Trichogramma ostriniae and European Corn Borer in Sweet Corn: Progress on the Path from Research to Commercialization in New York

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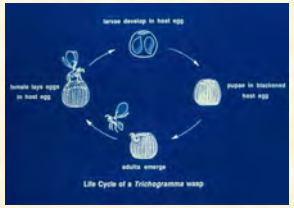
Background and History

Trichogramma ostriniae Pang et Chen was collected in the summer of 1990 from Gongzhuling, Jilin Province, China and imported and reared at the USDA APHIS, PPQ Mission Biological Control Lab in Mission TX. The collection host was *Ostrinia furnacalis*, the Asian corn borer. The collection was part of cooperative effort of USDA and university scientists and collection of *T. ostriniae* is attributed to Dr. David Ferro (University of Massachusetts) and Ma Chun Sen of China.



Trichogramma ostriniae is an egg parasitoid, completing its development in the host egg.

1991-1993

Initial work in New York focused on a classical biological control approach; releasing *T. ostriniae* in unsprayed corn fields and sampling the following season to determine if overwintering occurred. Wasps successfully established in the field, but did not successfully overwinter. Inundative release in small plots produced low levels of parasitism.

1996

Pilot study in commercial unsprayed sweet corn fields demonstrated high levels of parasitism (>80%), rapid dispersal ability, and ability to establish and persist in field.

1997-1999

Early season inoculative releases and dispersal trials confirm ability of T. ostriniae to establish and move to field to field. Cold storage studies initiated to improve shelf life and commercial prospects

2000

Life table studies demonstrate that a single inoculative release reduces ECB populations by 30% in sweet corn and 13% in field corn.

2001-2003

Trials integrating inoculative releases of 30K per acre with recommended thresholds do not reliably reduce the number of insecticide applications compared with paired non-release fields. Large scale tests in processing sweet corn show ability of wasp to persist in sprayed fields. *T. ostriniae* shown to have a wide range of lepidopterous hosts in lab studies. Diapause was successfully induced by day length and temperature manipulation. *T. ostriniae* shown to overwinter in suitable egg host, but feral overwintering is very rare. Wasps show an arrest response to ECB pheromones and prefer searching corn to other habitats.

2004-2005

Modified release strategy results in good ECB control in organic and no-spray sweet corn (reported here). Large scale releases in field corn show erratic results for improving yield. Overwintering studies find no feral overwintering. Habitat preference trials demonstrate ability to colonize non-target habitats and move vertically into forest canopies, although corn is preferred. IPM Laboratories in Locke, NY begins commercial distribution.

Recent Work

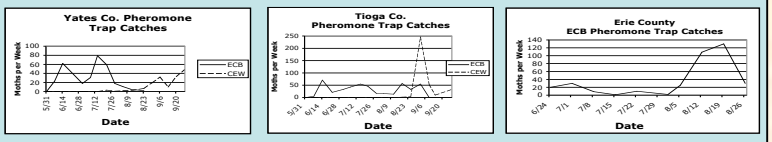
We have focused our recent demonstration efforts on organic sweet corn farmers and those with small acreages who do not have specialized sprayers. In 2005 we worked with five farmers; three organic and two who do not spray their corn. We made releases in all the sweet corn plantings on these farms; 20 plantings totaling 36 acres. Plantings ranged in size between 0.3 and 8.6 acres. We managed corn earworm (*Helicoverpa zea*) and fall armyworm (*Spodoptera frugiperda*) in these trials as well, using techniques approved for organic production. Flights of the three worm pests were monitored using pheromone traps on each farm.

European corn borer (ECB) is the major pest of sweet corn in upstate NY, and usually the only worm pest that needs to be controlled until the migratory corn earworm and fall armyworm arrive in August.

We made three releases of wasps in each sweet corn planting. One release of 30,000 per acre when the corn is in the 6-8 leaf stage, a second release of 30,000 a week later, and a third release of 60,000 per acre when the corn tassels start to emerge.

Wasps were released as pupae inside the *Ephestia* grain moth eggs in which they are reared. They are glued inside paper release packets, which are tied to corn plants, protecting the wasps from predation in the field. Adults emerge and exit the release packets to search for ECB egg masses.

Insect eggs parasitized by *Trichogramma* wasps turn black, allowing us to detect whether the wasps have successfully established in the field.



Pheromone trap catches from three of the participating farms. Insect populations were substantial on these farms and lower and more sporadic on the other two.

Effectiveness

Fields harvested before the corn earworm (CEW) flight started averaged 9% (range 2-22%) damaged ears at harvest. Our goal for fields managed using IPM thresholds and insecticides is 5% or less damaged or infested ears. Customers of the cooperating growers were surveyed to determine if the level of worm infestation at harvest was acceptable. Ninety percent of the customers returning surveys considered the quality to be acceptable.

Farm	Planting	Reach Threshold for ECB?	Percent Ears Infested at Harvest
Yates Co.	1		3.5
	2		2.0
	3*		66
	3		84
Tioga Co.	1		9.0
	2	√	6.0
	3	√	10.0
	4		14.0
	5	√	16.0
	6	√	9.0
	7*		10.0
	8		92.0
Wayne Co.	1&2		8.0
Seneca Co.	1		6.0
	2		4.0
	3		8.0
	4		22.0
	5&6*		0
	Late cleanup		100
Erie Co.	2&3		6.0

Rows highlighted in blue are late fields that were in an attractive stage during the corn earworm flight. Those marked with an asterisk were treated for corn earworm.
Checked fields were over threshold for ECB at the tassel emergence stage, indicating that the early releases would not have saved an insecticide application for a grower who uses insecticides. Other fields remained below threshold and would not have required a spray.

Controlling Corn Ear Worm

Growers participating in this study were offered the option of using a "Zealater" to deliver a small amount of soybean oil mixed with Bt, a natural insecticide, to the silks of each ear, or applying Entrust, the formulation of spinosad approved for organic production, with a backpack or other hand-held sprayer. Growers were very reluctant to use the Zealater because it is very time consuming (8 hours per acre!) and therefore expensive, and only practical for farmers who have very small fields. One farmer tried it on a planting of popcorn and found it very effective. The other fields treated for CEW received Entrust. Differences in effectiveness were due to timing and/or coverage issues.

Controlling Fall Armyworm

Infestations of fall armyworm in whorl-stage corn could be controlled with applications of Entrust to the whorl. Later season infestations in the silks would be controlled by whatever method is used for corn earworm control.

Commercialization

IPM Laboratories in Locke, NY is currently distributing wasps reared in the Hoffmann lab and will gradually take over the rearing as well.

Next Steps

Future work in fresh market sweet corn will focus on working closely with growers to ensure that they will have the knowledge and skills to use *T. ostriniae* on their own. Research is underway in NY and other states to explore the potential for T. ostriniae to control ECB in other crops such as peppers and potatoes as well as its potential for controlling other species such as grape berrymoth.