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RELATIVE SUSCEPTIBILITY TO CHICKPEA GENOTYPES TO PULSE BEETLE DURING STORAGE

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ABSTRACT

A laboratory study was carried out was during 2012-13 to study the relative susceptibility of chickpea genotypes. (four kabuli ; KAK 2, JGK 3, JGK1, JGK 43 and eight deshi ; JSC 55, JG130, JG 6, JAKI 9218, JG 11, JGG 1, JG 74, JG 16) at Sehore (MP).The results revealed that the maximum number of eggs were laid on variety KAK 2 (19.60) and minimum (7.33) on variety JAKI 9218. The highest population of adult was recorded from JGK 43 (59.66) and lowest in JG 16 (2.66). More adults (40.25) survived on kabuli varieties than deshi varieties (22.45). Significantly highest weight loss (8.02%) was recorded from JGK 43 followed by JGK 3 (7.21%). and least (3.28%) in JG 74. The average weight loss in deshi varieties was 4.74%, while it was 6.86% in kabuli varieties.The highest percent infestation was observed in JGK 43 (65.79) and the lowest in JG 74 (6.87). The highest index of susceptibility was recorded in JGG 1(7.4) while it was lowest in JAKI 9218 (2.1), Higher protein content (20.61%) was recorded in kabuli varieties than deshi varieties (20.43%). Chickpea varieties JAKI 9218, JG 74 and JG 16 may be recommended for longer storage as these were found less susceptible against the pulse beetle.

Keywords- *Cicer arietinum,* pest resistance, *Callosobruchus chinensis,* stored product protection

INTRODUCTION

Chickpea (Cicer arietinum L.); commonly known as Bengal gram provides high quality protein and considered to be the best food for vegetarian population in India. It is extensively cultivated as a cool season annual crop under a wide range of agro-ecological conditions mainly of rain-fed nature. India is the largest producer of chickpea.. Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Andhra Pradesh and Karnataka are the major chickpea producing states. Cultivated chickpeas are mainly divided in to two groups based on plant characteristics and seed size, shape and coloration as "*Kabuli"* and "*deshi*". The stem color helps in differentiating the two types of chickpeas. The *kabuli* type has a green stem and the *deshi* type has a green stem with a purple tinge. Enhanced production and safe storage of chickpea grain is imperative to meet the requirements of teeming population. The pulse beetle, *Callosobruchus chinensis* L. (Bruchidae: Coleoptera) is of significant importance as a major insect pest of stored chickpea (Rajasri and Rao, 2012).. About 55-60 % losses in seed weight and 45-66 % losses in protein content were reported due to its damage and the post harvest seed losses may reach up to cent per cent (Mahendran and Mohan, 2002) and thus the seeds become unfit for human consumption as well as planting . Hence, concerted efforts are needed to save the chickpea grain from this menace. However, the present trend towards alternate non-toxic control methods that poses no threat to the health of operators or consumers, and which are economically friendly. It is demanding to develop the alternative methods that are ecologically feasible and economically safer to control the storage grain insects (Moreno-Martinez *et al.,*, 2000). Use of resistant sources is the most environmentally friendly and reliable method (Sarwar *et al.,*, 2009). Resistant and least susceptible varieties are of particular interest for resource poor developing as well as developed grain exporting nations (Shafique and Ahmad, 2005). The chickpea intensification programmes can be achieved by producing high yielding varieties with inherent pest resistance characteristics during storage. Studies on pest control method in grain chickpea to illustrate the importance of deploying resistant varieties within the framework of an IPM are rather limited. Hence, the investigation was initiated to evaluate the relative susceptibility of chickpea genotypes to pulse beetle.

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METHODS AND MATERIALS

Investigation was carried out under laboratory conditions in the Department of Entomology, R.A.K. college of Agriculture, Sehore, during 2012-13. For maintenance of culture of *C. chinensis* on the bengal gram (chickpea) variety JG 130 (Check), 500 g fresh seeds were kept in glass trough (10 cm X 25 cm) and 100 pairs of freshly emerged beetles were released on seeds. The trough was covered by muslin cloth tied with rubber bands and kept in incubator at 28 ± 1° C. Fresh culture was maintained constantly from the newly emerged beetles. Aspirator was used for transforming and handling of beetles to avoid injury to them. Freshly emerged beetles of 24 hours were used for the experiments. Male and female beetles were identified on the basis of strongly unipectinate antennae in males and slightly serrated antennae and longer broad abdomen in females.

To study the effect of variety on the life cycle of the pulse beetle particularly on total number of eggs laid, total number of adult beetles emerged and survival percentage, fifty g seeds of each variety was kept in separate glass jars and then ten pairs of freshly emerged beetles were released in each plastic jar and beetles were forced to lay eggs. All the beetles were removed from glass jars after their death. The experiment was replicated three times. The number of eggs laid in each variety were counted and after oviposition, weekly observation was taken by counting number of adult beetles emerged. The survival percentage in each variety was also worked out on the basis number of eggs laid and number of adults emerged in each varieties. The per cent seed weight loss was also recorded. The index of susceptibility of chickpea varieties to *C. chinensis* was calculated by using the following formula

$$I = \frac{\log F}{D} \times 100$$

Where, I = Index of susceptibility, F = Total no. of F_1 adults, D = Developmental period**,** Nitrogen content in grain was determined by Kjeldahl method. Protein content was computed by multiplying percent nitrogen by the factor 6.25

RESULTS AND DISCUSION

Fecundity

The data on fecundity of the pulse beetle on different chickpea varieties (Table 1) indicated significant variation in number of eggs laid on different varieties. Minimum numbers of eggs were laid on JAKI 9218 (7.33) which was statistically at par with JG 16 (9.20) and JGK 3 (10.35). The maximum number of eggs of the test insect were deposited on KAK-2 (19.60), closely followed by JG 11 (19.33), While on the other remaining varieties it ranged from 18.40 (JGK 1) to 13.40 (JSC 55). On an average, more number of eggs (16.53) were laid on *kabuli* varieties than that of *deshi* varieties (14.35).

Adult emergence

The lowest population of beetle was recorded from JG 16 (2.66) which remained at par with JG 74 (3.3). The highest F_1 progeny was recorded on JGK 43 (59.66) which was significantly higher than all the other varieties. The remaining varieties showed intermediate progeny which ranged from 50.33 (JG 130) to 5.66 (JAKI 9218). More number of adults survived on *Kabuli* varieties (40.25) than *deshi* varieties (22.45). Varieties with hard, rough, wrinkled and dark in colour proved to be more resistant when compared with those having smooth, soft, bold and light coloured seeds. Sarwar (2012) found that tolerant genotypes exhibited hard and wrinkled seed coat, have dark brown colour and had small size grain. Thus, the differences in the seed coat of chickpea affected oviposition and larval development of the bruchid. Our result also indicated higher number of eggs laid on *kabuli* varieties and shorter development period of *C. chinensis*. However, the fecundity of the pulse beetle was quite similar to that recorded by Panzarino *et al.,* (2011); Kazami *et al.,* (2009) and Parameshwarappa *et al.,* (2007) in different experimental conditions. Thus, the larval development and progeny production may be dependent on oviposition and is greatly influenced by preferred host of good nutritive significance.

Weight loss (%):

Significant variation among the varieties was observed in terms of weight loss due to the infestation of pulse beetle. The average per cent weight loss in *kabuli* varieties was comparatively more (6.86%) than that of *deshi* varieties (4.74%). The maximum weight loss (8.02%) was recorded from JGK 43 which was significantly higher to other varieties. Least weight loss (3.28%) was observed in JG 74 closely followed by JG 16 (3.29%). Regarding per cent weight loss of chickpea varieties due to the infestation of the pest, JGK 43 was observed more susceptible while JG 74 and JG 16 were recorded as less susceptible varieties. Similar results were reported by Rai and Singh (1989) who observed more damage in the varieties having large yellow seed with smooth and thin seed coat, than small brown seeds with hard seed coat. Chickpea varieties JAKI 9218, JG 74 and JG 16 may be recommended for relatively longer storages as these were found less.

Table 1: Evaluation of chickpea varieties against Callosbruchus chinesis L

Varieties	Fecundity*	Adult emergence*	Weight loss (%) **	Infestation (%) **	Susceptibility index	Protein (%)		Developmental period (days)
						Fresh seed	Infested seed	
Kabuli								
KAK-2	19.60 (4.48)	43.00 (6.45)	6.46 (14.65)	57.02 (49.02)	7.4	18.38	16.63	25.9
JGK-3	10.35 (3.29)	32.66 (5.75)	7.21 (15.56)	30.90 (33.77)	4.2	20.83	17.33	26.0
JGK-1	18.40 (4.35)	25.66 (5.11)	5.74 (13.81)	20.15 (26.64)	4.8	21.18	15.75	26.5
JGK-43	17.80 (4.28)	59.66 (7.69)	8.02 (16.64)	65.95 (54.27)	4.9	22.05	15.05	26.2
Average (*Kabuli*)	16.53 (4.10)	40.24 (6.25)	6.86 (15.16)	43.50 (40.92)	5.3	20.61	16.19	26.15
Deshi								
JSC-55	13.40 (3.73)	18.66 (4.28)	6.55 (14.77)	32.34 (34.63)	3.5	16.98	15.83	28.6
JG-130	17.60 (4.25)	50.33 (7.12)	6.55 (14.77)	51.76 (45.97)	4.7	20.83	19.25	27.5
JG-6	16.00 (4.06)	23.00 (4.83)	4.65	23.72 (29.13)	6.2	19.95	19.60	28.7
JAKI 9218	7.33 (2.80)	5.66 (2.44)	4.66 (12.39)	16.64 (24.04)	2.1	22.05	21.18	27.0
JG-11	19.33 (4.45)	23.00 (4.83)	4.63 (12.39)	22.69 (29.38)	6.2	22.40	18.55	28.6
JGG-1	17.40 (4.23)	43.66 (6.62)	4.17 (11.68)	20.53 (26.92)	7.4	22.75	15.75	28.2
JG-74	14.60 (3.88)	3.33 (1.94)	3.28 (11.24)	6.87 (15.12)	2.4	16.75	15.20	30.4
JG-16	9.20 (3.11)	2.66 (1.77)	3.29 (10.31)	8.82 (17.26)	2.8	18.73	18.20	30.4
Average (*Deshi*)	14.35 (3.80)	22.45 (4.17)	4.72 (12.49)	22.92 (28.59)	4.4	20.43	17.94	28.5
S. Em ±	0.20	0.39	0.37	3.58				
C.D. (P=0.05)	0.61	1.23	1.16	11.19				

** Figures in parentheses are square root transformed data*
*** Figures in parentheses are angular transformed data*

Infestation (%):

The per cent infestation of the pulse beetle varied significantly among the varieties tested, recording more average infestation in *kabuli* varieties (43.50%) compared to *deshi* varieties (22.92%). The maximum infestation (65.95%) was recorded in JGK 43 which was significantly higher to other varieties except KAK-

2 (57.02%). Least infestation (6.87%) was observed in JG 74 (6.87%). Certain factors such as seed hardness, small seed size, absence of nutritional factors and presence of toxic substances may affect bruchid damage to legume seeds (Southgate, 1979). The *kabuli* type of chickpea varieties showed susceptibility to *C.chinensis*. The seeds of these varieties were bold in size, ivory white in color, irregular rounded in shape with smooth texture of the testa. Similarly, they were high in protein content.

Susceptibility index:

The index of susceptibility was observed higher on *kabuli* varieties (5.3) than *deshi* varieties (4.4). KAK 2 and JGG 1 recorded higher index of susceptibility (7.4) while it was lower in JAKI 9218 (2.1), JG-74 (2.4) and JG -16 (2.8). In other varieties it ranged from 6.2 to 3.5 values having medium response (Table 1).

Protein content:

The higher protein content was recorded in *kabuli* chickpeas (av. 20.6%) than the *deshi* varieties (20.43%). After 60 days of infestation, protein content in different varieties decreased by 21.4 % in *kabuli* chickpeas and by 12.1 % in *deshi* varieties. It was observed that higher protein content was recorded in *kabuli* varieties than the *deshi* varieties. The *kabuli* varieties were much preferred by the pest, whereas the *deshi* varieties were less preferred by the pest due to less protein content. Umrao and Verma (2003) reported that the genotypes recorded low protein content were least susceptible to the *C.chinensis* whereas chickpea genotypes with highest protein content were susceptible to pulse beetle. Similar results were reported by Erler *et al.,(*2009).

Developmental period:

The beetle completed its development in 26.15 days on *kabuli* varieties and 28.5 days on *deshi* varieties (Table 1). Numerically, the shortest developmental period (25.9 days) was recorded from variety KAK 2, while it was longest (30.4 days) in the variety JG 74. For the development and adult emergence, JG 74 and JAKI 9218 proved to be the least susceptible hosts, while JGK 43 and KAK 2 were most suitable host for development and adult emergence. The larval development and adult progeny production may be dependent on oviposition and is greatly influenced by preferred host of good nutritive significance. These results are in conformity with the findings of Katiyar and Khare (1983) who reported that initial moisture content of the seed was significantly correlated with different growth parameters, while seed size was also found to be associated with these parameters.

The *kabuli* variety KAK 2 was the most preferred host for oviposition by the pest. The JAKI 9218 was found least preferred for oviposition. The difference in oviposition may be due to wrinkled and smooth seed surface. The resistance to bruchids in chickpea may be related to tegument components as pigments in dark tegument genotypes affecting oviposition Lema (1994) reported that beetle laid most of their eggs on varieties having smooth seed coat and displayed a strong non preference for genotype with morphologically rough seed coat.

It may be concluded that the Kabuli varieties were found highly susceptible for infestation of pulse beetle than d*eshi* varieties. Higher index of susceptibility was recorded from *kabuli* varieties The protein content in different varieties decreased by 21.4 % in *kabuli* varieties and 12.1 % in *deshi* varieties. The developmental period was recorded longer on *deshi* varieties than *kabuli* varieties. In general, varieties of chickpea having smooth surface with boldness in seed size were more preferred for egg laying by pulse beetle than varieties having rough and wrinkled seed surface with small seed size.

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