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ASSESSING LOSSES IN MAIZE YIELD AND LARVAL SURVIVAL DUE TO DIFFERENT TIMINGS OF INFESTATION BY EUROPEAN CORN BORER, *OSTRINIA NUBILALIS* (HBN.) IN LOWER EGYPT

SADEK, E. S.[1] AND A. S. METWALLY[2]

1 Field Crops Research Institute, Agricultural Research Centre, Giza, Egypt

2 Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt

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Abstract

Trails were carried out at Gemmeiza Agricultural Research Station, Gharbia Governorate to study the effect of maize plant age (30, 45 and 60 days old), as a natural host of the European corn borer *Ostrina nubilalis* on larval survival, as well as , the effect of different timings of maize infestation on grain yield obtained . Considerable number of larvae had been found on the plants infested at the age of 60 days and counted 6 , 10 , 18 and 35 days after egg hatching . Maize plants during anthesis are highly susceptible to ECB moths oviposition . An artificial infestation made at anthesis stage of maize plant growth resulted in the highest infestation and the lowest grain yield obtained . The average yield reduction relative to the control was 33.3 %, 15.9 % and 7.2 % for maize plants infested with ECB egg masses at the age of 60 , 45 and 30 days old, respectively. Weight of 100 kernels as one of yield components was the great affected by the borer infestation and consequently caused yield losses .

INTRODUCTION

The European corn borer , *Ostrinia nubilalis* (Hbn.) is common in Lower and Middle Egypt up to Beni- Suef Governorate . The northern regions of the Delta are seriously infested and a gradual decrease in the degree of infestation is exhibited as we go southwards . This borer attacks maize when it is at least two feet high or 35 days after planting . It is believed that *O. nubilalis* has 3 – 4 generations a year in our country . This insect overwinters as a full grown larva inside stems and the ear cobs . European corn borer (ECB) , *O. nubilalis* (hubner) , is a major pest of corn (*Zea mays* L.) in Egypt , as well as , in many other countries (El – Saadany and Hosny 1973 , Hudon and Leroux 1986) . Two generations of this insect often occur in the Corn Belt of the United States , the first- generation eggs and larvae (i.e ,progeny from overwintering populations) usually are found when corn is in the whorl stage and second – generation

eggs typically are deposited during or shortly after anthesis (Hudon and Leroux 1986). In Egypt , because of irregular and successive maize planting dates , *O. nubilalis* has 3 - 6 generations annually under field conditions (Ismail , 1968) . Maize plants are subject to be attacked by *O. nubilalis* from 30 to 72 days after sowing (Metwally and Shehata 1999) . A great deal of research has been done on larval survival of first and second ECB generations on maize in USA and Europe (Guthrie *et al.* 1960 and Reed *et al.* 1972) . There was no documented study available on *O. nubilalis* larval survival on maize in Egypt . An understanding of the behavior and survival of these larvae , in Egypt , is essential for the effective control of this pest . The study reported herein was designed to identify the effect of different infestation timings on ECB larval survival as well as on maize yield and other yield components .

MATERIALS AND METHODS

Two field trials were made during two successive maize seasons , 2000 and 2001 at Gemmeiza Agricultural Research Station . The first trial was conducted to identify influence of maize infestation by ECB (*O. nubilalis*) egg masses at different plant ages on larval survival . The commercial hybrid corn Sc. 10 was sown on May, 10 and 26 and June, 10 in 2000 and on May,15 and 30 and June, 15 in 2001. Randomized complete block design with three replicates for each sowing date was used . Plots consisted of five rows , 8m. long and 80 cm apart and hills were spaced 25 cm along the row . Middle three rows of each plot were artificially infested with 9 black headed stage egg masses per plant (egg mass = 20 eggs approximately) on July 10 and 15 in 2000 and 2001 seasons , respectively . The artificial infestation with egg masses were done according to technique described by Awadallah et. al. 1982 . Nine plants in the three middle rows of each plot were randomly collected and dissected at 3 , 6 , 10 , 18 and 35 days after egg hatching to determine number of surviving larvae . The obtained data were subjected to a normal analysis of variance according to Snedecor and Cochran (1967) separately for each year .

The second study was conducted to measure the effect of different ECB infestation timing on maize yield. Maize hybrid Sc. 10 variety was planted on May, 26 and 30 in 2000 and 2001 seasons , respectively . All cultural practices were applied as recommended. The 4 treatments were the following

1. Control; the tested maize plants were exposed to the natural borer infestation in the field and no artificial infestation was done .
2. Tested maize plants were artificially infested 30 days after sowing .
3. Tested maize plants were artificially infested 45 days after sowing .
4. Tested maize plants were artificially infested 60 days after sowing .

Each trial consisted of 3 replications . Each experimental plot was 3 rows , 8 m. long and included 96 plants . Plants of the middle row in each plot were manually infested with 9 black head egg masses according to the previous mentioned technique . To estimate the effectiveness of the various treatments , the following observations , measurments and samplings took places . At harvest , 10 random plants from the middle row of each plot were examined to count number of holes per 100 internodes as a criterion of ECB infestation . Ears from the middle row of each plot were also harvested, weighed and shelled. Grain yield adjusted to 15.5% grain moisture . Five random ears from each plot were taken and examined for length , diameter and number of grains per row . A random sample of 100 kernels from each plot was weighed and recorded .

RESULTS AND DISCUSSION

Data presented in Tables 1. and 2. show number of *O. nubilalis* surviving larvae on 9 maize plants under artificial infestation conditions at different ages of maize plant i.e. 30 ,45 , and 60 days old . The highest number of surviving larvae (81.8 , 33.2) was observed on plants infested at 60 days old compared with those infested at 30 days old (48.9 , 15.5) and 45 days old (60.8 , 21.8) within 35 days after egg hatching in 2000 and 2001 seasons, respectively . High level of larval establishment (138.7) in 2000 compared with a much lower level (45.9) in 2001was recorded after 3 days of the artificial infestation . Larval mortality was very rapid within 6 days after egg hatching on plants infested at 30 days old (74.5 and 80.5%) and considerably low on plants infested at 60 days old (22.5 and 15.9%) compared to the number of the survived larvae after 3 days of egg hatching during two seasons, respectively. The high rate of larval survival on plants infested at 60 days old and 6 days after infestation, may be due to highly nutritive value of pollen grain accumulated behind leaf sheath (Guthrie *et al.* 1969). A heavy egg load from the natural moth population in the two

seasons increased number of larvae on plants infested at 30 days old and 35 days after egg hatching . Also, little increasing of larvae was noticed on plants infested at 45 days old ,18 days after egg hatching in the two seasons . These findings agree with that obtained by Guthrie *et al.* 1971 who stated that maize plants during anthesis are highly attractive to ECB moths for oviposition . However , the highest number of larvae recorded at 6,10,18 and 35days after infestation on plants infested at 60 days old and increased number of larvae on plants infested at 30 days old ,35 days after infestation ,coincided with tassel emergence, reveal that ECB prefers the anthesis stage of maize plant growth to survive and oviposition .

Data summarized in Table 3 show the effectiveness of maize infestation date by ECB egg masses on final infestation level of the borer at harvest as expressed by number of holes per 100 maize stalk internodes . The highest number of holes (69.5 and 52 /100 internodes) was detected for plants infested at 60 days old during the two seasons, respectively . This infestation represented 125.2 % in comparison to the natural infestation . The infestation at 30 days old had the lowest number of holes (30.5 and 37.4 /100 internodes in 2000 and 2001 , respectively) represented 25.6 increasing more than that of the control .

Mean performance of sc. 10 variety grain yield and its components as influenced by date of ECB infestation in 2000 and 2001, Table 4 revealed that , maize plants infested at 60 days old gave the lowest grain yield (4.6 Kg/row) . At the same time , weight of 100 kernels, ear length and number of grains per row significantly affected especially in the season 2000. The infestation of plants aged 30 days didn't significantly affect grain yield in relation to natural infestation in the two seasons . Yield losses and its components reductions of the artificial infestation treatments in relation to natural one are cleared in Table 5 and showed that the infestation of maize at 60 days old caused the highest yield losses reached 33.3 % . Also , the reduction in yield components , 100 - kernel wt. , ear length ,ear diameter and number of grain / row accounted for most of the yield losses . Weight of 100 kernels was the main component contributing to grain yield reductions, since it decreased by 28.5 % compared with natural one (Guthrie *et al.*, 1975) .

Table 1. Mean number of ECB , *O. nubilalis* larvae / 9 plants at different maize plant ages during 2000 season .

Sowing Date	Infestation Date	Age of* Plant (days)	Investigation interval (days)					Mean
			3	6	10	18	35	
May 10	July 10	60	120a	93a (22.5)	67a (44.2)	66a (45)	63a (47.5)	81.8
May 26	July 10	45	155a	44b (71.6)	35b (77.4)	40b (74.2)	30b (80.6)	60.8
June 10	July 10	30	141a	36b (74.5)	20.5c (85.5)	22c (84.4)	25b (82.3)	48.9
Mean			138.7	57.7	40.7	42.7	39.3	63.8

*At the infestation time

( ) : Number between brackets represent decreasing percentages compared to the number of larvae after 3 days of hatching

Table 2. Mean number of ECB , *O. nubilalis* larvae / 9 plants at different maize plant ages during 2001 season .

Sowing Date	Infestation Date	Age of* Plant (days)	Investigation interval (days)					Mean
			3	6	10	18	35	
May 15	July 15	60	44a	37a (15.9)	32a (27.3)	28a (36.4)	25a (43.2)	33.2
May 30	July 15	45	44a	14b (68.2)	16b (63.6)	20a (54.5)	15b (65.9)	21.8
June 15	July 15	30	49.7a	9.7b (80.5)	3.5c (93)	4.7b (90.5)	10b (79.9)	15.5
Mean			45.9	20.2	17.2	17.6	16.7	23.5

*At the infestation time

( ) : Number between brackets represent decreasing percentages compared to the number of larvae after 3 days of hatching

Table 3. Mean number of holes /100 internodes in relation to time of infestation with ECB during 2000 and 2001 season .

Time of infestation (days after sowing)	Season			Increasing * %
	2000	2001	Mean	
30	30.5 B	37.4BC	33.9	25.6
45	35.8B	39.1B	37.5	38.9
60	69.5A	52.0A	60.8	125.2
control (natural infestation)	21.4C	32.6C	27.0	

* than the control

Table 4. Mean performance of sc 10 grain yield and its components as influenced by date of ECB infestation in 2000 and 2001 seasons .

Time Of Infestation (Days after sowing)	Grain yield/row (kg)			100 kernels (g)			Ear length (cm)			Ear diameter (cm)			No . of grain/row		
	2000	2001	Mean	2000	2001	mean	2000	2001	mean	2000	2001	mean	2000	2001	Mean
30	5.7ab	7a	6.4	41.7a	43.4a	42.6	20.1b	21.1a	20.6	4.9a	4.9a	4.9	46.1b	47.6a	46.9
45	5.1b	6.4b	5.8	39.9a	43.0a	41.5	19.8b	20.9a	20.4	4.8a	4.9a	4.9	45.6b	47.2a	46.4
60	3.9c	5.2c	4.6	36.3b	41.5a	30.9	18.7c	19.7b	19.2	4.7a	4.7a	4.7	42.2c	45.6a	43.9
control	6.2a	7.5a	6.9	42.5a	43.8a	43.2	21.4a	21.3a	21.4	4.9a	5.0a	5.0	47.5a	47.7a	47.6

Finally, it could be concluded that an infestation at anthesis stage of maize plant (about 60 days old) were the highest infested at harvest and lower grain yield and yield components .These results agree with that obtained by Lynch *et al.* (1980) who stated that second generation larvae caused the greatest plant damage and yield reductions seemed to be 1.8 times greater when infestations were made at the anthesis stage .

Table 5. Decreasing percentages in grain yield and its components of the artificial infestation treatments in comparison to the natural one.

Time of infestation (days after sowing)	Grain yield %	100 kernels wt. %	Ear length %	Ear diameter %	No. of grain /row %
30	7.2	1.4	3.7	2.0	1.5
45	15.9	3.9	4.7	2.0	2.5
60	33.3	28.5	10.3	6.0	7.8

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تاثير موعد اصابة الذرة الشامية بحفار ساق الذرة الأوروبى على إعاشة اليرقات ومكونات محصول الحبوب فى مصر

صادق الشحات صادق[1] ، عبد الرحيم سلطان متولى[2]

١ معهد بحوث *المحاصيل الحقلية* - مركز *البحوث الزراعية* - *الجيزة* - مصر.
٢ معهد بحوث *وقاية النباتات* - مركز *البحوث الزراعية* - *الدقى* -*الجيزة* - مصر.

تمت هذه الدراسة بمحطة البحوث الزراعية بالجميزة بمحافظة الغربية خلال موسمى ٢٠٠٠، ٢٠٠١ لدراسة تأثير اختلاف عمر نبات الذرة (٣٠، ٤٥ ،٦٠ يوماً) كعائل طبيعي لحفار ساق الذرة الأوروبي على نسبة إعاشة اليرقات وكذلك تأثير موعد الإصابة على محصول الحبوب. أثبتت النتائج وجود نسبة عالية من اليرقات الحية عند الإصابة الصناعية للذرة في عمر ٦٠ يوماً بعد ٦، ١٠ ، ١٨ ، ٣٥ يوماً من فقس البيض. تكون نباتات الذرة أثناء مرحلة التزهير جاذبة لفراشات حفار ساق الذرة الأوروبي لوضع البيض . ينتج عن الإصابة الصناعية لنبات الذرة في مرحلة التزهير مستوى أعلى من الإصابة بالحشرة ومحصول حبوب أقل . كانت النسبة المئوية لنقص المحصول ٣٣,٣ ٪ و١٥,٩ ٪ و٧,٢٪ فى النباتات المصابة ببيض الحشرة فى عمر ٦٠ ، ٤٥ ، ٣٠ لنبات الذرة على التوالى بالمقارنة بمحصول النباتات التى نمت تحت ظروف الإصابة الطبيعية للثاقبة بالحقل . كانت صفة وزن ١٠٠ حبة أكثر مكونات المحصول تأثرا بالإصابة بحفار ساق الذرة الأوروبي مما نتج عنة من فقد للمحصول .