Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 151-154

Received: 14-05-2020
Accepted: 17-06-2020

Debjyoti chakraborty
Department of Entomology, Agricultural College, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India

T Madhumathi
Department of Entomology, Agricultural College, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India

SVS Gopalaswamy
Post-Harvest Technology Centre, Agricultural College, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India

V Prasanna Kumari
Department of Plant Pathology, Agricultural College, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India

Corresponding Author:
Debjyoti chakraborty
Department of Entomology, Agricultural College, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India

Growth, development and progeny production of Rusty grain beetle, *Cryptolestes ferrugineus* (Stephens) on broken, flour and whole maize

Debjyoti chakraborty, T Madhumathi, SVS Gopalaswamy and V Prasanna Kumari

DOI: https://doi.org/10.22271/j.ento.2020.v8.i4c.7106

Abstract
A laboratory experiment was carried out in the Department of Entomology Agricultural College, Bapatla to determine the influence of physical form of host grain on growth and development of rusty grain beetle, *Cryptolestes ferrugineus*. *C. ferrugineus* was reared on different physical form of maize (whole grain, brokens and flour) using mass rearing techniques. The effect of the different forms and rearing regimes on *C. ferrugineus* growth, development and reproductive capacity was measured. *C. ferrugineus* adults lived longer and produced significantly more progeny on brokens maize (Zea mays L.) rather than on whole grains and flour. Similarly, the higher growth index (0.78) was also found on maize brokens.

Keywords: cryptolestes ferrugineus, growth, progeny and adult emergence

Introduction
Cryptolestes ferrugineus (Stephens) (Cucujidae: Coleoptera), is an important and destructive insect pests of stored cereals, oilseeds, miscellaneous food grains and is cosmopolitan in distribution. It feeds on the germ portion of the grain in preference to endosperm [1]. These insect species have been reported in the Philippines, Japan, Indonesia and Indian subcontinent. Though this pest has been considered as a secondary pest, incidence will be wide in humid areas when temperature and relative humidity are high especially in coastal regions with high population build up. The pest incidence was found to be heavy among the grains infested with major pests, poor storage conditions and also improperly cleaned grains having brokens etc. Although C. *ferrugineus* has long been accepted as a serious maize pest, all of the considerable research on its biology has been done on wheat [2, 3]. There has been an increased recognition that more attention needs to be paid to this C. *ferrugineus.* Hence it is still an area of active research. Recent years have seen a rise in the number of C. *ferrugineus* in storage go-down. C. *ferrugineus* was the universally distributed genus of the stored grain product pests founds on the farms in 95.0 percent of the states of USA and 87.5 percent of the countries sampled. Out of seven species of stored product insects infesting maize in underground pits in Somalia, *C. ferrugineus* was most abundant (32.4%) [4]. To further enlighten the biology of C. *ferrugineus*, selected particle sizes of maize were used to incline their effects on C. *ferrugineus* growth, development, progeny production and adult longevity.

Material and methods
Collection of the test insect
The population of the test insect *C. ferrugineus* is collected from the godowns of Central Warehouse Corporation at Bapatla (Guntur Dist) in Andhra Pradesh. The population collected from Bapatla was used to study the influence of physical forms of maize (whole grain, broken and flour) on growth and development of the test insect.

Rearing of the test insect
The adult beetles of *C. ferrugineus* collected from the godowns of Andhra Pradesh were brought to the laboratory of the Department of Entomology, Agricultural College, Bapatla, Guntur District, and reared separately in wheat flour containing yeast powder in 10:1 ratio. About 200 g of the flour was taken in a plastic jar measuring 45 × 15 cm and about 50 adults were released into it for oviposition.

The pest populations were maintained at an optimum temperature of 32 ± 1 ˚C and 75± 2 percent relative humidity throughout the period of investigation [5]. After seven days, the adults were removed and released into another jar containing the diet, thus a succession of jars were maintained for utilizing the eggs laid staggeredly to ensure a constant supply of test insects of known age. After hatching of eggs, the diet in the jars was changed once in a week by sieving and transferring the pest stages to fresh jars containing diet up to pre-pupal stages. The newly emerged adults were changed into a fresh diet and used for the multiplication of culture and also for bioassay studies.

The population growth of *C. ferrugineus* on maize

Test Insect Population: The adult beetles of *C. ferrugineus* (one day old) obtained from the initial culture were used.

Test Commodities: Whole grains, brokens and flour of maize.

Methodology

Maize is tested in three physical forms *viz.*, whole grains, broken and flour. All these test material was subjected to fumigation with aluminium phosphide @ 3 tablets /ton for seven days. Ten pairs of freshly emerged adult beetles were released into each jar containing whole grains, brokens and flour. The adults were removed from the jars after an ovipositional period of ten days. The eggs were allowed to hatch and they were incubated until adult emergence. The experiment was done with five replications in each treatment. A small subsample of 50 g was taken in glass vials (15×5 cm) from these treatments replication wise for recording per cent adult emergence. In each sub sample desired numbers of neonate larvae were retained on the grains and the remaining larvae were removed. The vials were covered with muslin cloth and tightened with rubber bands and kept at room temperature (32 ± 1 ˚C) and (75 ± 2 %) relative humidity. From this sub sample, the day of first adult emergence, day wise number of adults, total number of adults emerged were recorded to calculate development period, growth index and per cent adult emergence [6]. From the main sample, total number of adults emerged and per cent weight loss were recorded.

Data collection and statistical analysis:

The number of adults of *C. ferrugineus* that emerged from different treatments was counted day wise from first day onwards and was removed from the respective jars. Counting was continued till they cease to emerge. Final data was pooled to get the total number of adults emerged from each treatment.

$$\text{Per cent adult emergence} = \frac{\text{Total number of adult emerged}}{\text{Number of eggs retained in the sample}} \times 100$$

$$\text{Growth Index} = \frac{\text{Percent adult emergence}}{\text{Developmental period}}$$

Mean Development Period (D): The mean development period of the test insect was calculated by using the formula -

$$D = \frac{\Sigma (A \times B)}{C}$$

Where

A = number of adults emerged on n^{th} day

B = 'n' days required for their emergence

C = total number of adults emerged during the experiment period

Weight Loss

The total number of adults were counted at 60 days after first adult emergence in the main sample. The final weight of the treatments was recorded to calculate the weight loss in individual treatments due to the development of *C. ferrugineus* [7]. The per cent weight loss due to the development of *C. ferrugineus* was calculated as mentioned below.

$$\text{Weight loss} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,

W_1 = Initial weight of the grains

W_2 = Final weight of the grains

Percent Moisture

Moisture content of the samples was determined before and after the treatment. The moisture content of each form of host-grain was estimated using electronic moisture balance (M/s Shimadzu Corporation, Analytical and measuring instruments division, Kyoto 604-8511, Japan).

The data on per cent adult emergence and per cent grain damage were subjected to angular transformations, total number of adults emerged were transformed into log values while the data of percent weight loss were subjected to square root transformations. The transformed data were subjected to ANOVA (CRD) [8].

Results and discussion

The population growth of *C. ferrugineus* on different physical form of maize (whole grain, brokens and flour)

The results pertaining to studies on population growth and development of *C. ferrugineus* on different physical forms of host grains *viz.*, whole grain, brokens and flour of maize was presented in Table 1.

Maize

Developmental period: The development period of *C. ferrugineus* was 51.20 days on maize whole grains which was minimum and significantly different from maize flour (56.10 days) and maximum (58.40 days) on brokens and both are on par with each other.

Growth index: The growth index of the host-grain was maximum in maize brokens (0.78) followed by maize whole grains (0.17) and maize flour (0.05) which were significantly different from each other. The least growth index was recorded in maize flour (0.05). The growth index of *C. ferrugineus* also depend significantly on the physical form of host on which it was grown.

Percent weight loss of grains: The percent weight loss of different physical form of hosts, on which *C. ferrugineus* grown, was significantly different from each other. The weight loss was 2.76, 4.76 and 11.58 percent in maize whole grains, flour and brokens respectively.

Percent adult emergence: The adult emergence of *C. ferrugineus* was significantly different on different hosts on which it was grown. The highest percent adult emergence of *C. ferrugineus* was recorded on maize brokens (48.45) which was significantly different from other physical form of host grains. It was 3.05 and 22.25 percent on maize whole grains and maize flour, respectively which are significantly different from each other.

First adult emergence: The results showed that the first adult emergence of *C. ferrugineus* varied significantly on different physical form of the host on which it was grown. The first adult emergence of *C. ferrugineus* was recorded on 27.00th day in maize brokens which was significantly different from other physical form of maize. It was 33.20 and 35.20 days on flour and maize whole grains respectively, which are significantly different from each other.

The total number of *C. ferrugineus* adults emerged from the main sample differed significantly on different forms maize. The highest no. of adults were recorded in maize brokens (306.80) which was significant different from other physical form of maize. The number of adults emerged were 23.60 and 27.00 on maize whole grains and flour, respectively which are significantly different from each other.

Moisture content: The moisture content of maize brokens after the development of *C. ferrugineus* was 12.74 percent on which it was maximum and significantly different from maize grains (10.33) while it was minimum for maize flour (8.97) which are on par with each other.

In the present study the adult emergence of *C. ferrugineus* in whole maize was 3.05 which is also supported by [9]. He stated that progeny production and duration of development of rusty grain beetles were determined on whole corn. Number of progeny produced per female per day of oviposition ranged from 2.2 on whole corn maintained at 75% RH. Progeny production increased and duration of development decreased as particle size of cracked corn increased at 75% RH. Few progeny were produced on whole kernels. The growth index was the higher in maize brokens (0.78) which followed by maize whole grain (0.17) and flour (0.05) and these are significantly different from each other (Table 1).

In the similar lines, [10] reported that the growth index of *C. ferrugineus* was 1.37, 0.85 and 0.66 on maize brokens, sorghum brokens and wheat flour respectively. It was inferred that preferred host produced higher growth index, while less preferred hosts showed lesser growth index. Similarly growth index on wheat ranged from 1.194 to 2.480 in different wheat varieties, being minimum in Kalyansona (1.194) and maximum in K 8121 (2.480) [11]. Significantly more progeny were produced on maize brokens (306.80) than any of the other physical forms combinations (Table 1). The next highest progeny production occurred on maize flour (27.00). Significantly fewer progeny were found on whole grains of maize (23.60) which is supported by [10]. Hence it can be concluded that maize brokens is most preferred host, which can be supported by [10], who also opinioned that *C. pusillus and C. ferrugineus* preferred mainly maize brokens rather than any other physical form of host grain.

Table 1: Population growth of *C. ferrugineus* on different physical forms of maize

S. No.	Physical form of maize	Day of first adult emergence	Development period (Days)	Adult emergence (%)*	Growth index	Weight loss (%)**	Total no. of adult emerged from main sample***	Moisture Content (%)**
1	Whole grains	35.20^{b}	51.20^{a}	3.05 (1.73)^{c}	0.17^{b}	2.76 (1.65)^{c}	23.60 (1.37)^{b}	10.33 (3.21)^{b}
2	Brokens	27.00^{a}	58.40^{b}	48.45 (6.95)^{a}	0.78^{a}	11.58 (3.38)^{a}	306.80 (2.48)^{a}	12.74 (3.56)^{a}
3	Flour	33.20^{b}	56.10^{b}	22.25 (2.10)^{b}	0.05^{c}	4.76 (2.17)^{b}	27.00 (1.43)^{b}	8.97 (2.99)^{b}
	SE m (±)	0.73	1.89	0.10	0.02	0.05	0.22	0.08
	CD (P=0.05)	2.25	5.83	0.018	0.04	0.17	0.70	0.26
	CV %	4.59	6.85	5.62	6.04	4.68	4.98	5.26

*Values in parentheses are angular transformed values
** Values in parentheses are square root transformed values
*** Values in parentheses are logarithmic transformed values

Conclusion

From the present study we have seen that, *C. ferrugineus* (Stephens) is one of the most common insect infesting maize. It is a secondary pest which attacks broken kernels. It has been found that the biology of *C. ferrugineus* (S.) differed significantly in different form of host grain and the developmental period of *C. ferrugineus* (S.) was longer in maize brokens as compared to both maize whole grain and flour. Based on the geographical distribution of *C. ferrugineus* and earlier literature citations, we can concluded that *C. ferrugineus* favors moisture and tropical temperatures. The present work supports these conclusions. Hence this study reveals that temperature can be a major factor in insect growth and development apart from other abiotic factors and can be used as a pest management strategy.

Acknowledgment

The authors are thankful to Acharya N.G. Ranga Agricultural University for providing financial help during the course of study and also extend gratitude to ICAR- New Delhi for giving the opportunity to pursue this MSc Agriculture in such a prestigious University by allotting a seat with fellowship through ICAR JRF examination.

5. References

1. Pingale SV. Insects and mites attacking food grain in storage. Indian Council of Agricultural Research, New Delhi, 1976, 186-188.
2. Davies RG. The biology of *Laemophloeus minutus* Oliv. (Col. Cucujidae). Bulletin of Entomological Research. 1949; 40(1):63-82.
3. Bishop GW. The comparative bionomics of American *Cryptolestes* (Coleoptera-Cucujidae) that infest stored grain. Annals of the Entomological Society of America. 1959; 52(6):657-665.
4. 4. Currie JE. Some effects of temperature and humidity on the rates of development, mortality and oviposition of Crvptolestes pusillus (Schönherr) (Coleoptera, Cucujidae). Journal of Stored Products Research. 1967; 3(2):97-108.
5. Andrewartha, H.G. Introduction to the study of animal populations. Chapman and Hall Ltd. 1961; 21:261-262.

6. Rameshchander and Bhargava MC. Development of lesser grain borer, *Rhyzopertha dominica* (Fab.) on different hosts. Journal of Insect Science. 2006; 19(1):13-15.
7. Agarwal RK, Shiv Shanker, Srivastava JL and Varma BK. Driage losses in rice, paddy and wheat. Bulletin of Grain Technology. 1984; 30:68-72.
8. Snedecor WG and Cochran WG. Statistical methods. Oxford and IBH publishing Co, New Delhi, 1967, 593.
9. Throne JE and Culik MP. Progeny production and duration of development of rusty grain beetles, *Cryptolestes ferrugineus* (Stephens) (Coleoptera: Cucujidae), on cracked and whole corn. Journal of Entomological Science. 1989; 24:150-155.
10. Cline LD. Progeny production and adult longevity of *Cryptolestes pusillus* (Coleoptera: Cucujidae) on broken and whole corn at selected humidities. Journal of Economic Entomology. 1991; 84:120-125.
11. Singh B, Pandey ND, Singh YP, Pandey S and Mohan K. Effect of wheat varieties on the development of lesser grain borer (*Rhizopertha dominica* Fabricius). Bulletin of Grain Technology. 1986; 24(1):50-57.