YIELD LOSSES TO FIELD CORN FROM FOLIAR FEEDING BY FALL ARMYWORM[1] (LEPIDOPTERA: NOCTUIDAE)

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(Accepted for publication April 17, 1987)

ABSTRACT

During a 3 year period, 1983 - 1985, field experiments were conducted to determine the extent to which fall armyworm, *Spodoptera frugiperda* (J. E. Smith), reduces yield of dent corn by feeding on foliage of whorl stage plants. Results indicate that whorl feeding reduces grain yield and the degree of yield reduction may be related to plant vigor as affected by rainfall.

Key Words: Fall armyworm, *Spodoptera frugiperda*, yield losses, *Zea mays*.

J. Entomol. Sci. 22(3): 270-274 (July 1987)

INTRODUCTION

The fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), migrates into Maryland each year from the south. The first flight of moths usually enter the lower Eastern Shore of Maryland between the middle of June to early July (F. P. Harrison, unpublished data). Linduska and Harrison (1986) and Buntin (1986) have observed that larvae feeding in the late whorl stage of corn do not cause significant yield loss, but corn in the early and mid-whorl stages is more susceptible to yield loss as a result of FAW feeding (Harrison 1984a). Much of the corn acreage in Eastern Maryland is double cropped, and, therefore, migrating moths consistently find late-planted corn young enough to infest. The extent of the infestation of the late-planted corn is somewhat dependent on the early arrival of FAW moths.

Cruz and Turpin (1983) have described the effect of artificially infesting corn with FAW larvae, and established that indirect damage, i.e. foliar feeding, reduced grain yield. The extent to which indirect damage reduces grain yield under Maryland conditions has not been demonstrated. This research was conducted to quantify the effect of FAW feeding in the whorl on subsequent corn yield in Maryland.

METHODS AND MATERIALS

This work was conducted in the years 1983 to 1985 at the Poplar Hill Research Farm, University of Maryland, located on the Eastern Shore of Maryland, and in 1984 on nearby privately owned farms. Throughout the work, Pioneer 3184 dent corn was used. Each year at the Poplar Hill Research Farm, corn was hand planted in 15 m × 30 m plots at weekly intervals, beginning on May 20, for 5

[1] Contribution No. 7431, Scientific Article NO. A-4441 of Maryland Agricultural Experiment Station.
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weeks. This established a series of plantings at various developmental stages when FAW moths arrived and resulted in a range of FAW larval infestations. In 1984, a planting of the same description was seeded at each of 3 nearby farms on June 8. In all plantings, rows were 0.9 m apart with ca. 30 cm between plants within a row. Fifteen plots, each with 10 plants, were established for each planting to accommodate 3 treatments replicated 5 times. Treatments were: 1) permethrin applied to the whorl and ears to protect the entire plant; 2) permethrin applied to the ears only; and 3) an untreated check. Permethrin was applied weekly with a back-pack sprayer calibrated to deliver 112 g actual permethrin in 189 liters water/ha (0.1 lb AI/A in 50 gal water). Replications receiving the 3 treatments were located on adjacent rows to minimize any possible effect of clumped distribution of FAW. Replications were distributed throughout the planting. Treatments with permethrin began prior to FAW activity.

The European corn borer, *Ostrinia nubilalis* (Hübner), is the only other insect that infests the whorl of corn in Maryland. During this study, the European corn borer was insignificant with egg masses on less than 1 percent of the corn plants. These egg masses were removed by hand from plants within the plots. The corn earworm, *Heliothis zea* (Boddie), infestations were also not significant in these plantings.

In late October of each year, ears were harvested from the plants in each plot. The corn was shelled by hand and weights in g/plots were recorded. The moisture content of the grain in 1983 and 1985 was ca. 20 percent, an acceptable level. Percent moisture was ca. 28 percent in 1984 because of excessive rainfall. However, because indirect damage to the corn plants did not result in significant yield loss in 1984, we did not correct for moisture of the grain.

Weight of grain from the plots were used to calculate percent yield loss as a result of whorl feeding by FAW larvae. Because grain yield reflects both direct and indirect types of damage, and significant losses can result from foliar damage before ears form, it is necessary to quantify the loss in yield from foliar damage alone as described by Harrison (1984b). Briefly, the procedure removes the effect of direct loss, i.e. ear damage, from total yield loss and, thus, calculates indirect loss, i.e. loss due to foliar feeding. Percent loss from indirect damage was then regressed against number of plants damaged in the whorl stage of plant development. Percent yield loss from foliar feeding was calculated for each planting date, i.e. from each replicated experiment, generating one data point. Thus, the regression of percent indirect loss on percent damaged plants was used to quantify the effects of FAW larvae feeding in the whorl of corn plants in Maryland.

RESULTS AND DISCUSSION

Percent yield loss due to FAW damage to corn in the whorl stage of plant development is presented in Table 1. Direct losses occurred only in 1983, but indirect losses were recorded for all 3 years. The relationship between the total number of plants showing foliar damage and percent yield losses in 1983 - 1985 is illustrated in Fig. 1. A close relationship between the regression lines were noted for 1983 and 1985, Fig. 1(a) and 1(c). During these two seasons plants were stressed by inadequate moisture, a common occurrence on the sandy soils of the lower Eastern Shore of Maryland. Conversely, in 1984 moisture was abundant. Total rainfall for May through July for each of the 3 years was 16.0, 36.5, and 23.3 cm,

Table 1. Percent yield losses from feeding within the whorl by FAW in plantings of 1983 - 1985. Wicomico County, MD.

	Percent yield loss							
	Planting date							
Type of yield loss	5/20	5/27	6/3	6/10	6/17	From privately owned land in 1984 6/8	6/8	6/8
				1983				
Total	1.0	3.0	72.0	86.0	-*			
Direct	0.0	0.0	51.0	55.0	-			
Indirect	1.0	3.0	21.0	31.0	-			
				1984				
Total	0.0	2.0	12.0	3.0	6.0	9.0	12.0	13.0
Direct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect	0.0	2.0	12.0	3.0	6.0	9.0	12.0	13.0
				1985				
Total	0.0	2.0	6.0	31.0	25.0			
Direct	0.0	0.0	0.0	0.0	0.0			
Indirect	0.0	2.0	6.0	31.0	25.0			

* Planting lost to drought.

respectively. The lack of correlation in the 1984 data was apparently because of increased plant vigor as a result of sufficient moisture which increased tolerance to FAW foliar damage. Buntin (1986) recognized the influence of soil moisture on plant response to the reduction of leaf area due to insect feeding. The same trend appears to be evident in the present study in that yield loss was greater in years of insufficient moisture, 1983 and 1985, than in the year of adequate moisture, 1984. FAW establishment and resulting damage may have also been affected by rain. More evidence of the same type of tolerance to insect damage is seen in the regression lines in Fig. 1(a) and 1(c). Water stress was more extreme in 1983 than in 1985. The point at which the regression line for 1985 intersects the x axis possibly indicates that yields were not affected as much at the lower levels of infestation in 1985 as compared with 1983. The regression line for 1983, Fig. 1(c), indicates that losses occurred at the lower level of infestations as a result of extreme drought stress. Actual yield losses for both of these years are presented in Table 1.

Regression into linear and quadratic components for 1983 and 1985 showed that only the linear component was significant. The slopes for the 1983 and 1985 linear regressions did not differ significantly and, thus, were combined. The combined regression is presented in Fig. 2.

Foliar feeding by the FAW in the whorl of the corn plant reduces the ability of the plant to produce and translocate photosenthate. However, the extent to which this type of damage reduces yield is variable. Gross et al. (1982) reported no significant yield reductions due to FAW larvae feeding on whorl stage corn (10 - 12

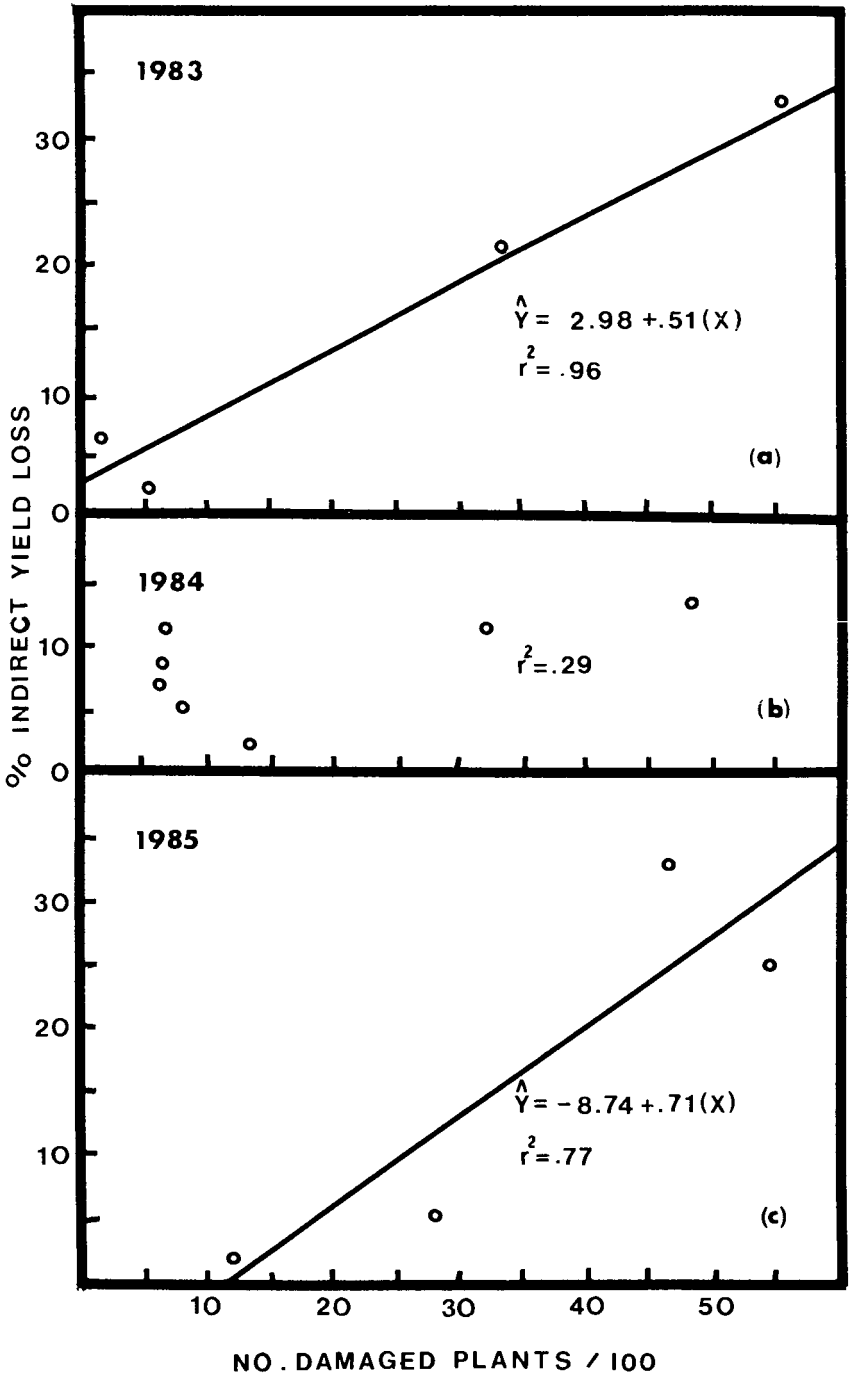

Fig. 1. The relationship of number of plants infested with yield loss from whorl damage by fall armyworm, 1983 - 1985, Wicomico County, MD.

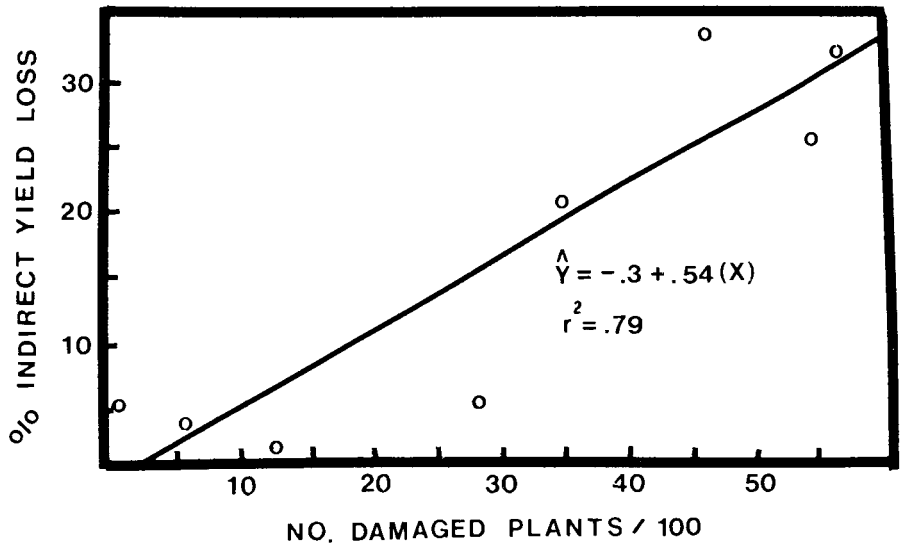

Fig. 2. Regression of combined data of 1983 and 1985 from Fig. 1(a) and 1(c).

leaf stage). Conversely, Cruz and Turpin (1983) reported a significant 7.7 percent yield reduction when only 10 percent of the corn plants in the mid-whorl stage received an egg mass, and a 15.3 - 18.6 percent yield reduction when ca. 100 percent of the plants were infested. Our results indicate that in Maryland FAW feeding on whorl stage corn may reduce yield and that stress caused by insufficient rain may interact with FAW defoliation of corn in the whorl stage to increase yield losses.

ACKNOWLEDGMENTS

We wish to thank Wayne Shaff, Extension Agent, and Glen Robinson, Norman Brittingham, and Calvin Sermon for providing facilities with which to do this work.

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