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SUSCEPTIBILITY OF SIX VARIETIES OF RICE TO THE INFESTATION OF RICE WEEVIL, *SITOPHILUS ORYZAE* (L.) (COLEOPTERA: CURCULIONIDAE)

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Abstract

The susceptibility of six varieties of rice, *Oryza sativa*, *viz.* Lata, Minicate, Nazersail, Parija, Kalijira and Kataribhog, to the infestation of the rice weevil, *Sitophilus oryzae* (L.), was studied on the basis of population build up under an ambient condition (28 ± 4ºC and 70 ± 4 % RH) of the laboratory. The mean weights of each grain of the above six rice varieties were 16.9, 16.1, 11.43, 13.87, 6.23 and 9.77 mg, respectively; mean lengths were 6.47, 6.56, 5.37, 5.38, 4.22 and 4.92 mm, respectively; mean widths were 2.45, 2.03, 2.05, 2.17, 1.6 and 1.9 mm, respectively; and moisture contents were 11.55, 10.75, 11.6, 12.71, 11.85, and 12.1 per cents, respectively. As far as the number of emerging adults is concerned, the weevil showed the highest number (695) in Nazersail on the 16th week, Lata (755) on the 18th week, Minicate (654) on the 16th week, Parija (482) on the 20th week, Kalijira (402) on the 20th week, and Kataribhog (456) on the 20th week. The mean numbers of the adult weevils in the above six varieties after 22 weeks of rearing were 425, 410, 351, 387, 357 and 400, respectively and was statistically significant at 5% level. The degree of susceptibility of the rice varieties to the rice weevils from the highest to lowest susceptibility was - Lata > Nazersail > Minicate > Pariza > Kataribhog > Kalijira.

Introduction

About 34 species of insects have been reported as the pests of stored paddy and rice from different countries[1]. In Bangladesh, 19 species of insects have been recorded in stored rice[2-3], out of which the rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) is considered to be the most common pest in all types of rice in the store houses of the country.

The susceptibility of different varieties of rice to the infestation of rice pest particularly *S. oryzae*, its occurrence and damage were studied[2, 4-13]. The susceptibility of cereals to the infestation of this insect pest and its implementation for pest managements was also studied[13-15]. Bangladesh imports different kinds of rice as well as it produces million tones of various types of rice every year and this rice has to be stored. For this purpose, it is necessary to know the susceptibility of the rice varieties to the infestation of

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insect pests. This will help the concerned authorities to take appropriate measures for the rice in storage. The present study was, therefore, undertaken to look into the nature of infestation of six rice varieties by the rice weevil, *S. oryzae* and to observe its population development on these varieties.

Materials and Methods

Six varieties of rice (*Oryza sativa*), studied were Najersail (parboiled), Lata (parboiled), Kalijira (un-parboiled), Pariza (parboiled), Minicate (parboiled) and Kataribhog (un-parboiled). The susceptibility of these varieties of rice to the infestation of the rice weevil, *S. oryzae* was studied in the Entomology laboratory of the Department of Zoology, University of Dhaka, at an ambient environment (28 ± 4ºC and 70 ± 4% RH) in the laboratory.

The rice varieties were collected from some rice-stores of Dhaka city. The rice weevils (*S. oryzae*) were collected from the stored rice of the dinning mess of the Jagannath Hall of the University of Dhaka. The weevils were identified following Alam [(2)], Metcalf and Flint[(16)], and Halstead[(17)]. Only fresh whole rice grains were selected; cracked or damaged rice grains were removed from the test samples. Any extraneous materials, when found, were also removed. Three rice grains from each of the varieties were randomly selected and their lengths, widths and weights were recorded. The grains were weighed with the help of an electric balance [Model: Scientech SA 210 (210 × 0.0001 G)].

The rice grain samples were disinfested by keeping them inside a deep fridge for one week and the grains were considered to be totally disinfested. After the treatment, the rice grains were spread on normal white papers at room temperature and humidity for 24 hours to bring them into normal condition. The moisture content of each rice variety was determined following the oven method. For this, 100 g of grains were taken from each variety and weighed. These were then kept in an oven at 60ºC for 24 hrs and after that the samples were weighed and recorded. The weight loss is considered to be equivalent to the moisture content of the rice grain. The per cent weight loss was calculated by the following formula:

Weight loss (%) = $[(X_1 – X_2)/X_1] \times 100$

where, X_1 = Initial weight of each grain sample; X_2 = Weight of the sample after heat treatment.

The treatments were replicated thrice for each variety of the rice grain. For this experiment, 25 g of whole rice grains (not cracked or broken) from each rice variety were accurately weighed with a Triple Bean Balance and kept in plastic containers measuring 8 × 6 cm each. Five pairs of the newly emerged adults of 24-48 hours age group in the ratio of 1 : 1 were released into each container. Four replications were taken for each rice variety. The opening end of the container was covered with a piece of "Markin" cloth (for aeration) and tied with rubber bands. The containers were kept under the condition of

normal room temperature and relative humidity for six months. The released weevils were allowed to remain undisturbed in the containers with the gains for the first four weeks. The first census of the weevils, both living and dead, was made after 30 days since the insect release, and subsequently at every 15 days of interval. After each count, the dead weevils were discarded and the living ones were returned to the rearing medium. The recording of the number of weevils continued up to 154 days. The data were analyzed statistically.

Results and Discussion

The estimates of weight, length, width and moisture contents of the varieties of rice are shown in Table 1. Each rice grain of the Lata variety showed the highest weight (16.9 mg) and the smallest was in Kalijira variety (6.23 mg). In terms of the length of each grain, Minicate variety showed the longest (6.56 mm in length) and Kalijira, the shortest (4.22 mm in length). Lata variety showed the widest (2.45 mm), while Kalijira, the smallest (1.6 mm) in width. Regarding the percentage of moisture content of the grains, Parija variety showed the highest (12.71%) and Minicate, the lowest (0.75%) (Table 1). Islam[12] recorded the weight, length, width and moisture contents of seven varieties of rice [*viz.* Najersail, Latisail (parboiled), Kalijira, Pariza (parboiled), Minicate, Pajam and Kataribhog], and the present findings were found more or less similar to the corresponding rice varieties reported by Islam[12].

Table 1. Weight, length, width and moisture contents of six varieties of rice, *O. sativa*.

Rice variety	Condition	Weight (mg) *Mean ± SE	Length (mm) *Mean ± SE	Width (mm) *Mean ±SE	Moisture (%)
Lata	Parboiled	16.90 ± 1.11	6.47 ± 0.18	2.45 ± 0.03	11.55
Minicate	Parboiled	16.10 ± 0.15	6.56 ± 0.05	2.03 ± 0.14	10.75
Nazirsail	Parboiled	11.43 ± 0.59	5.37 ± 0.04	2.05 ± 0.07	11.60
Parija	Parboiled	13.87 ± 0.19	5.38 ± 0.06	2.17 ± 0.04	12.71
Kalijira	Un-parboiled	6.23 ± 0.57	4.22 ± 0.16	1.60 ± 0.05	11.85
Kataribhog	Un-parboiled	9.77 ± 1.24	4.92 ± 0.04	1.90 ± 0.06	12.10

*Mean values of three observations of each rice variety.

As far as the number of emerging adults of *S. oryzae* is concerned, the insect pest showed the highest number (695) in Nazersail variety on the 16th week, Lata variety (755) on the 18th week; Minicate variety (654) on the 16th week, Parija variety (482) on the 20th week, Kalijira variety (402) on the 20th week, and Kataribhog variety (456) on the 20th week (Table 2). The present findings were in conformity with the findings of Islam[12] who reported that the number of the weevils emerged was the highest in the Najersail and the lowest in Kalijira among the seven varieties of rice. It may therefore be thought that, as far as quick growth and development is concerned, Nazersail is

qualitatively and quantitatively congenial to the growth and development of the rice weevil, the highest number (755) was produced in Lata though; on the other hand, Kalijira is the least favourable for the growth and development of the weevil. An analysis of variance showed that the susceptibility of the rice varieties did not vary significantly at 5% level up to the 4th week after the initial introduction of the weevils to the rice varieties, while the susceptibility among the test rice varieties varied significantly ($p < 0.05$) from the 6th week onward. Out of six rice varieties Kalijira exhibited significantly less susceptibility to *S. oryzae* and on the other hand, Lata was most susceptible to *S. oryza* (Table 2).

Table 2. Trends in the population development of the rice weevil *S. oryzae* in six varieties of rice.

Weeks	Number of living adults in rice varieties (#mean)						F
	Lata	Minicate	Nazersail	Pariza	Kalijira	Kataribhog	
4	9.75a	7.50a	8.50a	8.50a	9.25a	9.50a	0.660
6	78.25c	68.00b	88.50d	42.75a	52.75a	52.25a	7.356*
8	140.00c	123.25b	162.75d	76.25a	120.00b	122.75b	89.434*
10	190.25e	170.75d	225.25f	95.00a	138.00b	157.00c	177.051*
12	245.00e	209.00d	301.00f	120.50a	172.25b	183.25c	342.074*
14	380.75e	305.75d	409.25f	160.75a	200.75b	225.00c	13.272*
16	725.50f	**654.00**d	**695.00**e	296.00c	250.00a	276.25b	16.002*
18	**755.00**f	613.75e	535.25d	425.00c	313.00a	376.00b	14.396*
20	575.75d	599.00e	476.00c	**482.00**c	**402.00**a	**456.00**b	388.419*
22	425.00e	410.25d	350.75a	386.75b	356.75a	400.25c	106.569*

#Mean values of four replications; Numbers shown are cumulative totals of live adults; *Significant at 5% level; Means followed by the same letters in a row are not significantly different at the 5% level of DMRT.

There is common belief that the aromatic fine rice varieties are more susceptible to insect attack, which was not found to be true in this experiment as Kalijira, an aromatic fine rice variety (locally known as polao rice), was found to be less infested by the rice weevil where least total adults recorded 402 compared to the total adults emerged in other five rice varieties. However, none of the six rice varieties tested was found completely immune to the attack of *S. oryzae*. The degree of susceptibility of the rice varieties to the rice weevils from the highest to lowest susceptibility was - Lata (755) > Nazersail (695) > Minicate (654) > Pariza (482) > Kataribhog (456) > Kalijira (402).

It was found that the parboiled rice varieties (e.g. Kataribhog and Kalijira) were more susceptible to infestation than un-parboiled rice varieties (e.g. Lata, Nazersail, Minicate and Parija). Similar results were also reported by Prevett[4], Islam[12], and Arakaki and Takahashi[18]. Earlier experiments demonstrated that the factors, such as seed species,

variety, age, hardness, size, moisture, etc. influenced the oviposition, reproduction, development and infestation of the rice weevils[19-22]. In the present experiment, least susceptible variety like Kalijira was found to exert persistently accumulative effect in reducing the development of rice weevils at a slower rate and limiting their population build up. In the least susceptible rice varieties, the cumulative reduction of the weevil population was presumably due to the failure of adults and larvae to feed adequately, high mortality of larvae and adults, and low oviposition and hatching of the eggs. On the other hand, population increases on the susceptible varieties like Lata was much earlier than the resistant varieties because of their higher survival of parent and larval stages on these varieties.

In conclusion, it might be said that the susceptibility of rice varieties to insect pest is a complex phenomenon. The study also shows that the susceptibility of six rice varieties to the infestation of *S. oryzae* depends not only on a single factor; but, it depends on the combination of many factors like grain hardness, nutritive value, and natural resistance[12]. In addition, the factors comprising grain size and moisture content in the rice grains might be the reasons of severe infestation by the rice weevil population.

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