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Physical Factors Associated with Resistance against Pulse Beetle, *Callosobruchus chinesis* (L.) on Chickpea Genotypes in Laboratory Conditions

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ABSTRACT: Screening of fifteen chickpea genotypes for identifying the physical basis resistance were carried out against *Callosobruchus chinensis* (L.) under laboratory condition in Department of Entomology at Dr. Rajendra Prasad Central Agricultural University, Pusa during 2016-17. On the basis of morphological observation recorded that seed coat thickness ranged from 0.09 to 0.31 mm with maximum in C1064 (0.31 mm) and minimum in C1021 (0.09 mm). 100 seed weight ranged from 13.88 to 31.53 grams with maximum in BG 256 (38.03g) and minimum in C1063 (13.88g). The female beetle laid the lowest number of eggs on rough and small seeds of C1021, however, it preferred to highest number of eggs on smooth and medium seeds of C1025. None of the genotypes were completely resistant to the attack of *C. chinensis* differed in the resistance, which may seems to be due to the physical seed characters (colour, shape, size, texture, seed coat thickness and 100 seed weight) of chickpea genotypes.

Keywords: Chickpea genotypes, *Callosobruchus chinensis* (L.), susceptibility, seed coat thickness, colour, smooth.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important leguminous crops and is extensively cultivated in dry and rainfed areas of the world. The pulses constitute a major source of protein (20-30%) which is almost 3 times higher than that found in cereals and provide high quality protein for the vegetarian population in India, South Asia, West Asia and the Southern European countries (Divya *et al.*, 2013). India is the leading producer of chickpea in the world with an area of 10.56 Mha, production 11.38 Mt and productivity 10.78 q/ha in 2017-18 (Anonymous, 2019). In India, Madhya Pradesh (4.60 Mt), Maharashtra (1.78 Mt), Rajasthan (1.67 Mt), Karnataka (0.72 Mt), Andhra Pradesh (0.59 Mt), Uttar Pradesh (0.58 Mt), Gujarat (0.37 Mt), Chhattisgarh (0.32 Mt) and Jharkhand (0.29 Mt) are the major chickpea producing states contributing over 95% area (Anonymous, 2018). The crop is economically important in Bihar with an acreage, production and productivity of 0.059 Mha, 0.067 Mt and 1140 kg/ ha; respectively (Anonymous, 2018). Significant losses in quality and quantity of chickpea grains have been reported to occurs during storage either due to physical factors like moisture content of grains, humidity, temperature or biological factors like insect pests, diseases and rodents. Chickpea grains are attacked by various insect pests and among them the pulse beetle, *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae) causes significant damage upto 55.7 per cent to the stored legumes during severe infestation (Chaubey 2008). It can infest cultivated host plant as well as few wild legumes both in the field and store (Fahd, 2011). The chickpea intensification programmes can be achieved by producing high yielding varieties with inherent pest resistance characteristics during storage. The component of resistance in chickpea within the framework of an integrated pest management is rather limited. In India, conventional treatments have been used in protection of stored chickpeas against pulse beetle, but now other ecologically sound methods based on use of resistant varieties needed for an integrated approach to pest management are also in practice. Host plant resistance is a promising method of combating pest problems in storage. It is perhaps the easiest, most economical and effective means of controlling insect pests on stored grains. Resistance processes involve morphological, physiological and/or biochemical mechanisms which range from simply minimizing the effect of insect attack to adversely affecting the insects cellular processes, growth and development (Singh, 2002). Observation of chickpea genotypes for pulse beetle resistance has given an improved motivation to the identification and use of host plant resistance as a fundamental component of pest management worldwide. Many studies have showed that some physical factors are responsible for pest resistance. Therefore, the aim of the present study is to finding out chickpea genotypes for resistant/susceptible to the pulse beetle, *C. chinensis* (L.) on the basis of its physical parameters under laboratory conditions.

MATERIAL AND METHODS

The experiments were conducted at the laboratory of Department of Entomology, Dr. Rajendra Prasad Central Agricultural University, Pusa during 2016-17.

The Pulse beetle, *C. chinensis* was used as the test insect. Its nucleus culture was obtained by placing ten pairs of one day old adults collected from storage house of Department of Seed Technology in each glass jar (25 cm × 15 cm × 10 cm) containing 500g seeds for oviposition. After 48 hrs, adults of *C. chinensis* (L).were removed from the jars and discarded. Then the jars were covered with muslin cloth and tied up with rubber bands. These jars were kept in laboratory under optimum conditions. The cultures were maintained on chickpea genotypes at room temperature for obtaining continuous fresh supply of adults of *C. chinensis* for the experiment. Fifteen genotypes of chickpea *viz*., C1088, C1064, BG372, C1021, C1121, C1147, C1156, BG256, C1022, C1120, C1063, C1160, C1023, C1025 and C1165 were evaluated for resistance against pulse beetle on the basis of physical parameters of the insect; by using the "No choice" test. In this test, chickpea seeds were preheated at 50ºC for 2 hrs before usage in order to discard any chances for the presence of a concealed insect infestation in the seed lots. Hundred seeds of each chickpea genotypes were exposed to 5 pairs of one day old adult (5 males and 5 females) of *C. chinensis* and placed in an incubator at 30 ± 2ºC under 70 ± 5% relative humidity. The released pulse beetles were removed after 72 hrs with the assumption of maximum oviposition during this period. The experiment was conducted in Completely Randomized Design (CRD) and replicated three times.

The data pertaining to below following characters of seed was noted on visual basis like, seed colour, seed size, seed shape, seed texture.

Seed coat thickness: The seed coat thickness was evaluated by the vernier caliper before the release of insects by taking weight of 100 seed of each genotype.

RESULT

The physical seed characters (colour, shape, size, texture, seed coat thickness and 100 seed weight) of chickpea genotypes are given in (Table 1). The colour of chickpea genotypes seeds varied from dark brown and light brown. Maximum nine genotypes had light brown (C1088, C1064, BG372, C1021, C1121, C1156, C1022, C1023, and C1165) followed by six genotypes (C1147, BG256, C1120, C1063, C1160, C1025) had dark brown colour. Based on the shape, these were categorized in to two groups, *viz.* angular and oval. Observations showed that maximum fourteen genotypes (C1088, C1064, BG372, C1021, C1121, C1147, C1156, BG256, C1022, C1120, C1063, C1160, C1023, C1165) had angular shape followed by one genotype oval shape (C1025). Seed texture of genotypes were smooth and rough.

Thirteen genotypes possessed rough texture (C1088, C1064, BG372, C1021, C1121, C1147, C1156, BG256, C1022, C1063, C1160, C1023, C1165) while C1120, and C1025 were with smooth texture. Similarly, on the basis of seed size, these were categorized into three groups, *viz*., small, medium and large. Observations showed that three genotypes (C1064, BG256, C1120) were large in size followed by six medium (C1088, C1021, C1147, C1022, C1160, C1023, C1025) and five (BG372, C1121, C1156, C1063 and C1165) small in size.

Maximum weight of 100 seed was recorded in BG256 (31.53g) followed by C1120 (28.43g), C1064 (25.56g) C1147 (25.00g), and C1025 (21.89g). Weight of 100 seed was recorded minimum in C1063 (13.88g) followed by BG372 (14.22g), C1165 (14.66g), C1121 (14.72g), C1156 (15.65g), C1160 (16.16g), C1021 (17.7g), C1022 (18.61g), C1088 (21.81g). Seed coat thickness ranged from 0.09 to 0.31 mm with maximum in C1064 (0.31mm) followed by BG372 (0.17mm) and minimum in C1021 (0.09 mm). Similarly, 100 seed weight differed significantly among the genotypes. It ranged from 13.88 to 31.53 grams with maximum in BG256 (31.53g) followed by C1120 (28.43g) and minimum in C1063 (13.88g).

Table 1: Physical factors for resistance in chickpea genotypes against pulse beetle, (*C. chinensis)*.

Sr. No.	Chickpea genotype	Physical characteristics					
		Initial 100-seed Weight (g)	Thickness (mm)	Size	Shape	Colour	Texture
1.	C1088	21.81	0.24	Medium	Angular	Light brown	Rough
2.	C1064	25.56	0.31	Large	Angular	Light brown	Rough
3.	BG372	14.22	0.17	Small	Angular	Light brown	Rough
4.	C1021	17.07	0.09	Medium	Angular	Light brown	Rough
5.	C1121	14.72	0.12	Small	Angular	Light brown	Rough
6.	C1147	25.00	0.13	Medium	Angular	Dark brown	Rough
7.	C1156	15.65	0.11	Small	Angular	Light brown	Rough
8.	BG256	31.53	0.12	Large	Angular	Dark brown	Rough
9.	C1022	18.61	0.13	Medium	Angular	Light brown	Rough
10.	C1120	28.43	0.14	Large	Angular	Dark brown	Smooth
11.	C1063	13.88	0.19	Small	Angular	Dark brown	Rough
12.	C1160	16.16	0.13	Medium	Angular	Dark brown	Rough
13.	C1023	19.50	0.15	Medium	Angular	Light brown	Rough
14.	C1025	21.89	0.16	Medium	Oval	Dark brown	Smooth
15.	C1165	14.66	0.12	Small	Angular	Light brown	Rough
	S.Em ±	**0.96**	**0.03**				
	CD at 5%	**2.64**	**0.08**				

DISCUSSION

Present study clearly showed that chickpea genotypes varied significantly for resistance to *C. chinensis*. No genotype showed complete resistance to the pulse beetle. The female beetle laid lowest number of eggs on rough and small seeds of C1021; however, it preferred smooth and medium seeds of C1025 and laid maximum number of eggs on this genotype. These observations are in cogent evidence with the findings of Divija *et al*., (2020) who reported that genotypes with hard, rough, wrinkled and thick seed coat act as a barrier to pulse beetle as compared with those having smooth, soft and thin seed coat. These observations are aligned with the findings of Aslam *et al*., (2006) who showed that cultivars with hard, rough, wrinkled and thick seed coat proved to be more resistant when compared with those having smooth, soft and thin seed coat. The results of Shafique and Ahmad (2005) revealed that preference of the bruchid for host selection/oviposition seemed to be sensory to a larger extent as low number of eggs were laid on wrinkled and black grains genotypes. Grains of chickpea genotypes with wrinkled seed coat and black colour affected the beetle development and seemed to beless preferred than the smooth, plumpy and white colour seeds of chickpea cultivars. Divya *et al.,* (2013) reported that presence of thick seed coat in the horse gram accessions might have led to reduction in biological parameters of pulse beetle, it served as a barrier for the entry of bruchids. Ahmed *et al.,* (1993) found that the chickpea varieties with thick seed coat showed less damage and had less number of bored holes and therefore were more resistant than varieties with thin seed coats and present findings are in agreement with their results. It clearly indicated that seed coat thickness had no influence on the suitability of host to the pulse beetle; however, larger were preferred by the beetles as they provide larger area for growth and development. In general, grain resistance to differences in grain size (mass) indicate that the larger grains supply more food and space for insect growth and that the smaller grains or grains with less mass offer more resistance to pulse beetle attack. However, this was true to some extent in some cultivars but not in others in studies conducted by Lephale *et al*., (2012). The present results are in agreement with Pankaj and Singh (2011) who observed that the seed characters such as 100 seed weight, seed coat thickness, colour and texture of seed coat were not related with the ovipositional preference and host suitability of the pest to different pulse seeds. These observations are similar with the findings of Swamy *et al*., (2020) who observed that the varieties; NBeG 458, NBeG 471 and KAK 2 which recorded higher oviposition, adult emergence and grain damage were found to have thin seed coat and larger seed size (Pawara *et al*., 2019). Also found that the resistance/tolerance of 21 interspecific progenies of mungbean against pulse beetle. The cultivars with small, rough, wrinkled, hard and thick seed coat were more resistant compared to those having smooth, soft and thin seed coat. Similar findings with Sathish *et al.,* (2020) revealed that the Desi chickpeas with thick, rough or tuberculate seed coats were found to be resistant but none of them were found to be 'immune' or free from damage. In our present study, the Kabuli chickpeas, in general, were more susceptible to the *C. maculatus* than the Desi chickpeas. In the present study one genotype, PI 599066 was showed immune to the test insect *C. chinensis* in both free choice and no-choice test.

CONCLUSION

On the basis of the current findings it may be concluded that the chickpea genotype C1120 was highly susceptible to *C. chinensis* and thus needs special attention to store than the least susceptible genotypes. Seed weight governed by seed size, might have influenced the amount of surface available to *C. chinensis* for oviposition. Seed weight and seed coat thickness did not play any important role in *C. chinensis* resistance. The results of this study showed that the least susceptible genotypes having rough and angular seed surface with small size like BG256, C1025, C1147, C1160, C1165, BG372, C1064, C1088, and C1156 proved promising and thus could be in future breeding purposes as *C. chinensis* resistant line, and these genotypes also deserves further studies as it is free from damage by pulse beetle.

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Conflict of Interest. None.

REFERENCES

Ahmed, K., Khalique, F., Khan, I. A., Afzal, M., & Malik, B. A. (1993). Genetic differences for susceptibility of chickpea to bruchid beetle (*Callosobruchus chinensis* L.) attack. *Pakistan Journal of Scientific Industrial Research, 36*(2-3), 96-98.

Aslam, M., Shaheen, F. A., Abbas, M. A., & Saba, A. (2006). Management of *Callosobruchus chinensis* Linnaeus through use of resistance in stored chickpea varieties. *World Journal of Agricultural Sciences*, *2*(1), 82-84.

Chaubey, M. K. (2008). Fumigant toxicity of essential oils from some common species against pulse beetle, *Callosobruchus chinensis* (Coleoptera: Bruchidae). *J. Oleo Science,57*: 171-179.

Anonymous (2018). Economic Survey, Finance Department, Government of Bihar, India.

Anonymous (2018). Pulses Revolution - From Food to Nutritional Security. Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Government of India.

Anonymous (2019). Pocket Book of Agricultural Statistics. Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Government of India.

Divija S. D., Agnihotri M., & Reddy, M. S. (2020). Biophysical and biochemical basis of host plant resistance in chickpea germplasm against *Callosobruchus chinensis* (L.). *Journal of Entomology and Zoology Studies*, *8*(5): 769-774.

Divya, P., Kanaka Durga, K., & Udayababu, P. (2013). Studies on the effect of biochemical and physic-chemical characters on bruchid (*Callosobruchus chinensis* L.) resistance in horse gram. *Journal of Food Legumes*, *26*(1&2): 70-74.

Fahd, A. (2011). Crymazine concentration and host type effect on the biology of the southern cowpea weevil, *Callosobruchus maculatus*. *A Journal of Microbiolical. Research*, *5*(20): 3321-3326.

Swamy, S. G., Raja, D. S., & Wesley, B. J. (2020). Susceptibility of stored chickpeas to bruchid infestation as influenced by physico-chemical traits of the grains. *Journal of Stored Products Research*, *87*, 101583.

Lephale, S., Abraham, A. B., & Victoria, A. (2012). Susceptibility of seven cowpea cultivars (*Vigna unguiculata*) to cowpea beetle (*Callosobruchus maculatus*). *Agricultural Science of Research. J.*, *2*: 65-69.

Pankaj, N., & Singh, H. K. (2011). Correlation of seed characters of pulses with host suitability and preference of *C. chinensis* (L.). *Indian Journal of Entomology, 73*: 365-370.

Pawara., N. R., Bantewad., S. D., & Patil., D. K. (2019). India Assessment of different interspecific progenies of mungbean against pulse beetle, *Callosobruchus chinensis* (L.) and it's influence of seed physical characteristics on infestation *Journal of Entomology and Zoology Studies, 7*(1): 1335-1344.

Sathish, K., Jaba, J., Katlam, B. P., Mishra, S. P., & Rana, D. K. (2020). Evaluation of chickpea, *Cicer arietinum*, genotypes for resistance to the pulse beetle, *Callosobruchus chinensis* (L.). *Journal of Entomology and Zoology Studies*, *8*(3), 1002-1006.

Shafique, M., & Ahmad, M. (2005). Screening of pulse grains for resistance to *Callosobruchus analis* (F.) (*Coleoptera*: *Bruchidae*). *Pakistan Journal of Zoology*, *37*(2): 123-126.

Shaheen, F. A. (2006). Integrated Management of pulse beetle, *Callosobruchus chinensis* L. (*Coleoptera*: *Bruchidae*) attacking stored chickpea. Ph.D. Dissertation, *University of Arid Agriculture*, Rawalpindi, Pakistan, 226 pp.

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