Management of Lepidoptera on Processing Sweet Corn in Western New York

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ABSTRACT Processing sweet corn harvested from commercial fields in western New York was graded for insect injury and presence of larvae of European corn borer, *Ostrinia nubilalis* (Hubner); fall armyworm, *Spodoptera frugiperda* (J. E. Smith); and corn earworm, *Heliothis zea* (Boddie), during 1982 and 1983. In both years, boring injury caused by *O. nubilalis* was lower and remained relatively constant through the season relative to the dramatic increase in tip injury caused by *S. frugiperda* and *H. zea* as the season progressed. In 1982, the seasonal average of tip and boring injury was 6.43 and 1.11%, respectively, and in 1983, 6.94 and 1.51%, respectively. Tip injury reflected temporal trends in fall armyworm and corn earworm populations in harvested ears in both years. Boring injury only reflected the temporal trend of European corn borer in 1983. Testing of a management program, which compared scheduled applications in one section of the field against a sequential sampling program for European corn borer in another section of the same field was conducted in 11 commercial fields in 1984. For each processor involved, there was no significant difference in number of ears that were infested or culled in each section; however, scouted sections of fields required 25 and 33% fewer applications. Based on an analysis of insecticide savings and scouting costs, adoption of this management program should prove cost effective to the processing industry.

KEY WORDS *Ostrinia nubilalis*, sweet corn, insect pest management, crop loss, *Spodoptera frugiperda*, *Heliothis zea*

SWEET CORN GROWN for processing is a relatively low-value crop ($860 per ha) grown on ca. 10,000 ha in western New York. Nearly all insecticide applications are applied aerially by processors (rather than growers) and are aimed at controlling larvae of European corn borer (ECB), *Ostrinia nubilalis* (Hübner), from the midwhorl crop stage to harvest. Although other Lepidoptera (i.e., fall armyworm [FAW], *Spodoptera frugiperda* (J. E. Smith), and corn earworm [CEW], *Heliothis zea* (Boddie)) may also infest sweet corn in this area, their population levels are normally much lower than ECB. In addition, since they usually arrive late in the season, they are only early instars at harvest and their feeding damage is usually confined to the ends of the ear and can be trimmed. Injury by ECB usually involves boring into the ear, thus making the entire ear unmarketable. Although the processing companies in this area have not conducted specific research to develop decision rules for Lepidoptera, they do employ a decision-making protocol. Generally, their system relies on a trained scout who selects a key field (i.e., a field that traditionally has had ECB problems) for a given area (e.g., a 10-km radius encompassing 10 fields) and examines that field once per week. Scouting begins at the early green tassel stage (ca. 50 days after planting for the major cultivar Jubilee). A scout selects a site, which he judges to be the most likely place to find ECB egg masses, then examines 125 entire and consecutive plants. Once the scout finds three ECB egg masses in this sample, insecticides are applied to this key field, and all other fields within the area that are beyond the early green tassel stage, on a weekly basis until harvest. This approach is conservative since all fields are treated according to the situation in the key field. Furthermore, this approach is geared for initiating area-wide spraying and usually requires two to three applications of EPN followed by a final application of encapsulated methyl parathion (Penncap) or permethrin per field (processors suspect that sprays applied earlier will not protect the ear; see Harrison & Press [1971], Ferro & Fletcher-Howell [1985]).

In 1982, a project designed to evaluate insect control decisions of sweet corn processors in New York was begun. As a first step, harvest data was collected during 1982-83 from commercial fields to document losses caused by insects. Second, information necessary to design a sampling program for ECB was collected (Shelton et al. 1986). Third, a management program was designed and tested in commercial fields in 1984. Herein are reported the results of the first and third steps in developing an insect management program for sweet corn in western New York.

Materials and Methods

Documentation of Injury. During the harvests of 1982-83, all loads from ca. 2,000 ha contracted

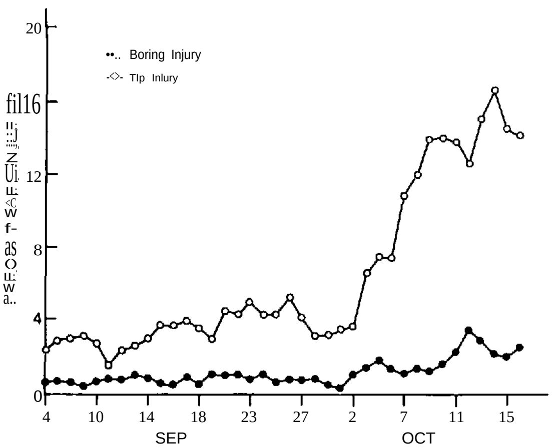

Fig. 1. Percentage of sweet corn ears injured by insect boring and tip feeding as determined by graders at a commercial processing plant during 1982, western New York.

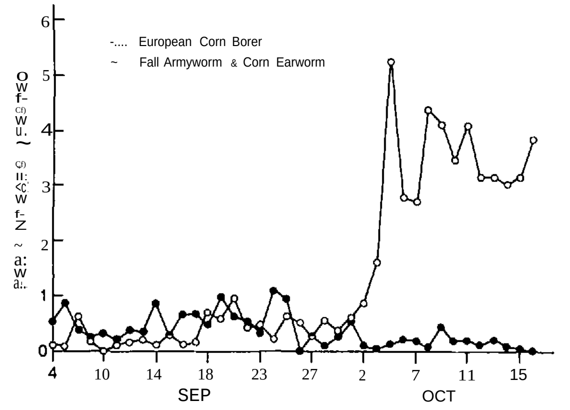

Fig. 3. Percentage of sweet corn ears infested by larvae of ECB and FAW and CEW as determined by graders at a commercial processing plant during 1982, western New York.

to one major processor were examined for insects and their injury. During the harvest, New York State Agriculture and Market personnel were instructed on the types of larvae and injury and they graded a sample of ca. 40 ears from each truck load. Ears were examined for larvae of ECB, FAW, and CEW and their injury.

Testing of Management Program. All work was conducted in 11 commercial fields within a three-county area in upstate New York during 1984. The size of the fields ranged from 5 to 12 ha and their harvest dates ranged from 25 August to 9 October. Fields were divided into two sections, with one section treated according to normal processor practices (i.e., weekly treatments from early green tassel stage until 7 days before harvest). The other section of the field was treated only after examination for insects indicated that the population had exceeded an action threshold. Based on the collective experience of processors and myself, an action threshold of three ECB egg masses per 120 plants was chosen. Based on ECB distribution (Shelton et al. 1986), a sequential sampling plan was constructed according to the following method. Plant samples were taken by selecting 12 sites along a V transect, which began at one corner of the field, went to the middle of the opposite side, and returned to the other corner of the side at which sampling began. At each site, 10 entire plants were inspected from tiller leaves to tassel for the presence of ECB egg masses, as well as any other potential pest problems. A decision to treat was made if the number of ECB egg masses was greater than two per 40 plants or greater than three per 120 plants. A decision not to treat was made if zero egg masses were found in the first 90 plants or less than three were found in 120 plants.

At harvest, each section of the field was harvested separately, taken to its respective processor,

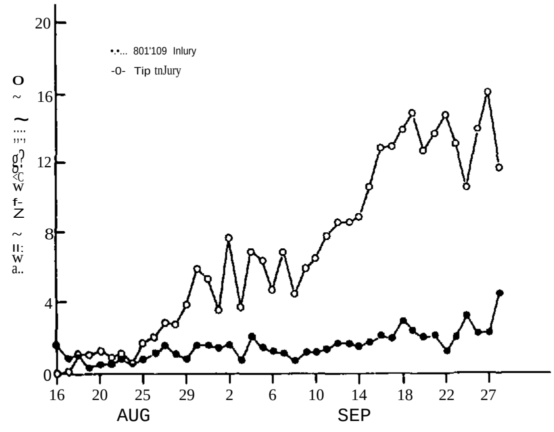

Fig. 2. Percentage of sweet corn ears injured by insect boring and tip feeding as determined by graders at a commercial processing plant during 1983, western New York.

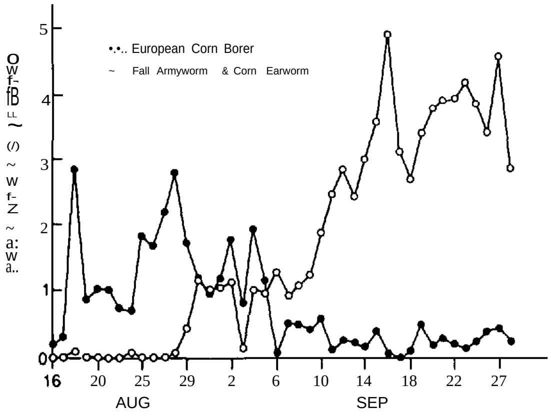

Fig. 4. Percentage of sweet corn ears infested by larvae of ECB and FAW and CEW as determined by graders at a commercial processing plant during 1983, western New York.

Table l. Percent sweet corn ears injured by Lepidoptera and culled, and the number of insecticide treatments applied for two management strategies in western New York,1984

	Harvested ears"		No. of insecticide treatments
	% infested	% culled	
Processor no. I			
Field 1	9.1	1.8	2
	7.3	1.2	4
Field 2	19.2	0	2
	8.6	0	4
Field 3	11.3	1.9	4
	5.6	3.8	4
Field 4	0	0	5
	1.5	0.8	5
Field 5	3.6	0	3
	0.8	0.8	5
Field 6	10.9	0	3
	2.9	1.7	5
Avg	9.0	0.6	3.17[b]
	4.4	1.4	4.50
Processor no. 2			
Field 1	4.9	0.9	2
	4.8	0	3
Field 2	3.9	0.3	2
	4.1	0	3
Field 3	14.9	0.2	2
	6.8	0	3
Field 4	12.4	0.5	2
	5.2	0	3
Field 5	0.8	0.5	3
	2.0	1.6	3
Avg	7.4	0.48	2.2[b]
	4.6	0.32	3.0

[a] Top number of each pair reflects data from scouted sections treated according to thresholds, and bollom number reflects data from sections treated in conventional manner.

[b] Significant djfferences by paired t test analysis ($P = 0.05$).

Table 2. Number of plants sampled before treatment decision based on ECB egg mass sequential sampling program in weslern New York, 1984

	No. of plants sampled					
	0-20	21-40	41-60	61-80	81-100	\0;;
Processor no. 1						
Treated (22)	4	11	2	2	2	1
Not treated (11)					8	3
Processor no. 2						
Treated (15)	5	6	1	2	0	1
Not treated (5)					4	1

and graded by Agriculture and Market personnel for insect injury. The percentage of ears injured was documented as either boring injury (i.e., feeding injury caused by ECB tunneling into the ear and rendering it a cull) or tip injury (i.e., feeding injury caused by FAW or CEW, which is usually surface injury and can be trimmed). The percent ears infested was documented as the number of ECB or FAW plus CEW larvae found in the ears (because small FA Wand CEW larvae could not be discriminated readily by graders, their numbers were combined). Harvest data, comparing the two sections of each field, were analyzed by paired t test using angular transformations on the percentage data. Data on the number of sprays used in each section of the field was analyzed by paired t test.

Results and Discussion

Documentation of Injury. The percent ears injured in 1982 and 1983 is shown in Fig. 1 and 2, respectively. In both years, the boring injury caused by ECB remained relatively low and constant through the season relative to the dramatic increase in tip injury caused by FA Wand CEW as the season progressed. In 1982, the seasonal average of tip and boring injury was 6.43 and 1.11%, respectively, and in 1983, 6.94 and 1.51%, respectively. To be culled, there must be <10 continuous em of uninjured corn on the cob. Since FA Wand CEW normally feed at the ends of the ear and lea ve >10 em of uninjured corn, most all the culls were due to boring injury by ECB; in these 2 years, this amounted to a 1-1.5% direct loss.

The percentage of ears infested in 1982 and 1983 is shown in Fig. 3 and 4, respectively. In both years, the percentage of ears with FA Wand CEW was higher than the percentage of ears with ECB. The seasonal average of ears infested with ECB was 0.36 and 0.77% for 1982 and 1983, respectively. The difference between years may be attributed to the earlier harvesting in 1982. For FAW and CEW, the seasonal average of ears infested was 1.42 and 1.72% for 1982 and 1983, respectively. In both years and for all insects, damage at harvest was higher than the percent ears infested, indicating that damage had occurred before harvest and the larvae had already left the ear.

In 1982, the temporal patterns of boring injury and infestation by ECB were similar (Fig. 1 and 3). The same was true for FAW and CEW. In 1983, the temporal patterns of tip injury and infestation by FA Wand CEW were similar (Fig. 2 and 4), but, in the case of ECB, high early season infestations by larvae were not reflected in high amounts of boring injury. One possible explanation is that the ECB larvae found on the ears from mid-August to the beginning of September were early instars that had not yet begun to bore into the ear.

Testing of Management Program. Data from the 11 commercial fields are presented in Table 1, and fields from each processor are analyzed separately. For each processor, there was no significant difference in the number of ears that were infested or culled in either section of the fields ($P = 0.05$). There were significant differences in the number of sprays applied to each section of the fields for each processor ($P = 0.05$) (processor no. 1: $t = -3.16$; df $= 5$; processor no. 2: $t = -4.00$; df $= 4$). Although processor no. 1 applied an average of 1.5 more sprays per field than processor no. 2 (due to earlier spray initiation), the reductions in applications in the scouted sections were similar (i.e., 33 and 25%, respectively). For each processor, the number of sprays applied did not influence the percentage of cull ears, indicating that some sprays were not needed.

The percentage culled due to insects (rather than the percent infested) is an actual measure of the loss due to insects, and the scouted sections in this test produced the same quality of corn at ca. 30% reduction in insecticide costs. The cost of an insect control program must take into account not only any pesticide savings, but also the cost of scouting. A summary of the number of plants per field examined before a treatment decision was made is presented in Table 2. Using the sequential sampling program, a decision to treat a field could be made ca. 50% (26 of 53 total samplings) of the time by sampling <40 plants. In the case of processor no. I, we made the decision to treat 22 times and not to treat 11 times. Fifteen times the decision to treat was made after an inspection of <40 plants, while only 7 times >40 plants had to be inspected. Therefore, this sampling program appeared efficient for determining when a field should be treated. If a field was not to be treated, ~90 plants had to be sampled. Of the 11 times a decision not to treat was made, 8 times the decision was made after inspecting 90 plants while only 3 times 120 plants had to be inspected. Again, this sampling method appeared efficient.

On a seasonal average, ca. 40 min was required to scout a 10-ha field before a decision to treat or not was made. The cost of insecticide and application for a lO-ha field is ca. $170. If we estimate the scouting costs at $10 per field visit (labor and transportation) and the field is not sprayed, the savings would be $160 per field visit. If our trials are representative of the 10,000 ha in western New York, and if we suppose that this area represents 500 separate fields that would receive 3.75 sprays per field (an average of the number of sprays by two processors), only 70% of the 1,875 field sprays are needed, then the overall savings would be $76,875 (562.5 field sprays x $160 savings per field minus 1,312.5 field sprays x $10 unrecouped scouting costs). Although these savings do not take into account some of the costs that would be incurred by scouting before treatment (e.g., managerial costs to the processor), they also do not take into account some of the benefits (e.g., weekly information on the disease, weed, and fertility situation). In any case, data from this study can provide some guidelines for further cost analysis for a pest management program.

Although costs must remain the focal point for the processors, they are also aware of other factors that influence their pest control practices. Much of the sweet corn in western New York is grown in small fields in semiresidential areas, and problems with aerially applied insecticides are a daily concern to both homeowners and processors. In addition, there are concerns about killing honey bees and an apparent buildup of resistance to some insecticides by ECB. These concerns must also be factored into an analysis of the management of Lepidoptera in processing sweet corn in New York.

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