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# Total egg production and duration of development of the *Callosobruchus maculatus* (L.), (Coleoptera: Bruchidae)

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## ABSTRACT

All numbers of eggs produced by individual Yemeni females of *Callosobruchus maculates* (F) on various numbers of cowpeas were calculated. Yemeni females laid around 29, 62 or 29, 66 when supplied with one cowpea, but when provided with more than one and the egg production increased 31,7. Very rare two adults emerged from a single cowpea regardless the number of eggs laid on the cowpea. The daily quantity of eggs produced declined when females provided daily with new cowpeas and removed the old ones, which had access to the females. Developmental durations varied between individuals and the lowest and highest in developmental duration were observed.

## INTRODUCTION

The cowpeas, *Vigna unguiculata* (L.) is an important grain legume, grown as food crop in Yemen and in many tropical and sub-tropical contries. It has highly and heavy yielding value. Since the crop is being consumed by Yemeni people throughout the year. Cowpea is subjected to destructive and severe insect attacks at the field and storage. The most important pets to the stored cowpea seeds being the Bruchid beetle, *Callosobruchus maculatus* (L.), which called in Yemen *Waqzah. Callosobruchus maculatus* occur any time at any place ever the cowpeas stored. It causes an extensive losses to cowpeas through its attacks. The estimation of the seeds content lost during larval development was shown by many authors among them El-Sawaf, 1956; Harris and Lindblad, 1978 and Caswell, 1973. They show that the Bruchids cause appreciable damage and losses to the post-harvest grain every year. Females do lay their eggs on the outer coat of the seed. Eggs are glued on the surface of cowpea coat, on which the embryo development takes place. Then the first instar larva dig deep down through the seed coat into the cowpea contents. The larval and pupal stages take place within the cowpea contents. The adult beetle then pop out through a round exit in the seed coat which was done by Bruchid scratching the underneath seed content. Few minutes after adult emergence copulation is happen and fertiled females start searching for new cowpeas to lay their eggs on them. Longevity of adult stage is about 8-9 days. Period of development depends on factors such as light, humidity and temperature (El-Sawaf, 1956). Different results of the mean of egg laid by cowpea weevil and that may be due to different factors affecting the fecundityof the bruchids**,** *Callosobruchus maculatus*. these results have been obtained by several authors for example Howe and Currie, 1964 foundthe mean of 91, Fujii, 1968 found different means of 81 and 58 of the same species and Giga and Smith, 1983 obtained almost the same values 73 and 72 Dick and Credland 1984 found 40 eggs when bruchids provided 1 cowpea and 75 eggs when bruchids were supplied with 40 cowpeas. This

study will concern on the bionomics in which bruchids breeding and development take place to get the real numbers of egg laying by the Yemeni cowpea weevils.

## MATERIALS AND METHODS

Cowpeas, which used for obtaining *Callosobruchus maculates*, were brought from Dhisufal (a village belong to Ibb province). Cowpeas were then put in glass jars capacity 1.5 litters. Filled up to two third of their size, jars were covered with gauze and firmly tighten with rubber-band so animals want die of lack of oxygen and put in the normal residential room, which represent the normal environment, in which they are subjected to extensive insect attack. A crowd of *Callosobruchus maculates* , males and females, unknown age was put into each jar to allow them laying their eggs on the cowpeas. Small, damaged and attacked cowpeas were discarded, Only good and healthy ones were used for the experiment. After sorting the cowpeas out, they were kept in the deep freezer for 72 hours to ensure that if any stage of developing larvae still alive in any cowpea content then must be killed.

The prepared cowpeas, prior to setting up the experiment, were spread on flat boxes, covered with gauzy cloth and sealed with sealing tape, then left for 12 days in the room to ensure their stability of temperature and humidity. After ward cowpeas were arranged in glass tubes 15cm high and 1.5cm diameter. Then the bruchids were collected from the stock and introduced into the tubes, the tubes were covered with gauzy cloth and binded with rubber-band and kept in the room at 25 degrees C+- 2 dgrees C and 50+-10 r.h.( which was arranged by humidifier and electric fan.

The employed bruchids, *Callosobruchus maculatus* were collected from the prepared culture. The newly emerged beetles were placed, males and females, in container for 6 hours to ensure that the females are meted. Under the above described conditions the adults emergence started about 50 days from the experiment was set-up for egg laying.

**Total egg laid by individual females on different numbers of cowpeas:**

Seventy two tubes of cowpeas, eighteen with each of 3,6,10 or 30 were used for egg laying as previously described. A 6hrs after emerged fertiled females were placed in each tube. All tubes were taken and cowpeas in each were changed for the same number of new cowpeas (bearing no eggs) every 24hrs until the day 8th, which was the time that all females in each tube had stopped to lay eggs. All eggs laid by individual females in each tube were counted every day. Then all tubes were kept in the maintenance room until adults started to emerge. The same method was followed as previously described, but with 1, 3, 6, 10, 20, 30, 40, 50, and 60 cowpeas fig.2

**Development duration and sex ratio:**

Fifty six tubes each contains 6 cowpeas were used for the experiment which was set up under the same condition as previously described. Newly emerged adults, males and females were collected and held in container for 6hrs to ensure that the females are mated.. Then only one female was place in each tube. This method was repeated with three replicates, which were afterward taken and kept in the same room until adult emergence started. All adults were collected and sexed every 48hrs until no one had emerged.

## RESULTS AND DISCUSSION

**Total egg produced by individual females on different numbers of cowpeas:**

Preparation and arrangement of the first experiment with the Yemeni *Callosobruchus maculates*, the number of eggs laid by individual females rose to about twice, when female provided with 30 cowpeas than when given only 3. The number of emerged adults increased from 16.6 to 94.5. Number of adults emerged from one cowpea was known, when they scored and sexed.

Mortality during egg stage and larval development in the cowpea content increased sharply having the same relation to the mean of egg quantity presented on the cowpeas. The number of eggs produced by compared females rises with the number of cowpea seeds given to each female (table no 1.)

Table 1: mean numbers of eggs produced by individual females on different numbers of cowpeas:

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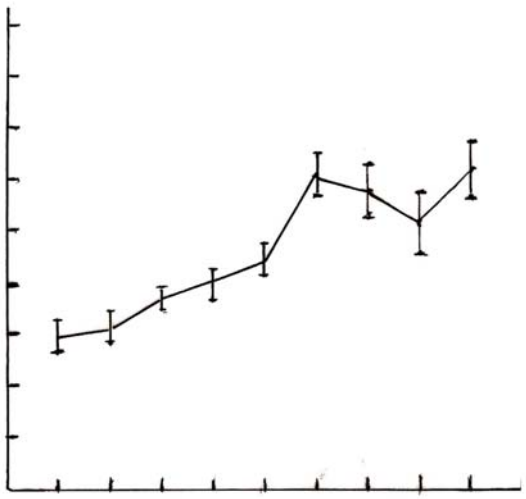
| No. of cowpeas | 3 | 6 | 10 | 30 |
|---|---|---|---|---|
| The mean | 31.7 | 39.7 | 54 | 61.2 |
| SE | 3.0 | 3.0 | 4.0 | 4.0 |

The highest number of eggs laid by C. maculates was 31.7 when provided with 3 cowpeas. There is an agreement between egg produced by individual females and the number of available seeds, up to 30 in the present studies. More than 30 cowpeas analytical calculation shows that there is no significant difference between different numbers of seeds provided and eggs laid on them.

Fig.2



| Number of cowpeas | 1 | 3 | 6 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 29,62 | 29,66 | 37,34 | 37,99 | 44,55 | 58,55 | 58,70 | 62,00 | |
| S.E. | 3,0 | 3,0 | 1,8 | 3,0 | 3,0 | 4,0 | 4,0 | 5,0 | 4,0 |

Relationship between eggs produced during 7 days from emergence by individual females
of Yemeni bruchids C.maculatus and number of cowpeas pro
provided to each female. Cowpeas were changed every 24 hours.

The highest number of eggs laid by *Callosobruchus maculatus* was 31.7 when provided with 3 cowpeas. There is an agreement between egg produced by individual females and the number of available seeds, up to 30 in the present studies. More than 30 cowpeas analytical calculation shows that there is no significant difference between different numbers of seeds provided and eggs laid on them.

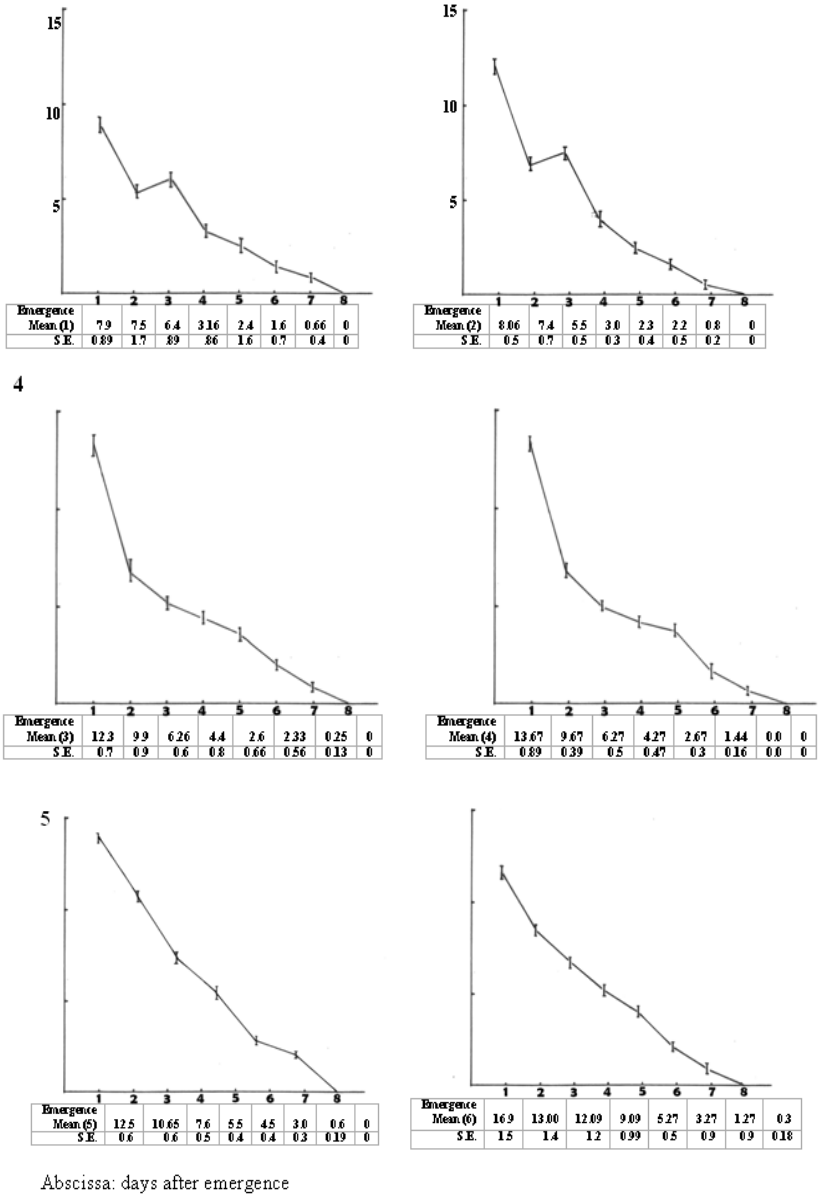
Cowpeas bearing up to 20 eggs on each, nearly above half of hatched larvae could emerged as adults, but cowpeas bearing more eggs, the number of adult acceded 2-6 adults more than the cowpea number (36 adults per 30 cowpeas, but very rare).

In spite of the number of eggs were oviposited by individual females on each cowpea, the mortality in C. maculates is very high if compared with the number of eggs on each cowpea.

The daily egg produced by individual female on new daily changed cowpeas:

The daily type of egg laying on new, daily changed , cowpeas increased as a whole number produced by individal females, but decreased each day until the female stopped laying (on the day eight from its emergence, but the total of eggs laid by each female was affected by the number of cowpeas (Fig.1).

Fig.1




Abscissa: days after emergence

Table 2:

| n | 56 | | 56 | 56 | 56 |
|---|---|---|---|---|---|
| Total adults emerged | Males<br>Females | 62<br>38 | 116<br>71 | 138<br>139 | 311<br>398 |
| Sex ratio % | Males<br>Females | 62<br>38 | 49,81<br>50,18 | 19.55<br>44,19 | 43.86<br>55.29 |
| Ratio of the failure % for both sexes | 11.309 Females<br>18.45 Males | | 42 | 25 | 17 |

Number of adults, males and females, and both sexes emerged from different numbers of cowpeas, had on them known number of eggs, which were laid in 24 hrs duration

Table 3

| No. of scoring | X=mean | M+F | M | F | Sex ratio | Duration |
|---|---|---|---|---|---|---|
| 1st scoring | X | 1.29 | 0.558 | 0.73 | 1:1.3 | 39days |
| | SE | 0.235 | 0.128 | 0.022 | 1.547:1 | 43 days |
| | X | 2.6346 | 1.0 | 1.547 | 1:1 | 61days |
| 2nd scoring | SE | 0.299 | 0.18 | 0.217 | Sex ratio | Duration |
| 3rd scoring | X | 4.692 | 2.39 | 2.30 | 1:1.3 | 39 days |
| | S E | 0.20 | —— | —— | —— | |

52 tubes in each 6 cowpeas, they have been subjected to bruchid attack, left for 13 days, then the total egg produced by.
individual female was counted as follows:
52 x 6 = 312-244 = 68 unhatched beetles
Percentage of the failure bruchids to emerge from cowpeas =
= 68 / 312 x 100 = 21.8

Hatched bruchids = x = means = 244 for all three scorings Emerged bruchids start to emerege in 2/4/--- the first scoring of
emereged bruchid was in 2/4--- Second scoring was in 6/4--- after 43 days, and its third scoring was in 24/4/--- after 61 days
The experiment was set up at 21/2 that means 39 days after oviposition

The number of eggs laid by females of Yemeni cowpea weevils were affected by many factors, however, the bruchids of the experiment still produce a notable amount of eggs dispite the above mentioned factors.

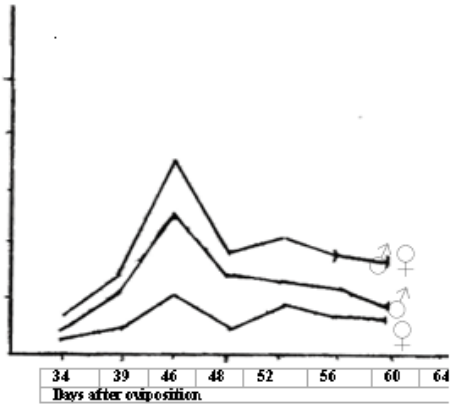
An appreciable increase of egg production was shown when females were provided with large number of cowpeas. Dick and Credland (1984) found that, in the Yemen *Callosobruchus maculatus*, was very obvious, when compared with Brazil and Nigeria cowpea weevils. The decline in egg production was shown when females of Yemen *Callosobruchus maculatus* were supplied with very small number of cowpeas.

This suppression in egg production activity disappeared with the increasing number of cowpeas. Females, which were daily provided with new replacement of the same number of cowpeas laid more eggs than those restricted to a small number of cowpeas (table 1.). Variance of the incupation periods between the first animal did pop out from the cowpea and the latest one may be due to the different factor combinations which affect hatching or due to the endogenous instinct. Dick and Credland, 1984 stated the slightly longer median developmental time and greater interval between first and last emergence of adults from eggs of the Yemeni strain suggest suboptimal conditions. El-Sawaf, 1956 concluded that it could be the optimum temperature for the hatching period was 35° C and gradual decrease below

that temperature resulted in the corresponding in the speed of metabolism in the egg-stage.

The most notable increase in the incupation period, in the present study was with those December and January in which temperature droped below 25° C and was almost 23° C, which affected the inculpation duration to increase up to 61 days, but when temperature started increasing even 2 degrees, the incupation period started decreasing (52 days and below), Fig. (A, B, C and table 3 ).

Fig. (A, B, C)




Total number of adults of each sex and both emerged daily from cowpeas, subjected to bruchids oviposition for 24 hours

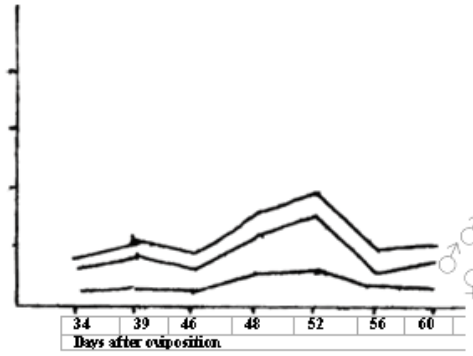
(A)

Average of emerged adults were 1,3 animals per one cowpea.

♂ ..... ..... males.

♀..... ..... females.

♂♀..... ..... both sexes.




(B)

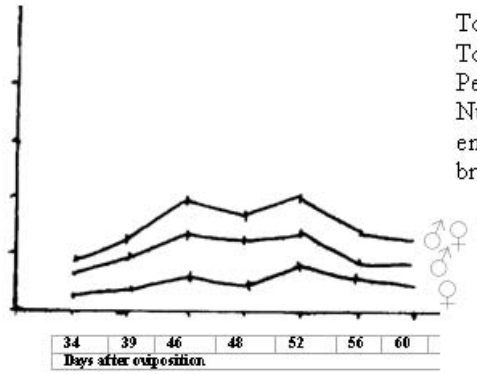
Percentage of the failure animals from cowpeas were 32%.

Average of emerged adults were 0.68 animals per one cowpea.

♂ ..... ..... males.

♀..... females.

♂♀..... ..... both sexes.




(C)

Total emerged animals 1502

Total cowpeas 1656

Percentage of failure 9,24%

Number of adults of each sex and both sexes emerged daily from cowpea, subjected to bruchids oviposition for 24 hours.

♂ ..... ..... males.

♀..... ..... females.

♂♀..... ..... both sexes.

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Table no.1

The experiment was set up at 21/2 after 39 days 52 tubes in each 61 cowpeas, they have been subjected to bruchid attack, Jeff for 13 days, then the total egg produced by individual female was counted. Emerged bruchids start to emerge in 2/4

The first scoring of emerged bruchid was in 2/4 Second scoring was in 6 /4— after 43 days, and its third scoring was in 24/4 after 61 days.

Regression of eggs produced by Individual females on the same numbers of new cowpeas available daily to the C. maculates.

Total eggs produced by individual females of Yemeni Bruchids, Callosobruchus maculatus on different numbers of cowpeas. The cowpeas were changed every 24 hours. Graphs 1_6 indicate 1,3,6,10,20, or 30 cowpeas were respectively provided to each female every 24 hours.

Regression of eggs produced by individual females on the same numbers of new cowpeas available daily to the *Callosobruchus maculatus* So the results gained above were interpreted in figs. A, B and C.

A total of 1656 of cowpeas have been subjected to bruchids oviposition. All of them had anknown number of eggs on them. The cowpeas, then were put in 72 tubes (each contains 23 cowpeas). All tubes left in the experimental room with condition as previous described above.Bruchids started to emerge day 34 from the experiment was set uo.Scoring of the adults emerged was done as follows: 34, 39, 46, 48, 52,56 and 60 days from oviposition

Tubes had number of adult bruchids acceded the number of cowpeas scored separetly as follows:

26 63 151 83 75 67 and 53 = 517 males
16 24 63 26 56 39 and 41 = 265 females
41 87 214 109 131 106 and 94 = 782 M & F

Tubes had less adult emerged bruchids than the number of cowpeas were as follows:

55 74 55 97 124 48 and 67 = 520 males,
15 22 23 35 48 36 and 21 = 200 females
70 96 78 132 172 84 and 88 = 720 M & F

Total emerged
adults: 80 137 206 180 199 115 and 120 = 1037 males
31 46 86 61 104 75 and 62 = 465 females
111 183 292 241 303 190 and 182 = 1502 M & F

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