IMPACT OF INITIAL POPULATION DENSITIES OF COWPEA BEETLE, *CALLOSOBRUCHUS MACULATUS* (F.) AND LEGUME SEEDS ON INSECTS DEVELOPMENT, SEED DAMAGE, FOOD CONSUMPTION AND WEIGHT LOSSES OF COWPEA AND FABA BEAN SEEDS.

ALI, M. A. M.[1], FERIAL M. A. EL-SAYED[2] AND H. M. I. EL-BISHLAWY[2]

[1] *Department of Plant Protection, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt.*
[2] *Plant Protection Institute, ARC, Dokki, Giza, Egypt*

(Manuscript received 26 October 2004)

Abstract

Different initial densities of parent *C. maculatus* (F.), 4, 8, 16, 32 and 40 beetles, considerably affected insect development, respective performance, food consumption and weight losses of cowpea and faba bean seeds. Results cleared that developmental time of *C. maculatus* (F.) reared in cowpea or faba bean seeds did not significantly differ with different population density of parent beetles. However, female fecundity significantly decreased by increasing beetle density, but mortality percentages of immatures as well as adult progeny were increased by increasing density of parent adults. Estimated of cowpea or faba bean seeds consumed and percentages of damaged and lost seeds were positively correlated with the increase of initial density of beetles. Results indicate that 75.5% and 47.3% damaged cowpea and faba bean seeds were obtained at a density of 4 beetles, however, these values increased to 99.6% and 89.3% at a density of 40 beetles.

Seed density (5, 10, 20, 40 and 80 seeds) of cowpea or faba bean showed significant increase of female fecundity, total developmental time and number of newly emerged beetles as the seed density increased. However, mortality rate of immature reared in cowpea or faba bean seeds was negatively correlated with seed density.

Seed consumption, damage and weight losses of infested seeds steadily increased by the increase of seed density to 40 seeds, after which considerable decrease in the former parameters was obtained by increasing seed density to the level 80 seeds.

INTRODUCTION

The cowpea, *Vigna unguiculata* Walp. and the faba bean, *Vicia faba* L. are the most important sources of protein for human nutrition in Egypt and other countries (Metwally, 1990 and El-Shazly, 1993). Legume seeds are attacked by bruchid beetles, particularly *Callosobruchus maculatus* (F.) and *Callosobruchus chinensis* (L.) which cause considerable losses if not adequately controlled. Adams (1977) reviewed the

literature on damage to stored grains and summarized estimates of damage caused by individuals of various insect species. Definition of the relationship between pest numbers and damage is necessary as basis for pest management (Shazali, 1990).

Food consumption, damage and weight losses of legume seeds are affected by several factors. Insect density and the quantity of seeds available are of great importance. The apparent weight losses in the faba bean seeds caused by 1, 2, 3 larvae of *Bruchidius incarnatus* (Boh.) was significantly greater in one larva than that caused by two or three larvae/seed (El-Sawaf, 1956, Shazali, 1990 Hashem and Risha, 1998, El-Degwi and Orabi, 1997).

The objective of this investigation is to assess seed damage, food consumption and weight losses of cowpea and faba bean seeds under different densities of *C. maculatus* adults and pulse seeds.

MATERIALS AND METHODS

1- Effect of initial adult density Sub samples of 20 gr. of test varieties of cowpea and faba bean were weighed into ¼ L Kilner jars. Jars of each variety were infested with 2, 4, 8, 16 and 20 pairs 0 - 24 hr-old adults. After the jars were covered with muslin cloth, they were stored for 15 days in an incubator adjusted on 28 ± 2 °C and 60-70% R.H. At the end of the period of exposure, the beetles were removed and discarded, the seeds were returned to the jars and stored at 28 ± 2 °C and 60-70% R.H. Each density and variety were replicated four times and the experiment was set up in randomized complete black design. The total number of eggs laid on the seeds of each variety at the different initial density of adults were counted. When the black windows of the future adult emergence appears on the seeds, all jars were examined daily to record the first adult emergence. Number of emerged adults were recorded every two days. The counting of the emerged beetles was facilitated by anaesthing it separately with chloroform after separation. Data on the developmental period, number of emerged beetles, mortality, percentages of seeds damage and losses were collected and all were analysed statistically and the mean values were separated by the Duncan's multiple-range test.

2. Effect of seed density Five different seed sets: 5, 10, 20, 40 and 80 conditioned cowpea or faba bean seeds of the different varieties were prepared, each set was placed in separate plastic tube of 3 x 5 cm. One newly emerged and unmated female and two males were introduced to each seeds set. Tubes of different sets were

covered with muslin cloth and fastened with rubber bands and kept in incubator adjusted at 28 ± 2 °C and 60 – 70 % R.H. Each set density and variety was replicated 10 times. After an exposure period of 15 days, the beetles were removed and seeds were returned again to the plastic tubes and the total eggs laid, number of hatched eggs as well as eggs density per seed were counted and recorded.

As the black colour of the windows of the future adult emergence appears on the seeds, a daily examination of the different seed sets were conducted to record the developmental period, number of emerged beetles, adult mortality and percent of emerged beetles. Weight loss, percent of loss and percent of damage were estimated as mentioned before. All recorded data were subjected to statistical analysis and the mean values were separated by the Duncan's multiple-range test.

Growth index was estimated by dividing the natural logarithm of the percentage adult survival (Log. S) by the mean developmental period (T) according to Howe (1971) formula in order to compare the susceptibility of different faba bean and cowpea varieties to infestation by *C. maculatus* at different seed densities.

RESULTS AND DISCUSSION

I-Impact of cowpea and Faba bean seeds on development of *Callosobruchus maculatus* (F.):

1. Effect on female fecundity Results illustrated in Table 1 reveal that the number of eggs deposited by single female of *C. maculatus* (F.) gradually decreased as the number of females in the same substrate increased. The number of eggs laid by a single female averaged 58.8 eggs at a density of 4 beetles (2 ♀♀: 2 ♂♂) and this number significantly lowered to 26.2 eggs/female when the density of beetles increased to reach 40 beetles. These results show a negative correlation (r = -0.4614) between population density of *C. maculatus* adults and female fecundity. The same trend was found considering number of hatched larvae (r=-0.4307). Egg hatchability did not affect by adult density and the percentage of hatched eggs ranged between 91.2 % and 93.9 % and 86.6 % - 90.6 % in case of of faba bean and cowpea, respectively. Nwanze and Horber (1975) found that as the number of *C. maculatus* parent females increased, the number of eggs laid per female decreased. They explained this phenomenon either because of interference and ecollosion among beetles or because the early laid eggs in the beetles life makes seed surface less attractive for further oviposition. Kapila and Pajni (1989) came to the same conclusion

as they recorded 6.6 eggs/female when 384 adult pairs were kept together in a glass petri-dish of 2 x 9 cm compared with 52.1 eggs/female when one pair of adults was kept individually in the same petri-dish.

2. Developmental period The mean developmental time required by *C. maculatus* immatures to complete its development did not significantly affected by the initial parent density. There were slight prolongation in developmental period at different insect densities, but the differences did not exceed 1.5 – 2 days. Developmental period averaged 26.5 days at a density of 4 beetles and it gradually increased to reach 28 days at 32 beetles, however it reagain decreased to 27.1 days when the density of beetles was 40 beetles Table 1.

3. Mortality of immatures Survival rate of *C. maculatus* larvae developed in cowpea seeds was significantly influenced by the density of parent beetles. As shown in mortality percentages of immatures increased as the population density of parent beetles increased ($r = 0.7229$). At 4 beetles density, mortality rate averaged 14.1 % and gradually increased to reach the highest 38 % at a population density of 40 beetles, Table 1. The considerable increment of immatures mortality could be attributed to the crowding and food shortage available to larvae.

4. Total adult production Data presented indicate that the number of adult produced significantly varied at different densities of initial adult populations. There was a high positive correlation between F_1 population and the number of initial beetles ($r = 0.9661$). The comulative total yield of the different parent densities increased gradually with the increase of parent beetles density Table 1. The total number of emerged beetles was 96.6 beetles at a parent density of 4 beetles, this number raised to 153.1 beetles at a density of 8 beetles and considerably increased to average 522.9 beetles when the density of parent beetles was 40 beetles. These results are confirmed by those of many investigations as Strong *et al.* (1968), Taylor (1974), Nwanse and Horber (1975) and Kapila and Pajani (1989). The results of Singal *et al.* (1989) revealed a high positive correlation between the initial infestation of seeds of chick peas, *Cicer arietinum* with 1, 2, 4 or 5 pairs of *C. chinensis*. This positive correlation occurred between F_1 population and the number of the pairs of the beetles, but such a correlation was not observed in the case of F_2 generation. Similarly, Taylor (1974) found a curvilinear relationship of active female production to initial adult population. These results are greatly corresponding with our achieved data.

5. Effect on food consumption A positive correlation (r = 0.8563) was found between the amounts of dry food consumed of cowpea seeds and the density of initial parent populations of *C. maculatus* Beetles consumed 4.3 mg of cowpea seeds at a population density of 4 adults, this value significantly (P = 0.01) increased to the double when the number of parent beetles increased to become 16 beetles Table 2. This tendency was observed by increasing adult population density, so the maximum food consumed 11 mg. was obtained at a density of 40 beetles. The same trend was denoted concerning the percentages of food consumption under the pressure of different adult densities.

Table 1. Relations between density of *C. maculatus* (F.) adults reared in cowpea seeds and development, fecundity, adult emergence and mortality.

Parametres	Initial density of beetles				
	4	8	16	32	40
No. of eggs./ female	58.8 ± 8.6	52.1 ± 5.4	46.4 ± 5.4	37.4 ± 2.7	26.2 ± 3.0
No. of hatched larvae	56.0 ± 8.2	47.7 ± 5.5	42.1 ± 5.2	34.8 ± 2.6	23.4 ± 3.1
% Egg hatchability	93.9 ± 1.2	91.6 ± 1.4	91.2 ± 2.1	92.6 ±1.1	93.6 ± 1.1
Developmental period (days)	26.5 ± 0.9	27.3 ± 0.9	27.3 ± 1.0	28.0 ± 1.0	27.1 ± 1.0
% Mortality	14.1 ± 3.4	18.6 ± 2.5	25.7 ± 3.5	26.5 ± 2.2	38.0 ± 3.5
No. of emerged beetles	96.6 ± 15.4	153.1 ± 18.9	280.7 ± 33.9	403.2 ± 21.5	522.9 ± 4.9

Table 2. Effect of adult density of *C. maculatus* (F.) adults reared on cowpea seeds on food consumption, damage and weight loss.

Parametres	Initial density of beetles				
	4	8	16	32	40
Dry weight food consumed (mg)	4.3 ± 0.4	5.3 ± 0.2	8.1 ± 0.3	9.1 ± 0.2	11.0 ± 0.2
% Food consumption	22.1 ± 0.9	27.4 ±1.3	41.9 ± 1.6	48.1±1.3	57.7 ± 1.2
Weight of damaged seeds (mg.)	15.2 ±0.9	16.2 ±0.5	18.5 ± 0.4	19.8 ± 0.1	19.9 ± 0.1
% Damage	75.7 ± 4.4	81.0 ± 2.1	92.4 ± 2.3	98.8 ± 0.4	99.6 ± 0.1
Dry weight loss	0.28 ± 0.1	0.28 ± 0.1	0.37 ± 0.2	0.43 ± 0.1	0.55 ± 0.1
% Weight loss	18.9 ± 1.7	24.2 ±1.0	37.3 ±1.7	43.3 ±1.2	54.7 ± 1.3

Faba bean seed consumption by *C. maculatus* behaved similarly to cowpea consumption. The amounts of faba bean seed consumed progressively increased as the population density of initial beetle population increased. At a density of 4 beetles the amount of faba bean seeds consumed averaged 0.9 mg, this value significantly raised to 3.5 mg when the beetles density was 40 beetles.

6. Effect on seed damage and weight losses Results in Table 2 revealed a high positive correlation between loss in cowpea seed weight and the beetle population (r = 0.8628). The coefficient of determination showed that 67 % and 86 % variability in seed damage and loss in cowpea seed weight were because of the number of beetles released initially. The percentages of cowpea damaged seeds averaged 75.7 % at initial beetle density of 4 beetles and increased gradually to become 99.6 % at beetle density of 40 beetles.

Similarly, it was found that weight loss of cowpea seeds was 18.9 % at a density of 4 beetles and this value significantly increased by increasing the population density of initial beetles released, the maximum weight loss 54.7 % was gained at the highest density of beetles (40 beetles).

Regarding seed damage and loss of faba bean, results showed positive linear relationship between these two parameters and the initial population density of *C. maculatus* adults (r = 0.6892, and r= 0.7847). Seed damage and loss were 47.3 % and 3.8 % at an initial density of 4 beetles (Table 4) these values increased by beetle density increase and reached the maximum (89.3 % and 15.4 %) when the number of beetles became 40 beetles, (Table 4).

Table 3. Relations between density of *C. maculatus* (F.) adults reared in faba bean seeds and development, fecundity, adult emergence and mortality.

Parametres	Initial density of beetles				
	4	8	16	32	40
No. of eggs/female	53.2 ± 9.7	38.3 ± 5.2	37.9 ± 3.1	29.1 ± 3.1	28.9 ± 9.4
No. of hatched larvae	49.0 ± 9.2	33.3 ± 4.2	34.2 ± 3.7	25.7 ± 3.0	24.8 ± 2.0
% Egg hatchability	90.6 ± 2.5	88.3 ± 1.5	90.5 ± 3.0	87.7 ± 2.6	86.6 ± 1.6
Developmental period (days)	30.4 ± 0.9	31.6 ± 1.2	30.4 ± 1.0	30.0 ±1.0	31.9 ± 1.0
% Mortality	66.8 ± 4.1	66.6 ± 6.8	69.8 ± 2.6	68.6 ± 1.8	72.6 ± 3.3
No. of emerged beetles	33.9 ± 9.1	44.7 ± 8.7	83.3 ± 10.8	130 ± 17.9	135.1 ± 19.6

Table 4. Effect of adult density of *C. maculatus* (F.) adults reared on faba bean seeds on food consumption, damage and weight loss.

Parametres	Initial density of beetles				
	4	8	16	32	40
Dry weight food consumed (mg)	0.9 ± 0.1	1.5 ± 0.2	2.7 ± 0.2	3.1 ± 0.2	3.5 ± 0.1
% Food consumption	4.9 ± 0.4	8.0 ± 0.7	13.9 ± 0.9	16.3 ± 0.9	18.1 ± 0.4
Weight of damaged seeds (mg)	9.5 ± 1.3	13.5 ± 1.0	16.1 ± 0.7	17.0 ± 0.7	17.9 ± 0.4
% Damage	47.3 ± 6.2	67.2 ± 4.9	80.1 ± 3.2	84.8 ± 3.7	89.3 ± 2.0
Dry weight loss	0.04 ± 0.002	0.1 ± 0.01	0.12 ± 0.01	0.14 ± 0.01	0.2 ± 0.01
% Weight loss	3.8 ± 0.3	6.3 ± 0.6	11.7 ± 0.5	13.5 ± 1.0	15.4 ± 0.8

Braich and Simwat (1984) stated that the weight loss and damage of mung bean seeds varied from 1.7 % to 21.5 % and 1.6% to 53.3% when the population density of *C. maculatus* (F.) was 1, 2 and 3 pairs/500 gm. of mung bean seeds. These results are in agreement with results derived from the present work.

II. EFFECT OF SEED DENSITY

1. Effect on total egg production Results in Tables 5 & 7 reveal significant variations in the total number of eggs produced by *C. maculatus* female as the number of cowpea or faba bean seeds available varied. It was found that the number of eggs laid by a single female increased as the number of available seed increased, (r = 0.7984 and r= 0.8868). On cowpea seeds, female laid 49.6 eggs when 5 seeds were available and this rate gradually increased by increasing cowpea seeds density and the maximum number of deposited eggs 89.9 eggs/female was recorded at 80 seed density, (Table 5). The same phenomenon was observed concerning faba bean seeds even the number of egg production was lower than on cowpea seeds. Female laid 35.9 eggs when the number of faba bean available seeds was 5 seeds and the total egg produced progressively increased to reach the maximum (60.1 eggs/female) at a density of 80 seeds, (Table 7).

On the other hand, a reverse relationship occurred between the number of eggs per seed and the density of seed available from both cowpea and faba bean seeds. Number of eggs per seed significantly depressed as the number of seed available increased, (r = - 0.8122 and r = - 0.8071). However, the percentage of egg hatchbility was not greatly affected by variations of seed densities. These results are in agreement with those of Credland (1986) who found that the number of eggs laid by *C. maculatus*, depends on the number of the cowpea seeds available and the strain

used and concluded that egg production was depressed at low seed densities but high seed density (40 seeds) was sufficient for each female to produce the maximum number of both eggs and adult beetles. Also similar results had been achieved by Chun and Ryoo (1992). Similarly, Ghareab (1995) reported that availability of 5 or 10 seeds of mung bean may restrict the total number of eggs produced by *C. chinensis*, while 20 seeds or more are sufficient for each female to lay its maximum number of eggs.

2. Effect on developmental period and adult production The time required by *C. maculatus* to complete development did not greatly affected by the number of seeds available of cowpea or faba bean. As shown in (Tables 5 and 7). the developmental period of *C. maculatus* bred in cowpea seeds ranged between 27.5 and 29.1 days at low or high seed densities. The same results were achieved at different densities of faba bean seeds where the developmental period ranged between 32.8 and 36.5 days.

Concerning the rate of immatures survival, there were negative relationship between seed density of cowpea ($r = -0.6950$) and faba bean ($r = -0.7553$) on one hand and the percentages of immatures mortality on the other hand. These results indicated that the rate of mortality decreased as the density of host seed increased. This relationship was significantly strong and evident in cowpea seed densities while it was some what weak for faba bean seed densities (Tables 5 and 7). Decrease of immature mortality by increase of available host seed could be explained by intraspecific competition between newly hatched larvae for seed penetration and food shortage under low seed densities.

Table 5. Effect of cowpea seed density on development, fecundity, mortality and adult production of *C. maculatus* (F.).

Parameters	Initial density of seeds				
	5	10	20	40	80
No. of eggs/female	49.6 ± 5.2	57.6 ± 8.3	65.5 ± 6.3	70.1 ± 6.5	89.9 ± 7.1
No. of eggs/seed	9.9 ± 1.0	5.8 ± 0.3	3.3 ± 0.3	1.8 ± 0.2	1.1 ± 0.1
No. of hatched larvae	42.5 ± 4.7	50.6 ± 7	58.7 ± 5.3	64.7 ± 6	82.7 ± 7.2
% Egg hatchability	86.2 ± 0.9	88 ± 1.8	90.3 ± 1.2	91.6 ± 2	92 ± 1.3
Develop. period (days)	28 ± 0.8	27.9 ± 0.6	29.1 ± 1.5	27.7 ± 0.4	27.5 ± 0.4
% Mortality	39.2 ± 7.0	25.7 ± 3.3	14.9 ± 4.4	9.9 ± 2.4	12.4 ± 1.7
No. of emerged beetles	25.5 ± 2.4	37.2 ± 4.6	49.7 ± 4.7	58.4 ± 5.6	72.7 ± 6.2
% Adult emergence	60.8 ± 7.0	74.3 ± 3.3	85.1 ± 4.4	90.1 ± 2.4	87.6 ± 1.7

Means followed by the same letter in the same row are not significantlydifferent [p=0.05 , Duncan's multiple range test (1955)].

Table 6. Effect of cowpea seed density on food consumption, seeds damage and loss caused by *C. maculatus* (F.).

Parameters	Initial density of seeds				
	5	10	20	40	80
Dry wt. Of food consumed (mg)	4 ± 0.2	6 ± 0.1	9.6 ± 0.3	12.2 ± 1.2	10.9 ± 0.4
% Food consumption	51.8 ± 1.5	40.9 ± 0.6	32.8 ± 0.7	21.7 ± 0.7	9.9 ± 0.3
Weight of damaged seeds (mg)	4.1 ± 0.3	10.4 ± 0.4	21.8 ± 5.4	55.4 ± 4.1	82.4 ± 8.9
% Damage	87.5 ± 12.5	95.6 ± 4.4	70.2 ± 23.2	61.2 ± 18.2	56.7 ± 7.7
Weight loss (mg)	5.2 ± 0.4	4 ± 0.04	3.2 ± 0.2	1.9 ± 0.2	0.8 ± 0.03
% Loss	49.5 ± 1.3	40.2 ± 0.5	31.5 ± 1.3	18.8 ± 1.9	3.5 ± 0.3

Means followed by the same letter in the same row are not significantlydifferent [p=0.05 , Duncan's multiple range test (1955)].

Seed densities of cowpea and faba bean also affected the number of emerged beetles. There was obvious relationship between seed density and the total number of adult production, (r = 0.9387, r = 0.9455). For cowpea and faba bean seeds, results clarified that the total number of adult production significantly increased by the increase of seed density. At low density of cowpea seeds (5 seeds), the total number of emerged adults averaged 25.5 beetles and this number became nearly three-times at maximum available seed density (80 seeds). Similarly, 11.8 beetles were produced from infested faba bean at density of 5 seeds and this number progressively raised to become 28.2 beetles at a density of 80 seeds. Percentages of adult emergence showed the same trend at different densities of cowpea or faba bean seeds. Credland (1986) achieved similar results on *C. maculatus* and stated that the number of adult progeny increased steadily with the increase of number of cowpea seeds.

According to the previous achieved results, low seed density of cowpea and faba bean may restrict both the number of egg production and the total number of emerged beetles. At the same time, the increase of seed density was followed by significant increase of egg and adult production. From these results, it could be suggest that the optimum conditions that could be used to determine the maximum number of adult progeny and female fecundity should not be based on low seed density but at least 80 seeds would be sufficient for producing actual and reseonable results.

3. Effect on seed consumption, damage and seed loss Seed density of cowpea and faba bean showed different effects on seed consumption, seed damage and seed losses caused by *C. maculatus* . The amounts of cowpea seeds consumed at different

seed densities showed steadily increase by the increase of seed density (r = 0.7361) which reached the maximum 12.2 mg. at 40 seeds after which this amount obviously decreased to 10.9 mg. at the highest seed density (80 seeds). Similar results were obtained in the case of faba bean, (r = 0.4077). Insect consumed 2 mg. at the low seed density (5 seeds) and reached the highest 12.1 mg. after which it dropped to 8 mg. at 80 seed (Tables 6 and 8). These results reveal that seed consumption by *C. maculatus* increases by the increase of seed density until definite level after which seed consumption decreases by the increase of seed numbers.

Loss percentages of cowpea or faba bean seeds as a result of *C. maculatus* infestation showed considerable increase by the increase of seed density until a level of 20 seeds after which these percentages values gradually decreased by the subsequent seed densities increase (Tables 6 and 8). The same trend was achieved concerning the percentages of seed losses at different seed densities. The increase of damaged seeds and losses by increase of seed densities until 20 seed means that adult female can distribute their eggs on available seeds up to 20 seeds, and eggs laying may be condensed on low number of seeds. The number of deposited eggs may distribute on higher number of seeds, but when the number of seeds overcomes 20 seeds, the insect cannot distribute equally their eggs on the seeds and therefore, eggs may disperse on the seeds but this mean that not each seed may have egg or eggs, accordingly under such high densities of seeds, the percentages of damaged seeds and loss may obviously drop.

Table 7. Effect of faba bean seed density on fecundity, development, mortality and adult production of *C. maculatus* (F.).

Parameters	Initial density of seeds				
	5	10	20	40	80
No. of eggs / female	35.9 ± 5.8	45.2 ± 10.7	50.9 ± 7.4	52.3 ± 8.8	60.1 ± 9.6
No. of eggs / seed	7.2 ± 1.2	4.5 ± 1.1	2.5 ± 0.4	1.3 ± 0.2	0.8 ± 0.1
No. of hatched larvae	30.3 ± 4.8	38.6 ± 9.9	45.2 ± 7.6	45.2 ± 7.8	53.3 ± 8.5
% Egg hatchability	85.1 ± 2	84.1 ± 3.1	89.2 ± 3.1	86.2 ± 1.6	89.6 ± 2.1
Develop. period (days)	32.8 ± 2	34.1 ± 2.9	36.5 ± 4.6	33.1 ± 3.4	33.4 ± 3.9
% Mortality	59 ± 9.8	51.2 ± 10.6	57.9 ± 7.4	51.5 ± 4.6	47.8 ± 4.5
No. of emerged beetles	11.8 ± 2.3	17.6 ± 6.3	19.1 ± 4.5	21.7 ± 4.5	28.2 ± 4.7
% Adult emergence	41 ± 9.8	48.8 ± 10.6	42.1 ± 7.4	48.5 ± 4.6	52.2 ± 4.5

Means followed by the same letter in the same row are not significantlydifferent [p=0.05 , Duncan's multiple range test (1955)].

Table 8. Effect of faba bean seed density on food consumption, seeds damage and loss caused by *C. maculatus* (F.).

Parameters	Initial density of seeds				
	5	10	20	40	80
Dry wt. Of food consumed (mg)	2 ± 0.1	4.4 ± 0.2	12.1 ± 0.7	9.6 ± 0.5	8 ± 0.5
% Food consumption	6.1 ± 0.2	6.9 ± 0.3	9.2 ± 0.7	3.6 ± 0.2	1.7 ± 0.01
Weight of damaged seeds (mg)	24.6 ± 2.7	35.4 ± 6.9	68.7 ± 9.7	80.8 ± 15.9	126.1 ± 19.7
% Damage	71.3 ± 9.2	56.9 ± 10.6	51.6 ± 7.3	30.9 ± 5.8	24.5 ± 3.6
Weight loss (mg)	1.2 ± 0.03	1.3 ± 0.04	1.4 ± 0.01	0.8 ± 0.2	0.3 ± 0.04
% Loss	11.8 ± 0.3	13.1 ± 0.4	14.1 ± 0.4	6.1 ± 0.4	3.4 ± 0.3

Means followed by the same letter in the same row are not significantlydifferent [p=0.05 , Duncan's multiple range test (1955)].

REFERENCES

1. Adams, J. M. 1977. Post-harvest losses in cereals and pulses. The result of a questionnaire survey, June 1976, by J. M. Adams. Trop. Prod. Institute, Slough, United Kingdom.
2. Braich, J. S. and Simwat. 1984. Effect of different levels of initial infestation of *Callosobruchus maculatus* (F.) and *Callosobruchus chinensis* (L.) on their population build-up and the resultant weight loss to moong. Bull. Grain. Technol., 22 (3): 240 – 246.
3. Chun, Y. S. and M. I. Ryoo. 1992. Ovipositional response of the azuki bean weevil to the densities of azuki bean and influence of intraspecific competition on the response. Korean J. Entomol., 22 (2): 73 – 80.
4. Credland, P. F. 1986. Effect of host availability on the reproductive performance in *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae). J. Stored. Prod. Res., 22 (1): 49 – 54.
5. El-Degwi, Mai S. and M. N. El-Orabi. 1997. Weight loss in legume seeds caused by puls beetle, *Callosobruchus maculatus* (F.) mixed with certain powders. Bull. Ent. Soc. Egypt, 75: 12-18.
6. El-Sawaf, S. K. 1956. Some factors affecting the longevity, oviposition and rate of development in the southern cowpea weevil, *Callosobruchus maculatus* F. Bull. Entom. Soc. Egypt., 40: 29 – 95.

7. El-Shazly, E. A. 1993. Studies on the relationships between two bruchids, *Bruchus rufimanus* (Boh.) and *Collosobruchus chinensis* (Col.: Bruchidae) and their host plants. Ph.D. thesis, Fac. Agric., Cairo University, 165 pp.
8. Ghareab, M. S. A. 1995. Studies on the cowpea beetle, *Callosobruchus chinensis* (L.) on mungbean seeds during storage. (Coleoptera: Bruchidae). M. Sci. Thesis, Faculty of Science, Zagazig Univ., Egypt.
9. Hashem, M. Y. and M. S. Richa. 1998. Post harvest losses caused by Southern cowpea beetle *C. maculatus* (F.) in faba bean *Vicia faba*, and its control using modified atmospheres. Bull. Ent. Soc. Egypt., Econ. Ser., 25: 85 – 97.
10. Howe, R. W. 1971. A parameter for expressing the suitability of an environment for insect development. J. Stored Prod. Res., 7 (1): 63 – 65.
11. Kapila, R. and H. P. Pajni. 1989. Effect of population density on fecundity, fertility, progeny and developmental period of *Zabrotes subfasciatus* (Boh.) on *Phaseolus vulgaris*. Indian J. Ent., 50 (3): 327 – 335.
12. Metwally, M. M. 1990. Bionomics of *Bruchidius incarnatus* (Boh.) in Egypt on legumes. Bruchids, Economic Ecology and Coevolution, pp 25 – 36.
13. Nwanze, K. F. and E. Horber. 1975. Laboratory techniques for screening cowpeas for resistance to *Callosobruchus maculatus* (F.). Envirom. Ent., 3 (3): 415 – 419.
14. Shazali, M. E. H. 1990. Weight loss in faba bean seeds caused by feeding of Bruchidius incarnatus (Boh.). Fabis Newsleter, 26: 30 – 32.
15. Singal, S. K., Z. Singh, and R. S. Jaglan. 1989. Effect of different levels of the bruchid, Callosobruchus chinensis (L.) on chickpea, Cicer arietinum (L.) in India. Tropical pest Management, 35 (2): 187 – 189.
16. Strong, R. G., G. J. Partida and D. N. Warner. 1968. Rearing stored product insects for laboratory studies: Bean and cowpea weevils. J. Econ. Ent., 61 (3): 747 – 751.
17. Taylor, T. A. 1974. Observations on effects in initial population densities in culture and humidity on the production of "active females" of Callosobruchus maculatus (F.). J. Stored Prod. Res., 10: 113 – 122.

تأثير الكثافات المختلفة من البذور وحشرة خنفساء اللوبيا *Callosobruchus maculatus* (F.) على معدل النمو والتالف و الفاقد فى وزن كلا من بذور اللوبيا والفول .

محمد على محمد على[1] ، فريال محمد على السيد[2] ، حمودة محمد ابراهيم البشلاوى[2]

١-قسم وقاية النبات بكلية الزراعة – جامعة الأزهر – مدينة نصر – القاهرة .
٢-قسم بحوث آفات الحبوب المخزونة – معهد بحوث وقاية النباتات ، مركز البحوث الزراعية – الدقى – محافظة الجيزة .

أجريت هذه الدراسة بهدف دراسة تأثير كثافات مختلفة من الحشرات البالغة لخنفساء اللوبيا حديثة الخروج من العذارى : ٤، ٨، ١٦، ٣٢، ٤٠ حشرة لكل ٢٠ جم بذرة – على معدل النمو، الفاقد فى وزن البذور المعرضة للإصابة بها وكمية التالف فى وزن البذور، ولقد أسفرت نتائج هذه الدراسة عن الآتى:

١- خصوبة الإناث:

توجد علاقة عكسية بين كثافة الحشرات البالغة والتى بدأت بها الإصابة وعدد البيض الناتج عنها حيث وجد نقص واضح فى العدد الكلى للبيض الناتج كلما إزدادت كثافة الحشرات البالغة، فلقد بلغ العدد الكلى للبيض ٥٨,٨ بيضة/أنثى عند مستوى كثافة ٤ خنافس بينما إنخفض هذا العدد إلى ٢٦,٢ بيضة/أنثى عند مستوى كثافة ٤٠ حشرة، بينما لم تؤثر الكثافات المختلفة للحشرات البالغة على النسبة المئوية لفقس البيض، ولقد كانت النتائج لكل من اللوبيا والفول البلدى متماثلة إلى حد كبير.

٢- فترة النمو:

أثبتت نتائج الدراسة أن الفترة اللازمة لإستكمال نمو الأطوار غير الكاملة لم يتأثر معنويا بإختلاف كثافة الآباء من الخنافس، فاليرقات التى تربت فى بذور اللوبيا إحتاجت ٢٦,٥ يوم لإستكمال النمو حتى ظهور الحشرات الكاملة للجيل التالى عند مستوى ٤ خنافس، بينما بلغت ٢٧,١ يوم عند إزدياد كثافة الآباء إلى ٤٠ خنفساء، وبالمثل كانت نتائج الفول البلدى تسير فى نفس هذا الإتجاه.

٣- معدل الوفاة فى الاطوار غير الكاملة:

كان للكثافات المختلفة من الخنافس تأثيرا قويا ومعنويا على معدل الوفاة بين اليرقات والعذارى النامية داخل بذور اللوبيا والفول البلدى، حيث كانت هذه العلاقة معنوية بناء على التحليل الإحصائى للنتائج أى أن معدل الوفاة يزداد زيادة معنوية كلما زادت كثافة الخنافس عند بداية التجربة، كان معدل الوفاة ١٤,١%، ٦٦,٨% عند مستوى ٤ خنافس فى كل من اللوبيا والفول البلدى،

بينما إرتفعت هذه المعدلات بصورة معنوية إلى ٣٨%، ٧٢,٦% عندما إزدادت كثافة الخنافس إلى ٤٠ خنفساء عند بداية التجربة.

٤- المجموع الكلى للنسل الناتج:

تشير النتائج أن هناك علاقة إرتباط موجبة بين كثافة الحشرات والنسل الناتج من الإصابة حيث إزدادت أعداد الخنافس الناتجة بإزدياد كثافة الخنافس عند بداية الإصابة (ر = ٠,٩٦٦١)، بلغ العدد الكلى للنسل الناتج من بذور اللوبيا والفول البلدى ٩٦,٦، ٣٣,٩ خنفساء عند مستوى كثافة أربعة خنافس بينما إزداد معدل النسل ليصل الى ٥٢٢,٩، ١٣٥,١ خنفساء لكل من اللوبيا والفول البلدى عندما كانت كثافة الخنافس فى بداية التجربة ٤٠ خنفساء.

٥- الإستهلاك الغذائى:

أوضحت نتائج التجارب المعملية على بذور الأصناف المختلفة لكل من اللوبيا والفول البلدى زيادة معنوية فى كمية الغذاء المستهلك من البذور بزيادة كثافة الخنافس المستخدمة عند بدء التجربة، إستهلكت الحشرات ٤,٣، ٠,٩ ملليجرام من بذور اللوبيا والفول البلدى عند مستوى كثافة أربعة خنافس، ولقد إرتفع معدل الإستهلاك الغذائى بصورة جوهرية إلى ١١، ٣,٥ ملليجرام عندما إزدادت كثافة الخنافس إلى ٤٠ خنفساء.

٦- تقدير التالف والفاقد فى وزن البذور:

أثبتت النتائج وجود علاقة موجبة قوية بين كميات الفاقد والتالف فى بذور كل من اللوبيا والفول البلدى عند مستويات الإصابة المختلفة بالخنافس، فعند مستوى إصابة أربعة خنافس بلغ معدل التالف فى بذور اللوبيا والفول البلدى ٧٥,٥%، ٤٧,٣% على التوالى، ولقد إزدادت هذه القيم إلى ٩٩,٦%، ٨٩,٣% عندما إرتفعت كثافة الخنافس إلى ٤٠ خنفساء.

تم التوصل إلى نتائج مماثلة للعلاقة السابقة بالنسبة لمعدل الفاقد فى وزن البذور المصابة فبذور اللوبيا والفول البلدى المصابة بمعدل ٤ خنافس / ٢٠ جم بذرة أدى إلى فقد نحو ١٨,٩%، ٣,٨ % من وزن البذور بينما إرتفعت هذه المعدلات إلى ٥٤,٧%، ١٥,٤% لكل من اللوبيا والفول البلدى عندما إزدادت كثافة الخنافس فى بداية التجربة إلى ٤٠ خنفساء.

ولقد اسفرت نتائج دراسة تأثير الكثافات المختلفة من البذور على ما يلى :

١- العدد الكلى للبيض الناتج:

أظهرت نتائج تعريض كثافات أو أعداد مختلفة من بذور اللوبيا والفول البلدى (٥، ١٠، ٢٠، ٤٠، ٨٠ بذرة / لكل زوج من الخنافس حديثة الخروج من العذارى) عن وجود علاقة موجبة بين عدد البذور والعدد الكلى للبيض حيث يزداد العدد الكلى للبيض بزيادة تعداد البذور المعرضة سواء من اللوبيا أو الفول البلدى، فعند مستوى خمسة بذور من اللوبيا بلغ عدد البيض الموضوع عليها ٤٩,٦ بيضة وقد إرتفع هذا العدد الى ٨٩,٨ بيضة عندما إزداد عدد البذور المعرضة للحشرات إلى ٨٠ بذرة، ومن الجدير بالذكر أنه وجدت علاقة عكسية بين عدد البيض الموضوع بالنسبة للبذرة

الواحـــدة وعـــدد الـــبذور الكلى أى كلما زاد عدد البذور كلما قل عدد البيض الموضوع على البذرة الواحـــدة وكانت جميع النتائج فى هذا الصدد متماثلة بين أصناف اللوبيا وأصناف الفول البلدى تحت الإختبار.

٢- فترة النمو وعدد النسل الجديد:

تـــدل النتائج المتحصل عليها عن عدم وجود تأثير للكثافات المختلفة لبذور اللوبيا أو الفول الـــبلدى علـــى معـــدل النمو أو فترة النمو اللازمة لحشرة خنفساء اللوبيا، بينما توجد علاقة عكسية واضحة بين كثافة البذور ونسبة وفيات الأطوار غير الكاملة.

أمـــا بالنسبة لتأثير كثافة البذور المتاحة من اللوبيا والفول البلدى فلقد أوضحت النتائج وجود علاقة إرتباط بين العاملين وأن تعداد الحشرات الناتجة يزداد بزيادة كثافة البذور المتاحة أثناء وضع البيض عند بداية التجربة.

٣- الإستهلاك الغذائى ، كميات التالف فى البذور والفاقد فى الوزن:

أظهـــرت النتائج أن كمية الغذاء المستهلك بواسطة حشرة خنفساء اللوبيا يزداد بزيادة كثافة البذور المتاحة من اللوبيا أو الفول البلدى عند بدء التجربة وذلك إلى مستوى معين (٢٠ بذرة) بعدها يلاحظ إنخفاض واضح فى كمية الغذاء المستهلك.

أمـــا بالنســـبة لمعدل البذور التالفة فلقد وجد أن معدل البذور التالفة من اللوبيا يزداد بزيادة كـــثافة الـــبذور حـــتى مستوى ٢٠ بذرة بعدها إنخفض هذا المعدل بصورة واضحة على الرغم من الإزديـــاد المضطرد لكثافة البذور، أما بالنسبة للفول البلدى فلقد لوحظ إزدياد معدل التالف من البذور بزيادة كثافة بذور الفول المتاحة فى بداية التجربة.

تـــدل النتائج أن معدل الفاقد فى وزن البذور ينخفض بصورة جوهرية مع زيادة كثافة البذور المقدمة للحشرات من اللوبيا أو الفول البلدى عند بداية التجربة.