

Bio-control and lower-risk options for insect control in sweet corn

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For the past three years the UMass Extension Vegetable Program has been working on a project to introduce sweet corn growers in Massachusetts to new methods of pest monitoring and control. The objectives of the program were to work with growers to improve on-farm scouting of sweet corn pests and to increase the use of reduced-risk insecticides and biological control for control of European corn borer (ECB) and fall armyworm (FAW). Two reduced risk products tested in this project were Avaunt (indoxycarb) and Spintor 2SC or Entrust (spinosad), both of which have lower human toxicity than carbamates and synthetic pyrethroids. They also offer alternative chemistries (modes of action) against pests, thus providing an important tool to delay insecticide resistance in the pyrethroids and carbamates. Growers also released the parasitic wasp *Trichogramma ostriniae* as a biological control for ECB in early corn. These methods were introduced along with training in IPM scouting and decision making. In general, growers were timing their applications according to trap counts, field scouting, and thresholds.

Two independent surveys of New England sweet corn growers, conducted in 2004, showed that the majority of sweet corn acreage was treated with pyrethroids and carbamates, and the most common materials used for control of caterpillar pests (including corn earworm as well as European corn borer and Fall armyworm) were Warrior (a synthetic pyrethroid) and Lannate (a carbamate). In the survey, growers were also asked what factors influenced their choice of pesticides in sweet corn. The most important factor was insecticide efficacy compared to other products, followed by the toxicity of the product to humans. Cost was ranked as less important.

Evaluation of Reduced-Risk Products. Ten growers in 2005 and seven growers in 2006 tested Avaunt (indoxycarb) for control of fall armyworm. All of these farms had a history of high armyworm pressure late in the season. Avaunt is not a contact poison, and must be ingested by caterpillars to be effective. When ingested, it causes paralysis and death. It is effective on all caterpillars but has proven to be especially effective against fall armyworm used in corn from whorl to tassel emergence. It is not labeled for use during silking, because it is not effective against pests that move into the ear without feeding (such as corn earworm). Avaunt is easy on predators that keep aphid populations under control. We recommended a rate of 3oz per acre, applied after FAW infestation levels were found to be 15% or higher in whorl stage corn. A second spray was applied if the field was still over the threshold. Of the growers who tested it, 94% reported that Avaunt worked as well or better than their standard products, and said they would use it again. One grower started using a FAW pheromone trap to detect when these migratory moths arrive and time his sprays better, and was very pleased with the results.

Ten growers tested spinosad in 2005 & eight in 2006 for control of European corn borer in early corn. We focused on early corn because ECB is a major problem, and corn earworm is less likely to be a problem. Most growers tested used Spintor, the liquid

formulation, but some used Entrust, a dry formulation that is allowed in organic production. Both formulations are general-use with a caution label and one day preharvest interval. Spinosad acts as both an ingested poison and a contact poison and is labeled for use in a wide range of crops against caterpillars, some beetles, thrips and leaf miners. It can be used on all stages of corn. It is less toxic to beneficial insects than the carbamates and pyrethroids, though not as easy on predators as Bt products. We recommended a Spintor rate of 3.5 to 4oz/acre, when ECB infestation levels were 15% or higher. Spintor is effective against low to moderate levels of corn earworm during silking; however, in our tests, growers generally used conventional products if corn earworm threatened their corn at the silking stage. Of the growers involved in the program, 88% reported that Spintor and Entrust worked to control ECB, and said they would use it again.

Evaluation of Biological Control for ECB. Four growers released *Trichogramma ostriniae* in 2005 and four in 2006, on a total of 56 acres of early corn. In 2007, we released on 9 farms, in 16 fields, totaling 51 acres. This tiny parasitic wasp (about the size of the period at the end of the sentence) inserts its eggs into the ECB eggs, where the larvae feed and develop inside of the ECB eggs. This prevents hatch of the ECB larvae that feed on the corn stalks and ears. New adult *Trichogramma* wasps emerge and go off in search of new egg masses. Wasps continue to reproduce and control ECB throughout the season. They need to be released every year because they do not survive the winter.

Timing is everything when releasing a biocontrol organism. Since the wasps lay eggs in ECB eggs you must release the wasps when the ECB moths start to lay eggs. ECB flights should be monitored starting in the beginning of May and releases made shortly after flight begins. Two or three releases at weekly intervals are needed to cover the whole period when ECB eggs are present in the field. In 2006, we made releases the weeks of June 6, 13, and 21. In 2007, we planned our first release for June 1 and were glad that we did, because the flight began the last week of May during a heat wave, and egg masses were found within 2-3 days after our first moth captures.

One major difference between *Trichogramma* and insecticides is that the *Trichogramma* are alive! You want to be sure that they are still alive and in good shape when you put them in the field. That means not letting them get too hot (don't leave them in the truck in the hot sun if you get sidetracked on the way to the field), not letting them get too cold (they should not be refrigerated), and not letting the wasps emerge before you put them in the field. Cards will arrive in a cold pack in the mail, and should be placed in the field the same day. The wasps will arrive from the insectary as pupae inside the grain moth eggs they were reared on, glued inside cardboard release packets. Each packet contains 30,000 pupae. We recommend a release rate of 30,000 to 60,000 wasps per acre, or 1 to 2 cards per acre. We have found that the higher release rate gives better control. The commercial source is IPM Laboratories, phone 315-497-2063, email ipminfo@ipmlabs.com. Order ahead – not later than the day you plant the corn!

The release packets are important because predators like lady beetles and lacewing larvae will feast on *T. ostriniae* pupae if they get the chance -- and there can be a lot of these predators in a corn field. The adult wasps will emerge from the pupae and easily escape from the release packet along the open edges. Distribute the packets as evenly as possible throughout the field, starting about 50 feet in from the field edges. If you have a

long narrow field less than 125' wide, distribute them evenly along the middle row. For wider or more square-shaped fields you'll need to use more than one row. They can be tied to a corn leaf, or attached to a stake if the plants are too small to attach them to. Do not put them on the ground.

Trichogramma suppress ECB populations, but do not always bring the population down to the level needed. Fortunately, regular scouting procedures at pretassel stage will determine if a spray is needed. Of the insecticides labeled for sweet corn, Bt products do the least harm to Trichogramma in the field, and Spintor and

Table 1. Advantages of new practices – % responses from growers (30 growers, 544 acres in 2005-2006)

Release of Trichogramma saved sprays later	100%
FAW control as good or better with Avaunt	94%
ECB control as good or better with Spintor	89%
Used fewer sprays	47%
Cleaner corn, fewer culls	40%
Less toxicity risk to applicator/safety	30%
Saved money and made more profit	23%
Less worry & stress	23%

Avaunt are less harmful than pyrethroids, so these products help you get the most out of your investment in Trichogramma. Every grower who released Trichogramma in 2005 and 2006 reported it reduced ECB infestation, resulted in very clean early corn, while reducing (though not eliminating) their need for sprays in early corn. All are interested in trying it again. They also reported that the impact continued into late season corn, where their late corn was fairly close to the fields where Trichogramma had been released in June.

To assess the effectiveness of the program, we surveyed the participants at the end of each season. Results are reported in Table 1. Some drawbacks reported were that Spintor was not effective against sap beetle, Avaunt is less effective against large fall armyworm than small caterpillars, and that the new products are more expensive. Every grower needs to weigh the factors of efficacy, safety, cost, and impact on beneficial insects for their own farm. The alternative products worked as well as conventional products in most situations. Trichogramma reduced need for sprays in both release blocks and in later corn. The majority of the growers who participated plan to keep on using these new practices on their own.

Update on products for use in the 'Zealater'

During development of the Zealater oil applicator and the methods for direct silk application of vegetable oil to control corn earworm and ECB, most of our work was done using corn oil as the carrier and *Bacillus thuringiensis* (Bt) as the toxin. We showed that using these together gave improved control compared to either alone.

Since then, we have looked at spinosad and neem as alternative toxins, as well as other oils or carriers. Each experiment was repeated over two years. In 2001-2002, we

conducted an experiment with late corn treated with soy, corn, canola or safflower oils, with and without Bt. There were no differences among oils in efficacy against CEW and ECB or in the degree of physiological injury to the tip from the oil (“cone tip”). All caused an increase in tip injury compared ears not treated with oil, but the average length of the cone tip was less than 0.5 inch for all the oils.

In a separate experiment, conducted in 2004-2005, late corn (cv ‘Delectable’) was treated with JMS Stylet Oil (a mineral oil), corn oil, or carrageenan (a food-grade gel made from seaweed) as carriers, and Bt (Dipel DF), spinosad (Entrust) or neem (Aza-direct) as toxins. All possible combinations were tested, plus an untreated control. Ears were rated for feeding damage and for physiological injury to the tip (“cone tip”). Among carriers, JMS caused more tip injury (longer cone tips) while carrageenan caused very little; feeding damage was not consistently different among the carriers. Among toxins, spinosad gave lower feeding damage ratings (higher % marketable) compared to the other toxins. All toxins had lower damage than the untreated ears (which was 60-70% unmarketable due to feeding damage). The mixture of spinosad with corn, spinosad with carrageenan, and neem with corn gave the best combination of insect control and tip quality. These three combinations met a standard of <1 inch cone tip length and <10% of ears with feeding damage.

For more information about using Trichogramma, IPM, or new products, please feel free to call the UMass Vegetable Program office (413-545-3696 or 413-577-3976) or visit the UMass Vegetable website, www.umassvegetable.org and search for sweet corn or one of the key pests.

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