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EVALUATION OF INFESTATION AND DAMAGE OF COWPEA BY THE POD BORER *ETIELLA ZINCKENELLA* TREITSCHKE (LEPIDOPTERA : PYRALIDAE) IN EGYPT

BACHATLY, M. A. AND V. SH. G. ABDEL MALAK

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

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Abstract

In a field experiment , cowpea (variety Fetreyat) was sown during the 1998 autumn and the 1999 summer seasons . The highest percentage of damaged pods was 86.26 % on November 10 (3rd harvest time) and 77.50 % (2nd harvest time) on June 29 . The highest percentage of damaged seeds was 69.03% (2nd harvest time)on October 27 and 79.62 % (3rd harvest time) on July 12 . The highest number of caterpillars / pod was found during th 2nd harvest time for the two plantations . There were correlations between damaged seeds and weather factors .

In the laboratory the damage was estimated on four different types of cowpea seeds consumed by each larval instar to reach the prepupal stage . The 2nd instar consumed 1.3 small and ripe seeds / larva until pupation .The highest percentage of pupation and moth emergence 84.99 and 91.66 was observed for the 5th instar feeding on large and unripe seeds and the 3rd instar on the same type of seeds, respectively . The longest period of nutrition was 12.66 days for the 3rd instar until the prepupal stage .

INTRODUCTION

The cowpea crop , *Vigna unguiculata* L.,marketed as dry seeds is cultivated in summer and autumn seasons in many governorates and new lands also , in Egypt. It is subjected to many pests throughout the season, but the most important are the pod borer complex , *Etiella zinckenella* Treitschke and *Cosmolyce boeticus* L. as well as the storage bruchids which destroy a great number of seeds . Even though, the adults of the *C.boeticus* were very abundant in all the adjacent cowpea fields there were found in few numbers as caterpillars in pods. Meanwhile, in the case of *Etiella*, at least two larvae were established in each cowpea pod in some harvest times and the larvae fed on more than one seed in the pod either green or ripe one (Personel observations) .

Many researchers evaluated the seed or pod damage by this pest . Abul Nasr and Awadalla (1957) reported that the damage was extended from dropped blossoms by younger larvae or infested small pods to rotten seeds and pods . Others found that the seeds in the infested pod were completely consumed, (Singh and Dhooria ,1971). One limabean pod borer larva can feed on more than one seed in a pod (Talekar and Lin, 1994). Also, Melo and Silveira (1998) quantified the damage .

Our study was carried out to evaluate the damage caused by the pod borer in the field (summer and fall plantations) and the consumed seeds by each larval instar till pupation in the laboratory .

MATERIALS AND METHODS

Field expriment: Cowpea variety Fetreyat was cultivated at the Experimental Farm the Horticulture Research Station at Kaha , Qaliobia Governorate in the autumn 1998 and summer 1999 seasons on August 2 and April 1, respectively. The experiment consisted of four replicates each of eight rows, four meters of length and 0.60 meter apart between rows . Plants were exposed to natural borer infestation in the field and all horticultural operations were as usually practised . Twenty ripe pods were randomly collected biweekly from each replicate for inspecting infested pods and seeds as well as number of larvae in the pod . Daily maximum and minimum temperature and relative humidity and soil temperature were recorded and computed .

Laboratory experiment: Healthy and sound cowpea seeds were selected and ranged into four groups : 1-large and unripe seeds , 2-large and ripe seeds, 3- small and unripe seeds and 4- small and ripe seeds .Twelve seeds of each type were placed in 10-cm diameter Petri dishes with each larval instar (from the 2^{nd} to the 5^{th}) and were kept on tissue paper till pupation. Daily records of number of damaged seeds , duration of larval and pupal periods and the feeding period as well as number of larvae that pupate were tabulated. Newly formed pupae were placed in moist filter paper-lined Petri dishes. The number of emerging adults was recorded .Experiment was carried out in an incubator at 25.00 ± 1.5 °C and 60-70% RH.

Data were analyzed at 5% (field test) and 1% (laboratory test) and L.S.D. was calculated , t values and correlation coefficients were also calculated if necessary .

RESULTS AND DISCUSSION

Data in Table 1 indicate that infestation occurred in summer as well as in fall plantation . Higher pod infestation was recorded for the 3^{rd} autumn harvest on November 10 (86.21%) and for the summer harvest on June 29 (77.50 %), whereas higher seed infestion was recorded for the 2^{nd} autumn harvest on October 27 (69.03%) and the 3^{rd} summer harvest on July 12 (79.62 %). Higher number of caterpillars in pods were found on October 27 (1.3 and 1.47 caterpillars /pod for the 2^{nd} ,3^{rd} instars and 4^{th}, 5^{th} instars , respectively) . Significant differences were found among harvest times and between the two plantations.

As reported by Abul Nasr and Awadalla (1957), percentage of infested pods was higher during summer than fall plantation and reached 43.30% on September 26 .They also found that the infested pods were destroyed or have to be discarded, the seed loss amounted to 35.50%. The same authors also found that two or three larvae occupy one pod and migrate to new pods and feed on their seeds . Our findings recorded that some of the pods harboured up to three larvae in some cases and the result was that the majority of seeds was damaged , 79.62 % on July 12. Talekar and Lin (1994) mentioned also that one larva can feed, at times, on more than one seed in a pod . Singh and Dhooria (1971) reported the same losses in seeds with pod infestation reaching 50.70%. Their studies on the pod borer seasonal history showed that the adult emergence started from February after an hibernation period , all the insect stages were in the field in April and were not observed during May - August and reappeared on October and November and this explained the highest infestation in some harvest times in our study . Moth peaks ,as directed by light traps, were fixed in April, May, September and October . Georgivits (1981)and Talekar and Chen (1983) supported these findings .

In Table 1, there were correlations between damaged seeds and temperature as well as relative humidity were found. The weakly correlation between damage and soil temperature showed that, even the fully mature larvae pupate in the soil around the host plant (Talekar and Lin ,1994) under a depth of 2 to 4 cm of soil in a diameter of 20 to 30 cm (Abul Nasr and Awadalla ,1957), the infestation seemed once established, it peaked with no appearent correlation . On the other hand, Metwally (1993) reported that pest fluctuations might be due to the climatic factors (temperature and RH) in the fall plantation.

As suggested by Abul Nasr and Awadalla (1957) the pod borer has many hosts causing different degrees of damage . Larvae reaching their fully grown size for pupating, can migrate from pod to a new pod (secondary infestation) and consuming big as well as small seeds , green or ripe ones. In a preliminary choice test, cowpea, pea and kidney bean seeds were offered to 5^{th} instar larvae. The results showed that larvae devoured a higher number of cowpea seeds more quickly and pupated after the lesser larval period .

Table 1. Infestation and loss caused by the pod borer *E. zinckenella* to cowpea pods and seeds, during the 1998 fall and 1999 summer plantations, at Qalyobia Governorate.

Harvest dates		% damaged pods		% damaged seeds		2nd &3rd instar caterpillars/pod		4th & 5th instar caterpillars/pod	
autumn 1998	summer 1999	autumn 1998	summer 1999	autumn 1998	summer 1999	autumn 1998	summer 1999	autumn 1998	summer 1999
13 Oct.	15 June	54.66	47.50	43.79	44.33	0.83	0.17	0.68	0.27
27 Oct.	29 June	72.44	77.50	69.03	56.07	1.32	0.82	1.47	0.70
10 Nov.	12 July	86.21	25.00	40.87	79.62	0.75	0.52	0.70	0.45
24 Nov.	26 July	58.33	65.00	23.77	29.77	0.29	0.35	0.52	0.15
t values		3.73*		8.61*		26.58*		14.69*	
LSD		13.16	12.70	23.72	10.89	0.25	0.17	0.30	0.12

Correlation coefficients			
Damaged seeds autumn 1998	X	min. temperature	0.47
	X	max. temperature	0.46
	X	min. % RH	-0.17
	X	max.% RH	0.87
	X	soil temperature	-0.32
Damaged seeds summer 1999	X	min. temperature	0.11
	X	max. temperature	0.62
	X	min. % RH	-0.59
	X	max.% RH	0.84
	X	soil temperature	-0.0012

* Significant t, table = 2.44

In Table 2, data show that there was 1.3 damaged seeds/larva if seeds were large and ripe and larvae were in the 5th instar. In case of the 2nd and 3rd instars larvae preferred the small ripe seeds with 1.10 and 1.3 seeds/larva, respectively. In all cases, larvae consumed seeds totally, leaving a thin shell. It seemed that seeds partially consumed had a some repellent effect on larvae such as seed consistence, smell or size.

Unexpectedly 4th instar larvae consumed more small and unripe seeds than other types ,0.94 seeds / larva with a higher rate 0.117 seeds /larva /day. In a mixture of different types, it consumed 0.59, 0.61, 0.85 and 0.82 seeds/larva during the 5th, 4th, 3rd and 2nd instar, respectively.

Abul Nasr and Awadalla (1957) reported that larva eats one-fourth to one-half of the seed before going to the next. After each larval moult, the larva resumes feeding, damaging more seeds that would be discarded from the yield weight . Talekar and Lin (1994) reported that larger seeds received more damage. Georgivits (1981) limit-

Table 2. Number of damaged cowpea (variety Fetreyat) seeds/larva ± SD consumed by each larval instar of the pod borer *E.zinckenella* till pupation.

Instars	Types of seeds	One half Damaged seeds	Three- fourth Damaged seeds	Totally Damaged seeds	Total number of Damaged seeds	Rate seeds/larva/day
5th Instar	Large and unripe seeds	0.20 ± 0.045	—	0.44 ± 0.24	0.60 ± 0.25	0.057 ± 0.025
	Large and ripe seeds	0.03 ± 0.05	0.19 ± 0.04	0.82 ± 0.075	1.03 ± 0.05	0.124 ±0.012
	small and unripe seeds	—	0.027± 0.047	0.38 ± 0.08	0.41 ± 0.085	0.051 ± 0.010
	small and ripe seeds	0.026 ± 0.046	—	0.24 ± 0.08	0.27 ± 0.046	0.031 ± 0.09
	LSD	—	—	—	0.49	—
4th Instar	Large and unripe seeds	0.19 ± 0.05	0.16 ± 0.053	0.16	0.52 ± 0.046	0.059 ± 0.010
	Large and ripe seeds	0.41 ± 0.16	0.33 ± 0.44	0.35 ± 0.17	0.85 ±0.046	0.093 ± 0.017
	small and unripe seeds	0.24 ± 0.21	0.163 ± 0.165	0.52 ± 0.126	0.94 ± 0.051	0.117 ± 0.006
	small and ripe seeds	0.027 ± 0.027	—	0.35 ± 0.092	0.38 ± 0.046	0.038 ± 0.004
	LSD	—	—	—	0.163	—
3rd Instar	Large and unripe seeds	0.16	—	0.60 ± 0.046	0.77 ± 0.046	0.089 ± 0.005
	Large and ripe seeds	0.3 ± 0.12	—	0.60 ± 0.092	0.91 ± 0.085	0.085 ± 0.004
	small and unripe seeds	0.10 ± 0.04	—	0.52 ± 0.046	0.63 ± 0.46	0.058 ± 0.008
	small and ripe seeds	0.083	—	1.02 ± 0.046	1.10 ± 0.046	0.121 ± 0.023
	LSD	—	—	—	0.22	—
2nd Instar	Large and unripe seeds	0.055 ± 0.047	0.16	0.22 ± 0.051	0.44 ± 0.05	0.041 ± 0.008
	Large and ripe seeds	0.33 ± 0.08	0.053 ± 0.093	0.52 ± 0.17	0.91 ± 0.14	0.98 ± 0.013
	small and unripe seeds	0.19 ± 0.051	—	0.44 ± 0.051	0.63 ± 0.046	0.079 ± 0.006
	small and ripe seeds	0.49 ± 0.38	—	0.94 ± 0.25	1.3 ± 0.24	0.14 ± 0.008
	LSD	—	—	—	0.47	—

ed the damage at unripe green seeds. Hatteri and Sato (1983) mentioned that fewer eggs were laid on dried pods than on fresh ones . Melo and Selveiro (1998) evaluated the damage of seeds in the laboratory ranging from 15.5 to 44.00 %.

In Table 3, higher percentage of pupation 84.99 % and adult emergence 91.66 %was observed for large and unripe seeds during the 5^{th} and the 4^{th} instars, respectively. Large and unripe seeds lengthened the feeding period 10.66 and 10.33 days for the 5^{th} and 4^{th} instars, respectively. Small and ripe seeds gave the highest feeding period 12.66 and 12.33 days for the 3^{rd} and 2^{nd} instars, respectively . Many researchers reported the duration of larval and pupal periods and percentage of survivals, Singh and Dhooria (1971) and Jaglan *et al.* (1996) found approximately similar results with cowpea among different legume hosts . Reduction in percentages of pupation and adult emergence probably indicated the presence of certain antibiotic factors in the developing seeds . NG *et al.* (1985) reported that larval survival and development were the most affected biological variables. Reduction in population was due to the high larval mortality that occurs within the first few days of life rather than a reduction in female fecundity .

From the previous studies, it could be concluded that the larva of the pod borer *E.zinckenella* damaged more than one seed in the pod and could migrate to a new pod until pupation , seeds were then discarded from the yield. It is practically impossible to control the pod borer with conventional insecticides because of the cryptic nature of its life stage (Talekar and Lin, 1994), but varieties of special seed size and maturity time that can escape the pod borer larval period would be recommended. The long periods during which the pest were absent indicate the predominant role of weather in regulating the pest numbers by extending the developmental period exposing them to parasites, predators or adverse environmental conditions (NG *et al.*, 1985). Preventing moth emergence and reinfestation from soil around plants by some agricultural practices and eradicating *Dolichos lablab* plant which supports at least one generation as intermediate host from the surroundings is a successful way for diminishing the pest population as suggested by Abul Nasr and Awadalla (1957). Further investigations are needed for development and use of experimental methods to estimate cowpea losses quantitatively and qualitatively due to this important insect pest .

Table 3. Some biological aspects + SD of the pod borer *E. zinckenella* reared on cowpea (variety Fetreyat) seeds.

Instars	Types of seeds	% pupation	% moth emergence	Larval period (days)	Pupal period (days)	Nutrition period (days)
5th Instar	Large and unripe seeds	84.99 ± 6.00	77.74 ± 5.55	13.66 ± 0.57	23.58 ± 0.38	10.66 ± 1.15
	Large and ripe seeds	68.68 ± 3.49	70.83 ± 7.2	12.33 ± 0.57	25.66 ± 0.76	8.33 ± 0.57
	small and unripe seeds	66.66 ± 8.33	79.95 ± 4.54	10.66 ± 0.57	29.00 ± 1.32	8.00
	small and ripe seeds	38.88 ± 4.80	78.33 ± 2.88	12.33 ± 2.08	25.66 ± 0.57	8.66 ± 1.15
	LSD	19.71	—	1.004	2.88	—
4th Instar	Large and unripe seeds	61.10 ± 4.80	68.44 ± 5.14	17.66 ± 4.16	27.33 ± 2.02	10.33 ± 1.15
	Large and ripe seeds	72.22 ± 4.81	84.71 ± 6.05	13.33 ± 0.57	27.10 ± 1.52	9.33 ± 1.15
	small and unripe seeds	47.22 ± 4.81	84.71 ± 6.05	13.33 ± 0.57	24.80 ± 1.44	8.00
	small and ripe seeds	72.00 ± 4.81	76.84 ± 1.59	10.66 ± 1.15	29.00 ± 1.00	10.00
	LSD	16.21	—	2.52	—	—
3rd Instar	Large and unripe seeds	38.88 ± 4.80	91.66 ± 14.43	11.66 ± 1.15	26.33 ± 1.52	8.66 ± 1.15
	Large and ripe seeds	47.22 ± 4.81	64.44 ± 2.84	15.66 ± 0.57	26.60 ± 0.28	10.66 ± 1.15
	small and unripe seeds	33.33 —	66.66 ± 14.43	13.33 ± 1.15	25.66 ± 0.57	11 ± 1.73
	small and ripe seeds	61.10 ± 4.8	58.92 ± 3.09	12.33 ± 1.15	28.83 ± 1.44	12.66 ± 0.57
	LSD	13.94	—	—	—	—
2nd Instar	Large and unripe seeds	47.22 ± 4.81	87.77 ± 10.17	11.33 ± 1.15	28.66 ± 1.15	10.66 ± 1.15
	Large and ripe seeds	27.77 ± 4.80	91.66 ± 14.43	15.66 ± 1.15	30.83 ± 0.76	9.33 ± 1.15
	small and unripe seeds	30.55 ± 4.80	55.55 ± 9.61	18.66 ± 1.15	29.66 ± 0.28	8.00
	small and ripe seeds	44.44 ± 9.62	55.55 ± 9.61	16.33 ± 1.15	31.00 ± 2.64	12.33 ± 0.57
	LSD	—	—	4.36	—	2.7

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دراسات حقلية و معملية على الإصابة والضرر الناتج لمحصول اللوبيا من دودة قرون اللوبيا في مصر

مجدا انيس بشتلي ، فيوليت شكرى جرجس عبد الملاك

معهد بحوث وقاية النباتات، مركز البحوث الزراعية، الدقى، الجيزة، مصر

فى تجربة حقلية زرع محصول اللوبيا صنف فطريات اثناء موسم ١٩٩٨ الخريفي و ١٩٩٩ الصيفي و كانت اعلى نسبة مئوية لاصابة القرون ٨٦,٢٦ ٪ في ١٠ نوفمبر (الأسبوع الثالث) و ٧٧,٥ ٪ في ٢٩ يونيو (الأسبوع الثانى) وكانت اعلى نسبة مئوية لاصابة البذور ٦٩,٠٣٪ في٢٧ اكتوبر (الأسبوع الثانى) و ٧٩,٦٢ ٪ في ١٢ يوليو (الأسبوع الثالث). و جدت اعلى نسبه لليرقات / القرن اثناء الأسبوع الثاني في الزراعة الصيقية و الخريفية كما يوجد ارتباط بين العوامل الجوية و مقدار الضرر في البذور .

في تجربة معملية قدر الضرر على اربعة اشكال مختلفة من بذور اللوبيا تستهلك بواسطة يرقات كل عمر الى ان تصل الى طور العذراء. وجد ان العمر الثاني يستهلك ١,٣ بذور صغيرة وناضجة/للفرد الى ان يتم التعذير وكانت اعلى نسبة مئوية للتعذر وخروج الفراشات هي ٨٤,٩٩ ٪ و ٩١,٦٦٪ للعمر الخامس الذى تغذى على بذور كبيرة وغير ناضجة والعمر الثالث الذى تغذى على نفس البذور ، على التوالي . و كانت اطول فترة للتغذية ١٢,٦٦ يوماً للعمر الثالث حتى بلغ مرحلة ما قبل العذراء .