



Screening for resistance against bruchid (*Callasobruchus maculatus*) damage in blackgram

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ABSTRACT

Bruchid (*Callasobruchus* sp.) is the most devastating pest causing severe damage to the blackgram seeds during storage. Hence it is essential to identify a genotype which is resistant to bruchids. A total of 61 blackgram genotypes were artificially screened for their resistance against *Callasobruchus maculatus* at National Pulses Research Center, Tamil Nadu Agricultural University, Pudukkottai during 2017. Among the genotypes TU 68 had comparatively less number of adult emergence in 40, 50, 60, 70, 105 days after infestation, less seed damage (%) and less seed weight loss (%). Genotype TU 68 was found to be resistant in the confirmatory experiment also. Less number of adult emergences even at the end of 105 days indicated the prolonged developmental period which is also a mechanism of bruchid resistance. TU 68 was derived from the interspecific cross TU 94-2 × *Vigna mungo* var. *silvestris*. TU 68 could be utilized in the hybridization programme to develop high yielding blackgram variety inbuilt bruchid resistance.

Key words: Blackgram, Bruchid resistance, *Callasobruchus maculatus*, Seed damage

Blackgram (*Vigna mungo* (L.) Hepper), popularly known as urdbean in India which is a rich source of protein (20.8 to 30.5 %) and total carbohydrate ranging from 56.5-63.7%. It is also popular for its fermented foods in Southern India. In India, blackgram is cultivated in 4.01 million ha with a production of 2.89 million tonnes and productivity of 547 kg/ha (MULLARP 2017). Storage pests that feed on seeds have always been one of the most important biotic constrain for the crop and causes severe economic loss during post harvest storage. Among storage pest, bruchid created a adverse effect and reduced the economic importance of the crop (Ramzan *et al.* 1990). However, black gram varieties known for their superior performance in field in terms of pest tolerance were found susceptible to pulse bruchid during storage (Swamy *et al.*, 2016). Seeds of blackgram are severely affected by bruchid species of the genus *Callasobruchus* (Coleoptera: Bruchidae). Bruchid species of the genus *Callosobruchus* (Coleoptera: Bruchidae) severely affected the seeds of these leguminous crops. The most serious of these species in Asia are azuki bean weevil (*Callosobruchus chinensis* L.), cowpea weevil (*C. maculatus* F.), and Graham bean weevil (*C. analis* F.). It infests the crop at pod maturity, and the damage is observed after harvest. The adults emerged during storage

also secondary infestations. This leads to total destruction of a seed lot within 3–4 months (Banto and Sanchez 1972). The post harvest damage caused by the bruchids varies from crop to crop depending on the bruchid species and their biotype. In India, *Callasobruchus maculatus* causes up to 90% yield loss in blackgram (Soundararajan *et al.* 2013). Several options including insecticidal application are currently available to reduce bruchid infestation. However, development of cultivars with adequate level of resistance can be cost effective, durable and ecofriendly approach. Hence this study was carried out to screen 61 genotypes of blackgram to assess the resistance to bruchid damage.

MATERIALS AND METHODS

Sixty one genotypes obtained from Bhabha Atomic Research Center, Trombay and National Pulses Research Center, Vamban Colony during 2017 were used in this study. The experiment was carried out during June-September, 2017 in Entomology laboratory at National Pulses Research Center, Tamil Nadu Agricultural University, Vamban Colony, Pudukkottai 622 303. Ten genotypes with less number of adult emergences on 50 days of infestation and less seed damage and four check entries were further confirmed for its resistance during December-March, 2017-18. Both experiments were conducted in completely randomized design with two replications. The resistance of the genotypes were compared to the susceptible check TU 94-2 in both trials. Among the various species of bruchid, *Callasobruchus maculatus* dominated the population. So it was subjected

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to mass culturing and for screening the test genotypes. The freshly emerged adults were used for screening.

An assay procedure described by Dongre *et al.* (1993) was followed with few modifications for screening of blackgram genotypes against bruchids. a) Five pairs of newly emerged adults from the stock culture was released on 50 seeds of each genotype placed in a 10 cm diameter plastic petriplates with two replications. The insects left to remain in petriplates for five days for oviposition, b) Released adults were removed after five days, from the petriplates to avoid secondary infestation. Data on total number of eggs laid on 50 seeds were counted and c) Adult emergence to be checked daily after 20 days of adult release. The adults emerged were counted on daily basis and removed from the petriplates to avoid secondary infestation. Four traits were observed for evaluation of bruchid resistance among the genotypes. The traits are as follows: a) Number of eggs laid: Total number of eggs laid on 50 seeds per replication was counted on fifth day, b) Adult emergence: Adult emergence was counted on a daily basis up to 105 days from adult release, c) Seed weight loss (%) and d) Seed damage (%). Statistical analysis was carried using STAR (2014) package (ver 2.0.1).

RESULTS AND DISCUSSION

Results of bruchid infestation among 61 blackgram

genotypes are furnished in Table 1. Oviposition is one of the important behaviour of an insect for continuation of its race and for their population establishment (Sehgal and Sachdeva 1985). TU 02 had less number of eggs laid on 50 seeds, whereas the genotype TU 23 had maximum number of eggs. This ovipositional responses could be due to biotic and ecological factors. Similar results were reported by Tripathi *et al.* (2015). The maximum number of genotypes had 100 to 200 eggs on the seed including the susceptible check. This is in accordance with findings of Talekar (1988) who reported 128 eggs were laid by *C. maculatus*. The maximum number of eggs (236) was laid on 50 seeds with an average of 4 eggs per seed. But maximum of one egg was hatched and single adult emerged from the single window. The present findings were similar with Talekar (1988). He also reported that it was due to the mixture of fatty acids, triglycerides, hydrocarbons which prevents hatching of more than one or two egg per seed and helped in the regulation of pest population and maximizing the use of food. Likewise chemical factor present in the seeds of resistant genotype prevent the hatching of eggs. Even though seed wouldn't suit for complete adult emergence, *C. maculatus* had oviposition on all the genotypes. Among the 61 genotypes TU 68, TU 72 and TU 80 would not favour complete development of adults. This was in accordance with Yadav and Pant (1974) who reported *Callasobruchus*

Table 1 Screening of blackgram genotypes against bruchid infestation

Genotype	No of eggs laid on 50 seeds	Number of adults emerged in					Seed damage (%)	Seed weight loss (%)
		40 days	50 days	60 days	70 days	105 days		
TU 02	42*	6*	19*	24*	24*	24*	41*	28*
TU 04	199	24*	44	46	48	48	71	42
TU 15	209	5*	32*	40	40	42	80	43
TU 18	96	39	44	44	46	46	82	42
TU 19	185	41	45	45	46	46	82	42
TU 20	160	47	50	50	51	52	79	44
TU 21	186	42	48	48	49	49	80	43
TU 22	221	44	45	45	46	46	86	44
TU 23	174	40	48	48	48	48	84	43
TU 25	199	41	46	47	47	47	86	42
TU 26	134	48	48	48	49	49	89	43
TU 27	116	42	46	47	47	48	77	41
TU 28	175	41	45	45	45	45	89	44
TU 29	160	42	46	47	47	47	74	43
TU 30	186	45	47	48	48	48	82	44
TU 31	193	40	47	47	48	48	78	41
TU 32	190	45	48	48	49	49	86	44
TU 33	184	45	47	47	47	47	77	43
TU 34	116	42	46	47	48	48	74	40
TU 35	141	43	48	48	49	49	83	44
TU 36	113	43	46	47	49	50	83	44

Contd.

Table 1 (Concluded)

Genotype	No of eggs laid on 50 seeds	Number of adults emerged in					Seed damage (%)	Seed weight loss (%)
		40 days	50 days	60 days	70 days	105 days		
TU 37	135	41	46	46	46	47	83	44
TU 38	207	41	46	46	46	46	77	44
TU 39	172	44	46	46	46	46	82	43
TU 40	146	39	45	46	46	46	74	41
TU 68	139	4*	9*	13*	18*	19*	40*	28*
TU 72	236	16*	24*	27*	28*	28*	43*	31*
TU 80	189	9*	19*	27*	30*	33*	53*	34
TU 100	142	20*	44	48	49	49	80	44
VBG 12034	122	44	45	45	46	46	77	42
VBG 12062	158	33	47	49	51	51	84	42
VBG 12064	203	40	47	47	49	49	75	40
VBG 12102	156	27*	50	51	51	51	69*	42
VBG 12105	100	48	48	51	53	53	80	39
VBG 12110	134	12*	41	44	44	45	69*	39
VBG 12111	115	41	44	45	46	46	78	38
VBG 12116	180	8*	44	45	47	48	69*	41
VBG 13001	162	42	48	49	51	51	80	41
VBG 13003	106	15*	37	40	44	47	76	39
VBG 14008	187	29*	39	40	42	42	63*	37
VBG 14010	152	41	47	48	53	53	74	41
VBG 14011	179	40	47	47	48	48	82	40
VBG 14012	130	13*	24*	25*	26*	29*	47	31*
VBG 14014	116	23*	42	43	45	46	89	41
VBG 14015	116	40	46	47	49	49	75	39
VBG 15007	119	41	44	44	46	46	76	40
VBG 15009	174	36	42	43	44	46	75	40
VBG 15010	134	19*	24*	27*	30*	31*	50*	33*
VBG 15011	127	30*	32*	33*	38	38	58*	36
TU 103	74	28*	46	47	48	48	77	40
ADT 5	85	37	38	39	40	40	64*	37
CO 5	171	42	48	48	49	49	86	42
LBG 752	165	41	43	43	43	43	67*	40
MDU 1	145	34	41	43	45	45	72	39
Vamban 2	159	45	46	46	49	49	80	44
VCN (Bg) 4	126	47	50	51	52	52	86	44
VCN (Bg) 5	119	43	45	45	46	46	78	43
VCN 6	191	18	42	44	45	46	82	41
VCN (Bg)7	136	29*	48	49	49	49	89	43
VCN 8	140	21*	42	44	45	46	83	41
TU 94-2	126	40	42	44	45	45	84	40
S E	25.96	3.08	3.19	3.26	3.22	3.36	4.93	1.96
CD (5%)	72.7	8.62	8.94	9.13	9.03	9.41	13.81	5.5
CV (%)	24.24	12.96	10.73	10.63	10.21	10.55	9.28	6.86

*Significantly superior than TU 94-2 (Susceptible check) at 5% probability.

Table 2 Confirmatory trial for validation of resistance

Genotype	Number of eggs laid on 50 seeds	Number of adults emerged in					Seed damage (%)	Seed weight loss (%)
		40 days	50 days	60 days	70 days	105 days		
TU 02	93 *	13*	37	38*	40*	44	70	43
TU 15	156	5 *	39	46	47	49	83	42
TU 68	98 *	2 *	7 *	12*	13*	13*	30*	21*
TU 72	158	17*	23*	25*	26*	26*	46*	29*
TU 80	156	11*	26*	29*	30*	31*	51*	32*
VBG 12110	178	23*	30*	38	39*	50	86	45
VBG 12116	102	18*	32*	40*	44	49	82	45
VBG 13003	163	38	43	45	45	48	77	45
VBG 14012	198	38	42	44	44	49	86	46
VBG 15010	165	46	46	50	51	51	90	46
TU 103	149	28*	34*	39*	42	49	80	45
ADT 6	149	39	39	40*	40*	49	86	45
VBN 6	245	32	35	39	43	48	80	45
TU 94-2	203	40	41	47	47	48	74	43
SE	30.2	3.1	2	1.5	1.5	1.5	3.4	1.2
CD (5%)	92.3	9.6	6.2	4.6	4.7	4.5	10.4	3.7
CV (%)	27.1	18	8.6	5.7	5.6	4.9	6.6	4.2

*Significantly superior than TU 94-2 (Susceptible check) at 5% probability.

species will oviposit on any seed even though the seed may not be suitable for the development of insects. Hence it represented the presence of a chemical factor in the seed which deterred the complete development.

In the present investigation, the adult starts to emerge from the seeds of all the genotypes in 30-35 days after infestation. More number of adults were emerged in 40 days itself in susceptible check TU 94-2. The similar finding was reported by Swamy *et al.* (2016). Five genotypes, viz. TU 02, TU 15, TU 68, TU 72, TU 80, VBG 14012, VBG 15010 and VBG 15011 in which less number of adults were emerged in 50 days after infestation. Most of the genotypes recorded more number of adults than susceptible check and few remained on par with check. Few genotypes behaved to have less number of adults in 40 and 50 days after infestation, found to have more number of adults at subsequent intervals. At the end of 105 days, five genotypes, viz. TU 02, TU 68, TU 72, TU 80, VBG 14012 and VBG 15010 remained to have less number of adults. It indicated the prolonged developmental period of larvae present inside the seed. This might be due to presence of unfavourable chemical constituents inside the seeds which delay the developmental period of a growing grub as noticed by Tripathi *et al.* (2015). The genotype TU 68 found to have less adult emergence. Similar result was observed by Swamy *et al.* (2016). Resistant varieties were not suitable for feeding and quick development of the life stages of the bruchids. Hence, less adult emergence was observed in resistant varieties. TU 68 is a cross derivative between TU 94-2 and *Vigna mungo* var. *silvestris*. The reduced oviposition, reduced seed damage,

prolonged developmental period might be due to antibiosis which is present in *Vigna mungo* var. *silvestris* as reported by Soundararajan *et al.* (2013). Thus TU 68 could be used as source of resistance for crop improvement.

In confirmatory trial, 10 promising genotypes with less number of adult emergences on 50 days of infestation and less seed damage and four checks were evaluated for their reaction against bruchids damage (Table 2). The results indicated that three genotypes, viz. TU 68, TU 72 and TU 80 found to be promising especially TU 68 towards bruchid infestation in oviposition, adults emergence in various interval, seed damage and seed weight loss. The less seed damage was attributed to the presence of resistance factor in the seeds of the resistant genotypes. Seed weight loss was one of the important resistance factors against bruchid and an important criterion due to the economic value of the seed. Among the genotypes TU 68 had less seed weight loss when compared to the susceptible check in both trials. It was found that TU 68 performed with same level of resistance in the confirmation experiment, whereas other selected genotypes had varied performance for various traits.

To summarize, it may be concluded that TU 68 had comparatively less number of oviposition, less adult emergence on 40, 50, 60, 70, 105 days after infestation, less seed damage (%) and less seed weight loss (%). Less number of adult emergences even at the end of 105 days indicated the prolonged developmental period. Hence, TU 68 could be utilized as a donor parent in the development of high yielding blackgram variety with bruchid resistance.

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