Improving Risk Alerts and Management for Sweet Corn Pests

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Sweet corn is the vegetable crop with the largest acreage and the highest insecticide input in Pennsylvania. Three factors are resulting in changes in management programs: (1) variability in pyrethroid efficacy (2) emerging changes in the pest complex due to regional effects of Bt-field-corn and a new threat from the western bean cutworm, and (3) our ability to use information technologies to develop risk alerts. In 2009, we focused on 3 objectives to improve risk alerts and management of these pests.

Objective 1. Test the efficacy of new materials that target the ryanidine receptor, and a microbial metabolite, to work under Pennsylvania conditions.

Objective 2. Determine if the western bean cutworm is now present Pennsylvania.

Objective 3. Develop and deliver migration alerts, delivered weekly updates.

Objective 1: Insecticide efficacy: In the last 2 years, we have been conducting efficacy trials to evaluate non-pyrethroid options, to help avoid problems with resistance. We have been working with insecticides with new modes-of-action. Two materials (Belt from Bayer, and Coragen from Dupont) target the ryanidine receptor in neuro-musculature connections. We have been including new adjuvants and adjusting rates to improve efficacy. In addition, we have been evaluating a modified microbial metabolite that targets receptors in the post-synaptic junction of the nervous system. This material is called Radiant – it is an analogue to the spinosyn materials, such as SpinTor. Earlier work suggested that under low insect pressure, Spintor could show fair-to-good efficacy for the pest complex in sweet corn. We reasoned that the new analogue, Radiant, would increase field stability and efficacy. Furthermore, all of these options may be better for one of the pest species, the fall armyworm.

We completed a replicated trial, evaluating 8 materials/rates for efficacy against European corn borer (ECB), corn earworm (CEW), and fall armyworm (FAW), and submitted the results to Arthropod Management Tests – results are also reported here. The work was conducted at Russell E. Larson Research Station, Pennsylvania Furnace, Centre County (Rock Springs). The field was planted with 'Providence' sweet corn with 30 inch row centers with a depth of 1.5 inches on 23 Jun. This late planted date was designed to help ensure strong insect pressure. The insecticides were applied beginning at first silk. Applications occurred on 24 and 27 Aug, and 1, 4, and 8 Sep. Insecticides were applied using a backpack sprayer with a straight boom, delivered through two TeeJet XR8002VS flat fan nozzles 18 inches apart. The boom was held almost vertically and aimed at the ear zone from each side of the 2-row plot. A backpack sprayer was used delivering 30 gpa; 32 psi pressure was maintained with a CO_2 propellant. Each plot was 4 rows by 30 ft with 4 replications in a RCB design. Ears were harvested for evaluation on 15 Sep. 25 ears from each treatment and replication and were picked randomly and assessed for damage. Damage was scored as being tip only (within 1-cm of the tip on the ear), silk (damage in the silk tube only), or deep (damage extending below the tip and/or on the side or base of the ear). Live larvae were counted and identified. The effects of treatments on the percent of clean and

damaged ears, and the number of live larvae, was analyzed with ANOVA and means separated using an LSD test at $P \leq 0.05$. Percentage data were transformed to arcsin prior to analysis.

All three lepidopteran pests were present with ECB being the most frequent followed by CEW and FAW. All treatments, including the pyrethroid grower standard (Baythroid), increased the percent of clean ears in this trial (Table 1). Radiant resulted in the highest percentage of clean ears, and was statistically the same as the pyrethroid, Belt with the NIS surfactant, and two of the Coragen options tested. Both Radiant and Belt are now registered for use in sweet corn. This shows that we have non-pyrethroid chemical control options in Pennsylvania.

Objective 2. Is the western bean cutworm present Pennsylvania: Historically, the western bean cutworm (WBC) has been a pest of dry beans and corn in the Great Plains; however, it has been moving eastward, infesting corn and causing economic damage. By 2008, it reached central Ohio (Wayne Co.; < 90 miles from the Pennsylvania border) and was found in Ontario. The caterpillar is a late season pest that can infest both field and sweet corn. Adults are active in mid- to late-summer, laying eggs on corn leaves. Larvae feed on tassels and developing kernels and can cause severe damage. Unlike corn earworm, multiple larvae can develop in each ear, causing damage deep into the ear, as opposed to staying near the tip. To be effective, foliar insecticides must be applied prior to the caterpillars entering the husk, but this window of opportunity is small (only a few days) because larvae can enter the ear as early as the second instar. Western bean cutworm bears some similarities to fall armyworm, which is one of the reasons that we are trying to include the Radiant treatment in our efficacy trials – should this species become part of our pest complex, we think Radiant may be important for control.

We collaborated with a coordinated monitoring system led by John Tooker, and involved Extension Educators that were part of Pestwatch. We determined that WBC is in our state. Approximately 90 moths were captured. The majority was in the northwest and northern portion of the state, but positive captures extended all the way to Franklin Co. in the southeast. Our data were compiled with results across the Great Lakes region by Tracey Baute, Field Crop Entomologist at the Ontario Ministry of Ag, Food, and Rural Affairs, and reported at

http://www.omafra.gov.on.ca/english/crops/field/news/croppest/2009/18cpo09a3.htm

As part of our effort, we improved on the trapping methods that were in place, which used milk-jug/propylene glycol method. We confirmed that commercial lures in UniTraps along with dichlorvos strips can capture moths. We obtained vouchers, and noted that pheromone trapping for WBC yields a lot of non-target moths, particularly the yellow striped armyworm (YSA; *Spodoptera ornithogalli* Guenée) and dingy cutworm (DC; *Feltia ducens* Walker). This suggests that the lure is not as effective as it could be, and may not be ideal for detecting low populations of WBC, which is the current status of WBC in Ohio, Ontario, Pennsylvania, New York, and other states on the eastern edge of the spread. We have designed studies to obtain a more specific lure, and are submitting grants to enable that work to proceed.

Objective 3. Develop and deliver migration alerts, delivered weekly updates: As in the past 3 years, we obtained matching resources for this objective. Pheromone lures and diclorvos strips were funded from the Environmental and Natural Resources Institute (ENRI,

http://enri.cas.psu.edu), at a cost of ~$2,800. We do this to help ensure quality control of the pheromones. We coordinated distribution of lures and diclorvos strips to 18 collaborating Extension Educators, and assumed the responsibility of weekly data from Centre County. We coordinated data flow through Pestwatch, at the Center for Environmental Informatics (see www.cei.psu.edu). We summarized results, and transferred them to PVGA approximately weekly through the field season.

We also collected fall armyworm and European corn borer from multiple sites in Pennsylvania, and are currently worked to get them embedded into lab analyses of their mitochondrial and nuclear DNA. These are on-going efforts to develop a better understanding of (1) the natal origins of fall armyworm that arrive in Pennsylvania, (2) the natal hosts of European corn borer and how that differs between the two pheromone strains, and (3) rates of gene flow. This also helps get graduate students involved in both applied and basic studies in field settings.

Pestwatch now is operating across much of the continental US, with ~700 sites participating in 2009. It is important for us to match standards that are occurring in the larger corn producing states. Standardizing pheromone and trapping methods, however, creates a new hurdle for us in Pennsylvania. The standard trap for the corn earworm is the Harstack trap: a wire cone trap that is larger than the older wire cone traps we currently use in Pennsylvania. We are trying to the upgrade to Harstack traps. Therefore, in 2009 we defined a system that would enable farm staff to build these traps during the winter months, and wrote two grant applications to obtain the necessary sheet-metal working tools (cost of ~$2,532). Those were unsuccessful, but we continue to submit applications for these tools.

Table 1: Evaluation of insecticides for control of corn earworm (CEW), European corn borer (ECB) and fall armyworm (FAW) at Rock Springs, Pennsylvania, 2009, in 'Providence' sweet corn.

Treatment				Ear evaluation				Live larvae per 25 ears		
Insecticide	oz/A	Surfactant	v:v	% clean	% tip	% deep	% silk	CEW	ECB	FAW
Check	--	none	--	3c	45a	37a	3a	13.5a	37.75a	1.5a
Baythroid XL	2.8	NIS	0.5%	86ab	7bc	6b	0a	0.75b	0.75b	0b
Belt 480SC	3	NIS	0.25%	86ab	6bc	2b	2a	1.25b	0.75b	0b
Belt 480SC	3	MSO	0.25%	81b	15b	3b	1a	2.5b	0.75b	0b
Radiant	6	Dyne-Amic	0.5%	94a	4c	2b	0a	0.5b	0.25b	0b
Coragen	3.4	MSO	0.5%	85ab	11b	3b	1a	1.5b	1.5b	0b
Coragen	5.1	MSO	0.5%	79b	14b	5b	2a	2.5b	0.5b	0.25b
Coragen	6.8	MSO	0.5%	88ab	9bc	2b	1a	1.5b	0.5b	0b

Means within a column with the same letter are not significantly different by LSD at the $P = 0.05$ level