

Original Research Article

Effect of sesame seed coat colour on the biology of rice moth, *Corcyra cephalonica* (Noctuidae: Lepidoptera)

Abstract:

A laboratory experiment was conducted to study the bionomics of *Corcyra cephalonica* on different coloured sesame genotypes viz., Swetha (white), GT-10 (black), and YLM-17 (brown). According to the results, the duration of egg, larvae, pupae and adult were observed to be significantly longest (6.40, 31.16, 14.87 and 10.70 days, respectively) in black seeded genotype GT-10. Whereas, it was shortest (3.64, 24.12, 7.80 and 7.26 days, respectively) in white seeded genotype Swetha. All tested sesame genotypes showed significant impact on the head capsule width, body length and width of different larval instars. Based on biological and morphometric parameters, black seeded genotype (GT-10) was less suitable for the *Corcyra cephalonica* development, while, white seeded genotype (Swetha) was most suitable.

Keywords: *C. cephalonica*, Bionomics, Morphometrics, Genotypes, Storage, Sesame Seed

Introduction:

Sesame seeds are very nutritious and therefore confer health benefits. The seeds contain high oil (32.8 – 62.7%) nominally about 52 – 55% [1]. The monounsaturated fatty acids such as oleic and polyunsaturated fatty acids such as linoleic acids are the two most important and predominant fatty acids in sesame seeds [2]. In addition, sesame oil is very resistant to oxidative deterioration due to tocopherols whose bioavailability can be increased by

sesamol, which can only be found in sesame seeds making it a very special oil crop [3]. These functional ingredients in sesame protect against hypertension, hypercholesterolemia, cancers, and for managing atherosclerosis, diabetes mellitus, obesity, chronic renal failure, rheumatoid arthritis, Alzheimer's disease as well as dermatological diseases [4]. The area of oilseed in 2020-21 28.79 million ha, production 36.10 million tonnes and productivity 1254 kg/ha [5]

About 81 species of insects belonging to 09 orders invade sesame crop in the field as well as in storage. In storage condition the rice moth, *C. cephalonica* St. and red flour beetle, *Tribolium castaneum* Hbst. cause economic damage [6, 7 and 8]. The larvae of *C. cephalonica* feed on the seeds by feeding under silken web. When infestation is high, the seeds are converted into powders and sometimes the entire stock of seeds may be converted into a webbed mass. Ultimately, a characteristic bad smell develops and the seeds become rancid and lost their germination capacity which rendered unfit for human consumption [9]. The information on the bionomics of rice moth on different sesame genotypes is meagre and hence the present investigation was conducted.

Materials and methods:

A life history study of rice moth was conducted under laboratory conditions on sesame genotypes during June 2019 - August 2019, when the laboratory temperature and relative humidity were in the range of 25⁰C to 30⁰C and 60 to 70 percent, respectively. Three sesame genotypes with different seed colours were used and five gram seeds of each genotype were placed in nine plastic boxes. Later, ten newly hatched first instar larvae per box were introduced by using camel hairbrush. The open end of the box was closed with a muslin cloth and fastens with a rubber band. The duration of different life stages (egg, larvae, pupae and adult) were recorded. Measurement of the different larval instars

head capsule width, body length and width of different life stages (larvae and pupae) were also performed with the ocular micrometre [8].

Results and Discussions

Incubation period: The egg was pear-shaped with a brownish tinge, gently rounded at one end, and pointy at the pedicel end.

Data presented in Table 1 and depicted in Figure 1 showed a significant difference in the incubation period among the genotypes. The mean incubation period ranged from 3.64 to 6.40 days. The incubation period was significantly prolonged in black seeded genotype GT-10 (6.40 days) followed by YLM-17 (4.70 days), while it was shortest in white seeded genotype Swetha (3.64 days). These findings are agreement with several workers [10], [11] and [8] they also reported that the average incubation period of *C. cephalonica* ranged from 4.66 to 5.80 days on different diets.

Duration of different larval instar

The data on different larval instar duration and morphometric are shown in Tables 1 to 2 and depicted in Figure 2 to 6. It was observed that the larvae passed through five instars.

The mean larval duration of first to fifth instar larvae was observed to be shortest on Swetha (4.11, 5.22, 4.66, 4.52 and 4.72 days, respectively). While, it was longest on GT 10 (5.00, 7.14, 5.99, 5.90 and 7.82 days, respectively). Similarly, [8] have also reported that the developmental period of first to fifth instar larvae of *C. cephalonica* fed on different sesamum cultivars ranged from 3.67-5.80, 3.73-5.00, 5.40-6.27, 4.93-5.60, 5.60-6.40 and 7.33-9.33 days, respectively.

The mean head capsule width of first to fifth instar larvae was found to be significantly maximum on Swetha (0.24, 0.27, 0.38, 0.55, 0.73 mm,

respectively) and minimum on GT-10 (0.16, 0.19, 0.24, 0.32 and 0.44 mm, respectively). This finding is in conformity with that of [12] who reported that head capsule width for first to fifth instar was 0.19, 0.22, 0.28, 0.39 and 0.52 mm, respectively.

The mean body length of first to fifth instar larvae was found to be maximum in white seeded genotype Swetha (1.70, 4.00, 6.61, 10.18 and 11.64 mm, respectively) and it was minimum in black seeded GT-10 (1.17, 2.22, 3.69, 4.83 and 6.23 mm, respectively). Similar results were reported by [8] according to them the body length of first to fifth instar *C. cephalonica* larvae were observed to be 1.80, 3.12, 5.60, 7.52 and 10.01 mm, respectively on different sesame cultivars.

The mean body width of first to fifth instar larvae was significantly maximum when larvae developed in white seeded genotype Swetha (0.24, 0.36, 0.75, 1.00 and 1.39 mm, respectively). Whereas minimum body width of first to fifth was noticed in black seeded genotype GT-10 (0.16, 0.28, 0.40, 0.62 and 0.93 mm, respectively). The present investigation is corroborated with the findings of [13] who reported that the mean body width observed to be 0.19, 0.23, 0.31, 0.41 and 0.55 mm, respectively for first to fifth instar.

Total larval period

The total larval period shows a significant difference between the genotypes (Table 1) and was shortest on white seeded genotype *i.e.*, Swetha (24.12 days), which was at par with YLM-17 (26.77 days). However, the highest total larval period was recorded on black seeded genotype *i.e.*, GT-10 (31.16 days) (Table 1). Similarly, [8] observed that the total larval period of *C. cephalonica* varied from 26-35 days on three sesamum genotypes.

Pupal duration:

The effect of different genotypes was significant with respect to the pupal period (Table 1 and Figure 7). The pupal period on different genotypes was 7.80, 11.39 and 14.87 days on Swetha, YLM-17 and GT-10. Similar work has been done by several workers namely [14], [15], [13] and [8] as they also reported that pupal period ranged from 7.00 to 16.00 days on different diets.

Pupal morphometric

The data presented in Table 3 revealed significant differences in pupal length and width in selected genotypes.

The minimum pupal length and width were observed on GT-10 (7.62 and 1.51 mm, respectively) followed by YLM-17 (7.82 and 1.74 mm, respectively), but significantly lower as compared to Swetha (8.27 and 1.91 mm, respectively). The present findings are close related with the findings of [14], [13] and [8] as they reported that the pupa length and breadth varies from 8.00×1.59 mm to 8.56×1.80 mm, when reared on different diets.

Adult longevity

The data on adult longevity shows that significant differences were observed among the tested sesame genotypes (Table 1 and Figure 8). It was significantly prolonged on GT-10 (10.70 days) as compared to other genotypes. This was followed by YLM-17 (9.39 days), whereas shortest adult longevity was noticed on Swetha (7.26 days). Similar, results were reported by [13] and [8] according to them the pupal period of *C.cephalonica* lasted for 6.00 to 14.00 days, respectively on different food diets.

Adult morphometrics

The data given in Table 3 revealed that significant differences were observed for wing expansion and length of both male and female moths among selected genotypes.

Male moth

The minimum male body length and wing expansion was observed in black seeded genotype GT-10 (7.24 and 12.64 mm, respectively), but was at par with YLM-17 (7.78 and 11.74 mm, respectively). However, it was maximum in white seeded genotype Swetha (8.86 and 14.81mm, respectively).

Female moth

Minimum female body length and wingspan was recorded on GT-10 (7.75 and 15.71 mm, respectively) which was followed by YLM-17 (10.14 and 16.45 mm, respectively), but significantly lower as compared to Swetha (11.26 and 17.04 mm, respectively). Similarly, [8] have reported that the female moth of *C. cephalonica* measured 12.24 mm in length and 16.38 mm in breadth, when developed on different sesame genotypes.

Total developmental period

The total developmental period was shortest on Swetha (35.94 days), which was at par with YLM-17 (43.20 days). Whereas, it was significantly delayed on GT-10 (52.47 days) (Table 1). The genotype GT-10 recorded longest development period in all the instars of *Corcyra cephalonica*. prolongation in the developmental time indicates a compensatory action, where larvae subjected to a poorer nutritional source tend to compensate for food stress by lengthening the immature stage [16]. The lengthening of the larval period would allow the larvae to reach the ideal (or minimum) weight for pupation, a stage with nutritional/energy expenditure for the insect [17].

Conclusion

Based on the above finding, it was concluded that the white seed coat genotype (Swetha) favoured rapid development of the insect and was

considered a highly susceptible genotype. On the other hand, the black seed genotype (GT-10) was considered less susceptible. However, the brown seeded genotype (YLM-17) was considered moderately susceptible to pest damage.

References

1. Couch A, Gloaguen RM, Langham DR, Hochmuth GJ, Bennett JM, and Rowland DL. Non-dehiscent sesame (*Sesamum indicum* L.): Its unique production potential and expansion into the southeastern USA. *Journal Crop Improvement*. 2017; 72p.
2. Zahran HA, Abd-Elsaber A, and Tawfeuk HZ. Genetic diversity, chemical composition and oil characteristics of six sesame genotypes. *Oilseed and Fats, Crops and Lipids*. 2020; 27(1):39
3. Wu WH, Kang YP, Wang NH, Jou HJ, and Wang TA. Sesame ingestion affects sex hormones, antioxidant status, and blood lipids in postmenopausal women. *Journal of Nutrition*. 2006; 136: 1270–1275.
4. Nagendra Prasad MN, Sanjay KR, Prasad DS, Vijay N, Kothari R, and Swamy SN. A review on nutritional and nutraceutical properties of sesame. *Journal of Nutrition and Food Sciences*. 2012; 2(2):127.
5. Ministry of agriculture annual report 2021-22 (Sep 26, 2021) Retrieved; <https://agricoop.nic.in/Documents/annual-report-2021-22.307p.pdf>
6. Behera PK. Management of major insect pests of sesame in coastal condition of Orissa, M.Sc. Thesis, OUAT, Bhubaneshwar. 2009; 216p.
7. Patnaik HP, Samal T, Dash M. and Ranasingh N. 2013. Susceptibility of sesame varieties to rice moth and red flour beetle under storage conditions. *Journal of Plant Protection and Environment*. 10(2): 81-82.

8. Soumya BB, Samal, T, Mishra MK, Mohanty S and Sahu J. Biology and morphometry of *Corcyra cephalonica* Stain in sesame seeds during Storage. *International Journal of Current Microbiology and Applied Science*. 2020; 9(7): 2766-2775
9. Majhi BK. Management of major insect pests of stored sesamum. M.Sc (Ag.) thesis, O.U.A.T., Bhubaneswar. 2000; 46p.
10. Jagadish PS, Nirmala P, Rashmi MA, Hedge JN and Nangia N. Biology of rice moth, *Corcyra cephalonica* (Stainton) on foxtail millet *Setaria italica* (L.). *Karnataka Journal of Agricultural Science* 2009; 22(3): 674-675
11. Menge AK, Naik KV, Jalgaonkar VN and Golvankar GM. Bionomics of rice moth *Corcyra cephalonica* on groundnut variety TG-37. *Journal of Entomology and Zoology Studies*. 2018; 6(6): 36-38
12. Rao DS. 1954. Notes on rice moth, *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae). *Indian Journal of Entomology*. 16(2): 95-144.
13. Ramanaji N, Dabhi MV and Thangavel S. Bio-ecology of rice moth *Corcyra cephalonica* (Stainton) on groundnut seeds. *Journal of Entomology and Zoology Studies*. 2020; 8(5): 2406-2410.
14. Ayyar PNK. A very destructive pest of stored products in south India, *Corcyra cephalonica* (Stainton). *Bulletin on Entomological Research* 1934; 25(2):155-160
15. Nirmala P. Bioecology and infestation behaviour of the rice meal moth, *Corcyra cephalonica* stainton (lepidoptera: pyralidae) on foxtail millet, *Setaria italica* (L.) M.Sc. (Ag.) Thesis, GKVK, Bangalore. 2007; 145p.
16. Silva IF, Baldin ELL, Specht A, Sosa-Gómez DR, Roque-Specht VF, Morando R and Paula-Moraes SV. Biotic potential and life table of

Helicoverpa armigera (Hübner) (Lepidoptera: Noctuidae) from three Brazilian regions. *Neotropical Entomology*. 2017; 47(1): 344–351.

17. Parra JRP, Panizzi AR and Haddad ML. Nutritional indices to measure food consumption and utilization by insects. In Panizzi AR and Parra JRP (eds) *Bioecology and insect nutrition: basis for integrated pest management*. Brasilia, DF: Embrapa Technological Information, 2009; pp. 37–90.

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Table 1. Duration of life cycle of *C. cephalonica* reared on different sesame genotypes

Sesame genotypes (seed colour)	Egg period (days) #	Larval period (days) #					Total larval period	Pupal period (days) #	Adult longevity (days) #	Total developmental period
		1 st instar	2 nd instar	3 rd instar	4 th instar	5 th instar				
Swetha (white)	3.64 (2.15)	4.11 (2.26)	5.22 (2.49)	4.66 (2.38)	4.52 (2.35)	4.72 (2.39)	24.12 (5.01)	7.80 (2.96)	7.26 (2.87)	35.94 (6.08)
GT-10 (black)	6.40 (2.72)	5.00 (2.45)	7.14 (2.85)	5.99 (2.64)	5.90 (2.63)	7.82 (2.97)	31.16 (5.67)	14.87 (3.96)	10.70 (3.42)	52.47 (7.31)
YLM-17 (brown)	4.70 (2.39)	4.31 (2.30)	6.08 (2.66)	5.38 (2.53)	5.10 (2.47)	6.10 (2.66)	26.77 (5.27)	11.39 (3.52)	9.39 (3.22)	43.20 (6.65)
S.Em	0.053	0.005	0.011	0.011	0.010	0.043	0.020	0.037	0.014	0.031
C.D (5%)	0.164	0.016	0.034	0.034	0.030	0.133	0.061	0.113	0.044	0.096

Figures in the parentheses are square root transformed values. All the values are mean of five replications

Table 2. Morphometric parameters of *C. cephalonica* larvae on different sesame genotypes

Sesame genotypes (seed colour)	Different larval instars head capsule with, body length and width (mm) #														
	1st instar			2nd instar			3rd instar			4th instar			5th instar		
	Body Length (BL) (mm)	Body width (BW) (mm)	Head capsule width (HCW) (mm)	BL (mm)	BW (mm)	HCW (mm)	BL (mm)	BW (mm)	HC W (mm)	BL (mm)	BW (mm)	HC W (mm)	BL (mm)	BW (mm)	HCW (mm)
Swetha (white)	1.7 (1.64)	0.24 (1.12)	0.24 (1.11)	4.00 (2.24)	0.36 (1.17)	0.27 (1.13)	6.61 (2.76)	0.75 (1.32)	0.38 (1.17)	10.18 (3.34)	1 (1.41)	0.55 (1.25)	11.64 (3.56)	1.39 (1.55)	0.73 (1.32)
GT-10 (black)	1.17 (2.45)	0.16 (1.08)	0.16 (1.09)	2.22 (1.80)	0.28 (1.13)	0.19 (1.09)	3.69 (2.17)	0.4 (1.18)	0.24 (1.11)	4.83 (2.41)	0.62 (2.61)	0.32 (1.15)	6.23 (2.69)	0.93 (1.39)	0.44 (1.20)
YLM-17 (brown)	1.64 (2.45)	0.19 (1.09)	0.18 (1.09)	(3.69) (2.10)	0.3 (1.14)	0.2 (1.09)	5.72 (2.59)	0.56 (1.25)	0.34 (1.16)	8.11 (3.02)	0.88 (1.37)	0.44 (1.20)	8.92 (3.15)	0.87 (1.36)	0.61 (1.27)
S.Em(±)	0.006	0.008	0.008	0.008	0.008	0.008	0.005	0.011	0.009	0.004	0.009	0.013	0.024	0.047	0.006
C.D (5%)	0.018	0.024	0.024	0.025	0.026	0.024	0.016	0.034	0.028	0.012	0.028	0.04	0.075	0.143	0.018
# Figures in the parentheses are square root transformed values. All the values are mean of five replications															

Table 3. Morphometric parameters of *C. cephalonica* pupa and adult on different sesame genotypes

Sesame enotypes (seed colour)	Pupa#		Adult#			
	Length (mm)	Breadth (mm)	Male		Female	
			Length (mm)	Breadth (mm)	Length (mm)	Breadth (mm)
SWETHA (white)	8.27 (3.05)	1.91 (1.71)	8.86 (3.14)	14.81 (3.98)	11.26 (3.50)	17.04 (4.25)
GT-10 (black)	7.62 (2.94)	1.51 (1.58)	7.24 (2.87)	12.64 (3.70)	7.75 (2.93)	15.71 (4.09)
YLM-17 (brown)	7.82 (2.97)	1.74 (1.66)	7.78 (2.96)	11.74 (3.57)	10.14 (3.34)	16.45 (4.18)
S.Em (\pm)	0.005	0.008	0.005	0.003	0.116	0.004
C.D (5%)	0.017	0.023	0.015	0.010	0.358	0.011

Figures in the parentheses are square root transformed values. All the values are mean of five replications

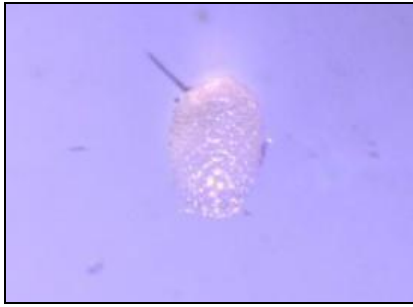


Fig 1. Egg of *C. cephalonica*



Fig 2. First instar larvae of *C. cephalonica*



Fig 3. Second instar larvae of *C. cephalonica*



Fig 4. Third instar larvae of *C. cephalonica*



Fig 5. Fourth instar larvae of *C. cephalonica*



Fig 6. Fifth instar larvae of *C. cephalonica*



Fig 7. Pupae of *C. cephalonica*



Fig 8. Adult of *C. cephalonica*

Life stages of *C. cephalonica* on sesame genotypes

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