EFFECT OF STORAGE PERIOD AND CONTROLLED TEMPERATURES ON INFECTION POTENTIAL, FOOD CONSUMPTION, DAMAGE AND WEIGHT LOSSES OF COWPEA AND FABA BEAN SEEDS INFESTED WITH *CALLOSOBRUCHUS MACULATUS* (F.)

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Abstract

Laboratory experiments were conducted to assess infection potential of *C. maculatus* (F.) (Coleoptera : Bruchidae) on four cowpea and faba bean varieties stored for 6 months. Infestation rates, loss in seeds weight and number of emerged beetles were the criteria used to assess the vulnerability of cowpea and faba bean to post-harvest infestation. Cowpea local variety and faba bean Giza 843 showed a slight degree of resistance to insect infestation, therefore they can be stored safely for a relatively long period (6 months) with lowest rates of infestation and weight losses of stored seeds.

The effect of store controlled temperatures 25°, 30° and 35°C ± 2°C on seed consumption, seed damage and losses of different cowpea and faba bean varieties was investigated. Results revealed that all the former parameters significantly ($P > 0.05$) decreased by the increase of store temperature. So, high temperature of 35°C or above can be used as an environmental element to store cowpea and faba bean seeds safely with the least damaged and losses of stored seeds for approximately 6 months.

INTRODUCTION

The cowpea beetle, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) is the most destructive pest of pulses particularly cowpea and faba bean causing considerable damage. Damage and weight losses of legume seeds were estimated by El-Sawaf (1956), Adams (1977) Shazali (1990), Hashem and Risha (1998) and El-Degwi and Orabi (1997).

Different bioecological factors such as ambient temperature, host plant and insect density have some effects on the bioactivities of bruchids including *C. maculatus* (F.). In many insect species, food consumption, consequently losses are increasing

with increase of temperature and storage time, however this relationship is not always linear (Ali, 1982; Ali and El-Sayed, 1983 and Ali *et al.,* 1982).

The objective of the present study is to evaluate infestation potential, damage and losses of different cowpea and faba bean infested with *C. maculatus* (F.) and stored for different periods and under different controlled temperatures.

MATERIALS AND METHODS

1. Effect of storage temperature this experiment was performed to study the effects of storage temperatures: 25, 30 and 35 °C ± 2 °C and laboratory temperature on *Callosobruchus maculatus* (F.) development and loss gained as a result of insect infestation to different varieties of cowpea and faba bean seeds. Samples of cowpea and faba bean seeds, each 20 gr., representing cowpea varieties : (Karim 7, Dokki 331, local and Kafr El-Sheikh-1) and faba bean varieties: (Giza 429, Giza 674, Giza 843 and Sakha-1) were prepared.

Seeds of each variety were placed in plastic tube 3 x 5 cm. Fifteen pairs of newly emerged beetles (0 - 24 hr-old) of *Callosobruchus maculatus* (F.) were released in each tube, covered with muslin cloth and fastened with rubber bands. For each variety 3 sets of test tubes (10 tubes each) were prepared. Sets of each cowpea or faba bean varieties were incubated at constant temperatures of 25, 30 and 35 °C ± 2 °C and laboratory temperature, respectively.

Tubes of each set were examined after one week, beetles were removed, the number of laid eggs was counted and seeds were returned back to the different temperatures. Seeds of the different sets were inspected daily until the emergence of the first adult. The following parameters were determined : the number of eggs laid, the number of L_1 having perforated the seed coat and reached the cotyledons, and number of adults emerging from the seeds. It was thus possible to determine the penetration rates (number of L_1 having penetrated/number of eggs laid) and the survival rates (number of emerging adults), total number of L_1 larvae having penetrated.

Rates of seed damage and weight of loss have been estimated as described before. Rates of penetration survival rates, number of F_1 progeny, rate of damage and percent weight loss recorded were all analysed statistically and the mean values were separated by the Duncan's multiple-range test.

2. Effect of storage period weight loss and seed viability were used as criteria for assessing quality loss of cowpea and faba bean seeds during different periods of storage. Sub-samples of test varieties of cowpea and faba bean each weighting 250 gr. were put in cotton bag and infested with 0 - 24 hr-old of *Callosobruchus maculatus* (F.). Each sub-sample was infested with 32 beetles (unsexed) and stored on shelves under laboratory conditions. Four replications were prepared for each test variety at predetermined storage periods of 1, 2, 3, 4, 5 and 6 months. Laboratory temperature and relative humidity were recorded daily during storage periods. An uninfested bags of cowpea and faba bean were set as a control of each test variety at the various periods of storage. Twenty four treatments were thus prepared for each cowpea or faba bean of the varieties tested.

To assess weight loss of the cowpea and faba bean due to beetle infestation, cowpea and faba bean seeds were weighed prior to the introduction of the beetles, then at each period of assessment, the beetles and all the dust they created were sifted and the infested seeds of cowpea and faba bean subsequently weighed. The uninfested cowpea or faba bean seeds were similarly weighed, and the observed differences in weight between infested and uninfested samples were used to calculate loss in weight.

3. Seed viability seed viability was assessed by the percentage of seeds germination and was determined by the filter paper method (Wallace and Sinha, 1962), using seeds of each cowpea or faba bean selected at random from the infested seeds at the different periods of storage. Germination percentage of the seeds was also determined before cowpea and faba bean were infested with beetles of *Callosobruchus maculatus* (F.).

RESULTS AND DISCUSSION

I- EFFECT OF STORAGE PERIOD in this part, infestation potential, seed loss and seed viability for germination of four varieties of cowpea and four varieties of faba bean were studied throughout 6 months of storage after seeds of the different tested varieties being infested with *C. maculatus* (F.).

1. Infestation potentiality The vulnerability of the test varieties to post-harvest infestation by *C. maculatus* (F.) is given in Table 1. There were great variations in infestation rates between varieties according to variety itself and duration of storage period.

Cowpea varieties indicated that the number of holed seeds, consequently percentages of infested seeds were different during the 6 months of storage. Incidence of infestation was observed in seeds of Karim 7 and the local varieties 3 months after storage where the percentage of infestation averaged 53 % and 14 %, respectively after which they progressively increased to reach 81 % and 87 % after elapsing of 6 months after storage.

On the other hand, the remained two varieties Dokki 331 and Kafr El-Sheikh-1 showed signs of infestation after elapsing of one month of storage and infestation rates averaged 29 % and 25 %, respectively. Infestation rates gradually increased by increasing storage period and reached 67 % and 44 % at the end of storage time (6 months). Means of infestation levels again proved that the local variety exhibited some degree of immunity to infestation by *C. maculatus* (F.) while the other tested varieties were susceptible to insect infestation. Furthermore, the results indicate the ability of Karim 7 and local varieties to tolerate insect infestation for 3 months even the presence of the pest among the seeds.

Faba bean seems to be less susceptible to *C. maculatus* (F.) due to the failure of newly hatched larvae to penetrate the seed coat or presence of some toxic chemicals, however faba bean varieties exhibited also great differences in the number of holed seeds and infestation levels during the storage period. Giza 429 and Sakha-1 became infested one and two months after storage and infestation rates were 10 % and 3 %, then they increased during the subsequent months to amount 6 % and 8 % at the end of storage time. Seeds of Giza 674 and Giza 843 remained free of insect infestation for about four months after storage and infestation levels during the remained two months did not exceed 1 – 2 %. Means of infestation rates elucidate great immunity of Giza 674 and Giza 843 for *C. maculatus* (F.) infestation while the other two varieties were liable to insect infestation. Meanwhile, Giza 429 and Sakha-1 could be remained free of insect infestation for 1 – 2 months after storage while this period can be extended for 4 months in the case of Giza 674 and Giza 843 varieties.

Table 1. Mean percent seed infestation of cowpea and faba bean varieties infested with *C. maculatus* (F.).

Crop	Varieties*	Total number of hold seeds							Infested seeds						
		Months after storage							Months after storage						
		1	2	3	4	5	6	Mean ± SX`	1	2	3	4	5	6	Mean ± SX`
Cowpea	Karim 7	0	0	0	917	1409	1386	618.7 ± 291.7 [a]	0	0	0	53	85	81	36.5 ± 17.3 [a]
	Dokki 331	0	395	696	515	980	796	563.7 ± 143.5 [a]	0	29	57	44	84	67	46.8 ± 12.4 [a]
	Local	0	0	0	319	1811	2201	721.8 ± 420.8 [a]	0	0	0	14	70	87	28.5 ± 16.4 [a]
	Kafr El-Sheikh-1	0	396	859	557	760	667	539.8 ± 129.0 [a]	0	25	56	36	49	44	35.0 ± 8.4 [a]
Faba bean	Giza 429	0	42	121	23	21	23	38.3 ± 17.8 [a]	0	10	30	6	5	6	9.5 ± 4.4 [a]
	Giza 674	0	0	0	0	6	7	2.2 ± 1.4 [a]	0	0	0	0	1	2	0.5 ± 0.3 [a]
	Giza 843	0	0	0	1	2	2	0.8 ± 0.4 [a]	0	0	0	0	1	1	0.3 ± 0.2 [a]
	Sakha $_1$	0	0	10	12	72	27	20.2 ± 11.4 [a]	0	0	3	3	21	8	5.8 ± 3.3 [a]

* Sample size = 250 gm.

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

2. Quality loss the quality loss as measured by the loss in weight and seed viability of the seeds during storage is shown in Table 2. The mean percent loss after one month was significantly high (P = 0.01) in Karim 7 and Kafr El-Sheikh-1. By the end of the experimental period (6 months after storage), the loss in weight remained significantly high (48 % and 40 %), while the lowest loss in weight was recorded in local variety. The monthly mean weight percent loss did not exceed 13 % and 8 % in Dokki 331 and local varieties, respectively. The loss in weight due to the beetle infestation significantly (p = 0.01) increased with the length of storing cowpeas. El-Sawaf (1956) found that actual percentage weight loss caussed by the progeny of 8 mated females of *C. maculatus* (F.) to 990 g. of cowpeas was 51.3 % during three months. In the present study weight loss caused by the progeny of mated females averaged 31 % during 6 months after storage.

The same trend was noticed in faba bean varieties. The mean percent loss averaged 8 %, 5 %, 4 % and 9 % after 6 months of storage. The lowest weight loss (3.2 %) was recorded in Giza 843 followed by Giza 674 (4.2 %) while the highest loss was in Giza 429. Similarly, weight loss increased with the increase of storing time. This is possibly due to the increase in infestation pressure. These results confirm the findings obtained by Mensah (1986). Caswell (1981) has estimated 87 % damage of threshold cowpeas after 9 months of storage by the local farmers in northern Nigeria while this rate did not exceed 25 % in the present investigation.

The initial seed viability of all varieties of cowpea and faba bean ranged between 89 – 100 %, and 98 – 100 %, respectively and remained unchanged after one month. Thereafter, there was a decrease in seed viability with time elapsed (Table 4). In cowpea varieties, seed viability of the local variety was consistently higher (p = 0.05) than most of the test varieties at each period of assessment as well as the overall assessment.

Seed viability of faba bean varieties showed the same trend of cowpea, viability of seeds decreased with length of storage period. The highest seed viability was recorded in Giza 843 followed by Giza 674 whilst the lowest seed germination percentage was in Giza 429.

Table 2. Mean percent loss in weight of cowpea and faba bean varieties infested with C. maculatus (F.).

Crop	Varieties	Dry weight of seed loss (gm.)							% Loss						
		Months after storage							Months after storage						
		1	2	3	4	5	6	Mean ± SX`	1	2	3	4	5	6	Mean ± SX`
Cowpea	Karim 7	69	6	30	39	114	119	62.8 ± 19.3 a	28	2	12	16	46	48	25.3 ± 7.8 a
	Dokki 331	10	14	14	28	67	52	30.8 ± 9.8 ab	4	6	6	11	27	21	12.5 ± 3.9 a
	Local	5	9	12	19	26	13	14.0 ± 3.1 b	2	4	5	8	15	15	8.2 ± 2.3 a
	Kafr El-Sheikh 1	45	12	16	27	45	51	32.7 ± 6.9 ab	18	15	16	11	18	40	19.7 ± 4.3 a
Faba bean	Giza 429	10	86	13	16	18	20	27.2 ± 12.1 a	4	34	5	6	7	8	10.7 ± 4.8 a
	Giza 674	5	17	5	8	14	13	10.3 ± 2.1 a	2	7	2	3	6	5	4.2 ± 0.9 a
	Giza 843	4	7	8	8	9	9	7.5 ± 0.8 a	2	3	3	3	4	4	3.2 ± 0.3 a
	Sakha 1	7	13	16	15	12	22	14.2 ± 2.1 a	3	5	6	6	5	9	5.7 ± 0.8 a

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

The seed viability of the various varieties of cowpea and faba bean was therefore a reflection of the extent of damage caused to the seeds.

3. Adult emergence table 3 shows the number of adult progeny that emerged from the various cowpea and faba bean varieties as a result of previous infestation with *C. maculatus* (F.).

Throughout the period of storing infested cowpeas, the mean number of adults that emerged was significantly low (p = 0.05) in local and Kafr El-Sheikh-1, which indicates the low susceptibility of these varieties to post-harvest infestation by *C. maculatus* (F.). In contrast, Dokki 331 and Karim 7 were very vulnerable to *C. maculatus* (F.) infestation during storage.

Similar results were achieved with faba bean varieties. The number of emerged adults 6 months after storage did not exceed 2 – 3 beetles in Giza 843 and 7 – 12 beetles in Giza 674. On the other hand, the number of emerged adults from Giza 429 averaged 32 adults at the end of storing time which indicates the high vulnerability of this variety to *C. maculatus* (F.) infestation.

The present results has clearly show that cowpea local variety and faba bean Giza 843 are less susceptible to post-harvest infestation by *C. maculatus* (F.) and can therefore be safely stored for a relatively long period with less loss in seed quality and generation of low infestation pressure. These varieties are therefore could be good sources of cowpea and faba bean resistance to *C. maculatus* (F.). The results of this investigation has also demonstrated that crop resistance can be a profitable insect control measure during crop storage.

Table 3. Mean number of adult *C. maculatus* (F.) that emerged from infested cowpea and faba bean varieties after 6 months of storage.

Crop	Varieties	Mean number of emerged beetles						
		Months after storage						
		1	2	3	4	5	6	Mean ± SX`
Cowpea	Karim 7	0	491	788	740	2131	1548	949.7 ± 319.3 [a]
	Dokki 331	0	0	0	192	2024	3720	989.3 ± 648.2 [a]
	Local	0	387	546	737	763	845	546.3 ± 131.3 [a]
	Kafr El-Sheikh 1	0	0	0	442	1573	1353	561.3 ± 301 [a]
Faba bean	Giza 429	0	8	17	24	43	99	31.8 ± 15 [a]
	Giza 674	0	0	0	0	7	12	3.2 ± 2.1 [b]
	Giza 843	0	0	0	0	2	3	0.8 ± 0.6 [b]
	Sakha 1	0	1	7	13	17	27	10.8 ± 4.3 [ab]

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

Table 4. Mean percent seed viability of cowpea and faba bean varieties after being infested with *C. maculatus* (F.).

Crop	Varieties	% Seed viability						
		Months after storage						
		1	2	3	4	5	6	Mean ± SX`
Cowpea	Karim 7	100	98	90	88	84	76	89.3 ± 3.7 [a]
	Dokki 331	94	74	74	88	72	64	77.7 ± 4.6 [a]
	Local	100	100	94	92	84	72	90.3 ± 4.5 [a]
	Kafr El-Sheikh 1	89	86	80	74	72	70	78.5 ± 3.2 [a]
Faba bean	Giza 429	98	94	84	80	80	72	84.7 ± 4.0 [b]
	Giza 674	100	100	100	96	92	92	96.7 ± 1.6 [a]
	Giza 843	100	100	100	98	90	90	96.3 ± 2.1 [a]
	Sakha 1	98	96	92	82	80	70	86.3 ± 4.5 [b]

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

II- EFFECT OF CONTROLLED TEMPERATURES The effects of controlled temperatures 25, 30 and 35 °C on the amounts of seed consumed, percent of damaged seeds and seed loss of cowpeas and faba bean varieties infested with *C. maculatus* (F.) were estimated after the development of one generation under these conditions.

1. Effects on seed consumption Data presented in Table 5 demonstrate that the average amount of cowpeas seed consumed obviously increased with the increase of storage temperature, but this relationship seems to be not linear. Beetles consumed 87 mg. at 25 °C, this rate slightly increased to 97.4 mg. at 30 °C. Increasing of temperature above 30 °C did not significantly alter the amount of food consumed and it remained nearly constant. The same relationship between storage temperatures and percent of seed consumption was similar for all tested varieties.

The effect of storage controlled temperatures on the amounts of food consumed from faba bean seeds was quite different. As shown in Table 6, the amounts of seed consumed significantly (p=0.01) decreased with the increase of storage temperatures. Beetles consumed 62.4 mg. of faba bean seeds stored at 25 °C and this value dropped to 41.4 mg. with raising storage temperature to 30 °C and drastically lowered to 19.6 mg at 35 °C. These results reveal negative relationship between food consumption and storage temperature. The same results were achieved concerning the tested faba bean varieties, however Sakha-1 exhibited the lowest rate of food consumption at 30 °C and 35 °C while at 25 °C Giza 843 was the least consumed variety. On the other hand, at 25 °C and 30 °C, Giza 429 was the most consumed, while at 35 °C Giza 674 was the greatest consumed variety .

Table 5. Mean percentages of seed cosumption, damage and seed loss of cowpea varieties infested with *C. maculatus* (F.) and stored at different controled temperature.

Store temp.	Cowpea Varieties*	Dry weight consumed (mg.)	% seed consumption	Weight of damaged seeds (mg.)	% Damaged	Weight loss (mg.)	% Loss
25 °C	Karim 7	94.4 ± 0.5 ^{b}	50.8 ± 0.5 ^{a}	199 ± 0.7 ^{a}	99.8 ± 0.3 ^{a}	5.1 ± 0.1 ^{b}	50.5 ± 0.5 ^{b}
	Dokki 331	51.8 ± 3.3 ^{c}	28 ± 1.7 ^{b}	200 ± 0 ^{a}	100 ± 0 ^{a}	2.8 ± 0.2 ^{b}	28 ± 1.7 ^{b}
	local	94.6 ± 3.2 ^{a}	50 ± 1.8 ^{a}	199.5 ± 0.3 ^{a}	100 ± 0 ^{a}	5 ± 0.2 ^{a}	50.3 ± 1.8 ^{a}
	Kafr El-Sheikh 1	107.2 ± 0.5 ^{a}	56.5 ± 0.3 ^{a}	199.9 ± 0.2 ^{a}	100 ± 0 ^{a}	5.7 ± 0.03 ^{a}	56.8±0.3 ^{a}
	Average	87 ± 1.9 ^{a}	46.3 ± 1.1^{a}	199.6 ± 0.3 ^{a}	100 ± 0.1 ^{a}	4.7 ± 0.1 ^{a}	46.4±1.1 ^{a}
30 °C	Karim 7	117.2 ± 0.6 ^{a}	62.5 ± 0.3 ^{a}	199.8 ± 0.3 ^{a}	100 ± 0 ^{a}	6.3 ± 0.03^{a}	62.5 ± 0.3 ^{a}
	Dokki 331	79.4 ± 8.6 ^{a}	42.8 ± 4.8 ^{a}	199 ± 1 ^{a}	99.5 ± 0.5 ^{a}	4.4 ± 0.5 ^{a}	43.5 ± 4.6 ^{a}
	local	94.5 ± 2.7 ^{a}	50.8±1.6 ^{a}	197.3 ± 0.9 ^{ab}	98.8 ± 0.5 ^{a}	5.1 ± 0.2 ^{a}	50.8 ± 1.6 ^{a}
	Kafr El-Sheikh 1	98.3 ± 2.4 ^{b}	52.8 ± 1.3 ^{b}	199.3 ± 0.8 ^{a}	100 ± 0.3 ^{a}	5.2 ± 0.1^{b}	52 ± 1.1 ^{b}
	Average	97.4 ± 3.6 ^{a}	52.2 ± 2 ^{a}	198.9 ± 0.8 ^{a}	99.6 ± 0.3 ^{a}	5.3 ± 0.2 ^{a}	52.2 ± 1.9 ^{a}
35 °C	Karim 7	93.4 ± 2.9 ^{b}	49.8 ± 1.4^{b}	199.3 ± 0.8 ^{a}	99.8 ± 0.3 ^{a}	5 ± 0.1 ^{b}	49.8 ± 1.4 ^{b}
	Dokki 331	97.1 ± 2.5 ^{a}	51.3 ± 1.5 ^{a}	199.5 ± 0.5 ^{a}	100 ± 0.3 ^{a}	5.1 ± 0.1 ^{a}	51.3 ± 1.5 ^{a}
	local	89.9 ± 4 ^{a}	48.8 ± 2.3 ^{a}	194 ± 2.3 ^{b}	97.3 ± 1.3 ^{b}	4.9 ± 0.2 ^{a}	48.8 ± 2.3 ^{a}
	Kafr El-Sheikh 1	108.3 ± 1.7 ^{a}	57.3 ± 0.9 ^{a}	200 ± 0 ^{a}	100 ± 0 ^{a}	5.7 ± 0.1 ^{a}	57.3 ± 0.9 ^{a}
	Average	97.2 ± 2.8 ^{a}	51.8 ± 1.5 ^{a}	198.2 ± 0.9 ^{a}	99.3 ± 0.5 ^{a}	5.2 ± 0.1 ^{a}	51.8 ± 1.5 ^{a}

* Weight of seed sample = 20 gm.

Means followed by the same letter in a column and row averages are not significantly different [p=0.05 , Duncan's multiple range test (1955)].

These results may illustrate that seed consumption of stored faba bean could be altered according to storage temperature and faba bean variety. For many phytophagus insects, it was found that foilage consumption increased with the increase of environmental temperature (Ali, 1974).

2. Effect on seed damage For cowpeas, percentages of damaged seeds as a result of attack with *C. maculatus* (F.) did not greatly varied at the different storage controlled temperatures and ranged between 99.3 at 35 °C and 100% at 25 °C. Similar results were achieved concerning cowpea varieties and ranged between 97 % and 100% Table 5.

In the case of faba bean, weight of damaged seeds as well as percent of damage greatly varied with variation of storage temperatures. There was an obvious negative relationship (r = -0.8521). Percent of damaged seeds averaged 94.3 at 25°C and drastically dropped to 45.7 at 35 °C (Table 6). These results are greatly corresponding with rates of food consumption. Similar trend was obtained between different faba bean varieties and storage temperatures. The greatest damaged variety, the lowest storage temperature and the lowest damaged seeds, the highest storage temperature.

3. Effect on seed loss Storage temperature showed slight effects on weight loss and percent seed loss of cowpea. Table 5 shows slight increase in percentage of seed loss at 25 °C and 30 °C. Increase of storage temperature above 30 °C was accompanied with slight decrease in seed loss. Similar results were achieved concerning seed loss of different cowpea varieties being infested with *C. maculatus* (F.) before storing at different constant temperatures.

On the other hand, a negative relation was found between storage temperatures and seed loss of faba bean infested with *C. maculatus* (F.). As shown in Table 6, faba bean seeds lost 32.5 % at 25 °C and this value drastically lowered to 10 % at 35 °C. The same relation was observed between faba bean varieties and storage temperatures. In all cases, faba bean varieties lost the highest rate at 25 °C while these values decreased to the minimum at 35 °C.

Based on the previous achieved results, it could be concluded that storage temperature is an important factor influencing seed damage and seed loss of cowpea and faba bean as a result of insect attack. In the present investigation these parameters were the greatest at 25 °C and the lowest at 35 °C. So storing of faba bean or cowpea at store temperatures above 30°C can reduce seed damage and seed loss and oppose insect development and reproduction.

Table 6. Mean percentages of seed cosumption, damage and seed loss of faba bean varieties infested with *C. maculatus* (F.) and stored at different controled temperature.

Store temp.	Cowpea varieties*	Dry weight consumed (mg.)	% seed consumption	Weight of damaged seeds (mg.)	% Damaged	Weight loss (mg.)	% Loss
25 °C	Giza 429	97.2 ± 2.4 [a]	49.5 ± 1 [a]	193.3 ± 0.3 [a]	100 ± 0 [a]	5 ± 0.1 [a]	49.5 ± 1 [a]
	Giza 674	67.4 ± 2.6 [a]	35.5 ± 1.2 [a]	188.3 ± 2.3 [a]	94.5 ± 1 [a]	3.5 ± 0.1 [a]	35 ± 1.2 [a]
	Giza 843	33.5 ± 1.9 [a]	17.3 ± 0.9 [a]	177.3 ± 7.6 [a]	88.5 ± 3.8 [a]	1.8 ± 0.1 [a]	18.3 ±0.9 [a]
	Sakha 1	51.6 ± 0.8 [a]	27 ± 0.4 [a]	185 ± 10.5 [a]	92.8 ± 5.3 [a]	2.7 ± 0.04 [a]	27 ± 0.4 [a]
	Average	62.4 ± 1.9 [a]	32.3 ± 0.9 [a]	186 ± 5.2 [a]	94 ± 2.5 [a]	3.3 ± 0.1 [a]	32.5 ± 0.9 [a]
30 °C	Giza 429	81.5 ± 1.7 [b]	41.8 ± 0.9 [b]	176.3 ± 17.4 [a]	90.5 ± 9.5 [a]	4.2 ± 0.1 [b]	41.8 ± 0.9 [b]
	Giza 674	30 ± 0.7 [b]	15.5 ± 0.3 [b]	177 ± 6.2 [a]	88.8 ± 3.2 [a]	1.6 ± 0.03 [b]	15.5 ± 0.3 [b]
	Giza 843	29.6 ± 0.8 [b]	15.5 ± 0.5 [a]	181.8 ± 4.9 [a]	91 ± 2.5 [a]	1.6 ± 0.1 [a]	15.5 ± 0.5 [a]
	Sakha 1	24.6 ± 0.2 [b]	13 ± 0 [b]	127.8 ± 9.9 [b]	64 ± 4.9 [b]	1.3 ± 0 [b]	13 ± 0 [b]
	Average	41.4 ± 0.9 [b]	21.5 ± 0.4 [b]	165.7 ± 9.6 [b]	83.6 ± 5 [b]	2.2 ± 0.1 [b]	21.5 ± 0.4 [b]
35 °C	Giza 429	18.3 ± 3.9 [c]	9.5 ± 2.2 [c]	103.5 ± 11.6 [b]	52 ± 5.8 [b]	1 ± 0.2 [c]	9.5 ± 2.2 [c]
	Giza 674	29 ± 0.5 [b]	14.5 ± 0.3 [b]	107.3 ± 11.7 [b]	54 ± 5.9 [b]	1.5 ± 0.03 [b]	14.5 ± 0.3 [b]
	Giza 843	24.5 ± 2.2 [b]	12.5 ± 1.2 [b]	90.5 ± 10.2 [b]	45.3 ± 5.1 [b]	1.1 ± 0.2 [b]	10.5 ± 1.7 [b]
	Sakha 1	6.7 ± 0.2 [c]	3.5 ± 0.3 [c]	62.8 ± 4.7 [c]	31.5 ± 2.4 [c]	0.4 ± 0.03 [c]	3.5 ± 0.3 [c]
	Average	19.6 ± 1.7 [c]	10 ± 1 [c]	91 ± 9.6 [c]	45.7 ± 4.8 [c]	1 ± 0.1 [c]	9.5 ± 1.1 [c]

* Weight of seed sample = 20 gm.

Means followed by the same letter in a column and row averages are not significantly different [p=0.05 , Duncan's multiple range test (1955)].

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تأثير فترة التخزين ودرجات الحرارة الثابتة على معدلات الاصابة ، الاستهلاك الغذائى ، والفقد فى بذور اللوبيا والفول البلدى المصابة بخنفساء اللوبيا (F.) ***Callosobruchus maculatus*** .

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أجريت هذه الدراسة المعملية بهدف معرفة ودراسة تأثير فترات التخزين (١، ٢، ٣، ٤، ٥ ، ٦ اشهر) على معدل الإصابة والفاقد فى أوزان بذور أربعة أصناف من اللوبيا (كريم ٧، دقى ٣٣١، محلى، كفر الشيخ-١) وأربعة أصناف أخرى من الفول البلدى (جيزة ٤٢٩، جيزة ٦٧٤، جيزة ٨٤٣، سخا-١)، تم قياس معدل الإصابة، الفاقد فى الوزن، الفاقد فى حيوية البذور، العدد الكلى للخنافس الناتجة خلال فترة التخزين كمعيار لهذا التقييم، أوضحت نتائج هذه الدراسة زيادة هذه المعايير بزيادة فترة التخزين وأن صنف اللوبيا المحلى وصنف الفول جيزة ٨٤٣ أظهرا درجة من المقاومة ضد الإصابة بخنفساء اللوبيا أثناء التخزين ولذلك يمكن تخزينهما لفترة طويلة مع أقل نسبة من الإصابة والفاقد فى وزن البذور وحيويتها.

وبالنسبة لتأثير درجات الحرارة الثابتة فلقد أوضحت نتائج ودراسة تأثير درجات الحرارة الثابتة (٢٥، ٣٠، ٣٥ درجة مئوية ± ٢ درجة مئوية) على معدل الإستهلاك الغذائى، معدل التالف فى البذور، والنسبة المئوية للفقد فى وزن البذور المصابة من اللوبيا أو الفول البلدى أن هذه المعايير تزداد بزيادة درجة الحرارة من ٢٥ الى ٣٠°م ولكنها تنخفض إنخفاضا ملحوظا عند درجة حرارة ٣٥°م وعليه فإنه يمكن القول بأن تخزين بذور اللوبيا والفول البلدى عند درجات حرارة أعلى من ٣٥°م يمكن من حمايتها من الإصابة بخنفساء اللوبيا ويقلل من معدل البذور التالفة والإنخفاض فى وزن البذور.