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Effect of Different Colours of Storing Containers on the Infestation of *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) on Stored Rice Grains in Terai Agro-Ecology of West Bengal

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A B S T R A C T

Laboratory experiments were carried out to study the effect of different colours of storing containers on the infestation of *Sitophilus oryzae* on stored rice grains during 2018-19. The results of the present investigation reveals that at 90 days after storage maximum grain infestation (%) was recorded in Mohanbhog (47.66%) followed by Seshphal (40.07%) while the lowest infestation was noted in Jhagarikartik (34.58%). When the effect of colour of the storage containers was considered, the black container showed the highest % of infested grains (48.86%) followed by blue (42.61%) and green (38.65%) container while the lowest grain infestation was recorded from the transparent container (32.96%) at 90 days after storage. Same trend was also noted at 30 and 60 days after storage. Likewise Mohanbhog again registered the highest weight loss percent with pooled mean values 34.98% at 90 DAS respectively which was followed by Seshphal (32.62%) and Jhagarikartik (30.94%) respectively. It also reveals that black coloured storage container registered the highest weight loss percent (40.70%) followed by blue coloured storage container (35.68%), green storage container (31.70%), whereas the least weight loss percentage was registered from the transparent storage container (23.31%) at 90 DAS. This trend was always observed at 30 and 60 days after storage of rice grains. When the germplasms and the coloured containers were considered together, the *S. oryzae* reared under Mohanbhog in black containers produced the highest population while the *S. oryzae* reared under in Jhagarikartik in transparent containers showed the lowest weevil population.

Introduction

Rice, *Oryza sativa* (Linn.) is an economically important crop and the most important staple foods for the world's population. More than 90% of the world's rice is produced and consumed in Asia. The rice grain consists of 75-80% starch, 12% water and only 7% protein with a full complement of amino acids. Rice is very intimately bound with the economy and well-being of Asia as is regarded its traditional home. The rice weevil, *S. oryzae* L. (Coleoptera: Curculionidae), is one of the most important pests of many common cereals and has a worldwide distribution (Gomes *et al.*, 1983). It is also a primary Coleopteran pest of stored rice and wheat (Longstaff, 1981). It was first described by Linnaeus in 1763. The species name of *oryzae* was given because it was found in rice. The adult rice weevil is attracted by lights. Zaklodnoi and Ratonova (1987) reported that during the developmental periods of weevils, the larvae consume about 50% of the total weight of grain. According to Alam (1971), 5- 8% of the food grains, seeds and different stored products are lost annually due to storage pests and if the losses incurred on farms were included, it would amount upto 10%. As many as 34 species of insects have been reported as pests of stored paddy and clean rice from different countries (Grist and Lever, 1969). Reliable estimates of overall losses during rice storage are difficult to obtain but these are much greater than generally appreciated.

Materials and Methods

Under these experiments effect of colour of different storage container on the infestation (weight loss, damaged grain percentage and population built up of adult weevils after 90 days of storage) of *Sitophilus oryzae* was studied.

For conducting these experiment bottles of different colours *viz.,* black, blue, green and transparent were used. Fifty grams of sterilized healthy and whole grains from each germplasm *i.e.*, Jhagarikartik, Mohanbhog and Seshphal were taken into the containers of different colours. After these, ten pairs of newly emerged adult weevils (male and female ratio of 1:1) were released into it and the mouth of the containers were covered with muslin cloth and tied with rubber band. Three replications were maintained for all the treatment upto 90 days. Observations were taken before the exposure of the weevil adults as well as 30, 60 and 90 days respectively after exposure or storage. Infestation of *S. oryzae* was considered in terms of weight loss of grains which was estimated following the formula as suggested by Harris and Linblad (1978)

Percent weight loss = (Initial weight – final weight/Total weight taken of grains)*100.

Again, Sterilized, fresh, uninfested and whole rice grains of 1300 in numbers of the above mentioned three germplasms were taken into storage containers *i.e,* bottles of different colours. Further, ten pairs of newly emerged weevils with male and female ration of 1:1 were released in each container. The bottles were then covered with a muslin cloth and tied with the rubber bands and kept in the shelf for further observations. The infestation of *S. oryzae* was considered in terms of percentage of damaged grains and for the same the infested/damaged grains were counted periodically at monthly intervals at 30, 60 and 90 days respectively after storage. The grains with holes were considered as damaged or infested grains. To determine the percentage of damaged grains, number of grains having holes and normal grains were counted per storage container or replicates.

The percentage of damaged grain in each germplasm was calculated by adopting the formula:

Percent damage grain (%) = (Number of damaged grains/Total number of grains exposed)*100

For the population built up the total number of adult weevils emerged in each replication was counted after 90 days of storage. Later the data were subjected to statistical analysis. The data in percentage were subjected to angular transformations before statistical analysis. Similarly population build up values were transformed to square root transformations.

Results and Discussion

The effect of colour of the storage containers was considered, the black container showed the highest % of damaged grains (48.86%) while the lowest was recorded from the transparent container (32.96%) at

90 DAS. The highest weight loss percent (40.70%) was also recorded from black coloured container whereas the least was registered from the transparent storage container (23.31%) at 90 DAS.

The adult population of *S. oryzae* after 90 days of storage, varied significantly among the different coloured storage containers. It was observed that in the black coloured container the highest number of adults was produced (493.33 adults) and the lowest population was recorded from the transparent container with 378.72 adults.

The result of the preferences of *S. oryzae* for containers of different colours showed significant differences among them. The observation of preferences of *S. oryzae* for the four different colors *viz.*, black, blue, green and transparent indicated that black coloured container had the highest weight loss percent, damaged grain percent and the adult population count which was followed by blue and green while the lowest values were recorded from the transparent containers.

Post harvest insect pests commonly prefer dark places. Greatest preference of the rice weevils for black colour may be usual for it is nocturnal which is active in the night. Insects have different similarities and inclination to the spectrum and wavelength of lights (Boror *et al.*, 1989; Opara, 2013). In a study with five coloured containers, Manueke *et al.*, (2015) observed that black containers had the highest population of *S. oryzae* followed by blue, red, yellow and lowest was in white colour. Thus the results of the present study lend support from this.

Table.1 Effect of storage colour on the % of rice grains infested due to *S. oryzae*

		30 days			60 days			90 days		
		2017	**2018**	**Pooled**	**2017**	**2018**	**Pooled**	**2017**	**2018**	**Pooled**
Genotype	**Jhagarikartik**	9.74 (3.18)b	8.78 (3.03)c	9.26 (3.10)c	22.39 (4.77)c	20.37 (4.55)c	21.38 (4.66)c	35.68 (5.99)c	33.47 (5.81)c	34.58 (5.90)c
	Seshphal	11.64 (3.48)a	11.15 (3.41)b	11.39 (3.44)b	25.62 (5.10)b	24.55 (5.00)b	25.08 (5.05)b	40.72 (6.40)b	39.42 (6.30)b	40.07 (6.35)b
	Mohanbhog	12.17 (3.54)a	12.95 (3.66)a	12.56 (3.60)a	29.10 (5.42)a	29.22 (5.44)a	29.16 (5.43)a	48.79 (7.01)a	46.53 (6.85)a	47.66 (6.93)a
	SEm(±)	0.023	0.023	0.016	0.030	0.030	0.021	0.034	0.036	0.025
	CD	0.067	0.066	0.046	0.086	0.088	0.060	0.100	0.105	0.071
	CV (%)	2.34	2.33	2.33	2.01	2.08	2.04	1.84	1.98	1.91
Colour	**Green**	11.50 (3.45)b	10.15 (3.25)c	10.82 (3.35)c	25.35 (5.08)c	23.02 (4.84)c	24.18 (4.96)c	40.11 (6.36)c	37.20 (6.12)c	38.65 (6.24)c
	Black	12.73 (3.62)a	12.27 (3.56)a	12.50 (3.59)a	30.40 (5.54)a	28.92 (5.40)a	29.66 (5.47)a	49.84 (7.08)a	47.87 (6.95)a	48.86 (7.02)a
	Transparent	8.63 (3.01)c	10.47 (3.27)c	9.55 (3.14)d	20.32 (4.55)d	22.02 (4.72)d	21.17 (4.64)d	33.07 (5.77)d	32.86 (5.76)d	32.96 (5.77)d
	Blue	11.87 (3.51)b	10.95 (3.38)b	11.41 (3.45)b	26.75 (5.22)b	24.90 (5.03)b	25.83 (5.13)b	43.90 (6.65)b	41.31 (6.45)b	42.60 (6.55)b
	SEm(±)	0.026	0.026	0.0186	0.034	0.035	0.0243	0.040	0.042	0.0288
	CD	0.077	0.076	0.053	0.100	0.101	0.069	0.116	0.122	0.081
Geno × Colour	**SEm(±)**	0.046	0.045	0.0322	0.059	0.060	0.0421	0.069	0.072	0.0499
	CD	0.134	0.132	0.091	0.172	0.175	0.119	0.201	0.211	0.141

*Figures in the parenthesis are square root transformed values

Table.2 Effect of storage colour on the weight loss % of rice grains due to *S. oryzae*

		30 days			60 days			90 days		
		2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Genotypes	Jhagarikartik	8.75c	8.49b	8.62c	20.32c	20.86c	20.59c	30.89c	31.00c	30.94c
	Seshphal	9.35b	9.45a	9.40b	22.55b	22.07b	22.31b	32.68b	32.55b	32.62b
	Mohanbhog	10.67a	9.59a	10.13a	24.71a	22.73a	23.72a	35.94a	34.03a	34.98a
	SEm(±)	0.132	0.116	0.088	0.139	0.124	0.093	0.134	0.204	0.122
	CD	0.384	0.338	0.248	0.406	0.361	0.263	0.390	0.597	0.345
	CV(%)	4.75	4.37	4.58	2.14	1.96	2.05	1.40	2.18	1.82
Colour	Green	9.03c	9.02c	9.03c	21.32	21.28c	21.30c	31.83c	31.58c	31.70c
	Black	13.32a	13.21a	13.26a	29.17a	28.04a	28.61a	40.83a	40.57a	40.70a
	Transparent	4.70d	3.94d	4.32d	14.41d	13.96d	14.18d	23.85d	22.76d	23.31d
	Blue	11.30b	10.54b	10.92b	25.21b	24.27b	24.74b	36.17b	35.19b	35.68b
	SEm(±)	0.152	0.134	0.101	0.161	0.143	0.107	0.154	0.236	0.141
	CD	0.444	0.391	0.286	0.469	0.416	0.304	0.450	0.689	0.399
Geno × Colour	SEm(±)	0.263	0.232	0.175	0.278	0.247	0.186	0.267	0.409	0.244
	CD	0.768	0.676	0.496	0.813	0.721	0.527	0.780	1.193	0.691

*Figures in the parenthesis are square root transformed values

Table.3 Effect of storage colour on the population of *S. oryzae* after 90 days of storage

		90 days after storage		
		2017	2018	Pooled
Genotype	Jhagarikartik	426.67 (20.64)c	434.58 (20.84)c	430.63(20.74)c
	Seshphal	458.83 (21.40)b	445.83 (21.09)b	452.33(21.25)b
	Mohanbhog	471.33 (21.70)a	455.67 (21.33)a	463.50(21.51)a
	SEm(±)	0.020	0.013	0.012
	CD	0.057	0.037	0.033
	CV (%)	0.32	0.21	0.27
Colour	Green	453.67 (21.30)c	447.89 (21.17)c	450.78(21.24)c
	Black	497.89 (22.32)a	488.78 (22.12)a	493.33(22.22)a
	Transparent	381.67 (19.55)d	375.78 (19.40)d	378.72 (19.47)d
	Blue	475.89 (21.82)b	469.00 (21.67)b	472.44(21.74)b
	SEm(±)	0.023	0.015	0.014
	CD	0.066	0.043	0.038
Genotype × Colour	SEm(±)	0.039	0.025	0.023
	CD	0.115	0.074	0.067

*Figures in the parenthesis are square root transformed values.

Colour vision is common in insects (Briscoe and Chittka, 2001). It influences the insects to locate hosts. Incase of pollinators, studies on colour vision are wide and it has been found that colour provides are for a particular flower's location (Chittka and Raine, 2006). Different coleopteran insects have been observed to possess colour vision (Briscoe and Chittka, 2001). This may be most likely in case of storage pests including *S. zeamais* (Motsch.) and others where containing colour cues with attractive colour cues are thought to enhance the fruitfulnesss of the storage traps. Earlier studies with coleopteran insects indicated that three or four photoreceptor types, especially with UV-, blue-, green- and red-sensitivity in the four receptor species (Briscoe and Chittka, 2001).

One of the main reasons behind the preference of the weevils for black and blue colour may be that they are included to invisible or visible light beams and black to blue colour have the wavelength of 475nm (Manueke *et al.,* 2015). However, in the present studies it was beyond the scope of investigation as this aspect the present findings of preference of the weevils for the black and blue colour are in agreement with Manueke (1993) and Samad (2010) (coleopteran insects have great likings for colour with short to medium wave length such as dark colours, blue and green and this too relates to other nocturnal insects. The results corroborate the observations of Borror *et al.,* (1989) and Opara (2013) who reported that *S. oryzae* is a nocturnal insect and they are active at night, so their preferences for black colour are obvious and also being a postharvest pest, the weevils generally prefers dark places.

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