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EFFECT OF SEED SIZE AND SEED COAT COLOUR ON ORIENTATIONAL AND OVIPOSITIONAL PREFERENCE, DEVELOPMENT AND SURVIVAL OF PULSE BEETLE

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Abstract

The adult orientation and egg deposition on the varieties of different seed coat colour under free choice condition showed significant effect of seed coat colour on orientation and oviposition by the pulse beetle. Varieties of dark brown in colour were less preferred for orientation and oviposition, followed by the varieties of brown in colour. Whereas, light yellow seeded varieties were most preferred by the beetle. There were no relationship between seed coated colour and survival of the beetle. The number of adults oriented on the varieties of different seed size was ranged 7.4 to 8.3 adults with no significant differences between them.

Key words: *Callosobruchus maculates,* Seed coat colour on orientation and Oviposition.

Introduction

Pulses play an important role in human diet as they are considered to be main source of protein. The protein content of pulses ranges from 17 to 24 per cent. Protein being one of the most important constituent, supplying the building material for the body, thus the importance of pulses in our diet can be easily appreciated. Gram (*Cicer arietinum* Lin.) is the most important pulse accounting for more than one 3rd of the area and about 40 per cent of the production of pulses in the country.

Pulse beetle popularly known as Dhora is an important storage pest of Chickpea in India. This includes three bruchid species, *Callosobruchus maculates* (Fab.) (Salunkhe and Jadhav, 1982), *C. chinensis* Lin. (Reddy and Singh, 1972) and *C. analis* (Raina, 1971). Insect pests inflict their damage on stored products mainly by direct feeding. Some species feed on the endosperm causing loss of weight and quality, while other species feed on the germ, resulting in poor seed germination and less viability (Malek and Parveen, 1989; Santos *et al*., 1990).

Most of the pulse beetle infests the pods and grains from the field and hidden infestation is not detected before storing of the pulses. So, the heavy amount of stored produce is lost by the beetles. Therefore, it is essential to know the factors responsible for causing this damage (Arora and Singh 1970 and Shehnaz and Theophillus 1975). Mukherjee *et al*. (1970) reported that leguminous seeds were more damaged by this pulse beetle (32.64%) as compared with those of vegetable and oil seeds (3%). The losses in seed by insect infestation due to improper storage in India has been reported to be lower in chickpea (4.8%) in comparison to pigeonpea (32.68%), cowpea (18.5%), Urd (14.9%).

The serious storage pests of Chickpea. *C. chinensis* has been reported to cause serious damage to pulses in India and many countries of the globe. It is cosmopolitan in distribution found in the countries where tropical and subtropical conditions prevail. It has a capability to infest not only cultivated host plants in the field but also in storage (Fahad, 2011). It is recorded that 55- 60% loss in seed weight and 45.50 to 66.30% loss in protein content of pulses is due to infestation caused by this beetle (Faruk

et al., 2011). In case of heavy infestation of grains by pulse beetle, the grains lose their germination capacity and become unfit for human consumption. Shafique and Ahmad (2005) Grains of chickpea genotypes with wrinkled seed coat and black colour affected the beetle development and seemed to be less preferred than the smooth, plumpy and white colour seeds of chickpea cultivars.

Materials and methods

A research experiment was carried out in the Laboratory of Department of Entomology, College of Agriculture, Gwalior during 2013-2014, laid out in CRD with 12 treatments. Pulse beetle (*Callosobruchus maculatus* Fab.) was reared in the laboratory to raise experimental culture of the insect. For rearing the insect in large numbers, about 500 g seed of local variety of chickpea was taken in glass jar and 100 pair of newly emerged adults were released in Jar. Jar was covered with muslin cloth and kept in incubators at $29^0 \pm 1^0$C temperature. After egg laying dead adults were removed by skiving. Fresh adults started emerging after 22 to 28 days. The newly emerged adults were used for experiment.

The data were subjected to $\sqrt{n}$ or angular (arc sin) transformation as the case may be for statistical analysis. The data obtained were statistically analysed by using the analysis of variance as described by Fisher (1958).

Results and Discussion

During the present investigation, the response of chickpea varieties on orientation, ovipositional preference, development and survival of pulse beetle, *Callosobruchus maculatus* (Fab.) were studied, under laboratory conditions in the Department of Entomology, College of Agriculture, Gwalior during 2013-14. Twelve varieties of chickpea having variation in seed size and seed coat color were included in the study under:

Relationship of seed coat colour with orientation of beetles revealed that seed coat colour influenced the orientation of pulse beetle significantly (table 1&2). The orientation of beetle on the varieties of different seed coated colour ranged from 6. 7 (dark brown) to 8.7 (light yellow).

The orientation of adults on dark brown seeded varieties was significantly less than light yellow and brown seeded varieties. There were no significant differences in orientation of pulse beetle on light yellow seeded and brown seeded varieties of chickpea.

Relationship of seed coat colour with oviposition recorded on number of eggs laid by pulse beetle on chickpea varieties of different seed coat colour showed significant difference among them. Minimum number of eggs was laid on the varieties of dark brown in colour (14.3), which was found significantly less than the eggs laid on the seeds of rest of the colours. The egg deposition on brown seeded varieties was at par with egg deposition on light yellow seeded varieties.

Relationship of seed coat colour with total developmental period on different varieties of different seed coat colour showed that seed coat colour did not influence the developmental period of pulse beetle. However, the developmental period on different seed coat colour was ranged from 28.7 to 30.5 in the dark brown and brown seed coat colour varieties, respectively.

Relationship of seed coat colour with survival percentage of pulse beetle on the varieties of different

Table 1: Orientational and ovipositional preference, developmental period and survival percentage of pulse beetle, *Callosobruchus maculatus* (Fab.) on different categories of seed coat colour of chickpea genotypes.

S. No.	Seed coat colour category and genotypes		Number of adults oriented*	Number of eggs laid *	Total developmental period (in days)	Survival ** percentage
A.	Mean	Light Yellow	8.67(2.93)	18.11 (4.24)	29.74	31.91 (34.20)
B.	Mean	Brown	8.14 (2.83)	17.24 (4.13)	30.50	40.73 (39.64)
C.	Mean	Dark Brown	6.67 (2.57)	14.33 (3.77)	28.73	34.65 (36.00)
SE(m)± and CD at 5% for between the seed coat colour			**SE(m)±CD**	**SE(m)±CD**	**SE(m)±CD**	**SE(m)±CD**
A	-	B	(0.10) (NS)	(0.13) (NS)	1.42 (NS)	(0.83) (NS)
A	-	C	(0.13) (0.27)	(0.18) (0.36)	1.88 (NS)	(1.10) (NS)
B	-	C	(0.12) (0.24)	(0.16) (0.32)	1.65 (NS)	(0.97) (NS)
SE(m)± and CD at 5% for within the seed coat colour of the genotypes			**(0.20) (0.42)**	**(0.27) (0.56)**	**(2.92) (6.02)**	**(1.71) (3.53)**

* Figures in parentheses are $\sqrt{n}$ and angular ** transformed values

Table 2: Orientational and ovipositional preference, developmental period and survival percentage of pulse beetle, *Callosobruchus maculatus* (Fab.) on different categories of seed size of chickpea genotypes.

S. No.	Seed coat colour category and genotypes		Number of adults oriented*	Number of eggs laid *	Total developmental period (in days)	Survival ** percentage
A.	Mean	Small	7.44 (2.71)	15.67 (3.94)	29.68	32.85 (34.84)
B.	Mean	Medium	8.29 (2.86)	17.52 (4.16)	30.14	41.17 (39.90)
C.	Mean	Bold	8.00 (2.80)	17.00 (4.08)	30.09	31.69 (34.12)
SE(m)± and CD at 5% for between the seed size			**SE(m)± CD**	**SE(m)±CD**	**SE(m)±CD**	**SE(m)±CD**
A	-	B	(0.10) NS)	(0.13) (NS)	1.42 (NS)	(0.83) (NS)
A	-	C	(0.13) (NS)	(0.18) (NS)	1.88 (NS)	(1.10) (NS)
B	-	C	(0.12) (NS)	(0.16) (NS)	1.65 (NS)	(0.97) (NS)
SE(m)± and CD at 5% for within the seed size of the genotypes			**(0.20) (0.42)**	**(0.27) (0.56)**	**(2.92) (6.02)**	**(1.71) (3.53)**

* Figures in parentheses are $\sqrt{n}$ and angular ** transformed values

Table 3: Per cent seed infestation and per cent loss in seed weight due to pulse beetle in different varieties of chickpea.

S. No.	Varieties	Percentage of seed infestation	Per cent loss in weight
1	RVS-201	60.3 (50.94)	30.1 (33.30)
2	RVS-202	58.1 (49.70)	29.1 (32.62)
3	RVS-203	52.3 (46.30)	26.1 (30.73)
4	JG-6	41.3 (39.63)	20.7 (27.00)
5	JG-11	57.7 (49.45)	28.9 (32.50)
6	JG-16	36.9 (37.40)	18.4 (25.41)
7	JG-130	38.5 (38.33)	19.2 (25.98)
8	JG-322	39.9 (39.15)	19.9 (26.54)
9	JGK-1	43.4 (41.21)	21.7 (27.76)
10	JKG-3	45.4 (42.38)	22.7 (28.45)
11	JGK-43	59.5 (50.46)	29.7 (33.04)
12	JGG-1	52.2 (46.30)	26.1 (30.75)
SE(m)±		**(0.95)**	**(0.53)**
CD at 5%		**(2.80)**	**(1.55)**

* Figures in parentheses are angulartransformed values

seed coat colour indicated that, there were no significant relationship of seed coat colour and survival of the beetle. However, the survival percentage was ranged from 31.9 (light yellow seed coat) to 40.7 (brown seed coat).

Relationship of seed size with orientation of beetles recorded on number of adults oriented on different varieties of different seed size showed that seed size did not influence the orientation of pulse beetle. However, the number of adults oriented on different seed size was ranged from 7.4 to 8.3 in the small and medium seeded varieties, respectively.

Relationship of seed size with oviposition recorded on eggs deposited on chickpea varieties of different seed size indicated no significant relationship of seed size with egg deposition. However, it ranged from 15.7 to 17.5 small and medium seeded varieties, respectively.

Relationship of seed size with total development period on different varieties of different seed size showed that seed size did not influence the developmental period of pulse beetle. However, the developmental period on different seed size was ranged from 29.7 to 30.4 in the small and medium seed size varieties, respectively.

Relationship of seed size with survival percentage of pulse beetle on the varieties of different seed size indicated that, there were no significant relationship of seed size and survival of the beetle. However, the survival percentage was ranged from 31.7 to 41.2 in the bold and medium size varieties, respectively.

Percentage of seed infestation (table 3) significant difference was observed among different varieties of chickpea with regards to per cent seed infestation. Variety 'JG-16' had minimum percentage of seed infestation (36.9%), which was significantly less than rest of the varieties, except JG-130, JG-322 and JG-6. On the other hand variety RVS-201 recorded maximum per cent of seed infestation (60.3%, which was found significantly higher than the seed infestation in rest of the varieties, except JGK-43, RVS-202 and JG-11.

Per cent loss in weight was (table 3) in the range of 25.41 to 33.30 in different varieties with significant difference among varieties. Significantly less per cent loss in seed weight was observed in variety JG-16 than rest of the varieties, except JG-130 and JG-322. On the other hand variety RVS-201 recorded maximum per cent loss in seed weight, but at par to JGK-43, RVS-202 and JG-11.

The adult orientation and egg deposition on the varieties of different seed coat colour under free choice condition showed significant effect of seed coat colour

on orientation and oviposition by the pulse beetle. Varieties of dark brown in colour were less preferred for orientation and oviposition, followed by the varieties of brown in colour. Whereas, light yellow seeded varieties were most preferred by the beetle. There were no relationship was recorded between seed coated colour and survival of the beetle. Muhammad and Maqbool (2005) also reported influence of seed coat colour on the egg deposition. During present investigation dark brown seeds were found less preferred for orientation and oviposition. Muhammad (2012) also reported genotypes of dark brown in colour to be tolerant against pulse beetle which collaborates present findings. The number of adults oriented on the varieties of different seed size was ranged 7.4 to 8.3 with no significant differences between them.

The eggs deposited on chickpea varieties of different seed size indicate no significant relationship of seed size with egg deposition. However, it ranged from 15.7 to 17.5 eggs on small and medium seeded varieties, respectively. The total development period of pulse beetle on different varieties ranged from 29.7 to 30.4 days with non-significant differences among them. The survival percentage was ranged from 31.7 to 41.2 per cent with no significant differences between them. Hence, during present investigations, seed size of the varieties did not influence the orientation, oviposition and survival of pulse beetle. Where as Muhammad (2012) reported small size grain to be tolerant against pulse beetle.

Genotype JG-16 had minimum percentage of seed infestation, which was significantly less than rest of the varieties, except JG-130, JG-322 and JG-6. On the other hand genotype RVS-201 recorded maximum per cent of seed infestation which was found significantly higher than the seed infestation in rest of the varieties, except JGK-43, RVS-202 and JG-11. Significantly less per cent loss in seed weight was observed in variety JG-16 than rest of the varieties, except JG-130 and JG-322. On the other hand variety RVS-201 recorded maximum per cent loss in seed weight, but at par to JGK-43, RVS-202 and JG-11.

Pokharkar and Chauhan (2010) also reported 62.79 to 81.60% seed damaged by pulse beetle in different genotypes of chickpea. Further, they reported 36.63 to 75.67% loss in grain weight caused by pulse beetle in different genotypes of chickpea.

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