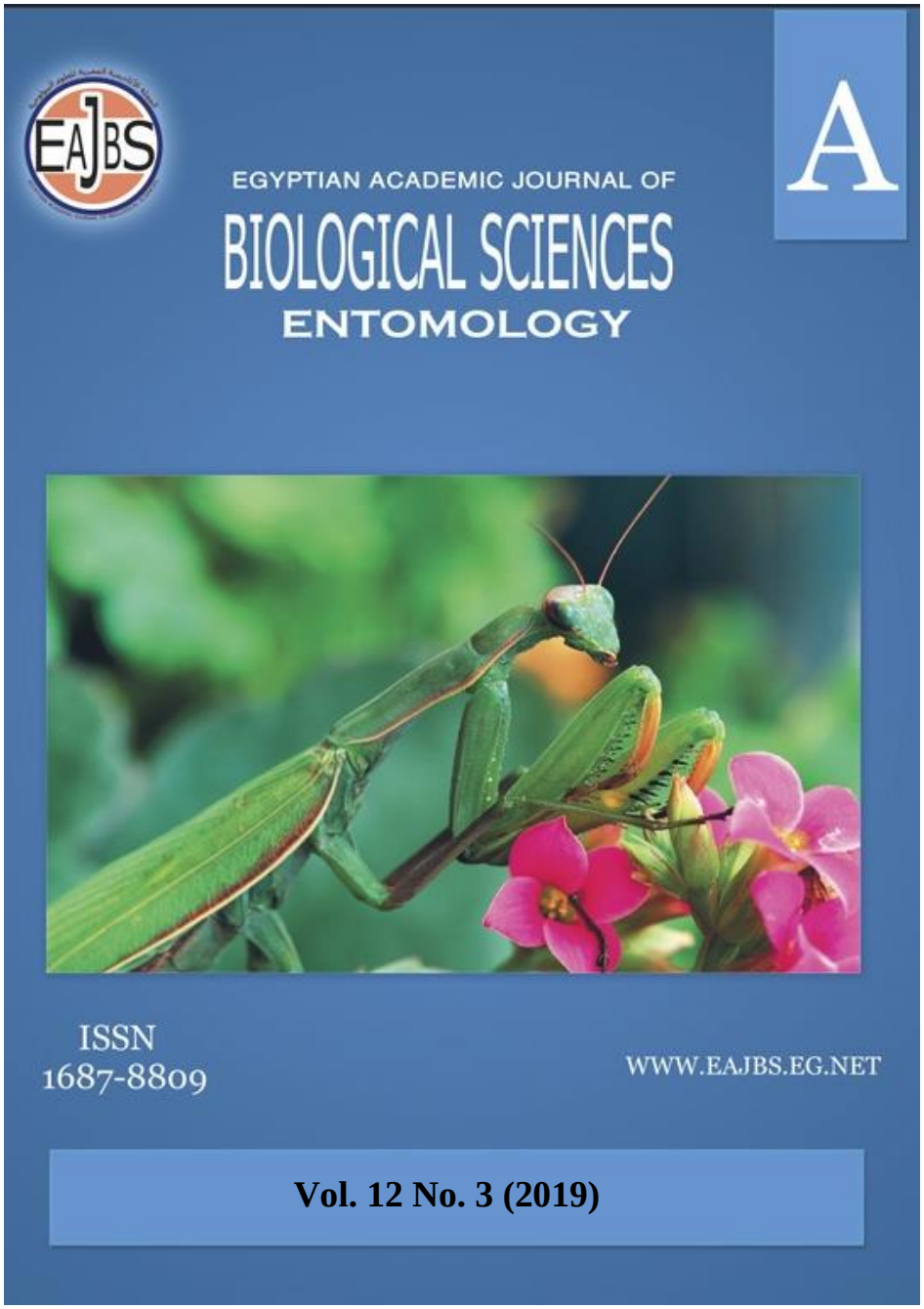

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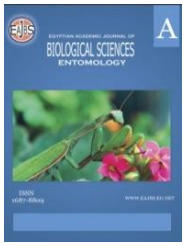

Effect of Some Legumes on the Biological Parameters of the *Acanthoscelides obtectus* Say

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ABSTRACT

Acanthoscelides Schilsky is the large genus of Neotropical bruchid beetles, in which most species show host plant specialization. The species of *A. obtectus* Say specialized on *Phaseolus* beans and therefore considered pests. Six legume grain species (Dried common bean, green common bean, lentil, cowpea, broad bean, and soybean) were selected to study the biology of this insect pest on these different legumes under the prevailing environmental conditions of 25 ± 2°C and 60 ± 10% RH. The results showed that an average number of eggs per mated female (fecundity) was recorded in common bean dried and green (26.33 and 22.66 eggs). While the fecundity decreased significantly to 10.00, 9.66 and 4.00 eggs/ female at Soybean, Broad bean and Lentil, respectively. The results also showed that there was a significant difference ($p<0.05$) in the percentage of emerged adults among the different legume hosts, namely dried common bean and Cowpea the highest value (88.00 and 76.65%) and lowest percentage (17.97%) of emerged adults in green common bean respectively, while no adults emerged in Soybean, Broad bean and Lentil hosts and the developmental periods of *A. obtectus* on different legume hosts and mean periods varies depending upon the different hosts.

INTRODUCTION

Beetles belonging to the family Bruchidae are the most important insect pests of stored legumes. Infestation by bruchids causes losses of weight, nutritional value and germination potential, and therefore the commercial value of the commodity may be reduced (Southgate 1979; Dick and Credland 1986). The neotropical genus of *Acanthoscelides* Schilsky (Coleoptera: Bruchidae), comprises almost 300 species of grain-eating beetles (Jhonson, 1990). It is one of the most diverse bruchid genera specialized in species and varieties of the fabaceous genus *Phaseolus* (common beans, lima beans, etc.), but grains of other fabaceous genera are attacked. The species of *A. obtectus* Say, multivoltine and can reproduce as long as resources are available. This species has a dimorphism, and appeared a great diversification between their individuals, such as colour variations in the antennae of male and female, and size between sexes, and also distributed worldwide. The aims of this work are; study of the biology of this species on different legume grains, within the environmental conditions of Egypt. Clarify and determined good taxonomic characters to distinguish the individuals of this species, and footing for fundamental and applied research of these bean bruchid.

MATERIALS AND METHODS

All experiments were conducted in the laboratory of the Plant Protection Department, Faculty of Agriculture, Alazhar University, Cairo, Egypt.

Insect Population and Rearing Technique:

The initial population of ***Acanthoscelides obtectus*** was taken from a laboratory culture maintained for several generations on dry grains of common bean in glass jars (1L.).

Morphological Study:

The present paper based on fresh specimens are collected from common bean *Phasoelus* varieties transferred into the lab and examined depends on morphological traits of the adult stage, genital characters male and female. For the study of genitalia, the whole beetles are immersed in potassium hydroxide solution for 24 hours, then rinsed by distilled water and transferred immediately to ethanol. Beetles are dissected by fine needles and the genitalia are examined, mounted on slide glasses in a drop of glycerol. All drawing is accomplished by camera lucida attached by stereomicroscope SZ61.

Biology of *Acanthoscelides obtectus* Say in Different Legume Grains:

Six-legume grain species (Dried common bean, green common bean, lentil, cowpea, broad bean, and soybean) were selected to comparative biology of this insect pest on these different legumes under the prevailing environmental conditions of 25 ± 2°C and 60 ± 10% RH. One kilogram of grains of each species was purchased from a reliable source. Grains were first oven-dried at 60ºC for 72 hours to kill all immatures of bruchids and also to keep the moisture at the same level.

To study the effect of six legume species on the reproductive biology and longevity of ***A. obtectus*** adults, ten pairs of newly emerged adults (24 h old) were collected separately from culture reared on common bean grains. Each couple was separately placed in a glass tube (3×10cm) and closed with a piece of cotton. 5 g of six-legume species grain were provided for each couple. The tested legume grains were daily examined to count the number of deposited eggs, egg hatchability percentage, adult emergence, and developmental periods. Ten replicates for each tested grain species were performed.

Weight Loss and Infestation Percentage Assessment of Different Legume Grains:

The infestation percentage and weight loss of the six legume grains were assessed using an artificial technique under laboratory conditions. In this test, five 24-h-old, randomly-collected *A. obtectus* pairs were placed in glass jars containing 50 g grains of each legume with three replicates (separately). The jars were then covered with muslin secured with rubber bands and kept in an incubator. The insects were removed after a 12-day infestation period, and the infested beans retained until the new adults started to emerge. The percentage of infested grains and the weight loss of grains from each legume were recorded after 50 days of infestation in accordance with Sibakwe and Donga (2015).

Statistical Analysis:

Data were subjected to analysis of variance (ANOVA) using "Costat" computer statistical program. Mean values were compared using Duncan's multiple range test (Duncan, 1955)

RESULTS AND DISCUSSION

Genus *Acanthoscelides* Schilsky:

Diagnosis: Small to large bruchids (1.1–3.5 mm), in the tribe Acanthoscelidini. Vertex and frons usually punctate, interspaces impunctate, punctate, or granulose; eyes protruding from lateral margins of the head, often sexually dimorphic with eyes larger in male than in female; antenna subserrate from 4th or 5th segment except for 11th segment elliptical, often sexually dimorphic with a male antenna longer or broader.

Pronotum: bell-shaped or subconical, disk convex without elevations, usually with slight depressions either side of the basal lobe and near posterior corners, basal lobe usually with brief sulcus; lateral carina absent or represented by a blunt ridge. **Scutellum** quadrate or slightly elongated, apical margin bidentate with angulate emargination between points. **Elytra** together as long as or longer than broad, striae varying in width and depth, often with basal or subbasal denticles; interstices usually flat, sometimes alternately variable in width, the surface usually minutely imbricate. **Metafemur** armed with large subapical acuminate spine followed by 0 to smaller spines, mucro 0.05- 1.0 times as long as tarsomere 1; **metatibia** straight to moderately arcuate, dilated toward apex, ventral and dorsomedial carinae always present, lateral and ventrolateral carinae varying in extent; apex with acute spine (mucro) on ventral margin extending one-tenth to nearly same length of basitarsus. First abdominal sternum often modified in male with median setose pit, sometimes flattened or concave, or with posterior margin lobed and fringed with long setae, 5th sternum moderately to deeply emarginated in male for reception of pygidial apex; 1st sternum of female not modified, 5th usually slightly emarginated; pygidium broadly ovate, arcuate in lateral aspect, male pygidium usually strongly inflexed at apex, female pygidium usually vertical at apex; disk micro foveolate or punctuate.
Male genitalia: usually elongate, median lobe lacking distinct dorsal valve, ventral
valve with base usually broad, the apex of various shapes, usually diagnostic; base of median lobe spoon-shaped; internal eversible sac armed with variously shaped spines, spicules, and denticles whose arrangement is usually species-specific; lateral lobes variously shaped, separated by the cleft of various lengths, apices with sensory setae.

***Acanthoscelides obtectus* (Say):**

Bruchus obtectus Say 1831:1

Description: (Fig. 1)

Length (pronotum and elytra) 2- 3.7 mm. width 1.3- 2.2mm.

Integument color: head black, usually with red-orange postocular spot, labrum and mouthparts usually red-orange; abdomen variably red, pygidium red; antenna with basal four and terminal segments red; pronotum black, coxa and remainder of leg red-orange ; elytron black with apical red-orange fringe; meso and metathorax black; legs red-orange except for venter of hind femur black, sometimes base of hind femur black, and also venter of meso femur black; abdomen red-orange with base of sternum 1 black, base of remaining sterna sometimes black; pygidium red-orange.

Vestiture: with recumbent white, golden yellow, and light brown pubescence as follows: Eyes with medial fringe of golden yellow hairs, postocular lobe with short golden yellow setae, postocular patch of dense golden yellow hairs; remainder of head with dense golden yellow hairs: pronotum with dense golden yellow hairs, underside with dense white hairs; elytron with dense golden yellow hairs and feebly contrasting subbasal, median, and apical brown patches; undersurfaces with dense white or intermixed white and golden yellow hairs; legs with moderately dense white or intermixed white and golden hairs; pygidium with moderately 2-dense to white or golden yellow hairs.

Structure: Head elongate, broad, densely punctulate; frons with median glabrous, impunctate, sometimes elevated line extending from front oclypeal suture to vertex; vague sometimes glabrous, transverse sulcus between upper limits of eyes; frons width slightly less than eye width; eye cleft from 0.5- 0.66 its length of ocular sinus; posterior margin of eye protruding from adjacent surfaces; postocular lobe rounded; distance from the antennae to apex of labrum about half as long as distance from upper limits of eyes to apex of labrum; antennal segments 1-4 filiform, 5- 10 eccentric, 11 acute apically; antenna extending to humerus or slightly beyond.

Prothorax: Disk campanulate; punctate, with punctulate fringe at apex; cervical sulcus shallow, extending from near coxal cavity to about 0.4 distance to pronotal midline; lateral n

prothoracic carina vague, extending from base to 0.2 distance to coxal cavity; short median impressed line on median basal lobe; prosternum separating procoxae for about 0.7 their length.

Meso thorax and meta thorax: Scutellum black, quadrate, densely setose, apex deeply emarginated and bidentate, clothed with dense golden yellow recumbent hairs; elytra slightly longer than wide, laterally convex but medially depressed, striae mostly parallel, occasionally slightly sinuate, shallow, with elongated punctures, 3rd and 4th striae with minute basal denticles; interstices flat, shallowly imbricate, 3rd, 5th, 7th and 9th interstices wider than alternates; humerus punctulate, sparsely pubescence, shiny; under surfaces and all of the hind coxa punctulate; metepisternum punctuate; hind-femur constricted apically and basally, expanded medially to about width of coxa; ventral surface without carina, femur armed with subapical acuminate spines about 1.2 times longer than width of tibial base and usually 2 acuminate spines about 0.5 as long as spine 1; tibia with ventral, later oventral carina obsolete; shallow sulcus between ventral and later oventral carinae; dorsal surface of tibia without fossa; tibial corona with about 4 spinules, mucro about 1/6 or less length of tarsomere 1; without sinus at base of mucro; tarsomere 1 with ventral and lateral glabrous longitudinal carinae, mesal carina obsolete.(Fig. 1).

Abdomen: Sternum 1 usually rounded, sometimes flattened medially, posterior margin straight, slightly longer than remaining sterna; sterna 2-4 unmodified, sternum 5 emarginated at apex; pygidium punctate, convex in lateral view.

Genitalia: median lobe elongate; in ventral, ventral valve acute apically, lateral margins slightly concave; armature of internal sac consisting of fine spicules basally, many spines and a paired spinescent structure medially or apically. Lateral lobes expanded apically, cleft to about 0.8 their length.

Dimorphism: (Fig. 2)

Male: shorter than female; antennomeres from 1st to 4th and 11th red-orange, the rest segments are dark brown; **abdominal** sternum 5 submarginate at the apex.

Female: larger than male; antennomeres from 1st to 4th and 11th red-orange, the rest segments are black; abdominal sternum 5 slightly convex forming a distinct ovipositor.

Biology of *Acanthoscelides obtectus* Say in Different Legume Grains:

Among the six host grains used in the experiment, the results in Table 1 show that an average number of eggs per mated female (fecundity) was recorded in common bean dried and green (26.33 and 22.66 eggs). While the fecundity decreased significantly to 10.00, 9.66 and 4.00 eggs/ female at Soybean, Broad bean and Lentil, respectively. The egg hatching percentage of ***A. obtectus*** was differed and decreased significantly slightly on different legume hosts, where the highest egg hatching was observed in dried common bean (89.81%) and lowest was recorded in Cowpea (75.62%). The results also showed that there was a significant difference ($p<0.05$) in the percentage of emerged adults among the different legume hosts, namely dried common bean and Cowpea the highest value (88.00 and 76.65%) and lowest percentage (17.97%) of emerged adults in green common bean respectively, while no adults emerged in Soybean, Broad bean and Lentil hosts (Table 1). Similar results were obtained by Shade and Pratt (1986) who studied the biology of *A. obtectus* feeding on the mature grain of tepary bean and common bean and found that the adult emergence rate from common bean grain was generally faster than from tepary bean grain. The slowest emergence rates from tepary accessions were significantly different from the fastest rates recorded from the common bean accessions and the rate of adult emergence between 10 and 90%, Thakur (2010) who showed that freshly emerged adults of ***A. obtectus*** females lay eggs on around the host grains (53.2 eggs per female). Ahmed *et al.* (2019) studied the biology of *A. obtectus* common bean grains and found that females lay eggs (11.90 eggs per female) and egg-hatching percentage was 96%.

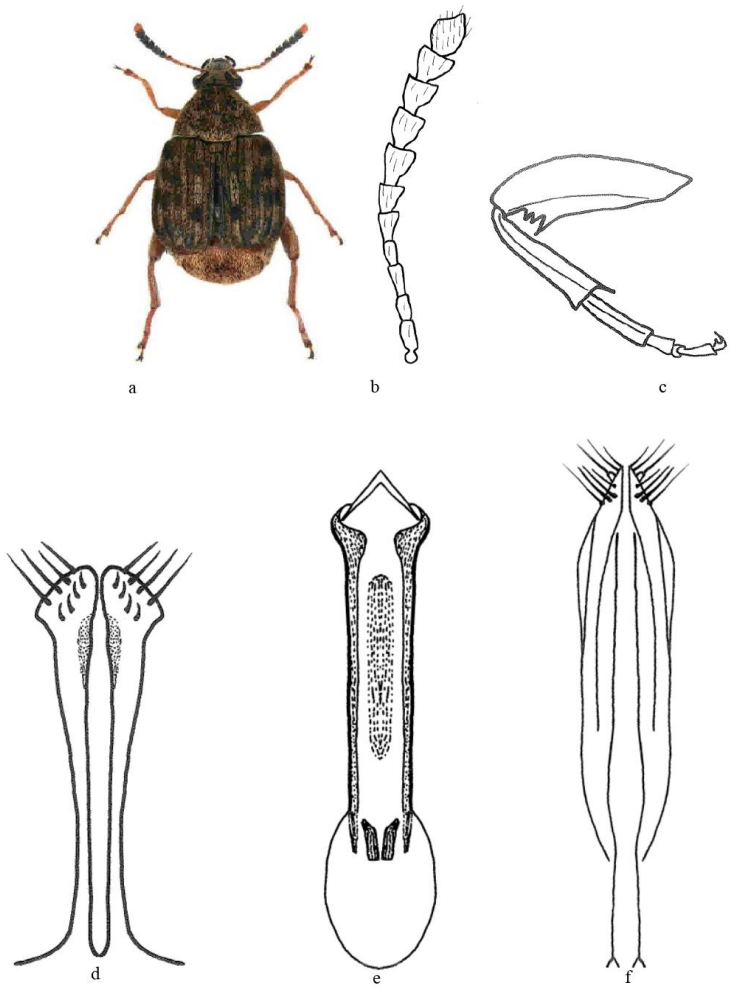

Fig.1; A. *obtectus*, a. adult, b. antenna, c. hind leg, d. lateral lobe or parameres, e. median lobe, f. coxites of female

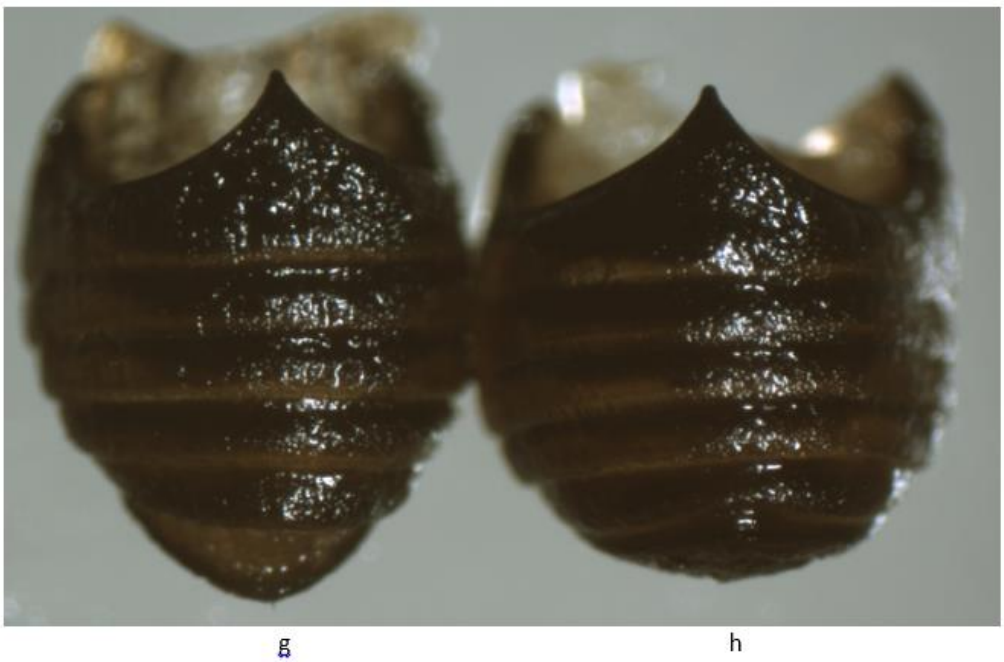

Fig. 2; Dimorphism of *A. obtectus* , g. female, h. male

Table.1 Egg numbers, hatching and Adult emergence percentage of *Acanthoscelides obtectus* Say in Major legumes

Different legume	Fecundity (No. of eggs/ female)	Egg hatch%	Adult emergence %
Dry common bean	26.33 a	89.81 a	88.00 a
Green common bean	22.66 ab	78.96 ab	17.97 c
Cowpea	15.33 bc	75.62 b	76.65 b
Soy bean	10.00 cd	76.28 b	00.00 d
Broad bean	9.66 cd	77.65 ab	00.00 d
Lentil	4.00 d	85.34 ab	00.00 d

Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability

Developmental Periods of *A. obtectus* Say in Different Legume Grains:

The data in table (2) demonstrated there was a significant difference ($p<0.05$) in the developmental periods of *A. obtectus* on different legume hosts and mean periods varies depending upon the different hosts, where the egg incubation period was 5.00 days in dried common bean and reached the highest period in case of Broad bean (5.80 days).

While the larval, pupal and total developmental periods of *A. obtectus* on three legume hosts were shorter in dried common bean and higher in cowpea grains, the larval period was 18.48, 21.56 and 23.00 days, the pupal period was 6.12, 6.24 and 7.04 days and the total developmental period was 30.16, 32.40 and 35.52 days in dried common bean, green common bean and cowpea, respectively. Similar results were obtained by Săpunaru *et al.* (2000) concluded that the duration of ***A. obtectus*** egg in different years was between 8-16 days, the larval duration ranged from 19-23days and the pupal duration from 10-16 days on common bean.

Table.2 Developmental periods of *Acanthoscelides obtectus* Say in different legume grains

Different legume	Egg Period (day)	Larval Period (day)	Pupal Period (day)	Total developmental Period (day)
Dry common bean	5.00 c	18.48 c	6.12 b	30.16 c
Green common bean	5.40 b	21.56 b	6.24 b	32.40 b
Cowpea	5.60 ab	23.00 a	7.04 a	35.52 a
Soy bean	5.44 b	--------	--------	--------
Broad bean	5.80 a	--------	--------	--------
Lentil	5.60 ab	--------	--------	--------

Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability

Thakur and Renuka (2014) mentioned that the incubation period of *A. obtectus's* eggs were 8-10 days on common bean grains**.** Ahmed *et al.* (2019) found that the incubation period of *A. obtectus's* eggs were 6.10 days, the larval duration ranged from 16-32days, the pupal duration 7 days and the total developmental period was 24-59 days on common bean grains.

Weight Loss and Infestation Percentage of Different Legume Grains Infested with *A. obtectus* :

The results are shown in Figure 3 shows the percentage of weight loss of different

legume grains caused by *A. obtectus*. Where the dried common bean was the highest mean weight loss of 5.88%, followed by cowpea (4.66 %) and green common bean (4.00 %), respectively. The same trend was obtained with respect to the percentage of infestation demonstrated in Figure 4. The highest percentage of grain infestation was recorded for dried common bean (21.21%), followed by cowpea (11.37%) and green common bean (2.93%). Similar results were obtained by Sibakwe and Donga (2015) who mentioned that percent weight loss of infested common bean grains by *A. obtectus* ranged from 3 to 29 % and the infestation percentage ranged from 20% in resistant varieties to 88% in highly susceptible varieties.

Allotey *et al.* (2016) found the weight loss caused by *A. obtectus* on common bean grains was 13.7%. Ebinu *et al.* (2016) showed that *A. obtectus* decreased common beans grain weight to 27% and all the common bean varieties evaluated were susceptible or highly susceptible to this insect pest.

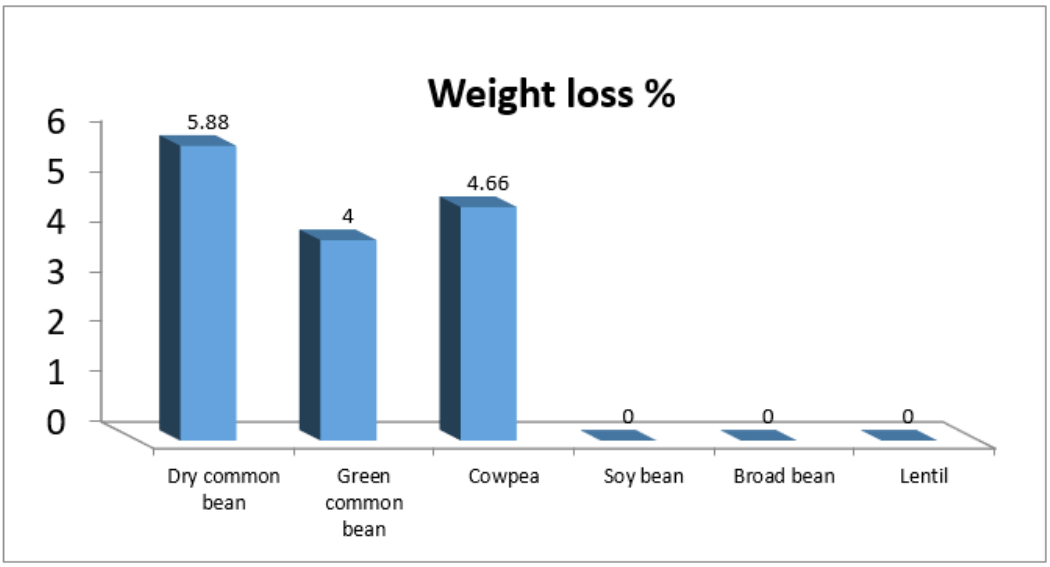

Fig. (3) Weight loss percentage of different legume grains infested with *Acanthoscelides obtectus*

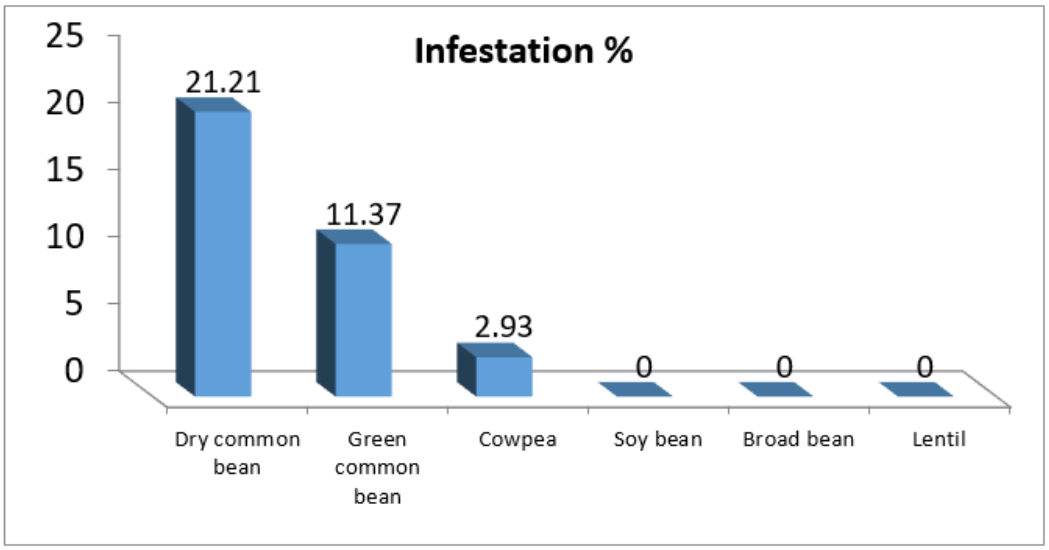

Fig. (4) Infestation percentage of different legume grains caused by *Acanthoscelides obtectus*

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ARABIC SUMMARY

تاثير بعض البقوليات على الصفات الحيوية لحشرة خنفساء البقوليات الجافة

حسن عبد الرحيم جاد و محمد كامل عامر عبيد
قسم وقاية النبات – كلية الزراعة – جامعة الازهر بالقاهرة

يعتبر جنس *Acanthoscelides* من اكثر الاجناس المنتشرة من خنافس البقوليات فى العالم ولها مدى واسع من العوائل النباتية ومن امثلة الافات الحشرية المنتشرة من هذا الجنس هى حشرة خنفساء البقوليات الجافة *Acanthoscelides obtectus* والتى تصيب البقوليات خاصة الفاصوليا الجافة. تم اختبار ستة انواع من حبوب البقوليات وهى الفاصوليا الجافة والخضراء والعدس واللوبيا والفول البلدى والفول الصويا على بيولوجية هذة الحشرة فى المعمل . واوضحت النتائج ان كمية وضع البيض للاناث كانت الاعلى على حبوب نباتى الفاصوليا سواء الجافة او الخضراء بمعدل 26.33 و 22.66 بيضة واقل معدل وضع بيض كانت على الفول الصويا والبلدى والعدس بمعدل 10و 9.66و 4 بيضة على الترتيب . بينما نتائج خروج الحشرات الكاملة من البيض الفاقس اختلفت من الناحية الاخصائية حيث كانت اعلى نسبة خروج على الفاصوليا الجافة واللوبيا بمعدل 88 و 76.65% على الترتيب واقلها كانت على الفاصوليا الخضراء بمعدل 17.97% ولم يلاحظ اى خروج للحشرات الكاملة على نباتات الفول الصويا والبلدى والعدس وكذلك اختلفت مدد التطور للحشرة بختلاف العوائل.