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Biology of Sitophilus oryzae (L.) on maize grains in Talwandi sabo, Bathinda

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Abstract : The current studies were carried on *S. oryzae* L. (Coleoptera: Curculionidae), as it is considered the most destructive pest of cereals like maize, wheat, pea and rice under storage condition. The results on the biology of rice weevil on maize grains revealed that the oviposition period ranged from 4-5 days with an average of 2.76±0.176 days. The average incubation period of eggs was found to be 16.6±0.245 days and the mean fecundity rate of adult female was recorded as 307.24±8.48 eggs per female. The larval period of first, second, third, & fourth instar was observed to be 4.56 ±0.23, 6.56 ±0.09, 7.98 ±0.137 and 4.95 ±0.163 days, respectively.

***Index Terms - Sitophilus Oryzae,* Biology, Maize grains.**

I. INTRODUCTION

Maize or corn (*Zea mays* L.) native of America is third staple cereal crop, widely grown in temperate, subtropical and tropical parts (Shah *et al*., 2006; Jalali and Singh, 2003). Globally, 160 countries producing maize (Das *et. al.* 2008) in these countries India ranks seventh with respect to production of maize (Sridhar, 2008). In India during year 21-22 maize was grown on 31 million hectare with record production (FAO, 2022). Maize has valuable components such as fiber, starch, protein, fats, minerals and vitamins due to which it is used as human diet as well as in poultry and livestock feed (Chaudhary, 1983; Prasanna *et al.* 2001). Its high protein content improves human and animal health (Hussain *et. al*. 2006).

For developing countries maize is a major source of dietary energy (> 5 percent) provider to human population (Singh *et. al*. 2018). But these stored grains are subject to losses due to a number of causes such as physical, sanitary and nutritional deficiency. Around 10-30 % to complete loss is reported in maize due to insects attack during its cropping and storage (Tefera *et. al.*, 2011). Kumar *et al*., (2014) also reported the total losses as 13.2 % by different insect pests and diseases in maize crop.

Among several insects attacking maize seeds during storage following are the economically important store grain pests: *Sitophilus spp*, *Rhizopertha domonica*, *Sitotroga cereallela*, *Tribolium castaneum*, and *Corcyra cephalonica*.

In this the current study was conducted on one of the major pest of maize *Sitophilus oryzae* L. (Coleoptera: Curculionidae). It considered as most destructive pests of cereals such as maize, wheat, peas and rice under storage condition (Longstaff, 1981; Gomes *et. al*., 1983; Grenier *et. al*., 1997). It can able to cause absolute damage to stored grain if not proper control measures are taken (Ofuya and Credland, 1995). This pest infestation also increases the growth of pathogens and secondary insect pests (Weston and Rarrlingourd 2000; Hill, 2002).

Sitophilus zeamais (Motsch) and *Sitophilus oryzae* (L.) causes 18.30 per cent losses to stored corn (Adams, 1976). Bitran *et al.*, (1978) reported 92.40 to 98.30 per cent of damage in different parts of the world. In India *S. oryzae* causes massive losses up to 100 percent in maize under storage condition (Singh *et al.*, 1974). The female of maize weevil makes a tiny hole on its seed for egg laying. These eggs are then covered with the secretion of gelatinous fluid. The grub hatches out from egg starts feeding inside the maize grain. Further pupation takes place inside the seed. The adult emerges through outlet made on the maize seed (David and Kumaraswamy, 1975). This infested causes weight and nutritional value of maize which further reduce its market price (Tefera, 2012).

II. LITERATURE REVIEW

Narayan Swamy *et al*., (2014) reported on maize grains that, *S. oryzae* have taken an incubation period of 5.10 days, larval and pupal period of 27.60 days and 9.50 days, respectively. The fecundity was 56.50 eggs per female and the total life cycle from egg to adult was 42 day.

Bhandari *et al*. (2015) studied the biology of rice weevil on sorghum. Result revealed that the incubation period varied from 3.78 to 6.12 days. The total larval period was of 26.39 ± 1.24 days. The pupal period varied from 6 to 7 days. The pupation took place in larval tunnels inside pupal case. The fecundity ranged from 122 to 265 with an average of 163.87 ± 27.37 eggs per female. The adult longevity ranged from 81 to 101 days for females.

Akhter *et al*. (2017) reported the oviposition preference and development of *S. oryzae* on parboiled rice (*Oryza sativa*), wheat (*Triticum aestivum*) and pulse (*Cicer* arietinum). In no choice tests, the mean number of eggs laid were 360.3 ± 2.60 in rice, 382 ± 2.49 in wheat and 394 ± 2.06 in pulse. In case of choice tests, the mean number of eggs laid were 13.6± 0.4 in rice, 14.2 ± 0.37 in wheat and 15.6 ± 0.4 in pulse. The differences between the number of eggs laid in rice, wheat and pulse varied significantly in both no-choice and choice tests. The respective incubation period, larval and pupal period of the weevil reared on rice, wheat and pulse were 5.7 ± 0.27, 5 ± 0.47 and 5.4 ± 0.27 days, respectively, 21 ± 0.47, 20.3 ± 0.27, 19 ± 0.47 days, respectively and 10.3 ± 0.27, 10.7 ± 0.27, 11.3 ± 0.27 days, respectively. The total development time from egg to adult recorded in rice, wheat and pulses was 37 ± 0.47, 36 ± 0.47 and 35.6 ± 0.72 days, respectively. The difference between the larval periods was significant ($p < 0.05$) when they reared in wheat and pulses. The larval and pupal periods varied significantly ($p < 0.05$) between the individuals reared in rice and pulses. The developmental period was shorter in pulse than in rice and wheat.

Singh (2017) recorded the incubation period turned out to be 6-7 days larval stage lasted for 21-27 days. Whereas the adult female, with continuous food supply survives for 81 to105 days, the adult male remains alive for 57-63 days.

Devi *et al*. (2017) reported the comparative biological study of two species of *Sitophilus* spp. The results revealed that the developmental period, longevity, mating and premating period were longer in *S. zeamais* compared to *S. oryzae*. The developmental periods of eggs, first to fourth instar larvae, pupae and adults were 6.9, 5.8, 7.0, 8.4, 7.5, 12.5 and 3.5 days, respectively with total life cycle duration of 51.6 days in *S. zeamais.* It was 5.5, 5.0, 5.7, 6.5, 7.0, 7.4 and 2.4 days, respectively with total life cycle duration of 39.1 days in *S. oryzae*.

Vijay and Bhuvaneswari (2018) carried out experiment at the Entomology Laboratory, Horticultural College and Research Institute for Women, Trichy on the biology and development of *S. oryzae* L. under laboratory conditions. The result revealed that oviposition rate per female (9.43 nos), total number of eggs (94.30 nos), adult emergence per 100 grains (38.50 nos), reproductive potential (35.50 nos), egg to adult survival percentage (41.85), adult female longevity (12.88 weeks) and adult male longevity (8.33 weeks) were higher in redgram under room temperature condition. In case of sorghum, all the above parameters were superior to redgram feeding by the respective population under room and controlled temperature condition. The larval (26.13 days), pupal (7.63 days) and adult emergence period (33.75 days) was maximum in lentil under room temperature as compared to controlled lab condition.

III. MATERIALS AND METHODS

The pure stock cultures of rice weevil, *Sitophilus oryzae* (L.) (Curculionidae: Coleoptera) procured from Punjab Agricultural University, Ludhiana, Punjab. For further studies and multiplication of culture, the whole maize grain was processed as per the following techniques.

To avoid contamination, the whole maize collected from market was washed to remove dusts and the sun dried. Then these were sterilized at 60°C for 60-90 minutes in sterilized containers. Then this sterilized maize was transferred in sterilized plastic containers. These containers were filled with 500 g of Maize grains. In these containers 50 *S. oryzae* adults were released from stock culture, which was covered using muslin cloths and rubber bands to prevent *S. oryzae* to escape. After 10 days the newly emerged 1-2 days adults were taken as parental population for the study.

Biology of *Sitophilus oryzae* (L.) on Maize:

Following parameters was observed under laboratory experiments.

a. Fecundity and Oviposition Period

The total fecundity of each female was recorded during its oviposition period. Five pairs of male and female were introduced in jars, having 50g grains of maize with controlled conditions in three replications. The observations are on total number of eggs laid by single female in life was recorded from each tube. The newly emerged larvae were transferred into jars for studying the larval instars and duration.

b. Duration of Larval Instars and Total Larval

On hatching the larvae of rice weevil were allowed to feed individually inside the maize grains. Five grains per day were dissected out to see the different stages of the larvae. The larval duration was recorded in days from the hatching of eggs till the formation of pupae. The newly hatched larvae of *S. oryzae* were individually placed in separate containers having maize as a source of food**.** The food was replaced daily. The duration of larval instars or stages, observations were made on casting of exuviate daily. Further total larval duration was also recorded.

c. Duration of Pupal period and Adult longevity

The time taken from initiation and pupa formation till emergence of adults was considered as pupal period. For observing the pupal period, last instar larvae was removed and placed in twenty five containers having five pupae in each and average pupal periods were also calculated. Further the duration of adult life was recorded from the day of emergence of adults till their death. The emerged adults were removed now the total development period was calculated by using the formula-

$$\text{Weighted mean} = \frac{\Sigma wx}{\Sigma w}$$

Where, **X** = Value of an item or observation (days) **W** = Weight of X (Number of emerged adults)

IV. RESULTS AND DISCUSSION

The results on biology of rice weevil on maize grains revealed that the oviposition period was ranged from 4-5 days with an average of 2.76±0.176 days. Incubation period of eggs was of an average of 16.6±0.245 days. Average fecundity rate of adult female was recorded as 307.24±8.48 eggs per female.

The first, second, third, fourth larval period was of 4.56 ±0.232, 6.56 ±0.09, 7.98 ±0.137 and 4.95 ±0.163 day's duration, respectively. The total larval duration ranged from 26-35 days with an average of 24.05 ±0.33 days.

The pupal period was average of 6.56±0.101days. Adult female longevity was higher compared to adult male. The adult longevity of male and female was of 56.32 ± 0.28 and 77.76 ±2.35 days, respectively on maize grains.

Table 1: Life Cycle of Rice weevil, *Sitophilus oryzae* on Maize during 2019 at Talwandi Sabo

STAGES	AVERAGE	RANGE
Fecundity (No. of Eggs)	307.24±8.48	250-390
Oviposition period (Days)	2.76±0.176	2-4
Incubation period (Days)	16.6±0.24	15-18
Nymphal Periods (Days)		
I Instar	4.56±0.231	3-6
II Instar	6.44±0.101	6-7
III Instar	7.64±0.181	7-9
IV Instar	4.56±0.153	4-6
Total Nymphal Period	23.2±0.389	20-27
Adult Longevity (Days)		
Male Adult Longevity	56.32±0.28	55-59
Female Adult Longevity	77.76±2.35	60-89
Male Adult Longevity (without food)	5.8±0.15	5-6
Female Adult Longevity (without food)	8.48±0.24	7-11

Table 2: Metamorphosis of different growth stage of *S. oryzae*

S. no.	Growth stage		Morphology in mean(mm)	Range
1	Egg		0.70	0.68-0.70
2	Larva		2.3	2.3-2.5
3	Pupa		2.9	2.6-3.1
4	Adult	Male	3.2	2.5-3.7
		Female	2.9	2.3-3.5

Table 3: Temperature and Humidity during lab. Conditions

		Months		
	Lab. Condition	**15 Aug. to 15 Sep.**	**15 Sep. to 15 Oct.**	**15 Oct. to 15 Nov.**
Temperature(C°)	**Maximum**	34.5	35.3	30.2
	Minimum	20.4	21.2	19.2
	Range	34.5-20.4	35.3-21.2	30.2-19.2
	Average	27.45	28.25	24.7
Humidity	**Maximum**	86.3	84.4	80.4
	Minimum	67.3	65.5	62.2
	Range	86.3-67.3	84.4-65.5	80.4-62.2
	Average	76.8	74.95	71.3

V. CONCLUSION

The experiment entitled "Biology and management of *Sitophilus oryzae* (L.)on maize grains" revealed that the female laid around 307.24 eggs, the first larval instar took 3 to 6 days, second instar larvae moulted to third instar in 6 to 7 days, third instar larvae took 7 to 9 days to moult into fourth larval stage. Finally the fourth larval stage took 4 to 6 days to convert into pupal stage on maize grains. The total larval period was ranged from 20-27 days. The mean pupal period of *S. oryzae* ranged between 7 to 11 days. The adult longevity results revealed that female live longer than male. Longevity of male adults ranged from 55 to 59 days, whereas the female longevity varied from 60 to 89 days.

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