Addressing the Sweet Corn Trapping Infrastructure

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WITH THE HELP OF PVGA, WE INITIATED PESTWATCH (www.pestwatch.psu.edu) in the 1990's and initiated web and interactive cartography to disseminate the information in 1998. The program is comprised of people monitoring trap catch from pheromone-baited traps, standard protocols, web-based data flow, interactive cartography, and information dissemination. The work is organized through Extension Educators, an Extension Specialist, and the Center for Environmental Informatics at Penn State. This brought the attention of ag economists, who included this in studies of the economic impact of IPM based on surveys, assigning values to pesticide use patterns and effect on environmental impacts, and extrapolating to the Commonwealth as a whole. This independent analysis reported savings of ~$6 million to growers, and another $6 million through reduction in pesticide use[1] for the Commonwealth. Extension Educators work directly with growers, and estimate cost savings of approximately 3 to 7 fewer applications per farm and the direct cost savings vary farm acreage.

Four factors make PestWatch increasingly important. First, resistance to multiple insecticides is well documented in corn earworm. Alternatives are available, but at much higher expense. Knowing when that investment is warranted is important. Second, warm summers can result in higher populations: in 2002, 2007, and 2010 we witnessed severe pest pressure from corn earworm. Third, a newly invasive lepidopteran, Western bean cutworm, is approaching, can cause severe damage to sweet corn, and our trapping infrastructure can help determine its presence and intensity. Fourth, a decrease in the European corn borer may occur in areas of widescale deployment of CryIA(b) transgenic field corn. Where this occurs, sprays could be reduced during the early part of the season.

IRONICALLY, THE INCREASED VALUE OF THIS IPM PROJECT HAS ALSO REVEALED A DECLINING FIELD INFRASTRUCTURE AT HOME. The field tool needed is the Harstack trap - a wire cone trap (diameter of the bottom opening of outer cone is 75 cm, top opening of the inner cone is 50 cm), and data using this quality is needed for advancing to the level of risk alerts that is occurring in the Midwest. This trap is not commercially available. Scaled-downed versions - diameter of the bottom opening of the outer cone is 50 cm, top opening of the inner cone is 25 cm - with lower quality data are easier to ship, and were commercially available in the 1990's, but this is also no longer available. PestWatch was initiated over 12 years ago, with the scaled down version, and these methods are worn out and outdated. Cloth options are available, but are less dependable and not used in the more significant sweet corn growing regions of the US.

The primary objective of this proposal is to enable us to replace, over time, the trapping infrastructure tools in a sustainable fashion by upgrading metal-working equipment within the Entomology Farm at Rock Springs. Additionally, we worked to measure the geographic expansion of Western bean cutworm, and evaluate spray programs that utilize the newer modes-of-action.

[1] Norton G. W., S. M. Swinton, S. Riha, J. Beddow, M. Williams, A. Preylowski, L. Levitan, and M. Caswell. 2001. Impact Assessment of IPM Programs. Report produced under cooperative agreements between Cornell, Michigan State, Virginia Tech, and the USDA ERS. 175 pp.

Objective 1. *Upgrade sheet metal-working equipment so that we can fabricate and deliver wire cone traps to cooperating Extension Educators in the vegetable-growing regions of the Commonwealth. Structure this so that trap replacements and repair can be accomplished with minimal effort and cost.*

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 the Penn State Entomology 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. The timing of the purchase coincided with the field season at the farm, therefore we had to wait until approximately October (after most harvesting and winter cover crop installation was complete). We are now in the process of transport and installation of the equipment. We will make the traps during the winter of 2011 (prior to the field season).

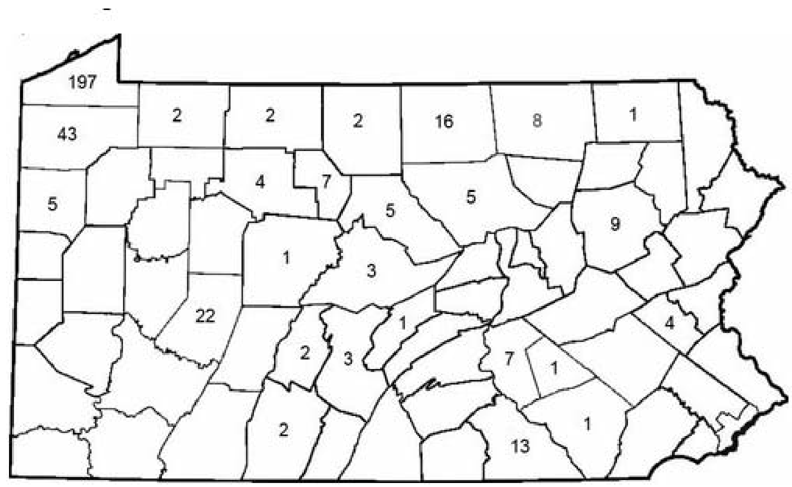
We did not budget for the cost of supplies (sheet metal, galvanized wire mesh, fasteners). We estimate the maximum cost of ~$100 per trap for supplies. However, during the summer of 2010 we collaborated with the Pesticide Education program at Penn State, who is looking into integrating components of PestWatch into the Ag Education program that exists in some high schools. As a prototype of working towards this, we obtained funds from the Pesticide Education program which we will use to make an initial supplies purchase, hopefully enough to construct 20 traps.

Trap design will follow standands (see www.uky.edu/Ag/Entomology/entfacts/misc/ef010.htm), with slight modifications based on our earlier work with these traps, such as using galvanized wire that is more easily commercially available in our area. Our emphasis will first be on trapping for corn earworm as opposed to European corn borer. We will also manufacture a series of trap parts, with an emphasis on the top cylinders. This will make future repairs easier, and set us up for rapid replacement of parts in the future. We will prioritize trap manufacture for the 18 cooperating Extension Educators, who will deploy them on cooperating farms. Our distribution will initially emphasize monitoring for corn earworm. This will place us on par with the Midwestern and southern states, improving our pest forecasting abilities in the future.

Data flow continued through PestWatch, with 12 weekly reports (www.pestwatch.psu.edu/cgi-bin/displaycommentary.cgi?2010). The data also summarized in table format, and sent weekly to PVGA. 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. The phenology model information is limited to the one species because it is the only one where populations overwinter, and for which long-distance migration does not strongly influence local conditions. Also, for European corn borer, it is important to couple the prediction of the timing of a given life stage (the phenology model predictions) with the observed densities, because we are increasingly seeing density decreases due to high rates of adoption of Bt-field corn.

Objective 2. *Tracking Western bean cutworm.*

The Western bean cutworm is moving into Pennsylvania, and economic damage is now being reported by Midwestern entomologists. To help alert us to the status of this pest, PVGA helped sponsor the collection of trapping data with work led by John Tooker, field crops entomologist at Penn State. The map shows continued movement into Pennsylvania, with most of the captures in Erie Co. We have not yet reached economically damaging levels.



Distribution of Western bean cutworm captures in 2010. We captured 366 moths in 2010, up from ~ 90 moths in 2009 which was the year of first detection in Pennsylvania.

Objective 3. *Evaluate use of the newer modes-of-action.*

We evaluated Bt-sweet corn and foliar insecticides on the control of ECB, CEW and FAW in 'Providence', and BC0805 (a Bt-sweet corn), at the Russell E. Larson Research Station, Pennsylvania Furnace, Centre County (Rock Springs). The field was planted with 30 inch row centers with a depth of 1.5 inches on 16 Jun. No insecticides were applied to BC0805, or to the untreated check of 'Providence'. In the treated plots, 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. The boom was held almost vertically and aimed at the ear zone from each side of 2-row plots. A backpack sprayer was used delivering 30 gpa, 32 psi pressure, maintained with a CO2 propellant. Each plot was 4 rows by 30 ft with 4 replications in a replicated complete block design. On Sep 3, 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.

Pest pressure was strong: untreated checks averaged only 43% clean ears, and close to 10 live corn earworms per 25 ears. Unsprayed BC0805 gave 93% clean ears. All foliar treatments significantly increased the percent clean ears, and there were no statistical differences among foliar treatments in percent clean ears. All options except Coragen-2 resulted in >90% clean ears, and Belt-2, Coragen-1, and Radiant alone resulted in 96% clean ears.

Unsprayed BC0805, or several foliar options sprayed at intervals suggested by the PestWatch trapping numbers (in this case, a 4-5 day spray interval) resulted in high rates of clean ears.

Table 1. Evaluation of foliar insecticides in sweet corn, along with unsprayed Bt-sweet corn, 2010. Treatments consisted of an untreated check, combinations that utilized Belt or Coragen, or Warrior or Radiant alone. There were 5 applications, and the materials used for each application are detailed in Tables 2 and 3, below. Treatments were compared with ANOVA, and means separated with Tukey's HSD test.

	Ear evaluation		Live larvae per 25 ears		
Treatment	% clean	% tip only	CEW	ECB	FAW
check	43a	31a	9.75a	3a	0a
Belt 1	92b	7b	0.5b	0b	0a
Belt 2	96b	4b	0b	0b	0a
Coragen 1	96b	4b	0.25b	0b	0a
Coragen 2	81b	15ab	1.75b	0b	0a
Coragen 3	91b	9b	0.25b	0b	0a
Warrior	93b	4b	0.75b	0b	0a
Radiant	96b	1b	0b	0b	0a
BC0805 (Bt sweet corn, no sprays)	93	6	0.25	0	0.5

Spray dates:
8/12/10 all treatments
8/16/10 all except Coragen 1 applied on 8/17/10
8/20/10 all except Coragen 1,2,3 applied on 8/21/10
8/25/10 all except Coragen 4,5,6 applied on 8/26/10
8/30/10 all except Coragen 1,3 applied on 8/31/10

Table 2. Fomulations and rates used in the evaluation of foliar insecticides above.

Compounds and Rate	Surfactant
Asana XL @ 6 fl oz/ac	-
Baythroid XL @ 2.8 oz/ac	-
Belt 480 SC @ 3 oz/ac	Dyne-Amic @ 0.25%
Coragen @ 3.5 fl oz/ac	0.5% MSO (0.5 ml/100ml)
Lannate @ 1.5 pt/ac	-
Radiant @ 6 oz/ac	Dyne-Amic @ 0.5%
Warrior II @ 1.92 fl oz/ac	-

Table 3. Listing of the compounds used, alone or in combination, for each of 5 applications in the 8 treatments.

Treatment	**Application 1**	**Application 2**	**Application 3**	**Application 4**	**Application 5**
check	none	none	none	none	none
Belt 1	Belt	Baythroid	Belt	Baythroid	Belt
Belt 2	Belt + Baythroid	Belt + Baythroid	Lannate + Baythroid	Belt + Baythroid	Belt + Baythroid
Coragen 1	Coragen	Lannate + Asana	Coragen	Lannate + Asana	Coragen
Coragen 2	Lannate + Asana	Coragen	Coragen	Coragen	Lannate + Asana
Coragen 3	Asana	Coragen + Asana	Coragen	Coragen	Coragen
Warrior	Warrior	Warrior	Warrior	Warrior	Warrior
Radiant	Radiant	Radiant	Radiant	Radiant	Radiant