Managing Corn Earworm while Conserving Aphid Biocontrols

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A wide range of sweet corn pest management options now exist. Some are adopting Bt-sweet corn, while others chose not to or avoid this due to concern about market risk or cost of seed. Some are incorporating the more expensive insecticides (Coragen, Belt, Radiant, pre-mixes that contain these active ingredients), while others are utilizing the inexpensive pyrethroids. However, we are hearing increasing concerns of outbreaks of corn leaf aphid. This is somewhat surprising because wild populations of predatory insects often control corn leaf aphid (Hoheisel and Fleischer 2007).

Recent changes in the pest complex and grower markets suggest that controlling corn earworm in sweet corn with a nuclear polyhedrosis virus (NPV) would have merit. These include a reduction in European corn borer pressure due to regional adoption of Bt-field corn, an increase in aphid problems possibly due to over-reliance on pyrethroids, and organic marketing options.

A biologically based insect pathogen for CEW, called Gemstar, is a commercially available liquid suspension of a nuclear polyhedrosis virus that is specific to CEW (or the related tobacco budworm). This has the potential of effective control with no reduction in generalist predatory insects that typically control aphids in sweet corn. Gemstar has shown efficacy in sweet corn in the west, and tomatoes and cotton in the south. It has a 0 day PHI and 4-hour REI, and would be an option for both conventional and organic growers. Alone, this option would not be useful if ECB, FAW or other pests were also present, but in today's situation we have locations and times when these pressures are very low or absent. We also have more effective spray options that could be tank-mixed if, for example, ECB was a concern.

This project is designed to test the efficacy of Gemstar against CEW in conditions in Pennsylvania. In 2016, we evaluated the effectiveness of foliar insecticides on the control of ECB and CEW in sweet corn at the Russell E. Larson Research Station, Pennsylvania Furnace, Centre County, and Glen Run Valley View Farm, Atglen, Chester County, Pennsylvania. We also include here results from an earlier trial that included the same NVP material, conducted in Centre Co. is 2011.

Methods. In 2016, Chester County was planted on May 30 with 'Providence' sweet corn with 30-inch row centers with a depth of 1.5 inches. Warrior II, Radiant and Gemstar insecticides were applied beginning at first silk on 18 July, 22 July, 29 July, 3 Aug, and 8 Aug using a backpack sprayer with a straight boom, covering 4 rows. The boom was held over top of the corn to simulate grower sprays. A backpack sprayer was used delivering 30 gpa; 40 psi pressure was maintained with a CO_2 propellant. There were four treatments including one untreated check. Each plot was 4 rows by 50 ft with 4 replications in a RCB design. Ears were harvested for evaluation on 16 August and

delivered to Roberts and Fleischer. Twenty-five ears from each treatment and replication and were picked randomly and assessed for damage.

The Russell E. Larson Research Station was planted with 'Abbott & Cobb 552742' sweet corn with 30-inch row centers with a depth of 1.5 inches on 14 June 2016. Warrior II and Gemstar insecticides were applied beginning at first silk on 12 Aug, 17 Aug and 22 Aug 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. There were three treatments including one untreated check. Each plot was 4 rows by 30 ft with 4 replications in a RCB design. Ears were harvested for evaluation on 25 August. Twenty-five ears from each treatment and replication were picked randomly and assessed for damage. The 2011 trial at this location used the same methods, except the cultivar was 'Providence'.

For all trials, damage was scored as being tip only (within 0.5-in of the tip on the ear), tip and side (damage on tip extending beyond 0.5-in or damage to the side of the ear), or side or base. Live larvae were counted and identified. Blemished kernel was denoted for brown discoloration of kernels potentially due to hemipteran feeding. The effects of treatments on the number of clean or damaged ears and the number of live larvae were analyzed with ANOVA and means separated using Tukey's LSD (alpha=0.05).

Results. Chester County trialed Gemstar along with a water control (check), Warrior II (conventional) and Radiant (Gemstar alternative). Lepidipteran pest pressure was very low, and the treatments did not differ in efficacy (Table 1). However, it did appear that the Gemstar treatment had less variation in percent clean ears (Fig 1).

Table 1. Chester County Sweet Corn Gemstar Efficacy Trial, 2016. Live larvae/treatment is the count of CEW and ECB averaged across the 4 replications of 25 ears totaling 100

Chester County Sweet Corn Gemstar Efficacy Trial 2016								
		Ear Evaluations					Live Larvae/ Treatment	
		Average % Damage						
Treatment	Rate (oz/Acre)	% clean	% tip only	% tip and side	% side or base	% blemished kernel	CEW	ECB
Check	n/a	81a	2a	9a	0a	8a	0	0
Warrior II		90a	0a	3a	3a	4a	0	0.01
Gemstar		84a	4a	8a	1a	3a	0.01	0
Radiant		76a	6a	11a	1a	7a	0	0

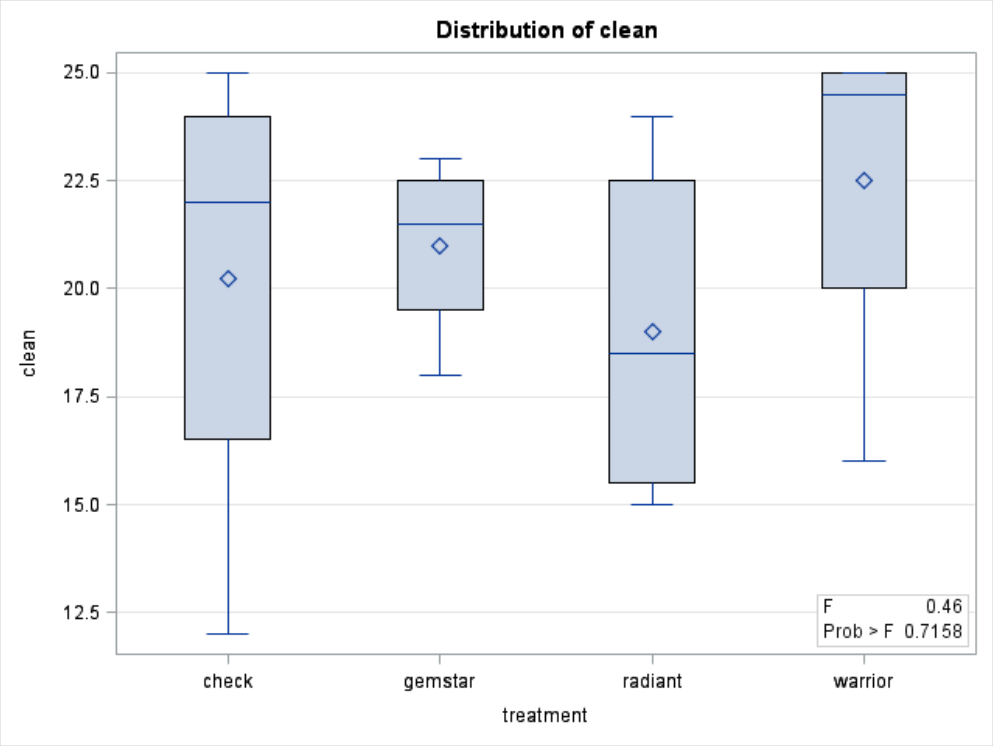

Figure 1 ANOVA Box plot distribution of the number of clean ears for Chester County in 2016. The treatments were not different in the distribution of clean ears at an alpha=0.05 (F=0.46, p=0.7158, DF=3).

Centre County trialed Gemstar along with a water control (check) and Warrior II. As in Chester Co., lepidopteran pest pressure was light, but it was not as low as in Chester Co. Both Gemstar and Warrior treatments were different for the number of check clean ears compared to the untreated control (Table 2).

Table 2. Centre County Sweet Corn Gemstar Efficacy Trial, 2016. Live larvae/treatment is the count of CEW and ECB averaged across the 4 replications of 25 ears totaling 100.

Centre County Sweet Corn Gemstar Efficacy Trial 2016							
		Ear Evaluations				Live Larvae/ Treatment	
		Average % Damage					
Treatment	Rate (oz/Acre)	% clean	% tip only	% tip and side	% side or base	CEW	ECB
Check	n/a	81a	9a	3a	7a	0.04	0.01
Warrior II		93b	3a	2a	2a	0.02	0.01
Gemstar		91b	5a	1a	3a	0.03	0

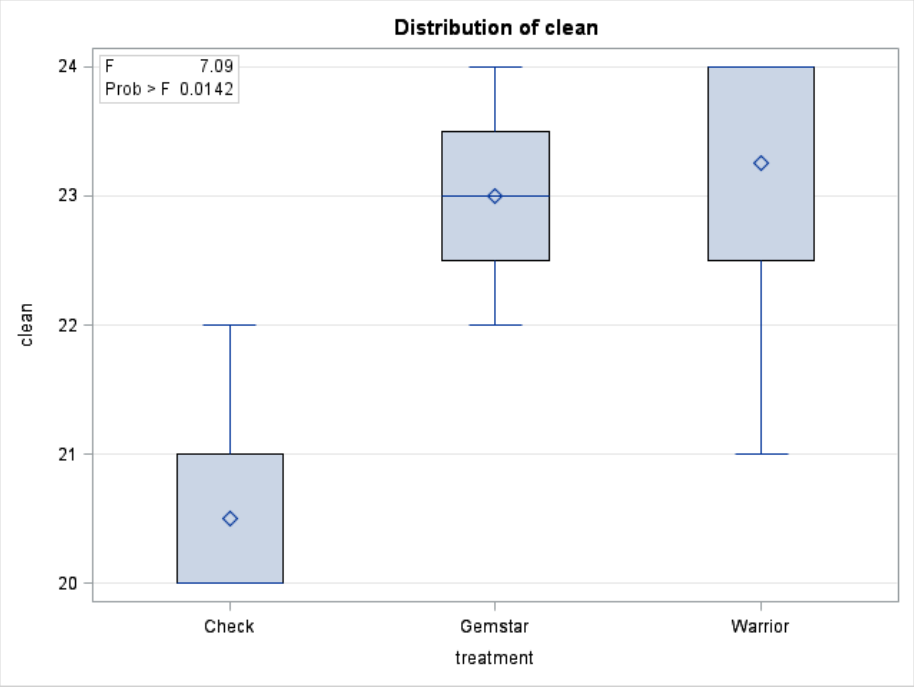

Figure 2. ANOVA Box plot distribution of the number of clean ears for Centre County in 2016. The treatments Gemstar and Warrior were different in the distribution of clean ears compared to the check at an alpha=0.05 (F=7.09, p=0.0142, DF=2).

The 2011 trial that included Gemstar had higher lepidopteran pest pressure (Table 3). All treatments had a higher number of clean ears than the untreated control, but the Gemstar-alone treatment was not significantly higher.

Table 3. 'Providence' Sweet corn efficacy trial from 2011, Rock Springs, PA. Harvested August 31, 2011.

		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% v:v 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

Discussion. Taken together, these studies confirm that a wide range of options exist for managing lepidopteran pests of sweet corn in Pennsylvania. Although this may not be true in other locations, under environmental conditions and pest pressure we currently see

in Pennsylvania, these studies suggest that these options work, and they include materials that are highly species-specific (such as Gemstar). Growers who are seeing problems with corn leaf aphid could reduce use of pyrethroids and utilize Gemstar if their pest pressure is limited to corn earworm, based on pheromone trap catch data at their farm. Alternatively, they could use Gemstar with other materials that are not pyrethroids (Radiant, Entrust, Coragen, Belt, or Bt-sweet corn). Among these, the option that can be expected to promote the highest densities of generalist predators is Bt-sweet corn. An option allowable in most certified organic operations is Entrust, which could be tank-mixed with Gemstar. Growers would need to be prepared to deal with pests that are not lepidopterans, such a sap beetle, silk feeders (Japanese beetles, adult corn rootworms), or stink bugs.

Literature Cited

Hoheisel G. A., and S. J. Fleischer. 2007. Coccinellids, aphids, and pollen in diversified vegetable fields with transgenic and isoline cultivars. 12pp. Journal of Insect Science 7:61, available online: insectscience.org/7.61