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Organic Sweet Corn IPM: A Fifteen Year Project

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Abstract

In 1992, ten Northeastern farmers who wanted to grow sweet corn without chemical inputs met together and identified caterpillar control as a key barrier to this goal. In the fifteen years since, the UMass Vegetable IPM Program has worked on developing practical solutions that meet organic standards. With the help of many collaborators, funders, and trials, we figured out how to use vegetable oil with microbial insecticides as a direct silk application to control corn earworm and in the process created and commercialized the 'Zealater' applicator. New materials such as spinosad have made the task easier. Season-long clean organic sweet corn is now possible and growers are doing it. We are now adding *Trichogramma ostriniae*, an egg parasite of European corn borer to this organic IPM system. SARE has been in on this story since the beginning.

Critical Pests

Migratory **corn earworm (CEW)** moths, *Helicoverpa zea*, attack late season corn in the Northeast. Eggs are laid on silks and caterpillars enter ears through the silk channel. Infested ears are unmarketable.

European corn borer (ECB), *Ostrinia nubilalis* is a resident pest that feeds in tassels and tunnels into ears.

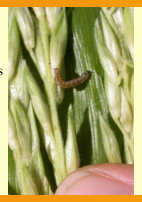
Acknowledgments

We thank the following collaborators Ellen Siedlecki, Brian Schultz, & David Holm, Hampshire College; Douglas Hartwell, Pamela Westgate, Amanda Brown, Neil Woodard, Anne Carter, Rosalind Cook, UMass; Eric Sideman, MOFGA; Tori Jackson, David Handley U. Maine. Farmers: Andy Caruso, Cromwell, CT; Doug Coldwell, Coolwater Farm; Tom Harlow, Westminster Station, VT; Rob Johanson, Dresden, ME; Dan Kaplan, Amherst, MA; Jack Manix, Putney, VT; Steve and Ray Mong, Stow, MA; Skip Paul, Little Compton, RI and many others . We appreciate funding from SARE, Organic Farming Research Foundation, the Lemelson National Program for Innovation and Invention at Hampshire College, University of Massachusetts Integrated Pest Management Program and the UMass Commercial Ventures and Intellectual Property Office. Many manufacturers provided product for use in trials.

1992 — 1995 — 1997 — 1999 — 2001 — 2003 — 2005 — 2007

Available IPM tools and techniques

MONITORING. From the outset, we have depended on IPM monitoring techniques and action thresholds with a proven track record. On every cooperating farm, we used pheromone traps to monitor moth flights of corn earworm (CEW) and European corn borer (ECB). We did field scouting from tassel emergence stage and used the standard threshold of 15% infestation for insecticide applications for ECB. These tools were the foundation for the organic system.



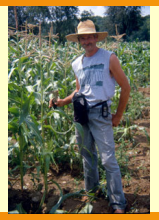
MICROBIALS. In the 1990's, several *Bacillus thuringiensis* products were available. We tested foliar applications for ECB caterpillars, which ingest Bt on exposed tissue. Release of Entrust (spinosad) in 2003 expanded the options, because it has activity against CEW as well. Now, larger growers use spinosad for repeated sprays on silk, comparable to conventional methods for CEW control.

TRANSPLANTS. Profitability of organic corn took a leap with the use of transplanting. Direct-seeded early corn suffers poor emergence and high weed pressure. Transplants @ 2 seeds/cell give a full 16,000 plants/acre. Yield increases outweigh costs. Jon Satz, Brandon VT tested cell sizes (SARE FN03-491) & found larger cells (128's +) produce stronger roots. For early corn, this practice is now almost universal among New England organic corn growers.

Trichogramma ostriniae, an egg parasitoid that is lab-reared for release when ECB eggs are present in the field, has been shown to reduce or eliminate the need for sprays in early sweet corn. In a 2007 SARE project (LNE07-263), New York (A. Seaman), Virginia (T. Kuhar) & Massachusetts are working with sweet corn and pepper farmers to build skills and confidence in using *T. ostriniae*. We make 3 weekly releases with 1-2 cards/acre @30,000 wasps/card in early corn.

People and projects

NEFFIE. The Northeast Farmer to Farmer Information Exchange was an early SARE R&E project. In 1992 and 1993, small groups of farmers met to discuss how to produce certain crops using sustainable or organic methods. Sweet corn was the focus one of these groups. Corn earworm was the worst problem – growers could not get clean corn all season. One grower had learned about 'oiling corn' from an old-time farming neighbor. Apply oil to each ear -- could this possibly work?

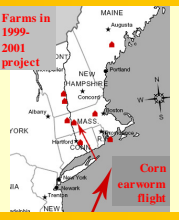


Steve Mong hosted many trials at Applefield Farm in Stow MA. He wondered, could using Bt in the oil make it work better?

In 1993, Hampshire College student Ellen Siedlecki joined the 'oiling corn' project. She helped design and test the tool for applying a small dose of oil to each corn silk.

With SARE's help (SARE 95ANE95.26, *Integrating microbial insecticides and oils into sweet corn IPM in Massachusetts*), we tested microbials and oils, both as foliar sprays and direct silk treatments.

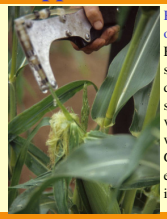
For three years (1999-2001), eight vegetable farms in New England participated in on-farm trials in which they compared oiled vs non-oiled plots within each of three late corn plantings. Farms ranged from coastal locations with extremely high CEW pressure to inland hills with lower CEW and high ECB. Growers met each year to assess and advise. SARE (99LNE99-118) made this possible.



The Organic Farming Research Foundation provided three successive grants (1999 to 2002) for "*Integrated Caterpillar Control in Organic Sweet Corn*" to support on-farm trials, experiments to determine the best timing and materials for oil application, and a fact sheet that was distributed nationally.
(http://www.umassvegetable.org/soil_crop_pest_mgt/crops/corn_sweet.html

The new tool: Zealater oil applicator

Canola, corn or mineral oil were first applied with an oil can. Oils had to meet 3 standards: registered with FIFRA - or exempt; granted a food tolerance - or exempt; allowed in organic production. Corn and soy oils meet all three criteria.



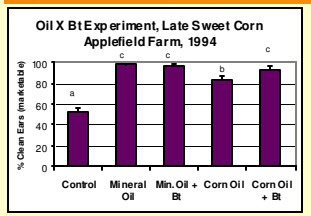
How to deliver 0.5 ml oil to each of thousands of ears of corn? Ellen, with UMass engineering student Doug Hartwell, developed a syringe pump, using simple mechanics, one-way valves and springs. Using the whole hand was key for comfort. Growers field tested it and met each winter to discuss how to improve it.

A patent for the device, now dubbed the 'Zealater', was sought in 1997 and granted in October 1999. Who would commercialize it? We found Enabling Devices in upstate NY, which specialized in tools for people with disabilities. They molded and constructed further prototypes and the 1st commercial device.

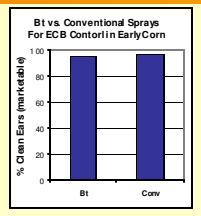
In 2001, Johnny's Selected Seeds of Albion ME signed an exclusive licensing agreement to sell the Zealater. The custom-built version proved too expensive, and Johnny's developed 'Zealater II' with the same mechanics, reliable, off-the-shelf parts, and a price tag under $100.

Zealaters have traveled all over the US and are generally purchased by small-scale fresh market organic growers with succession planted corn. With this control method as an option, season-long control of both corn earworm and European corn borer is possible. The best timing is 5-7 days after silk initiation, when silk starts to wilt and pollination is complete, but CEW larvae have not reached the ear.

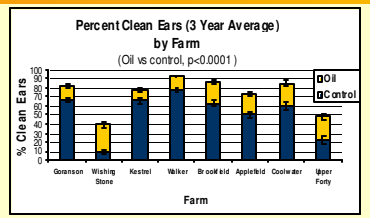
Research trials and results



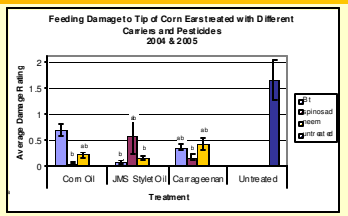
Mineral oil & corn oil, w/ and w/o Bt, were applied to late corn at wilted silk. 'Marketable' meant damage to kernels. Bars with different letters are significantly different at p <0.001. This was one of numerous experiments conducted on cooperating farms and the UMass research farms from 1992, to evaluate types of oil, microbials, timing, and rates. In corn oil, addition of Bt consistently improved control.

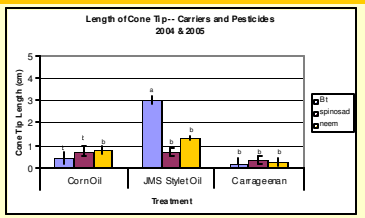


In 36 blocks of early corn ('94-'96), growers used Bt sprays (MVP or Dipel ES) for ECB in half the block and their conventional sprays in the other half. 34 blocks exceeded threshold; avg. ECB infestation at pretassel was 43%. The level of ECB control of was equivalent in the two treatments (p<0.05).



On eight commercial farms in New England (see map, above), blocks of sweet corn (cv 'Delectable') were divided into untreated vs direct-silk applications of corn oil mixed with Bt using the Zea-later. In each of 3 years, feeding damage was significantly lower in oil treatments on all farms (mean improvement over all blocks= 21.6%). For more details see final report for SARE 99LNE99-118.





Our early trials used mineral or vegetable oil as the carrier and *Bt kurstaki* as the toxin. Newer materials may provide better control. Factorial experiments in 2004 and 2005 tested three carriers (corn oil, JMS Stylet Oil, and carrageenan) X three toxins (Bt, spinosad and neem). Feeding damage was scored for each ear (0 = none, 1 = silk only, 2 = kernel dmg. < 1 in. from the tip of the ear, 3 = kernel dmg. > 1 in. and < 2 in. 'Cone tip' is a section of kernels at the tip that is not fertilized; length of cone tip is measured from the tip of the ear. Bars of treated corn with different letters are significantly different at p<0.05. All treatments were different from untreated corn.
In this study, corn oil or carrageenan with spinosad gave better control than the previous standard, corn oil with Bt. Control with neem was equivalent to other toxins. JMS stylet oil gave good control but cone tip was worse with Bt, and ears were gummy. Average length of cone tip (for ears with cone tip) was <1 cm for both corn oil and carrageenan.