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Study on both the life cycle and morphometrics of *Sitophilus oryzae* on rice cultivar *Sampa mashuri* in laboratory condition

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ABSTRACT

Life cycle and biology of the rice weevil S. oryzae on rice grain local variety Sampa mashuri was observed under laboratory condition covering three consecutive months (June-August) of 2013. The laboratory temperature ranges from 30.7^{0}C and 23.7^{0}C *and relative humidity from* 86 to 69 *per cent respectively. The average length of the adult male and female weevil was* 2.9 ± 0.6 mm and 2.8 ±0.6mm *respectively. Longevity of adult female with food ranged from 85 to109 days. Weevil freely copulated under laboratory condition; commenced mating 4 to 6 days after emergence and subsequently mating occurs. Equally longevity of the adult male was 59-64 days with food. Total larval period lasted for 22-29 days. The larvae after full grown pupated inside the rice grain. Pupal period lasted for 7-8 days with a mean of 7.5 ± 0.84 days. Duration of total life cycle starting from egg to adult ranges 35-49 days with mean of 41.2 ± 5.79 days.*

Keywords: Life cycle, developmental stages, *Sitophilus oryzae*, rice grain.

INTRODUCTION

Stored grains are subject to losses due to a number of causes which includes physical, sanitary and nutritional deprivation, from their maturation to the utilization. In India the damage of stored grains by insect pests was estimated to 6.5 percent of the total grain storage (Raju, 1984). Among the stored grain pests, the rice weevil, *Sitophilus oryzae*(Linnaeus, 1763) (Coleoptera, Curculionidae), is one of the significant pests of stored rice causing both quantitative and qualitative losses to grain imparting severe economic loss (Aslam *et al*.2004; Shaaya *et al.* 1991). Regardless of the accessibility of modern technologies for grain storage and pest control, some farmers still use traditional methods of storage. Grain stored under such conditions is very susceptible to heavy losses (Aslam *et al*.2004). Understanding of the pest life-cycle is thus the prerequisite for the adoption and execution of the proper management strategy . A considerable work on the life cycle of *S.oryzae* though had been carried out but expressed variable results (Wille 1923; Bheemanna 1986; Barbuiya *et al.,* 2002). The duration of each life cycle (Wille, 1923), the characteristics of the morphs (Barbuiya *et al.* 2002) of each growth stages and the number of generation in each year (Bheemanna 1986) varied considerably in consideration of both the prevailing climatic factors and the food source.For this reason study of *S. Oryzae* life cycle in consideration of micro-climate is imperative.

The District Malda, West Bengal, India offers a very congenial environment for the cultivation of a number of both local and high yielding rice cultivars. *S. oryzae* is found as one of the major stored grain pest of rice in this region. As *S. oryzae* have unique characteristics that justify their importance and the need for specific control measures that should be adopted in their management. It can also be regarded as another reason for the growing interest in the study of the life cycle in region specific manner. In this consideration, the present study contemplates the observation on the life cycle and accordingly the study on the morphometric in the agroclimatic region of Malda, West Bengal, India where no such experiment was carried earlier.

MATERIALS AND METHODS

Place and time of experiment: Studies on the life cycle and biology of *Sitophilus oryzae* (L.) on rice cultivar *Sampa mashuri* were conducted for three consecutive calendar months (July-September) of 2013 in the Entomology Laboratory, Department of Zoology, University of Gour Banga, Malda, West Bengal, India.

Microclimatic conditions of the laboratory (Table 1): The average maximum and minimum room temperature during the time of the experiment varied from 30.7^0C and 23.7^0C.While the relative humidity ranged from 86 to 69%.

Table1. The extent of micro-climatic condition in the practical room

Room micro-climate		Months		
		July	**August**	**September**
Temperature (^{0}C)	Maximum	30.07	29.93	30.72
	Minimum	23.54	23.83	23.07
	Range	30.07 – 23.54	29.93 - 23.83	30.72 - 23.07
	Average	26.82	26.93	27.24
Humidity (RH%)	Maximum	87.34	86.56	84.43
	Minimum	69.40	71.56	73.56
	Range	87.34 - 69.40	86.56 - 71.56	84.43 - 73.53
	Average	78.45	79.23	79.54

Collection of biological sample:

Rice cultivar: Fresh rice grains were purchased from the local market and used for this study. The grains were dried under softly sunlight to prevent moldiness and stored in air tight plastic jars. Only complete intact un-infested grains were selected for the experiment.

Insect sample: Stock culture of the rice weevil was started by collecting the adult weevils from the infested rice grains from the local market of the rice retailer. The culture was further maintained in glass bottle of two liter capacity containing same rice grains. The mouth of the container was covered with a piece of white cotton cloth for aeration. Clean and fresh grains were provided intermittently and adequately to the vials to ensure proper growth and development of the weevil. The culture was periodically inspected and accordingly precautions were taken

Fig 1 : Replication of *S. Oryzae* culture

Pure culture of the weevil was then prepared by infesting insect free, properly cleaned pre-weighted rice grains with freshly emerged single mating pair. The culture was maintained in the plastic jar. Each jar contains 25 rice grains and had five replications **(Fig.1)**.

The equipment

For maintaining the insect culture: Temperature of the plastic vial is measured with the help of a digital probe thermometer (HTC DT-1) and accordingly recorded.

For morphometic observation: Morphs of the adult insect was measured by the help of a slide calliper (Mitutoyo-CD-S6"C) and micrometer whichever is required.

For photography: Image of the whole insect body and life stages was taken by cannon Power Shot-A590IS, while the insect body part and micro images was taken by binocular dissecting microscope (Olympus-Magnus-ms13/ms24) and trinocular microscope (Olympus CH20i) respectively.

Data analysis: Both the microscope was befitted with a computer having image analytical system or software for essential function. The average data on the body part measurement and life cycle were taken and accordingly CD and SE value was calculated.

RESULTS AND DISCUSSION

Studies on the biology of the rice weevil, *S. oryzae* was carried out under laboratory condition when the maximum and minimum temperature was 30.7^0C and 23.7^0C respectively. The maximum and minimum relative humidity were 86 and 69 per cent respectively during the course of investigations.

*The adult***(Fig.2)***:*

Adult longevity: The ability of the adults of *S. oryzae* to live in the presence of food was determined by enclosing male and female adults obtained from the culture separately. Ten such vials were maintained for each of the male and female with food. Longevity of adult female with food ranged from 85 to109 days. Equally longevity of the adult male was 59-64 days with food . The average length of adult male and female was 2.9 ± 0.6 mm and 2.8 ±0.6mm respectively. The adults are reddish-brown to black in colour with four reddish or paler spots on the corners of the elytra; prothorax is strongly pitted with round or irregularly shaped pits.

Fig 2 : Adult *Sitophilus* sp.

Fig 3 : Matting pair

Ovipositional studies **(Fig.3)** : A pair of emerged weevils was collected in specimen tube (7.5 cm x 2.5 cm) and such ten replication tubes were maintained. The weevils were allowed to mate and accordingly observed. Weevil freely copulated under laboratory condition; commenced mating 4 to 6 days after emergence and subsequently mating occurs.

Egg stage **(Fig.4):**
Thirty rice weevils were enclosed with 50 g rice grains in each bottle and these bottles were kept in ambient conditions. Damaged grains were replaced every day with un-infested grains. Grains containing eggs were separated out by examining under microscope and were used for further study. The average length of *S.oryz*e egg is 0.68±0.03 mm.

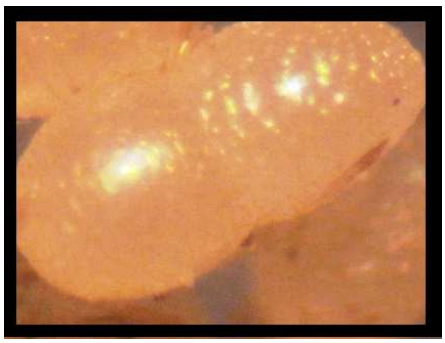

Fig 4 : Eggs

Fig 5 : Larval stage

Incubation period: Rice grains with rice weevil eggs so obtained were maintained in a glass vials for incubation. Daily twenty grains from the day of oviposition to egg hatching were dissected to determine the incubation period. The incubation period for egg was 6 to 7 days on rice.

Larval period **(Fig.5) :**

On hatching the larvae of rice weevil were allowed to feed individually inside the grains in specimen tube of 7.5 cm x 2.5 cm size having 5 gram rice grains. Five grains per day were dissected out to see the different stages of the larvae. The dissection of grains was made up to the pupal stage. The period between egg hatching and pupation was observed as the duration of larval period. Total larval period lasted for 22-29 days . The larvae after full grown, pupated inside the rice grain. The average length of the larva was 2.8 ±0.2 mm.

Table 2:

Growth stages	description	Mean(mm)	Standard deviation (+ SD) (mm)	Range (mm)
Adult	***male***	***2.9***	***2.9 ± 0.6***	***2.3 – 3.5***
	Female	***2.8***	***2.8 ±0.6***	***2.2 – 3.4***
Larva	-	***2.8***	***2.8 ±0.2***	***2.5 – 3.0***
Pupa	-	***2.3***	***2.3 ±0.1***	***2.2 – 2.4***
Eggs	-	***0.68***	***0.68±0.03***	**0.65 - 0.70**

Fig 6 : Pupa.

Fig 7 : Infested rice

Pupal period **(Fig 6***) :*

The pupal period of the pests was studied by observing the same larvae for pupation inside the grains. This was maintained and the observations were made till the adult emergence **(Fig 7)**. The period between formations of pupae till the adult emergence was noted as pupal period. Pupal period lasted for 7-8 days with a mean of 7.5 ± 0.84 days. The pupa resembled adult in all respects. Duration of total life cycle starting from egg to adult ranges 35-49 days with mean of 41.2 ± 5.79 days.

Present study was partly supported by Barbuiya *et al.* (2002) who have noted an incubation of 5 to 7 days on rice. On maize grains, Yevoor (2003) have observed an incubation period of 5 days at 14 to 34^0C temperature and 55 to 88 % relative humidity (RH). Present study was contradicted by the observation of Wille (1923) who have noted that the egg stage of *Ccalandra oryzae* (L.) on husked rice during summer lasts for six to nine days. In addition to this he had reported that each grain contains single grub of *S. oryzae* and total larval period ranged from 12 to 17 days during summer. Wille (1923) have recorded 7 to 11 days of pupal period but, Okuni (1924) had observed 5 to 20 days. A variable duration of life cycle was reported by Wille (1923). He had observed 45 days in summer, five months in cool weather of autumn and winter for completion of one generation. In the present observation the complete duration of *S.oryzae* life cycle extends up to 42 days. But contrary to this, Okuni (1924) reported eight generations of *S. oryzae* in a year with the adult average longevity for 160 days. The duration of incubation period in the present observation is far above the observation of Okuni (1924) who, on the other hand, have noted that the incubation period under normal condition extends up to three to four days. From Australia, Newman (1927) has registered three to five days of egg stage and had recorded 20 to 30 days of larval period of rice weevil. According to Newman (1927) the adult lived for 12 months and had passed seven to eight generations per year as the life cycle was completed in 30 days in summer. Under warm moist conditions egg stage on an average extends for three days as reported by Wenholz(1927). Sattigi (1982) critically observed the biology of *S. oryzae* on sorghum and noted that the freshly laid eggs were white and oval shaped and became pink and opaque prior to hatching. The incubation period

ranged from five to nine days and length and breadth of egg measured on an average of 0.46 mm and 0.11 mm, respectively. At 27 to 28^0 C and 90 to 95 per cent relative humidity, egg period lasts for 6 to 7 days as noted by Treiman (1937).Lefevre (1953), on contrary to this, have recorded on an average of 2.65 days of incubation period in laboratory situation. On sorghum cultivar CSH-5, Bheemanna (1986) have observed that the incubation period ranges from 5 to 8 days and had reported a larval period of 25-34 days and Pupal period of 8 to 11 days on CSH-5 sorghum hybrid. Bheemanna (1986) also have reported that the weevil laid eggs singly inside the scooped grains. In general only one egg was found inside the grain. Egg measured 0.341 mm to 0.0379 mm in length and 0.151 mm to 0.189 mm in width. But 8 to 9 days of pupal period was recorded on maize by Bhuiyah *et al.* (1990).Bheemanna (1986) observed adult longevity ranging from 14 to 165 and 7 to 11 days with and without food, respectively. Bhuiyah *et al.* (1990), on the other, hand had noted that adult longevity in male and female was 114 to 115 and 119 to 120 days, respectively when a day old adults were released into 2 kg sacks of maize. Bhuiyah *et al.,* (1990),on the other hand, observed that the incubation period of rice weevil on maize lasts for 5 to 6 days while the room temperature varies from 23 to 30^0C and relative humidity 79 to 87 per respectively. The larval period ranged from 16 to 20 days on maize grain at 23 to 35^0C and 79 to 87 per cent relative humidity (Bhuiyah *et al.*, 1990). Like the present study, Treiman (1937) recorded upto four larvae in a grain which occupied 18 to 20 days to complete larval stage in rice. According to Sattigi (1982) the larval period ranged from 23 to 33 days with an average of 28 days during February to March, 1982. Urrelo *et al.* (1989) had registered four instars of *Sitophilus zeamais* (M.) on maize at 70 per cent relative humidity and at 27^0C temperature. Yevoor (2003) reported pupal period of 8 to 9 days on maize at temperature of 14 to 34^0C and 55 to 88 % RH.

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