Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

ISSN 2320-7078
JEZS 2014; 2 (6): 09-11

Received: 02-10-2014
Accepted: 06-11-2014

Janardan Saikia
PhD. Scholar, Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat-785013, Assam, India.

M. M. Goswami
Senior Scientist, Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat-785013, Assam, India.

Badal Bhattacharyya
Senior Scientist, Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat-785013, Assam, India.

Correspondence:
Janardan Saikia
PhD. Scholar, Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat-785013, Assam, India.

Biology and detection technique of angoumois grain moth, *Sitotroga cerealella* Olivier (Lepidoptera: Gelechiidae) on stored rice and maize grains.

Janardan Saikia, M. M. Goswami, Badal Bhattacharyya

Abstract
The Angoumois grain moth, *Sitotroga cerealella* (Oliv.) (Lepidoptera: Gelechiidae), is a cosmopolitan and most destructive primary insect pest of several stored grains. The biology and detection techniques of *S. cerealella* on rice and maize grains were studied under laboratory conditions at 31±1 °C and 90 ± 5 % relative humidity. Based on the measurements, the 1st, 2nd, 3rd and 4th larval instars lasted 3.0, 4.1, 4.4 and 4.5 days respectively in rice and 4.4, 5.4, 5.2 and 5.6 days in maize, resulting in total larval duration of 16.2 days in rice and 20.7 days in maize. The detection technique found expeditious was acid fuchsin staining technique followed by Tullgren Funnel method, flotation method and visual method, while Tullgren Funnel method was efficient in extracting first instar larva.

Keywords: Angoumois grain moth, Biology, Detection technique, Sitotroga cerealella.

1. Introduction
Grain production has been steadily increasing due to advancement in production technology, but improper storage results in high loss in grains. The loss in storage is caused mainly due to weevils, beetles, moths and rodents. The loss due to insect infestation in rice, range from 4.09 to 12.61 per cent [1]. India has the world's largest area devoted to rice cultivation, and it is the second largest producer of rice after China. India till date has a population of 1.15 billion inhabitants out of which 70 per cent rely on rice and maize for at least a third of their energy requirements. While comparing the efficiency of washing versus the Tullgren method for extracting microarthropods from dead leaves and branches in the canopy of *Cryptomeria japonica* trees it was found that, the washing method is appropriate for collecting Oribatida and other microarthropods, whereas the Tullgren method is better for collecting Collembola from the canopy litter of *C. Japonica* trees [2]. The present investigation attempted to study the biology and efficiency of different detection techniques against Angoumois grain moth, *Sitotroga cerealella.*

2. Materials and methods
The experiment was conducted in the laboratory of the Department of Entomology, College of Agriculture, Assam Agricultural University, Jorhat-13 during 2010 and 2011, which is located at latitude 26° 44' N, longitude of 94° 10' E, altitude of 91 m above mean sea level (MSL). As biology study and detection technique of *S. cerealella* has not been carried out so far in North-eastern region, it was studied on the rice var. 'ranjit' and maize var. 'navjot'.
Five hundred grams of rice and maize grains were sterilized by exposing them to -20 ^{0}C for 12 hours. The moths were allowed to oviposit on both the grains for a week, after which they were removed. Developmental parameters of *S. cerealella* like the larval period, instar duration and pupal period were recorded by means of the shed head capsule as an indicator of the completion of the first moult. Subsequent moults were determined by the presence of exuviae or head capsule. To observe the reproductive parameters, freshly emerged adults obtained from separate cultures raised from single pair of *S. cerealella* were placed in plastic jars (of 2 L capacity) with 50 g of rice and maize grains. 50 % sugar solution was supplied for moth feeding. The fecundity, rate of oviposition and incubation period, on rice and maize were observed and recorded. The number of eggs in each jar was counted after 10 days. A separate similar setup was kept to observe the adult longevity and life cycle duration of *S. cerealella*.

Adult longevity was recorded from each jar and the data were analyzed statistically applying "paired *t*- Test." The trial were replicated twenty times and the average weight of freshly emerged adults from rice and maize were measured by means of a "Mettler H5 IAR" electric balance. For this, one pair (male and female) of freshly emerged adults, emerging from rice and maize were collected separately in small specimen vials and weight of insects was recorded individually and mean weight of males and females emerging from each sample was worked out. For comparison of different detection technique to see the percentage infestation by *S. cerealella*, five pairs (male and female) of *S. cerealella* were reared in one kilogram each of maize and rice grains separately. Four methods, *viz.*, visual method, Tullgren funnel method, Acid fuchsin method and flotation method were taken for testing efficacy in detecting *S. cerealella* infestation in 400 grains each from rice and maize grains. In visual method, visual inspection was carried out with the help of magnifying glass for the presence of damaged grains. In Tullgren method, *S. cerealella* larvae were extracted by Tullgren funnel from rice and maize samples. The samples were analyzed in Tullgren funnel by adjusting to high light intensity (with 40 watt electric bulbs) and extraction process continued for 72 hours. Light intensity was measured by using Luxmeter, which recorded 4500 lux for high intensity. After completion of 72 hours, the *S. cerealella* larva that could be extracted in the collecting tube containing 70 per cent ethyl alcohol was transferred to a petridish and was counted. It was assumed that each larva extracted had infected a single grain in the sample. For Acid fuchsin test, the hidden infestation was detected by staining method [3]. The grain samples were soaked in warm water for five minutes. The water was then drained off and the grains were covered with the acid fuchsin stain solution on petri-dish. The solution was prepared with,

Glacial acetic acid - 50 ml
Acid fuchsin - 0.5 g
Distilled water - 950 ml

After five minutes the stain solution was drained off from the petri-dish and the grains were washed with tap water to remove the excess stain. The kernels were examined to locate the punctures stained in light red colour. The number of infested grains was counted and expressed on percentage basis. In floatation method, distilled water was used to make a rapid separation of infested grains from the non-infested grains in rice and maize samples respectively and the uninfested grains settled down, whereas the infested grains kept floating. In all the four methods grains were separated, counted and expressed on percentage of total grains sampled. Each technique was evaluated with 5 replicates.

3. Results and discussion

3.1 Developmental and reproductive parameters

The results on biology of *S. cerealella* are given in table 1. There were four larval instars when *S. cerealella* was reared on the seeds of above host plants. The host seeds had a significant effect on the duration of the larval instars of *S. cerealella.* The larval period recorded in rice was 16.20 days and 20.70 days in maize. This variation in larval duration might be due to nutritional status of hosts. The egg stage of *S. cerealella* (Oliv.) varied from 4-7 days, larval stage 14-20 days and pupal stage 7-16 days, while the mean larval period was reported to be 29.8 days in wheat, pupal duration 5.1 to 5.7 days in rice and maize grains respectively [4, 5]. It was also observed that the body size of female was larger than male in both rice and maize grains. Another prominent characteristic was the presence of black strips on the ventral abdominal portion in case of male adults, whereas in case of female adult the black strips were absent as reported earlier [6].

It was evident that the fecundity was 126.35 eggs/female in rice and 128.75 egg/female in maize grains. The variation in fecundity might be due to insufficient mating, amount of food supplied and difference in microclimate in laboratory condition. The total life cycle of female was 43.2 days in rice and 44.3 days in maize, whereas the total life cycle of male was 37.4 days in rice and 43.3 days in maize. The variations in total life cycle duration might be due to variation in nutritional availability of the grains. The adult longevity was recorded 6.0 days for both male and female, respectively in rice grains, whereas 6.1 days and 7.1 days for both male and female, respectively in maize grains. However, it was reported 8.9 days in male and 9.8 days in female respectively for adult longevity [7, 8].

Table 1: Developmental period of different life stages of *Sitotroga cerealella* on rice grain in the laboratory.

Developmental Stages	Duration (in days)	
	Rice (mean±se)	Maize (mean±se)
Oviposition	5.3±0.7	8.20±4
Incubation	3.3 ±0.5	2.8±0.8
Larval Period		
1st Instar	3.0±0.8	4.4±1.0
2nd Instar	4.1±0.6	5.4±0.7
3rd Instar	4.45±0.6	5.2±0.8
4th Instar	4.5±0.6	5.6±0.6
Per-pupal	3.0±0.04	3.2±0.2
Pupal	5.1±0.6	5.7±0.9
Adult longevity		
Male	5.0 ±0.7	5.4 ±0.8
Female	7.0 ±0.6	8.1±0.9

3.2 Comparison of different detection techniques against *S. cerealella*

Comparison of different detection techniques revealed significant variation (table 2). With the use of magnifying glass in visual method, the eggs of *S. cerealella* laid on the surface of the grains were distinctly visible. The total percentage infestations detected were 15.20% in rice and 18.20% in maize. In Tullgren method, at 24 hours of exposure, the average number of larvae extracted with the funnel from rice and maize sample was found to be 7.5 and 5.7 respectively. At 36, 48 and 72 hours of exposure, the mean number of larvae extracted with the funnel were 11.7, 21.2 and 27.2 in rice samples, respectively and it varied significantly from the mean number of larvae extracted with the funnel in maize sample, which were found to be 7.2, 11 and 18, respectively. Acid fuchsin method, resulted egg- plugs to be stained in cherry red colour after staining and the percentage of infested grains out of 400 seeds was found to be 37.2 per cent in rice and 52.7 per cent in maize. Whereas, in floatation method percentage of damaged grains was recorded to be 24.9 per cent in rice and 15.2 per cent in maize. However, some of the seeds were damaged by fungal infection, which were difficult to distinguish from the infested seed grains. The results are in close conformity with those reported by [9].

The acid fuchsin method, was better for detection of infested grains as compared to visual and flotation method, though

Tullgren funnel method can be used to extract the first instar larva.

Table 2: Comparison of different detection technique for determining percentage of infestation by *Sitotroga cerealella* on rice and maize

Methods	Rice (% infestation)	Maize (% infestation)
Visual method	15.2	18.2
Tullgren Funnel method	14.7	9.0
Acid fuchsin staining	37.2	52.7
Flotation method	24.9	15.2

4. Conclusion

The present investigation indicated that for biological studies, rice as host seed grain is comparatively better against maize for raring *S. cerealella* and acid fuchsin staining method proved as expeditious detection technique among the others.

5. Acknowledgement

The author is thankful to the head, Department of Entomology, Assam Agricultural University, Jorhat-13 and to the Directorate of Post Graduates Studies for providing the necessary facilities.

6. References

1. Shafique M, Ahmad M. Susceptibility of milled rice genotypes to Angoumois grain moth, *Sitotroga cerealella* Oliv. (Lepidoptera: Gelechiidae). SAARC Journal of Agriculture 2003; 1:193-197.
2. Tomohiro Y, Naoki H. Efficiency of extracting microarthropods from the canopy litter in a Japanese cedar (*Cryptomeria japonica* D. Don) plantation: a comparison between the washing and Tullgren methods. The Japan Forest Society 2007; 10(4):2-8
3. Frankenfeld JC. Staining methods for detecting weevil infestation in grain. USDA Bureau of Entomology and Plant Quarantine 1948; 256:1-4
4. Prakash MA, Chhillar BS, Kashyap RK *et.al*. Studies on the biology of Angoumois grain moth, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae) on wheat varieties. Ind J Entomol 2004; 66(3):264-266
5. Ghosh SK, Durbey SL. Integrated Management of stored grain pest. Department of Entomology, Bihar Agricultural College, Ragendra Agricultural University, Sabour, Bhagalpur (Bihar), 2003, 36-37.
6. Prakash A, Rao J. Losses due to insects in stored rice. Bulletin of Grain Technology 1985; 23(1):77-82.
7. Koleva L, Ganeva G. A Study on the Life Cycle of Angoumois Grain Moth *Sitotroga cerealella* Oliv. (Lepidoptera: Gelechiidae) during Feeding on Different Wheat Genotypes (*Triticum aestivum* L.). Plant Science 2009; 46(2).
8. Ashamo MO. Relative resistance of paddy varieties to *Sitotroga cerealella* (Lepidoptera: Gelechiidae), Division of Entomology, Indian Agricultural Research Institute (IARI). New Delhi Biologia 2009; 65(2):333-337.
9. Sharifi S. Oviposition Site and Egg Plug Staining as Related to Development of Two Species of *Sitophilus* in Wheat Kernels. J appl Entommol 2009; **7**(1-4):428-431.