

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.607.320>

Comparative Biology of *Rhyzopertha dominica* (Fab.) in Major Cereals

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ABSTRACT

Aiming at verifying the effect of host on the development, the biology of *Rhyzopertha Dominica* (Fab.) was studied on paddy variety, Sumati, Maize Hybrid DHM-111 and sorghum variety M 35-1 during 2009-10 in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad. The biological parameters assessed were egg duration, egg hatching percentage, total larval and pupal period, total development period, fecundity, male and female longevity, sex ratio, pre-oviposition, oviposition and post oviposition period. When *R. Dominica* was reared on paddy, maize and sorghum the egg period was lowest in paddy variety sumati (6.57) and highest in maize hybrid DHM 111 (7.72). The egg hatching percentage is lowest in Maize Hybrid, DHM-111 (68.48±3.95) and highest in case of sorghum var. M 35-1 (73.65±5.12). The total larval and pupal period shortest in sorghum var. M 35-1 (35.35±1.95) and highest in Maize Hybrid, DHM-111 (43.85±1.45). The shortest total developmental period of 42.17±2.13 and 41.63±2.17 were recorded in male and female of *R. Dominica* in sorghum var. M 35-1 and the longest developmental period of 51.57±1.28 and 50.77±1.14 were recorded in males and females of *R. Dominica* in case of Maize Hybrid, DHM-111. In all the three hosts it was found that the longevity of female was longer than male. The shortest pre-oviposition, oviposition and post oviposition periods of 4.03±0.67, 31.33±2.41, 6.13±0.73 days were recorded in Maize Hybrid DHM- 111 respectively. The results obtained shows that among the three host grains used for the study, Maize hybrid was found to be the least preferred host, followed by paddy variety, Sumati and sorghum variety, M 35-1.

Keywords

Rhyzopertha dominica (Fab.), Paddy, Maize and sorghum, Variety and hybrid.

Article Info

Accepted:

23 June 2017

Available Online:

10 July 2017

Introduction

Cereal grains are the main sources of human diets. Grain losses in cereals during storage can reach 50 per cent of the total harvest where major part of quantitative and qualitative loss of grain is caused by insects (Fornal *et al.*, 2007). Among the pests of stored grain, lesser grain borer, *Rhyzopertha dominica* F. (Coleoptera: Bostrichidae) infests the cereal crops viz paddy, sorghum and

maize (Menon *et al.*, 2002) and was considered as the major pest. This insect pest is considered as both external and internal feeder. Both larvae and adults of this insect feed on whole, sound grains and cause extensive damage (Rees, 2007).

In view of the importance of the pest, laboratory studies were conducted to know

the biology of this pest among different cereals including paddy, maize, and sorghum.

Materials and Methods

The biology of *Rhyzopertha dominica* (Fab.) was studied on paddy variety, Sumati, Maize Hybrid, DHM-111 and sorghum variety M 35-1 during 2009-10 in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad. The experiment was conducted in the laboratory at room temperature.

Mass culturing of test insect

The lesser grain borer *Rhyzopertha dominica* (Fab.) (Coleoptera: Bostrichidae) was used as the test insect. The parental culture of *R. dominica* emerged from paddy grains were procured from Agricultural Research Institute (ARI), Rajendranagar, Hyderabad. The same was multiplied on the maize hybrid, DHM - 111.

Twenty pairs of *R. dominica* adults were released into glass jars (20 x 15 cm) containing 500 g of disinfected maize grain and the mouth of the jar was covered with muslin cloth and tied with rubber bands.

Ten such jars were maintained for mass culturing of test insect. The jars were kept undisturbed under laboratory conditions till the emergence of F1 adults. The freshly emerged adults were used in the present study.

Sexing of insect

The male and female of *R. dominica* adults were identified based on the description given by Stemley and Wilbur (1996). The males usually have the last exposed abdominal tergum uniformly brown and that of the female is usually pale yellow.

Test seed material used in the study

The biology of *Rhyzopertha dominica* was studied on the paddy var. Sumati, Maize Hybrid, DHM 111 and sorghum var. M 35-1.

Life history

In order to study the various stages of *R. dominica*, the adults (5 pairs) were released in petri plates (1.5 × 9 cm) containing 25 gm of grains of Sumati, DHM-111 and M 35-1 for egg laying. Likewise 10 sets were prepared. Female were found laying eggs on the bottom of petri plate in groups of 2-30 or rarely single egg was also observed. The adults were removed and eggs were kept in petri plates same as for further observations and petri plates were covered with muslin cloth and tied with rubber bands.

Egg

Egg period was considered as the period between dates of egg laying to the egg hatching. After hatching of the eggs the fresh larvae were individually transferred to new petri plates with the help of fine camel hair brush and kept with few grains for further development.

The eggs were considered as hatched on the basis of a hole at upper side of the grain.

Total larval and pupal period

Larvae of *R. dominica* being internal feeder, it was not possible to recognize change of larval instars by observing moulted off skin. It was recorded as time between the dates of hatching of egg to the emergence of adult.

Total developmental period

The developmental period was calculated as the period between eggs laying to the emergence of adult.

Sex ratio

The adults emerged from reared pupae under laboratory condition were separated as male and female. Thus, the sex ratio was calculated.

Oviposition

Freshly emerged male and female adults were separated and paired in a petri plate with 100 uninfested paddy, maize and sorghum grains. For recording observations on the egg laying, firstly the pair of adults were shifted to new petri plate and then number of eggs laid by female daily were recorded. The oviposition period was studied in three parts viz., pre-oviposition period, oviposition period and post-oviposition period.

The pre -oviposition period was calculated as the date of emergence of female to the date of starting of egg laying. The ovipositional period was calculated as the date of starting of egg laying to the date of cessation of egg laying by individual female. The post-oviposition period was calculated as the date of cessation of egg laying to the date of female death.

Fecundity

The total number of eggs laid during entire life span of the female was considered as its fecundity. To determine the fecundity, eggs laid by each female were counted daily till the death of the female and the average fecundity was calculated.

Longevity

The longevity of male and female was recorded from the period between the emergences of the adult to the death of the adult.

Results and Discussion

Among the three host grains used in the experiment, the results in table 1 shows that the egg period of 7.03 ± 0.90 was recorded in sorghum var. M 35-1, shortest egg period was recorded in Paddy var. Sumati (6.57 ± 0.54) and highest in case of Maize Hybrid, DHM-111 (7.72 ± 0.85). Faroni and Garcia observed egg period of 6.8 ± 0.2 in sorghum, shortest egg period in paddy (6.8 ± 0.1) and highest in maize (6.9 ± 0.1). Sattigi *et al.*, (1987) reported that the egg period of *R. dominica* varied from 5 to 9 days on sorghum. The egg hatching percentage is lowest in Maize Hybrid, DHM-111 (68.48 ± 3.95) and highest in case of sorghum var. M 35-1 (73.65 ± 5.12). The present results support the findings of Singh *et al.*, (1986) and Meenakshi and Srivastava (2010) who have observed the hatching percentage varied from 72.90 to 89.20 and 60.70 to 83.55 per cent on different wheat varieties, respectively.

The results in table 2 shows that the total larval and pupal period was 39.08 ± 1.58 in Paddy var. Sumati, shortest in sorghum var. M 35-1 (35.35 ± 1.95) and highest in Maize Hybrid, DHM-111 (43.85 ± 1.45). Previously, Singh *et al.*, (1986) recorded total larval and pupal period of *R. dominica* 36.60 days on wheat variety Kalyan sona. Kumawat (2007) also found that total larval and pupal period varied from 24.2 to 44.8 days.

The total developmental period of 45.93 ± 1.46 and 44.53 ± 1.66 were recorded in male and female *R. dominica* in Paddy var. Sumati. The shortest total developmental period of 42.17 ± 2.13 and 41.63 ± 2.17 were recorded in male and female of *R. dominica* in sorghum var. M 35-1 and the longest developmental period of 51.57 ± 1.28 and 50.77 ± 1.14 were recorded in males and females of *R. dominica* in case of Maize Hybrid, DHM-111. Bains, 1971 reported the longest mean total

developmental duration of *R. dominica* as 51.37 days and shortest as 34.57 days at 27°C and 33°C temperature on stored wheat grains. Singh *et al.*, (1986) recorded that total developmental period of *R. dominica* from egg to adult emergence was 55 and 44.50 days on Kalyan sona and Sonalika varieties of wheat, respectively under laboratory condition. Potter (1935) reported that the total length of the life - cycle from egg to adult averaged for about 58 days.

The fecundity of 220.43±12.75 was recorded in Paddy *var.* Sumati, the lowest fecundity of 128.73±11.70 was recorded in Maize Hybrid, DHM-111 and the highest fecundity rate was observed in sorghum *var.* M 35-1 (233.23±13.90). The longevity recorded in Paddy *var.* Sumati was 42.13±2.79 and

45.73±3.13 days respectively for male and female *R. dominica*. The longest longevity of 46.13±3.09 and 48.47±2.84 days were observed in male and female in sorghum *var.* M 35-1 while the shortest longevity of 37.13±2.61 and 37.97±2.66 days were recorded in male and female *R. dominica* in Maize Hybrid, DHM-111. In all the three hosts it was evident that female lived longer than male. Similar observations were made by Jagadish *et al.*, (2009) who observed longer adult life on finger millet grains (43 to 71 days with a mean of 54.7 for female and 37 to 54 days with a mean of 43.2 days for male). Meenakshi and Srivastava (2010), also found that the longevity of female beetle ranged from 34.7 to 55.7 days and male longevity ranged from 33.0 to 54.1 days.

Table.1 Egg period and Egg hatching percentage of *Rhyzopertha dominica* (Fab.) on Paddy *var.* Sumati, Maize Hybrid DHM- 111 and Sorghum *var.* M 35-1

Variety/ Hybrid	No. observed	Egg period	No. observed	Egg Hatching percentage
Paddy <i>var.</i> Sumati	30	6.57±0.54	120	70.87±5.34
Maize Hybrid DHM-111	30	7.72±0.85	108	68.48±3.95
Sorghum <i>var.</i> M 35-1	30	7.03±0.90	128	73.65±5.12

Table.2 Biological parameters of *Rhyzopertha dominica* (Fab.) on Paddy *var.* Sumati, Maize Hybrid DHM- 111 and Sorghum *var.* M 35-1

Variety/ Hybrid	Total Larval and Pupal period*	Total Developmental Period**		Fecundity (No. of eggs/ female)**	Longevity**	
		Male	Female		Male	Female
Paddy <i>var.</i> Sumati	39.08±1.58	45.93±1.46	44.53±1.66	220.43±12.75	42.13±2.79	45.73±3.13
Maize Hybrid DHM-111	43.85±1.45	51.57±1.28	50.77±1.14	128.73±11.70	37.13±2.61	37.97±2.66
Sorghum <i>var.</i> M 35-1	35.35±1.95	42.17±2.13	41.63±2.17	233.23±13.90	46.13±3.09	48.47±2.84

Note: *values based on average of 60 observations
 **values based on average of 30 observations

Table.3 Sex ratio of *Rhyzopertha dominica* (Fab.) on Paddy var. Sumati, Maize Hybrid DHM- 111 and Sorghum var. M 35-1

Variety/ Hybrid	No. observed	Sex ratio
Paddy var. Sumati	450	1: 1.30
Maize hybrid DHM-111	390	1: 1.20
Sorghum var. M 35-1	480	1: 1.32

Table.4 Pre oviposition, Oviposition and Post Oviposition Period of *Rhyzopertha dominica* (Fab.) on Paddy var. Sumati, Maize Hybrid DHM- 111 and Sorghum var. M 35-1

Variety/ Hybrid	pre- oviposition period	oviposition Period	post oviposition Period
Paddy var. Sumati	6.77±0.82	33.80±1.92	7.57±1.10
Maize Hybrid DHM-111	4.03±0.67	31.33±2.41	6.13±0.73
Sorghum var. M 35-1	6.47±1.25	35.43±1.89	7.03±0.89

Values are based on average of 30 observations each.

Sex ratio (male: female) of *Rhyzopertha dominica* (Fab.) on Paddy var. Sumati is 1:1.20, in Maize Hybrid DHM- 111 the ratio is lowest among the three hosts (1:1.20) and the highest sex ratio was recorded in Sorghum var. M 35-1(1:1.32) as shown in table 3. The findings were in agreement with Meenakshi and Srivastava (2010) who recorded that the sex ratio of *R. dominica* of male to female was 1: 1.39 and 1: 1.25 in variety Mandakani and Ujiyar of wheat, respectively.

The shortest pre-oviposition, oviposition and post oviposition periods of 4.03±0.67, 31.33±2.41, 6.13±0.73 days were recorded in Maize Hybrid DHM- 111 respectively. The findings are in agreement with Faroni and Garcia (1992) who reported that the pre - oviposition period of female of *R. dominica* was between four and six days. They observed the pre-oviposition period was minimum on maize (3.7 ± 0.2 days) and intermediary on sorghum (4.7 ± 0.2 days).

The oviposition duration was highest in Sorghum var. M 35-1 (35.43±1.89) while the oviposition period of 33.80±1.92 was recorded in Paddy var. Sumati (Table 4)

However, the pre-oviposition period (6.47±1.25) and post oviposition period (7.03±0.89) of Sorghum var. M 35-1 were comparatively lower than pre-oviposition period (6.77±0.82) and post oviposition period (7.57±1.10) of *R. dominica* in Paddy var. Sumati. Jagadish *et al.*, (2009) recorded that the pre - ovipositional period of *R. dominica* ranged from 6 to 9 days with an average of 7.40 days. The ovipositional period ranged from 28 to 45 days with a mean of 34.20 days, while Mason (2010) observed that oviposition period varied from 15 days to 4 months which are in support of the present findings.

The results obtained from the comparative biology of *R. dominica* on the three host grains shows that maize hybrid (DHM-111) is the least preferred host, paddy variety, Sumati is the moderately preferred host and the sorghum variety M 35-1 is the highly preferred host. The current findings are supported by Khatibi (1977) who had tested the food preference of *R. dominica* and found that this insect pest preferred less of rice and maize.

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How to cite this article:

Sudheer Kumar, P., T. Uma Maheswari and Padmakumari, A.P. 2017. Comparative Biology of *Rhyzopertha dominica* (Fab.) in Major Cereals. *Int.J.Curr.Microbiol.App.Sci*. 6(7): 2205-2210. doi: <https://doi.org/10.20546/ijcmas.2017.607.320>