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Screening of Chickpea Genotypes for Resistance to the Pulse Beetle, *Callosobruchus chinensis* (L.)

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ABSTRACT: Laboratory experiments were carried out to evaluate twenty genotypes of chickpea against pulse beetles (*Callosobruchus chinensis* (L.) for three consecutive years from 2020-21 to 2022-23. Twenty genotypes/varieties of chickpea were used to characterize their resistance against pulse beetle by using "No choice" test. Resistance of chickpea genotypes was evaluated on the basis of per cent chickpea seed damage by *C. chinensis*. The results revealed that none of the genotype was completely immune to the attack of *C. chinensis*. Susceptibility studies of chickpea revealed that among twenty genotypes, Vijay recorded less number of eggs laid (14.00 eggs/10 seed) and lesser per cent adult emergence (33.93 %) and prolonged developmental period (31.67 days, respectively). Vijay exhibited minimum seed weight loss (1.33%) with least seed damage (5.33%). While genotype KAK II and Gulak exhibited maximum per cent seed damage (44.00 and 39.75 %), seed weight loss (30.50 and 28.50 %) and were categorized as highly susceptible cultivar. Lower seed damage in genotypes Vijay, JAKI 9218 was attributed due to lower number of eggs, per cent adult emergence, growth index and more developmental period. However, maximum seed damage and seed weight loss in genotypes KAK II and Gulak was due to more number of eggs, per cent adult emergence, growth index and less developmental period recorded in these genotypes. Based on per cent infestation being main index of resistance, variety Vijay was found highly tolerant against pulse beetle, *C. chinensis*.

Keywords: Chickpea, *Cicer arientinum* L. genotypes, screening, *C. chinensis* and Vijay.

INTRODUCTION

A wide variety of pulses are grown in India. Amongst pulses, chickpea (*Cicer arientinum* L.) is an important pulse crop grown in *rabi* season. During 2020-21, chickpea had a lion's share of 49.30 per cent in the total pulses production whereas; pigeonpea contributed 16.20 per cent production. The main insect pest of chickpea in storage is pulse beetle, *Callosobruchus* spp. which begins the seed infestation in the field. There is historical documentation of high seed infestation (30 %) and dramatic losses of germination (60-90 %) in chickpea seed. In India, a loss of 15.33 to 17.00 per cent is recorded in chickpea seed storage by *C. chinensis* (Parameshwarappa *et al*., 2007). Especially small scale farmers lose a sizeable proportion of their harvested pulses which estimated to be 10 to 20 per cent for 3 to 6 months of storage (Khare, 1994). With view of this, present studies were undertaken to determine the susceptibility/resistance response of chickpea germplasm against *C. chinensis.*

MATERIALS AND METHODS

Laboratory experiments were conducted at the seed entomology laboratory of Seed Technology Research Unit, Mahatma Phule Krishi Vidyapeeth, Rahuri for three consecutive years from 2020-21 to 2022-23. The seed of each genotype and varieties of chickpea tested were supplied by Pulse breeder, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. Twenty genotypes of chickpea were used for screening against pulse beetle. 100 g weighed seeds of each genotypes/varieties of chickpea were kept separately in plastic bottles and ten one/ two days old adults of pulse beetle were released in plastic bottles separately. The released insects were removed after 72 hrs. The numbers of eggs laid on seed of each genotype were recorded. The experiments were continued for next 360 days and data obtained were used for computing the adult emergence, per cent seed damage and per cent weight loss using formula given by Singh *et al.* (2017). The data obtained from the experiments were statistically analyzed as per Panse and Sukhatme (1976).

RESULT AND DISCUSSION

The *C. chinensis* showed differential response to different genotypes of chickpea. No chickpea genotype was found immune to bruchids infestation and showed significant difference in terms of oviposition, developmental period, adult emergence and seed weight loss. Pooled mean data on number of eggs deposited by the females of *C. chinensis* on different genotypes of chickpea (Table 1) ranged from 14.00 to 46.66. The genotype Vijay was least (14.00 eggs) preferred by the pulse beetle for oviposition followed by JAKI 9218, Vishal and Harita with 17.00, 20.00 and 22.66 number of eggs, respectively. The highest number of eggs (47.50 eggs) were recorded from the seed of Kanak followed by KAK II 2 (44.33) and PDKV Kabuli 4 (41.50). Mean data on number of adults emerged on different genotypes of chickpea are presented in 1 revealed that the number of adults emerged varied from 4.16 to 24.33. The genotype Vijay recorded least number of adults emerged (4.16 adults) followed by JAKI 9218 and Vishal with 6.33 and 8.00 number of adults emerged, respectively. Next genotypes with lower number of adults emerged were BDNG 797, Harita, PDKV Kanchan which recorded 11.33 number of adults emerged. The highest number of adults emerged (23.33) were recorded from the seed of Gulak (24.33) and KAK II (23.33). Pooled data pertaining to per cent adult emergence revealed that pulse beetle adult emergence ranged from 33.93 to 61.67 (%) in all chickpea genotypes. The lowest per cent adult emergence (33.93) was observed in Vijay followed by JAKI 9218, Vishal and PDKV Kanchan with 35.68, 37.09 and 37.93 per cent adult emergence. The highest adult emergence per cent (61.67) were recorded from the seed of KAK II followed by Gulak (60.42) and Kanak (57.41). Developmental period of *C. chinensis* on different chickpea genotypes ranged from 25.67 to 31.67 days. The highest developmental period (31.67 days) was recorded in Vijay and JAKI 9218 followed by Vishal (30.33 days). Pooled mean data (Table 2) revealed that the growth index of chickpea genotypes ranged from 1.05 to 2.33. Significantly the least growth index (1.05) was recorded in Vijay followed by JAKI 9218 (1.14), Vishal (1.20) and PDKV Kanchan (1.41). Significantly, the highest growth index (2.33) was recorded in KAK II followed by and Kanak (2.16).

Pooled mean revealed that the per cent seed damage due to pulse beetle ranged from 5.33 to 44.00 %. The least seed damage (5.33 %) was recorded from Vijay. It was followed by JAKI 9218, Vishal, PDKV Kanchan, Vishwraj, BDNG 797 and Vikram with 9.50, 10.33, 14.00, 17.16, 18.33 and 22.33 per cent seed damage, respectively. Significantly, the highest seed damage (%) was observed in KAK II (44.00) followed by Gulak (39.75), PDKV Kabuli 4 (35.00) and Kanak (37.50).Pooled mean data regarding per cent seed weight loss due to pulse beetle ranged from 1.33 to 30.50 per cent. Significantly, the least seed weight loss (1.33 %) was recorded from Vijay. It was followed by JAKI 9218, Vishal, PDKV Kanchan, BDNG 797, Vishwraj, Vikram, AKG 1109 and Digvijay with 2.50, 3.00, 4.50, 7.33, 8.00, 11.66, 13.00 and 15.66 per cent seed weight loss, respectively. Significantly, the highest seed weight loss was observed in KAK II (30.50 %) followed by Kanak with 26.00 per cent seed weight loss.

Usually the genotypes with more developmental period are considered as least susceptible. The variation in the development time of the beetle could be the result of intra-specific competition of larvae developing within seeds and depending on the population of the larvae, longer or shorter among the different beetle populations. High larval competition may prolong the development of the beetle. The antibiosis type of resistance is characterized by an increased span of time between the egg and adult phases, as well as by the reduction in adult emergence. Ability of a resistant host to delay the development of pest results in decreased reproduction rates or the number of insects in natural populations due to the increased average time of each generation. The results clearly indicated that shorter development period of *C. chinensis* was observed in highly susceptible genotypes and longer developmental period in resistant cultivars. The present findings are in accordance with, Kamble *et al.* (2016) who reported variety Vijay exhibited wrinkled seed coat, rough, yellowish brown colour and medium size seed characteristics were found to be least preferred for oviposition of *C. chinensis*. Similarly, Pokharkar and Chauhan (2010) reported the differences in their susceptibility against *C. chinensis* cultivar and found vijay as resistant against *C. chinensis* with minimum chickpea seed damage. The results are in close proximity with Prasad *et al*. (2013) who observed the longest developmental periods on the least susceptible chickpea cultivars. The shortest developmental periods were registered for the most susceptible cultivar. Higher growth indexes indicated the susceptibility, whereas lower growth indexes suggested moderate resistance against *C. chinensis.* The shortest developmental period, highest preference for oviposition and the highest number of adult emergence was recorded in KAK II and Gulak which indicates the susceptibility of these varieties against *C. chinensis*. This was based on higher preference for oviposition and suitability of the seeds for larval development; this is for the reason that suitability of the chickpea varieties to the development of the beetles would be reflected by the number of adults that completed their development. So it can be used for laboratory rearing of *C. chinensis*. Susceptibility studies of chickpea revealed that among twenty genotypes Vijay, was found resistant to *C. chinensis* on the basis of per cent seed damage under laboratory condition. While genotype KAK II and Gulak exhibited maximum per cent seed damage, seed weight loss and were categorized as highly susceptible cultivar. Lower seed damage in genotypes Vijay was attributed due to lower number of eggs, per cent adult emergence, growth index and more developmental period. However, maximum seed damage and seed weight loss in genotypes KAK II and Gulak was due to more number of eggs, per cent adult emergence, growth index and less developmental period recorded in these genotypes. Hence it is concluded that, Vijay pigeonpea variety can be effectively used as promising donors for developing bruchid resistant varieties which would ensure food security by reducing postharvest losses under storage conditions.

Table 1: Number of eggs laid, adult emergence, seed damage and seed weight loss by *C. chinensis* on different chickpea genotypes.

Sr. No.	Genotypes	Pooled mean three years data from 2020-21 to 2022-23.						
		Number of eggs laid/10 seeds	Number of adults emerged	Adult emergence (%)	Seed damage (%)	Seed weight loss (%)	Total developmental period (days)	Growth index
1.	Vikram	39.00 (6.32)*	16.33 (4.21)*	41.15 (42.26)**	22.33 (27.46)**	11.66 (19.37)**	27.00	1.53
2.	Vikrant	26.00 (5.15)	13.00 (3.67)	51.92 (46.10)	27.66 (31.95)	18.33 (25.84)	28.33	1.81
3.	Vijay	14.00 (3.81)	4.16 (2.30)	33.93 (35.63)	5.33 (13.05)	1.33 (7.03)	31.67	1.05
4.	Vishal	20.00 (4.52)	8.00 (2.92)	37.09 (37.52)	10.33 (19.37)	3.00 (9.97)	30.33	1.20
5.	Kripa	30.66 (5.12)	15.66 (4.36)	52.46 (51.77)	28.33 (32.58)	20.00 (26.57)	28.00	1.87
6.	Virat	30.33 (5.57)	16.66 (4.18)	55.74 (48.29)	31.00 (34.14)	23.00 (28.66)	27.67	1.99
7.	Digvijay	25.00 (5.05)	12.00 (3.61)	49.02 (44.44)	29.00 (32.90)	15.66 (22.79)	29.00	1.68
8.	Rajvijay	41.66 (6.51)	23.00 (4.06)	49.47 (46.41)	27.66 (32.27)	15.66 (23.58)	27.00	1.82
9.	Vishwraj	32.66 (5.90)	13.33 (3.94)	40.91 (49.26)	17.16 (24.54)	8.00 (16.43)	27.67	1.50
10.	BDNG-797	29.66 (5.81)	11.33 (3.47)	38.33 (38.25)	18.33 (25.84)	7.33 (15.34)	28.33	1.34
11.	Gulak	43.66 (5.01)	24.33 (3.88)	60.42 (51.01)	39.75 (39.09)	28.50 (32.27)	28.00	2.15
12.	Kabuli 1	27.00 (5.79)	16.00 (3.67)	51.98 (46.30)	34.25 (35.82)	25.00 (30.00)	27.33	1.90
13.	PDKV-kabuli 4	30.00 (6.93)	18.50 (4.90)	53.99 (48.11)	35.00 (37.17)	26.50 (30.98)	28.33	1.91
14.	AKG-1109	28.00 (6.18)	15.00 (3.94)	50.88 (45.50)	25.00 (30.00)	13.00 (21.13)	29.00	1.73
15.	Harita	22.66 (4.73)	11.33 (3.42)	52.27 (46.30)	27.00 (31.31)	17.00 (24.35)	29.33	1.82
16.	PDKV Kanchan	29.00 (5.43)	11.33 (3.42)	37.93 (38.02)	14.00 (21.97)	4.50 (12.25)	29.33	1.41
17.	JAKI 9218 (RC)	17.00 (4.24)	6.33 (2.64)	35.68 (39.51)	9.50 (17.95)	2.50 (9.10)	31.67	1.14
18.	Kanak (SC)	46.66 (5.75)	22.66 (4.98)	57.41 (39.76)	37.50 (37.76)	26.00 (30.66)	25.67	2.16
19.	KAK II	44.33 (6.45)	23.33 (4.65)	61.67 (44.70)	44.00 (41.55)	30.50 (33.52)	26.33	2.33
20.	BDNG-798	26.00 (5.05)	13.50 (3.74)	52.94 (46.69)	31.50 (34.14)	22.50 (28.32)	27.67	1.92-2.16
	Range	14.00-44.33	4.16-24.33	33.93-61.67	5.33- 44	1.33-30.50	25.67-31.67	1.05-2.33
	SE(m)±	0.19	0.07	1.05	0.21	0.53	1.30	0.85
	CD @ 1%	0.60	0.21	3.15	0.84	2.78	3.90	2.93

*Figures in the parenthesis are $\sqrt{X+0.5}$ transformed means **Figures in the parenthesis are arcsine transformed means

CONCLUSIONS

From the above investigation it is concluded that, Vijay chickpea variety can be effectively used as promising donors for developing bruchid resistant varieties which would ensure food security by reducing postharvest losses under storage conditions.

FUTURE SCOPE

Genotypes under tolerant category may be utilized as potential donors in future breeding programme to develop the bruchid tolerant variety. Besides, it is also needed to explore the physical as well as biochemical and molecular basis of resistance to elucidate the tolerance mechanism and for their effective utilization in chickpea breeding programme.

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