Report to the Pennsylvania Vegetable Marketing and Research Program and the Pennsylvania Vegetable Growers Association

Monitoring and Management of Worms in Sweet Corn

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Objective 1 is for the bulk purchase and distribution of pheromones. We also continued work on replacement of the trapping infrastructure, which had been initiated using PVGA funds from 2010.

Objective 2 is to find ways to economically incorporate the newer modes-of-action for corn earworm control.

Objective 1. Bulk purchase and distribution of pheromones. The intent of this objection was to continue the sweet corn trapping network. The funding request dealt with the cost of the pheromone lures. **Key results were (i) distribution of the lures, (ii) dissemination of trapping information, (iii) continued progress on replacing traps in the field, and (iv) discovery of a new invasive species in Pennsylvania.**

Distribution of lures and dissemination of information. We purchased and distributed 4 types of pheromone lures:

Lure Identification	*Source*
Corn Earworm / *Helicoverpa (Heliothis) zea*	Hercon
European Corn Borer / E isomer / New York strain / *Ostrinia nubilalis*	Hercon
European Corn Borer / Z isomer / Iowa strain / *Ostrinia nubilalis*	Hercon
Fall armyworm PSU - *Spodoptera frugiperda*	Scentry

In addition, we purchased Vaportape from Hercon Environmental. These are plastic strips impregnated with dichlorvos insecticide which is placed inside the UniTraps that are used to monitor for fall armyworm. Lures and Vaportape was provided for a 2-week replacement period (~10 lures per trap per site). Supplies were distributed to 20 collaborators, who provided data from 42 sites.

Data was summarized weekly, in 13 reports, weekly from June 9 to August 30. As in 2010, the synopsis considers data from Pestwatch in Pennsylvania and neighboring states, past experience, and model projections of the timing of the life stages of European corn borer based on phenology models which are posted through the PA-PIPE. These were posted to the PestWatch website, and sent to PVGA for compilation and distribution. We also contributed reports to a 1-800 phone line, and to the Veg Hort team blog.

Towards replacing the sweet corn trapping infrastructure. Although funding for this was provided in 2010, we were not able to complete the work, and so we report the combined results from 2010 and 2011 here. In 2010, we purchased a pan-and-break, a 52-inch foot shear, a 24-inch slip role, and a cutter/shear power tool. This upgrade will enable workers at Penn State's Russel E. Larson Research and Extension farm at Rock Springs to respond to requests for replacement traps now and in the future. Purchase of the equipment occurred in the spring of 2010, but some parts were on back-order, thus we completed this effort in 2011. The timing of the purchase coincided with the field season; therefore we had to wait until approximately

October 2010 (after most harvesting and winter cover crop installation was complete). We completed purchase, transport and installation of the equipment in 2011.

Cost of supplies (sheet metal, galvanized wire mesh, fasteners) is to be assumed at the local level. To clarify, we have set up a system where a county-based cooperator would need to reimburse the Department of Entomology for the cost of supplies, and arrange for transportation of the trap to the cooperating farm, and the Department of Entomology would manufacture the traps at the research farm during the winter months. Trap design will follow standards (see www.uky.edu/Ag/Entomology/entfacts/misc/ef010.htm), with slight modifications, such as using galvanized wire that is more easily commercially available in our area. These plans are available on the web, and any shop with sheet-metal working tools can manufacture the traps. Our trapping infrastructure did not create sufficient demand, and our past experience has been that the effort to set up and build traps on a case-by-case basis resulted in higher costs (typically $120 to ~180 per trap) and inconsistent availability. We originally estimated the maximum cost of ~$100 per trap for supplies; however by making bulk purchases we are constructing traps and invoicing county-based Educators at half that cost ($50/trap).

Over 20 traps were manufactured and distributed in 2011. Much of the funding for supplies for this group of traps came through grants that the western PA county educators obtained through the Pesticide Education Program. This fall of 2011, ten county-based programs placed orders for a total of 39 traps. We anticipate manufacturing these during the 2011-2012 winter months, for deployment in spring of 2012.

Discovery of a new species to Pennsylvania. At approximately 3 to 4 of the sites, a moth that closely resembled the European corn borer was detected in the traps baited with the E-isomer (the New York strain) of the European corn borer pheromone blend. They were not found in the traps baited with the Z-isomer. Samples were identified first by Dr. David Biddinger (Penn State, Fruit Research and Extension Center, Biglerville PA) and confirmed by the Pennsylvania Department of Agriculture. They were *Sitochroa palealis*, which has the common name of carrot seed moth. This species has been recently reported from Midwestern states, but this is the first report we are aware of from Pennsylvania. It infests umbels (seed heads) of plants in the carrot family, which includes cultivated species (carrot, parsley) and several important noxious weeds. Growers of carrot for seed could consider this a new pest species; however, if you are not growing for seed, this species may contribute to biological control of noxious weeds.

Objective 2. Economically incorporate newer modes-of-action. Corn earworm had historically high trap captures in 2002, 2007, and 2010, and some areas report variable control with pyrethroids, which could be due to resistance. Some areas of the country clearly have populations that are resistant to pyrethroids. It is less clear if the populations that occur in Pennsylvania are resistant, and the degree to which resistance will be a problem in Pennsylvania will vary from year-to-year, and site-to-site.

To help address pyrethroid resistance in corn earworm, we worked to develop and register several new modes-of-action. These options are now labeled as “Belt” by Bayer, and “Coragen” by Dupont. In addition, pre-mixes that contain Coragen are marketed by Dupont, notably “Volium Xpress”, which contains both Coragen and the pyrethroid lambda-cyhalothrin.

However, their costs are high. Finding spray sequences that reduce cost but maintain efficacy is needed.

In addition, we worked in recent years to determine if a biologically-based option (Radiant^{TM}) can be effective in our area. Furthermore, a second biologically based option emerged in 2010, but to the best of our knowledge, it has not been tested in Pennsylvania. This is a formulation called 'Gemstar' that uses the *zea* nuclear polyhedrosis virus, which was recently commercialized by Certis. We need to determine if it is efficacious in our area, if it works with sufficient speed to prevent entry of small, intoxicated larvae into the ear, and if we can make it work in conjunction with methods to control the other pest species. Therefore, we tested it alone, and in combination with materials that work on European corn borer that would be of interest to organic growers (the Entrust formulation of spinosyns).

We conducted this efficacy trial at the Russell E. Larson Research Station, Pennsylvania Furnace, Centre County using 'Providence' planted with 30 inch row centers with a depth of 1.5 inches. Planting date was 16 June, which tends to give us high corn earworm pressure during the fresh-silk growth stage of the plant. Insecticides were applied beginning at first silk using a backpack sprayer with a straight boom, delivered through two TeeJet XR8002VS flat fan nozzles 18 inches apart, held almost vertically and aimed at the ear zone from each side of 2-row plots. A backpack sprayer delivered 30 gpa, 32 psi pressure, maintained with a CO_2 propellant. We made 4 applications, on 11, 16, 22, and 26 of August. Ears from each treatment and replication were picked randomly on 1 September and assessed for damage, and live larvae were counted and identified.

Pest pressure was surprisingly low: untreated checks averaged 80% clean ears. Similar planting dates and pest density in nearby pheromone traps led to much higher rates of damage in previous years. The relative synchrony of silking between field and sweet corn may help explain this low rate of infestation in our experiment. Wet weather delayed field corn planting in 2011, and hot mid-summer temperatures sped development of sweet and field corn. We had much larger plantings of nearby field corn silking at the same time that our plot was silking, diluting the distribution of eggs. In most years, field corn has completed silking by the time our plots are silking when we use mid-June planting. Damage in the untreated plots was from both corn earworm and European corn borer. We found no fall armyworm in any ears.

All foliar treatments significantly increased the percent clean ears, and there were no statistical differences among foliar treatments in percent clean ears. Belt (one of the newer modes-of-action) provided 100% clean ears, and lowering costs by alternating Belt with Baythroid (a pyrethroid) provided a similar level (97%) clean ears, a value that was not statistically different than Belt alone. As in past years, Radiant alone resulted in a high percentage (98%) of clean ears, suggesting excellent efficacy with yet another mode-of-action that is different than pyrethroids. Entrust alone, and Gemstar + Entrust, provided >95% clean ears, suggesting that certified organic spray options were efficacious under this level of infestations. Thus, this study showed efficacy with 3 modes-of-action that differ from pyrethroids [(i)Belt, (ii) Radiant or Entrust, and (iii)Gemstar], and with options that are available to organic growers. However, the conditions of this 2011 trial, especially the relatively low pest pressure, make it difficult to recommend these options widely. The experiment should be repeated under higher pest pressures.

Table 1. Evaluation of sweet corn ears, Rock Springs, PA, 2011. Planting date was 16 June. Spray dates were 11, 16, 22, and 26 of August.

		Ear evaluation			Live larvae per 25 ears	
Treatment	Rate	% clean	% tip only	% other damage	CEW	ECB
check	…	80b	14a	6a	2a	3.25a
Radiant	6 fl oz	98a	1b	1a	0b	0b
Gemstar	5 fl oz	89ab	7ab	4a	1ab	1.75ab
Entrust+Gemstar	Entrust @ 3 oz/ac + Gemstar @ 5 oz	95a	4ab	1a	0.25ab	0.75ab
Belt	Belt 480 SC @ 3 oz/ac + Dyne-Amic @ 0.25%	100a	0b	0a	0b	0b
Belt alt. Baythroid	Belt 480 SC @ 3 oz/ac + Dyne-Amic @ 0.25% alternated with Baythroid XL @ 2.8 oz/ac	97a	3ab	0a	0b	0.5ab
Baythroid	Baythroid XL @ 2.8 oz	95a	4ab	1a	0.25ab	0.75ab
Entrust	3 fl oz	100a	0b	0a	0b	0b