OBSERVATIONS ON THE INFESTATION OF CORN BY FALL ARMYWORM (LEPIDOPTERA: NOCTUIDAE) WITH REFERENCE TO PLANT MATURITY

Floyd P. Harrison
Department of Entomology
University of Maryland
College Park, MD 20742 USA

Abstract

A series of corn plantings were closely observed for evidence of the effects of plant maturity on infestation by fall armyworm, *Spodoptera frugiperda* (J. E. Smith). Plants in the early whorl stage and younger were preferred for oviposition. Plants infested early in their development were less tolerant than plants infested later.

Resumen

Se observó cuidadosamente una serie de siembras de maíz para los efectos de la madurez de las plantas en la infestación por el gusano cogollero (*Spodoptera frugiperda* (J. C. Smith)). Se prefirieron las plantas en el período early whorl y las más jóvenes para oviposición. Las plantas infestadas temprano en su desarollo fueron menos tolerantes que las infestadas más tarde.

An obvious factor of susceptibility to fall armyworm, *Spodoptera frugiperda* (J. E. Smith), damage to corn is maturity. Hunt (1980) has observed a preference for younger corn in North Carolina. The work presented here attempts to examine the impact of fall armyworm on grain corn as is influenced by plant maturity.

It is important at this point to describe the unique circumstances under which this work was conducted. On 29 and 30 June 1983, there was a single flight of adults that deposited eggs on young corn in the area of this study. Subsequently, these eggs hatched and the larvae, all the same age, grew to maturity and pupated before any other fall armyworm activity took place. On 9 July, the first foliar feeding became evident. Larval feeding and interplant migration continued until larvae pupated. No adult activity resumed until all larval activity from these egg masses ceased. Evidence of this was that no moths were captured in any of 15 pheromone traps that were in the area and no moths were captured in nearby black light traps. Daily, 160 plants were carefully examined for eggs. None of these monitoring techniques indicated the presence of adult fall armyworm or oviposition activity. This situation provided the opportunity to observe fall armyworm behavior and plant-pest relationships that otherwise could not be observed. It was possible, therefore, to determine the length of a single generation of larvae and to measure the extent of interplant migration.

It is the purpose of this work therefore to (1) define the various effects that plant maturity has on the activity and impact on host plants of fall armyworm, (2) demonstrate the extent of interplant migration of fall armyworm larvae.

Methods

This work was conducted at the University of Maryland Poplar Hill Research Farm located on the lower Easter Shore of Maryland. In 1983, a series of plantings was made, each ca. 1 week apart (Fig. 1). In each of these plantings when the plants were yet in the seedling stage, 8 small plots of 10 plants each were selected at random. Each plant in these plots was designated a number. From that time until late silking, each was examined daily for fall armyworm eggs, the time these eggs hatched and the date each plant showed visible feeding signs. In late October, individual ears were harvested and the weight of shelled grain was recorded for each ear.

Results and Discussion

Fig. 1 illustrates (1) the preference for younger plants and (2) the larval migratory activity in each of the plantings. On 29 June when oviposition took place the earliest planting averaged ca. 100 cm in height, early whorl. The latest was germinating, indicating that infestation of this plant-

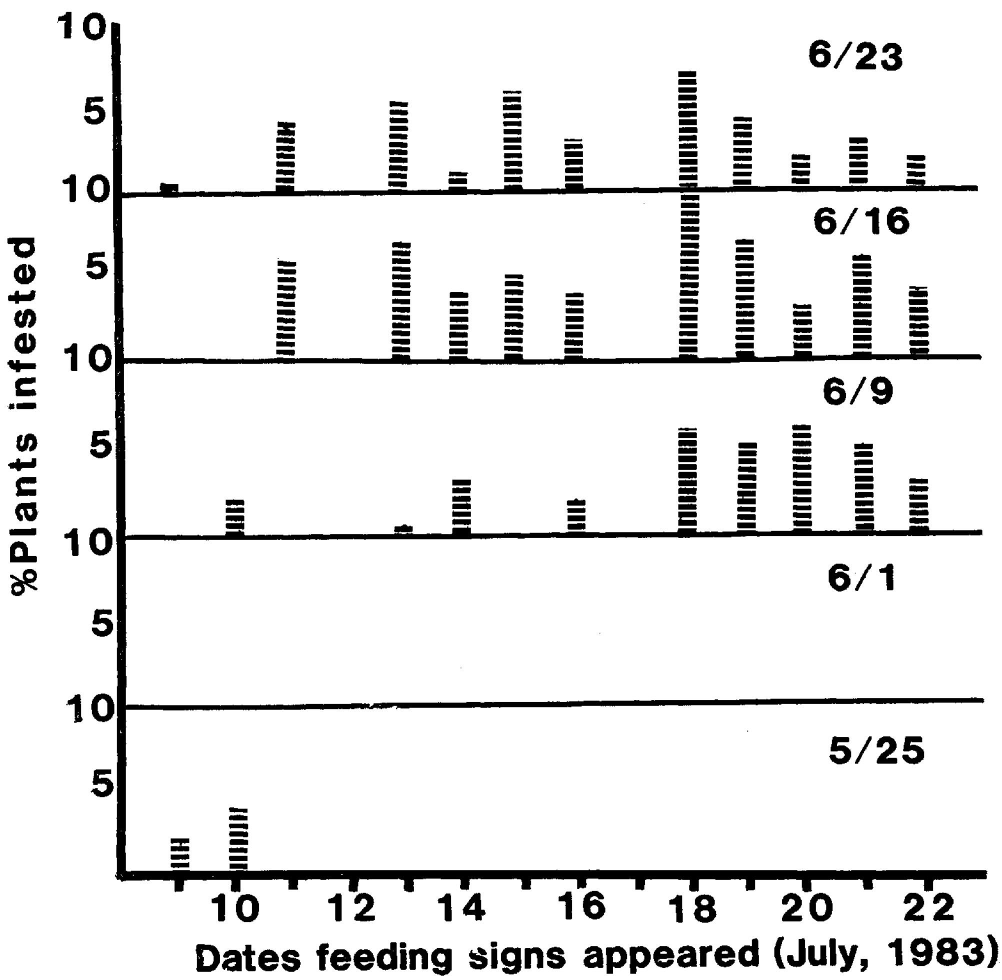

Fig. 1. The effect of plant maturity on preference of corn by fall armyworm.

ing was by migrating larvae. Note that by 22 July migration, i.e. continued infestion of uninfested plants, ceased. An examination of the plants at this time indicated all larvae had left the plants. The 2 earliest plantings escaped significant infestation. Plantings of VI-9 through VI-23 were heavily damaged. The preference was for plants in early whorl or younger. Whereas these data indicate a preference there is also the possible factor of tolerance as affected by maturity. Yields of individual ears were grouped into categories according to the date on which the plant became infested. These data are summarized in Table 1. Note that those plants infested the 1st week of oviposition exhibited the greatest loss of yield. Analysis indicated significance ($p<0.05$).

TABLE 1. EFFECT OF PLANT MATURITY AT TIME OF OVIPOSITION ON YIELD OF SHELLED GRAIN (1ST EGG MASSES DEPOSITED AT EARLY WHORL).

Stage of development at time of oviposition	Avg. Wt. of shelled grain (gr)	% reduction
Uninfested	103.8	—
1st week[1]	80.2	22.7
2nd week	89.0	14.3
3rd week	88.7	14.5

[1]Indicating the week subsequent to the 1st egg masses deposited.

Contribution No. A-3785, Scientific Article No. 6762 of the Maryland Agricultural Experiment Station.

REFERENCES CITED

HUNT, T. N. 1980. Monitoring and predicting fall armyworm infestations in North Carolina. Florida Ent. 63: 361-3.

THE DEVELOPMENT OF AN ECONOMIC INJURY LEVEL FOR LOW POPULATIONS OF FALL ARMYWORM (LEPIDOPTERA: NOCTUIDAE) IN GRAIN CORN

FLOYD P. HARRISON
Department of Entomology
University of Maryland
College Park, MD 20742 USA

ABSTRACT

A series of plantings in 1983 was used to measure direct and indirect grain yield loss by fall armyworm (*Spodoptera frugiperda* J. E. Smith). A regression analysis provided a prediction model for estimating yield losses from plant infestations.

RESUMEN

En 1983 se empléo un serie de siembras para medir la pérdida de rendimiento directo e indirecto por el gusano cogollero (*Spodoptera frugiperda* J. E. Smith). Un análisis regresivo proveýo un modelo predictivo para estimar las pérdidas de rendimiento de plantas infestadas.

Occasionally the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) severely infests grain corn in Maryland. Hunt (1980) has shown that in North Carolina later planted corn is more susceptible to fall armyworm attack. He has provided a guide for using planting date to determine which fields should bear the closest attention of IPM scouts. The author has observed the same condition in Maryland. There are well organized IPM programs in Maryland but to this date there is no objective economic injury level (E.I.L. as defined by Stern 1973). Cruz and Turpin (1983) have reported a very complex relationship between infestation and yield. There is a need, therefore, for a basis on which to establish an E.I.L. for Maryland.

This work was conducted at the University of Maryland Poplar Hill Research Farm near Quantico on the lower Eastern Shore of Maryland. 'Pioneer 3184' was grown on conventionally tilled land following current herbicide and fertilizer recommendations. Drought conditions existed in 1983.

Even a cursory observation of fall armyworm activity in grain corn will reveal that there are 2 sources of grain loss. Defoliation causes plants to produce less than maximum yields—i.e., indirect loss. Larvae also invade ears and cause direct damage. A model which predicts an injury level should distinguish between these 2 sources of yield loss, for direct loss should not confound a decision based on sampling of larvae in plants that cause indirect loss. The objective in this experiment was to devise a prediction model that could separate indirect from direct loss and associate infestation levels with each source of grain loss.

METHODS

In 1983, a series of 5 plantings of corn, each ca. 0.23 ha was made beginning 25 May (Table 1). Mini-plots of 10 plants each were established in each planting. Three plots were established congruently, one designated T which was completely protected from fall armyworm by weekly treat-

TABLE 1. A COMPARISON OF PLANTS SHOWING FOLIAR FEEDING AND A SIGNIFICANT DEGREE OF INDIRECT LOSS BY FALL ARMYWORM ON GRAIN CORN, QUANTICO, MD, 1983.

Planting date	% Infested Plants	% Indirect Loss
25 May	6	0
1 June	2	0
9 June	63	20.9
16 June	69	31.0
23 June	84	—

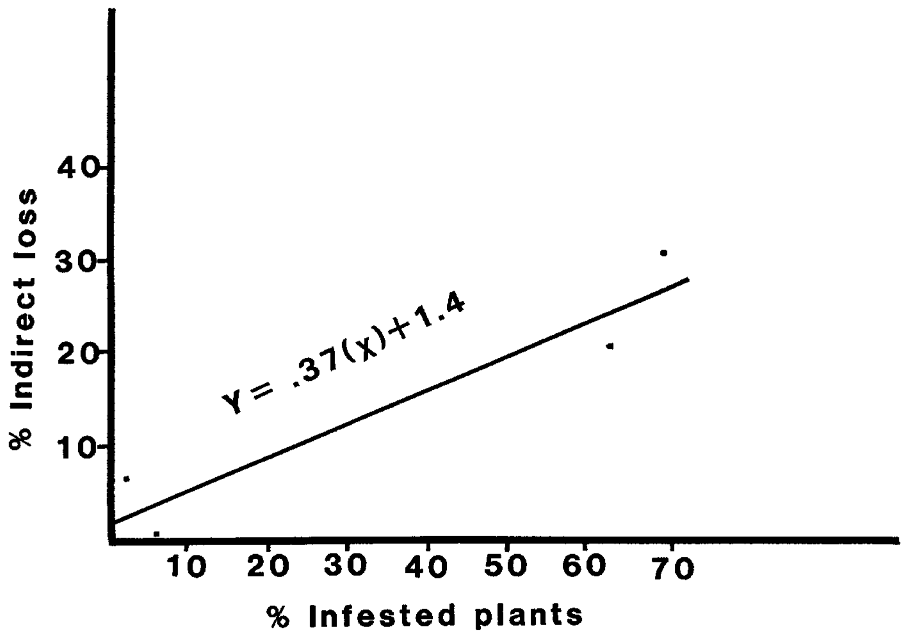

Fig. 1. The effect of plant infestation of fall armyworm on the indirect loss of grain in corn as expressed by linear regression.

ments of chlorpyrifos (15G) in the whorl and when ears began to form with regular spray treatments of permethrin. Plots designated U were left untreated. Plots designated E received only the treatments protecting the ears. These treatments were replicated 5 times in each of the 5 plantings. Since fall armyworm infestations usually begin in early- to mid-July and then increase, these plantings were so timed to offer a progression of infestation levels (Table 1). Each plot was examined daily and the date on which each plant became infested was recorded. On 22 October the plots were harvested. Individual ears were placed in paper bags with the plant number noted. The ears were later shelled and the weights from each plot recorded and totaled.

The following method was utilized to calculate the total amount of grain loss, the amount of direct loss and the amount of indirect loss.

$$L_t = \frac{Yt - Yu \times 100}{Yt}$$

$$L_i = \frac{Yt - Ye \times 100}{Yt}$$

$$L_d = Lt - Li$$

where:

L_t = % total loss by FAW,
L_i = % direct loss by FAW,
L_d = % direct loss by FAW,
Y_t = yield of shelled grain from protected plots,
Y_u = yield of shelled grain from unprotected plots,
Y_e = yield of shelled grain from plots receiving only ear protection.

Results and Discussion

Table 1 summarizes the results of this experiment, showing the extent of significant indirect loss of grain from fall armyworm defoliation in each planting. Significance ($P<0.01$) was determined by an analysis of variance. Fig. 1 illustrates the regression analysis and prediction model. There was no such close correlation between time of infestation, ears infested and direct loss (Table 2).

The results of these experiments do not provide a final answer to decision-making with fall armyworm in grain corn. They do provide a crude prediction model and a method for further refining of this model. Predicting indirect loss is more feasible than predicting direct loss, but this does not seem to complicate determining injury levels since direct injury occurs some time after initial foliar infestations. An E.I.L. based on indirect loss would normally be reached before direct loss could be predicted by examining developing ears.

Utilizing the prediction model from Fig. 1, the following example will serve to illustrate its use.

Because the model predicts losses as a percentage, the expected yield must be a parameter in calculation of predicted losses.

Let:

L = Yield loss in bushels
X = % plants infested
E = Expected yield

Therefore:

$$L = \frac{[0.37(X) + 1.4]\,[E]}{100}$$

If the expected yield is 80 bushels per acre and 12 percent of the plants are damaged by fall armyworm:

Then:

$$L = \frac{[0.37(12) + 1.4][80]}{100}$$

TABLE 2. YIELD LOSS OF SHELLED GRAIN FROM DIRECT LOSS BY FALL ARMYWORM IN EARS OF CORN, QUANTICO, MD, 1983. (INITIAL INFESTION OF EARS, VIII-2-83).

Maturity stage[1] at time of infestation	% ears infested	% direct loss
Early silk	15	0
Pre-tassel	34	34.5
Late Whorl	25	51.3
Late-Mid Whorl	23	55.0
Mid-Whorl	100	100

[1] An early infestation from eggs deposited on VI/29 and VI/30 produced an infestation that had pupated before any other fall armyworm activity resumed on VIII/2 which resulted in ear infestation.

$$L = \frac{(5.80)\,(80)}{100}$$

$$L = 4.6 \text{ bushels per acre}$$

The regression indicates that economic injury levels are rather low. Two considerations enter into this possibility, (1) that these data were collected under extreme drought conditions and (2) the likelihood that corn has very little tolerance for defoliation.

Scientific article No. A-3784, Contribution No. 6761 of the Maryland Agricultural Experiment Station, Department of Entomology.

References Cited

CRUZ, I., AND F. T. TURPIN. 1983. Yield impact of larval infestations of the fall armyworm (Lepidoptera: Noctuidae) to midwhorl growth stage of corn. J. Econ. Ent. 76: 1052-4.

HUNT, T. N. 1980. Monitoring and predicting fall armyworm infestation in North Carolina. Florida Ent. 63: 361-3.

STERN, V. M. 1973. Economic thresholds. Ann. Rev. Ent. 18: 259-80.

MONITORING FALL ARMYWORM FOR SUSCEPTIBILITY/RESISTANCE TO METHOMYL

JOHN R. LEEPER
E. I. DuPont de Nemours and Co., Inc.
Experimental Station
Wilmington, DE 19898 USA

Abstract

DuPont has monitored the fall armyworm, *Spodoptera frugiperda* (J. E. Smith), for methomyl susceptibility/resistance since 1976. This effort has not documented resistance in any populations of fall armyworm to methomyl.

Resumen

DuPont ha observado la susceptibilidad/resistencia del gusano cogollero, *Spodoptera frugiperda* (J. E. Smith), desde 1976. Este esfuerzo no ha documentado la resistencia a "methomyl" de ninguna población del gusano cogollero.

Fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), populations from throughout the US, have been monitored for susceptibility/resistance to insecticides since 1976. This has been done as a part of the Insecticide Resistance Management Program in the DuPont Company. The purpose of this paper is to report the monitoring data for technical Lannate® insecticide (97% methomyl).