase the effectiveness of *B. bassiana* as a crop protectant and will give growers an alternative to synthetic insecticides for insect pest control.

The objectives of these studies were to evaluate alternative carriers for delivery of *B. bassiana* to whorl-stage corn for season-long suppression of the ECB, without increasing the amount of indigenous mycotoxins.

**Approach and methods**

In 1998 and 1999, the investigators conducted on-farm research with cooperators from the Practical Farmers of Iowa and an additional private farmer. Treatments consisted of five different *B. bassiana* carriers applied at a rate of 10 lb/acre and an untreated control.

In an earlier study, the *B. bassiana* was formulated on a corn kernel-based carrier. The Envi-
Environmental Protection Agency raised concerns that the use of this carrier might lead to elevated levels of mycotoxin from *Aspergillus spp.*, which could be present in the carrier. To address this concern, four alternative carriers were evaluated to determine their efficacy in controlling ECB and their propensity to increase levels of aflatoxin in grain.

Carriers tested were the corn kernel based carrier, corn cob grit, clay, and the substrate used to grow the fungus ground to a 14/20 or 20/40 mesh. Granules were applied with an over-the-row applicator, with four to six replications per location.

Entomological data on the efficacy of larval control from each treatment were collected at plant maturity by splitting 20 plants from tassel to base and determining the amount of corn borer larval feeding. The number and length of larval tunneling, number of larvae infected with *B. bassiana*, and the number of plants with no evidence of corn borer feeding were determined. At maturity, each plot was harvested and a weigh wagon was used to determine yields. Corn from each plot also was sampled for aflatoxin testing.

**Results and discussion**

Because of the wet spring in 1998, the investigators were unable to apply the *B. bassiana* at the most efficacious growth stage. Application at the Bruck farm occurred at the proper time, but subsequent flooding of the field resulted in reduced stands and complete herbicide failure. Applications at the other three locations were made past the proper growth stage, which reduced the effectiveness of the treatment. Time constraints in the fall did not allow collection of data from the Alert farm. In 1999, granules were applied at all locations at the proper growth stage and entomological and yield data also were obtained from all locations.

Findings showed that there were alternatives to the corn kernel-based carrier that provide the same level of corn borer control without the worry of inadvertently elevating the aflatoxin levels. The amount of corn borer pressure was very light in 1998, and there were no consistent differences in reduction of corn borer feeding or significantly increased in yield compared with 1997 preliminary findings by the project investigators. Significant differences in corn borer feeding were observed only at locations with the highest levels of infestation during both years of the study. There were significant differences in 1998 yields at Cumming, Iowa, but no corresponding differences in insect injury.

The fact that two completely different scenarios played out emphasizes that insect injury is only one part of the yield equation. Injury from insects has to be quite severe before insect control measures result in a corresponding increase in yield. Losses can still average up to 6 percent even if a chemical insecticide treatment is used.

Results of testing showed the aflatoxin levels on all of the treatments at each location during both years were below the detectable level of 20 ppb, with the exception of one plot at Cumming where levels reached 55 ppb in 1999. (It is not uncommon to find a sample within a field with slightly elevated aflatoxin levels.) Therefore, based on these results and 1997 data in which there were no detectable levels of aflatoxin in preliminary work, all of the alternative carriers are suitable substitutes for the corn kernel-based carrier.

**Conclusions**

Because of the low corn borer populations during the period of the study, the investigators were unable to detect differences in the efficacy of any of the carriers in reducing corn
borer injury. With substantial populations, *B. bassiana* often has been shown to provide season-long control of the corn borer. Whorl stage and pollen-shed applications of *B. bassiana* reduced larval feeding from 37 to 75 and 43 to 66 percent, respectively, when similar numbers of Colony Forming Units/plant were applied.

Earlier studies during the first generation of *O. nubilalis* found that whorl stage applications of *B. bassiana* reduced larval tunneling by 37 to 51 percent, and second generation tunneling by 2 to 51 percent over a two-year study. Similar results (9 to 52 percent and 13 to 45 percent reductions) occurred in tunneling by first and second generation larvae, respectively.

Application of *B. bassiana* also did not result in significant increases in yield, again primarily due to the overall lack of corn borer pressure. Results of the aflatoxin testing showed that none of the carriers tested caused elevated mycotoxin levels and all are suitable substitutes on that basis alone.

### Impact of results

Because of the lack of corn borer pressure and absence of consistent entomological and yield differences, the impact of the results of this study are limited to the results of the aflatoxin testing. *B. bassiana* often has been shown to repress corn borer populations. Based on the results of our aflatoxin data, any of the alternative carriers studied could be used.

### Education and outreach

Field days were held at the Alert and McLaughlin Farms in 1998 with 20 to 25 people in attendance. An article, “Beyond Bt”, appeared in *The Furrow* in November 1998. A journal article on the research is in progress.