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Physio-chemical parameters of pigeonpea seed affecting the infestation of pulse beetle, *Callosobruchus maculatus* (Fabricius)

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Abstract
The investigations were carried out to determine the impact of physio-chemical characters of promising genotypes of pigeonpea seed against pulse beetle, *Callosobruchus maculatus* (Fabricius). Out of 25 genotypes, PKV-TARA was found most superior, which was recorded less ovipositional preference (10.25 eggs/10 seeds), adult emergence (71.01%), adult longevity (7.50 days) of *C.maculatus* and growth index (2.56). Among the physical parameters, hardness of seed played an important role on biological parameters of *C.maculatus* and grain damage. The PKV-TARA also recorded less grain damage (76.86%) and loss in grain weight (2.22%) with highest hardness of seed (21.94 kg/grain). The next promising genotypes *viz*., Vipula, BSMR-736 and PT-03-142 were found comparatively superior over rest of the genotypes. As regards the biochemical parameters, the genotypes having higher ash content with lower content of protein, carbohydrate and fat in seeds was found to be less preferred by the bruchid having less growth and development of *C.maculatus* with minimum grain infestation in the test genotypes.

Keywords: Pigeonpea, Physio-chemical parameters, pulse beetle, grain damage

Introduction
Pulse beetle, member of genus *Callosobruchus* spp. is a major storage pest of pigeonpea and other pulses. The infestation of the pest begins in the field and the population multiplies rapidly in storage resulting in reducing seed weight, nutritional quality and seed viability that makes most of the pulses unfit for marketing as well as human consumption. Nearly 8.5 per cent of the total production of the pulses in India is lost during post harvest and storage (Agarwal *et al*., 1988). Pulse beetles caused 30.20 to 55.70 per cent loss in seed weight and 17.00 to 66.30 per cent loss in protein content (Gujar and Yadav, 1978) [6].
Developing varieties that could combine both grain and pod resistance may result in an effective approach to achieving a high and durable level of resistance to bruchid attack. Several characters associated with resistance have been identified, such as reduction in insect oviposition and adult inset emergence due to physical and chemical characteristics of the plant host. A lot of these traits have been identified by several workers (Regupathy and Rathnaswamy, 1970; Satyavir, 1981, And Vishwamithra *et al.*, 2015) [12]. Developing countries are adopting use of resistance grain varieties to control stored grain weevils a population attack to use of the chemical. Although, lot of work is being carried out on evolving varieties of pulses resistant to storage against pulse beetle. In view of the nutritive value of pulses in the present era of protein deficiency, it was felt necessary to undertake the studies on physical and biochemical parameters against pulse beetle, *C. maculatus* in storage imparting resistance/ susceptibility in genotypes of pigeonpea, *Cajanus cajan.*

Materials and methods
Pulse beetle culture
The experiment was conducted during *Kharif* 2015-16 in the laboratory of Department of Agricultural Entomology, Post Graduate Institute, Mahatma PhuleKrishiVidyapeeth,Rahuri-413 722 (M.S.)under ambient conditions. Pulse beetle, *Callosobruchus maculatus* (Fabricius) was collected from the storage godown of Seed Technology Research Unit, MPKV, Rahuri. The beetles were identified as per the key given by Raina (1970) [10].

Physical parameters of seed
The varieties preference studies were conducted with 25 pigeonpea genotypes seed procured from Pulses Improvement Project, MPKV, Rahuri. The moisture content of the test grain was

standardized before starting the experiment. Thirty grains of each genotype healthy, sound and disinfect was study to the physical traits including seed colour, seed size, seed volume, hundred grains weight and seed hardness.

Biochemical constituents in seed

Biochemical constituents *viz*., protein, carbohydrate, fat and ash was analyzed on the equipment i.e. NIR-Spectrometer which was provided by the Department of Agricultural Botany, PGI, MPKV, Rahuri. Moisture content of grains was determined as per the method given by Chalam *et al*. (1967).

Biological parameters of *C. maculatus*

Fifty grams grain of each genotype kept in plastic container and 5 pairs of 10 days-old adults were released in each container and 48 hours after released all adults were removed. The experiment was replicated 4 times. The grains was observed daily and after 15 days onward to record the egg laid per 10 seeds, adult emergence, adult longevity, developmental period (egg to adult), per cent grain damage, per cent loss in grain weight and growth index. Growth index was calculated based on the data obtained in each genotype with the following formula.

$$\text{Growth index} = \frac{\text{Log Per cent adult emergence}}{\text{Average developmental period in days (from egg to adult stage)}}$$

Statistical analysis

The data obtained from different aspects were analyzed by using complete randomized block design method. The different parameters *viz.*, biological, morphological/ physical and biochemical constituents were correlated with each other to find out the role of these parameters on varietal resistance/ susceptibility and bruchid development.

Results and discussion

The data on biological parameters of pulse beetle, *C. maculatus* are summarized in Table 1. The results showed that all the 25 genotypes of pigeonpea were preferred by the adults for oviposition. Among the genotypes tested, PKV-TARA and BSMR-736 was less preferred (10.25 eggs/10 seeds) for oviposition, while genotypes ICPL-87 and PT-417-7-1-14 were most preferred for oviposition(14.00 eggs/10 seeds). These results are in agreements with Khokhar and Singh (1987) who reported the number of eggs laid by the beetle on pigeonpea varieties varied from 34.7 to as high as 238.0 eggs/20 seeds.

The highest adult emergence was displayed in PT-00-12-1-1 (91.38 %) followed by BDN-2001-6 (90.68 %), PT-04-24-2 (90.23%) and ICPL-87 (90.00%) whereas, the less adult emergence was observed in PKV-TARA (71.01 %) followed by Vipula (72.66%), ICPL-332 (74.91%), BSMR-736 (78.14%), PT-04-257 (78.65%) and ICPL-88039 (79.09%) and it was statistically at par with each other. Irrespective of adult emergence, the adult longevity ranged from 7.50 days in PKV-TARA to 12.25 days in BSMR-853. The present results are in supported with the findings of Gokhale (1973) who reported adult emergence *of C. maculatus* to the extent of 77.47 to 86.44 per cent when reared on Bengal gram and the minimum (43.36 to 61.59%) adult emergence of *C. chinensis* on different pigeonpea genotypes.

The results on development period indicated that the less development period of *C. maculatus* was observed in Vipula (26.00 days) followed by BSMR-736 (26.25 days) and highest development period was recorded in BSMR-853 (31.75 days) followed by PT-04-24-2 and PT-01-24-1-1 (31.25 days). These findings are in line with Shivanna *et al.* (2011) observed the development period of *C. maculatus* in the range of 30.00 – 36.00 days in the genotypes of pigeonpea.

In the present study, the genotype PT-00-12-1-1 proved to be most nutritious to *C. maculatus* recording high growth index (3.38). While the least nutritious genotype was PKV-TARA recorded 2.56 growth index and it was at par with BSMR-853 (2.61). Similar observations are made by Vishwamithra *et al.* (2015) who observed the growth index of *C. chinensis* in between 0.00 to 6.00 in different varieties of pigeonpea.

The minimum grain damage and loss in grain weight on weight basis was observed in the genotype PKV-TARA (76.86 and 2.22%, respectively) and it was found at par with BSMR-736 (78.00 and 2.55%, respectively). Whereas, the maximum grain damage was recorded in ICPL-87 (95.58%) followed by PT-00-12-1-1 (92.63%) and the maximum loss in grain weight was recorded in PT-00-12-1-1 (22.81 %) followed by ICPL-87 (21.15 %). These results are in supported with Patnaik and Samalo (1987) [9] reported the seed infestation of pigeonpea genotypes by pulse beetle, *C. maculatus* in the range of 5.2 to 88.7 per cent. They also reported seed weight loss varies in pigeonpea due to pulse beetle.

It is evident from the data presented in Table 2, the genotype PT-01-24-1-1 showed highest seed volume (116.0 seeds/10 cc) indicating small seed size. ICPL-88039 was observed less seed volume (82.1 seeds/10 cc) indicating boldness of seed. Hundred grains weight of PKV-TARA was recorded 11.29 g indicating boldness of seed and ICPL-87 recording less grain mass (9.25 g). The grain of PKV-TARA genotype was observed harder (21.95 kg/grain) followed by PT-00-12 (19.87 kg/grain) and BSMR-736 (19.33 kg/grain), while ICPL-87 was noted less hardness (8.80 kg/ grain) followed by ICPL-98008 (9.00 kg/grain) and PT-01-24-1-1 (10.61 kg/grain). There was no any association was observed in individual genotype with different seed physical characters. These results are in agreement with Regupathy and Rathnaswamy (1970) who observed no association of seed colour, seed volume and hardness of seed.

Irrespective of physical characters of seed, the biochemical constituents in seeds of different pigeonpea genotypes no association was observed with the bruchid infestation. However, the highest protein content was found in ICPL-87 (20.18 %) followed by PT-00-5-7-4-1 (19.30%). The less protein content was observed in ICPL-98008 (17.32%). The highest per cent carbohydrate was recorded in PT-2001-11-2 (69.49 %), followed by ICPL-87 (67.63%)and it was less in PKV-TARA (57.63%). The highest fat content was found in PT-04-12-1-1 (1.40%), whereas, the less fat content was observed in PKV-TARA (0.93%) followed by PT-2001-11-2 (0.95%).The high ash content was noticed in Vipula (4.02%) followed by PKV-TARA (3.80%). The less ash content was recorded in PT-04-12-1-1 (2.58%) followed by ICPL-332 (2.60%). The moisture content in seeds of different genotypes was recorded in between the range of 8.67 per cent in PT-04-31 to 9.32per cent inBDN-2001-6 per cent. These findings are in conformity with the results reported by Gujar and Yadav (1978) [6] recorded 44.5 to 66.3 per cent loss in protein due to feeding of *C. maculatus* and 17 to 53.5 per cent loss in protein due to *C. chinensis* in green gram. Khattak *et al.* (1991) reported high ash content of varieties of chickpea significantly reduced the insect infestation. Dwivedi and

Sharma (1996) [3] reported a decrease in preference by the bruchid, *C. chinensis* with increasing protein and fat content. Vimla and Pushpamma (1983) [14] asserted changes in carbohydrate contents of seed of red gram, green gram, black gram and Bengal gram by feeding of pulse beetles (*C. chinensis.)* in three agro-climatic zones.

The results on correlation coefficient (r) are presented in Table 3. Among the physical characters of seed, hardness of seed played an important role in biological activities of *C. maculatus* and grain infestation. It was negative and non significant correlated with number of eggs laid and positive and non significant with growth index. Seed hardness was significant and negatively correlated with adult emergence (r= -0.427), development period (r= -0.478) of pulse beetle, per cent grain damage (r= -0.575) and per cent loss in grain weight (r= -0.493). It means that increases in hardness of seed decreases the biological activity of bruchid. Other physical characters were partially associated with biological activities of pulse beetle. These findings are corrugated with the results of Regupathy and Rathanswamy (1970) who observed no association of seed colour, seed volume and hardness of seed, whereas Gawade (2010) [4] reported increase in hardness, 100 grains weight and seed size, decreases the number of eggs of *C. maculatus* on cowpea.

Table 1: Reaction of pulse beetle to seeds of different pigeonpea genotypes

Sr. No.	Genotypes	No. of eggs laid/10 seeds	Adult emergence (%)	Adult longevity (Days)	Development Period (Days)	Growth index	% grain damage (Weight basis)	% loss in grain weight
1	PT-00-1-25-1	11.50	85.68	10.75	30.75	2.79	85.50(67.62)*	19.37 (26.11)
2	PT-00-12-1-1	12.75	91.38	8.25	27.00	3.38	92.63(74.25)	22.81 (28.52)
3	PT-04-24-2	11.00	90.23	11.75	31.25	3.03	88.18(69.89)	11.85 (20.13)
4	PT-04-31	13.00	88.46	9.50	29.00	3.05	88.31(70.01)	11.60 (19.90)
5	PT-01-24-1-1	11.00	87.95	11.00	31.25	2.81	85.85(67.91)	14.05 (22.00)
6	PT-005-7-4-1	10.50	82.73	9.25	28.75	2.88	85.73(67.81)	15.79 (23.41)
7	PT-00-16-4-2	10.75	85.90	10.25	30.25	2.84	79.05(62.75)	10.23 (18.64)
8	PT-00-4-16-2	11.25	84.66	9.00	29.75	2.85	84.27(66.63)	15.76 (23.38)
9	PT-04-257	10.75	78.65	8.75	27.25	2.89	79.03(62.75)	16.64 (24.07)
10	PT-2001-11-2	10.50	83.18	9.75	29.00	2.89	88.63(70.29)	11.39 (19.72)
11	PT-417-7-1-14	14.00	86.29	8.75	29.00	2.98	86.43(68.39)	14.17 (22.09)
12	PKV-TARA	10.25	71.01	7.50	27.75	2.56	76.86(61.25)	2.22 (8.23)
13	PT-17-12-2	10.50	82.01	9.25	29.75	2.76	90.00(71.56)	20.47 (26.90)
14	BSMR-736	10.25	78.14	7.75	26.25	2.98	78.00(62.02)	2.55 (9.07)
15	PT-00-12	11.00	81.97	9.75	28.50	2.88	80.00(63.43)	7.37 (15.74)
16	PT-03-142	11.75	83.29	8.50	28.25	2.95	79.92(63.38)	4.30 (11.53)
17	Vipula	11.25	72.66	7.50	26.00	3.10	78.00(62.03)	4.01 (11.39)
18	BDN-2010-12	10.50	88.18	11.00	30.50	2.89	90.50(72.05)	15.80 (23.42)
19	BDN-2001-6	11.00	90.68	10.75	30.25	2.97	79.89(63.36)	11.67 (19.98)
20	ICPL-87	14.00	90.00	10.25	30.00	3.00	95.58(77.87)	21.15 (27.37)
21	ICPL-332	11.00	74.91	10.50	31.00	2.62	90.73(72.27)	9.51 (17.95)
22	ICPL-87119	10.75	83.41	8.25	26.75	3.12	85.17(67.35)	15.20 (22.94)
23	ICPL-98008	10.50	84.13	9.50	28.75	2.93	88.32(70.01)	9.27 (17.68)
24	ICPL-88039	10.75	79.09	8.75	28.25	2.80	86.22(68.21)	14.38 (22.28)
25	BSMR-853	12.00	89.07	12.25	31.75	2.81	84.00(66.42)	14.87 (22.67)
S.E. ±		0.62	3.34	0.44	0.59	0.001	0.14	0.45
C.D. at 5%		1.76	9.41	1.23	1.65	0.003	0.39	1.27

* Figures in parentheses are arc sine transformed values.

Table 2: Biochemical reaction to pulse beetling seeds of pigeonpea genotypes

Sr. No.	Genotypes	Morphological characters of seed					Biochemical constituents				
		Seed colour	Seed size	Seed volume (seeds/10cc)	100 grain weight (g)	Seed hardness (kg/grain)	Protein content (%)	Carbohydrate Content (%)	Fat content (%)	Ash content (%)	Moisture content (%)
1	PT-00-1-25-1	Red	Small	100.7	10.97	15.20	19.10	66.83	1.20	3.50	9.05
2	PT-00-12-1-1	Red	Small	90.4	9.73	18.30	19.06	62.72	1.40	2.58	9.12
3	PT-04-24-2	Red	Small	101.2	10.20	14.17	18.60	62.28	1.22	3.49	9.05
4	PT-04-31	Red	Small	102.8	10.90	17.87	18.92	62.59	1.24	3.22	8.67
5	PT-01-24-1-1	Red	Small	116.0	10.45	10.61	19.18	65.15	1.23	3.45	8.90
6	PT-005-7-4-1	Red	Medium	92.9	10.45	12.00	19.30	62.64	1.21	2.96	9.00
7	PT-00-16-4-2	Red	Medium	93.1	9.86	13.30	18.15	64.90	1.06	3.21	9.03
8	PT-00-4-16-2	Red	Medium	94.0	10.25	17.10	18.32	63.23	1.22	3.44	9.27
9	PT-04-257	Red	Medium	90.6	10.41	14.27	18.36	62.62	1.15	3.18	9.12
10	PT-2001-11-2	Red	Medium	92.2	11.14	16.44	17.56	69.49	0.95	3.34	8.87
11	PT-417-7-1-14	Red	Medium	96.5	10.52	13.48	18.34	66.60	1.17	3.35	9.05
12	PKV-TARA	Red	Bold	87.6	11.29	21.94	17.83	57.63	0.93	3.80	9.12
13	PT-17-12-2	Red	Bold	97.0	11.00	11.00	18.51	63.38	1.19	3.41	9.05
14	BSMR-736	Red	Bold	85.7	9.92	19.33	18.37	59.15	1.19	3.49	8.90
15	PT-00-12	Red	Bold	84.4	10.00	19.87	18.64	62.48	1.18	3.30	9.20
16	PT-03-142	Red	Bold	89.2	10.00	15.29	18.62	59.28	1.16	3.76	8.85
17	Vipula	Red	Bold	88.1	9.82	17.72	17.95	61.95	0.96	4.02	9.02

18	BDN-2010-12	Light brown	Small	99.8	10.89	11.88	18.98	63.01	1.20	3.38	9.10
19	BDN-2001-6	Light brown	Small	99.5	11.06	15.60	18.96	62.83	1.21	3.26	9.32
20	ICPL-87	Light brown	Small	102.8	9.25	8.80	20.18	67.63	1.17	3.07	8.97
21	ICPL-332	Light brown	Medium	98.7	10.48	13.86	18.13	65.35	1.00	2.60	8.85
22	ICPL-87119	Light brown	Bold	84.3	10.19	11.87	18.04	60.46	1.17	3.40	9.00
23	ICPL-98008	Light brown	Bold	85.8	9.61	9.00	17.32	62.30	0.97	3.25	9.07
24	ICPL-88039	Light brown	Bold	82.1	10.69	17.26	18.31	62.94	1.11	3.40	9.17
25	BSMR-853	White	Small	102.4	10.05	12.00	18.82	63.25	1.21	3.52	9.15

Table 3: Correlation coefficient 'r' between biochemical reaction to pulse beetling seeds of different pigeonpea genotypes

Particulars	Correlation coefficient 'r'					
	No. of eggs laid/ 10 seeds	Adult emergence (%)	Development Period (Days)	Growth index	% grain damage (Weight basis)	% loss in grain weight
Seed volume(seeds/10 cc)	0.337	0.546**	0.770**	-0.133	0.392	0.380
100 grain weight(g)	-0.314	-0.158	0.202	-0.479*	-0.072	0.007
Seed hardness (kg/grain)	-0.129	-0.427*	-0.478*	0.017	-0.575**	-0.493*
Protein content (%)	0.504*	0.570**	0.350	0.200	0.364	0.538**
Carbohydrate content (%)	0.367	0.373	0.506**	0.055	0.548**	0.519**
Fat content(%)	0.383	0.692**	0.152	0.489*	0.280	0.586**
Ash content(%)	-0.087	-0.251	-0.137	-0.142	-0.472*	-0.427*
Moisture content (%)	0.181	0.080	0.053	-0.060	-0.229	0.205

* Significant at 5%=0.396 and ** Significant at 1%=0.505

In respect of biochemical constituents correlation, it revealed that the seed content of protein, carbohydrate and fat was more nutritious with positive correlation with biological activity of the pest and negative correlation with fat content in the genotypes. However, protein, carbohydrate and fat content were found significant and positive correlation with per cent grain damage (r=0.364, 0.548 and 0.280, respectively) and loss in grain weight (r=0.538, 0.519 and 0.586, respectively), whereas, ash content was significant and negative correlation with per cent grain damage (r = -0.472) as well as loss in grain weight (r = -0.427).These present findings are in agreement with Satyavir (1981) observed a positive and significant correlation between adult emergence of test insect and protein content. Vishwamithra *et al.* (2015) observed that the chemical parameters like high ash of test varieties were detrimental to the growth and development of test insect, while protein content of the test varieties favored the successful development of bruchid and high infestation.

References

1. Agarwal A, Lal CP, Gupta KC. Natural products a protectants of pulses against pulse beetles. Bull. Grain Tech., 1988; 26(2):154-164.
2. Chalam GV, Singh A, Johnson ED. Seed testing manual, JMH. Press Private Limited, Delhi-6, 1967, p-249.
3. Dwivedi SC, Sharma MK. Extend of damage caused and host preference of *Callosobruchus maculatus* Linn. India Bioved., 1996; 4(2):249-254.
4. Gawade AA. Screening of cowpea germplasm and evaluation of seed protectants against pulse beetle [*Callosobruchus maculatus* (F.)]. M.Sc. (Ag.) thesis submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra), India, 2010.
5. Gokhale VG. Development compatibility of several pulses in the Bruchidae-I. Growth and development of *C. maculatus* F. on host seeds. Bull. Grain Tech., 1973; 11(1):28-31.
6. Gujar GT, Yadav TD. Feeding of *C. maculatus* and *C. chinensis* in green gram. Indian J. Ent. 1978; 40(2):108-112.
7. Khattak SU, Alam M, Khalil SK, Hussain N. Response of chickpea cultivars to the infestation of pulse beetle, *Callosobruchus chinensis* (L.).Pakistan J. Zool. 1991; 23:51-55.
8. Khokhar KS, Singh D. Relative susceptibility of different genotypes of pigeonpea to pulse beetle, *Callosobruchus chinensis* (L.). Bull. Grain Tech. 1987; 25:244-251.
9. Patnaik HP, Samalo AP. Studied on the susceptibility of pigeonpea varieties to the pulse beetle, *Callosobruchus maculatus* Fabr. Bull. Grain Tech., 1987; 25:191-193.
10. Raina AK. *Callosobruchus chinensis* infesting stored pulses (grain legumes) in India and a comparative study of their biology. Indian J. Ent. 1970; 32:303-310.
11. Regupathy A, Ratnaswamy R. Studies of comparative susceptibility of seeds of certain red gram, *Cajanus cajan* L. Madras Agric. J. 1970; 57(2):106-109.
12. Satya Vir. Note on relative susceptibility of different varieties of cowpea to *Callosobruchus maculatus* Fabricus. Indian J. Agric. Sci. 1981; 51(11):813-815.
13. Shivanna BK, Ramamurthy BN, Gangadhara Naik B, Gayathri Devi S, Mallikarjunaiah H, *et al*. Host preference of pulse beetles, *Callosobruchus maculatus* (F.) and *Callosobruchus analis* (F.) on selected pulses. Internal. J. Sci. Nature. 2011; 2(2):228-240.
14. Vimla V, Pushpamma P. Storage quality of pulses stored in three Agroclimatic regions of Andhra Pradesh. I. Qualitative changes. Bull. Grain Tech., 1983; 21(1):54-62.
15. Vishwamithra V, Reddy K, Vijayalakshmi K. Morphological and chemical parameters associated with resistance to *Callosobruchus chinensis* in pigeonpea. Indian J. Pl. Protec. 2015; 43(1):34-39.