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Quantitative Damage Caused by Pulse Beetle, *Callosobruchus chinensis* L. on Different Pulse host-grains

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ABSTRACT

The quantitative losses in different pulse host-grains *viz*., bengalgram (*Cicer arietinum* L.), redgram (*Cajanus cajan* L.), blackgram (*Vigna mungo* L.), greengram (*Vigna radiata* L.) and pillipesara (*Phaseolus trilobus* L.) caused by *Callosobruchus chinensis* were estimated. The quantitative damage caused by *C. chinensis* in terms of per cent weight loss of the grain, per cent moisture gain, per cent number of grain damage and per cent weight of damaged grain increased with increase in storage period. Among all the host-grains, pillipesara has recorded significantly maximum per cent weight loss (51.55%), per cent number of grain damage (97.82%) and per cent weight of damaged grain (95.47%).The maximum per cent moisture content was also recorded in redgram (14.2%) and pillipesara (13.88%).

Key words : Bengalgram, Blackgram, *C. chinensis,* Greengram, Pillipesara, Redgram.

Pulses are the important source of protein in Indian diet and being a seasonal crop, these are usually stored for different periods varying from six months to one year. One of the major constraints in production and storage of pulses, is the insect pests which inflict severe losses both in field and storage. In India, over 200 species of insects have been recorded infesting various pulses. Among these, the pulse beetles, *Callosobruchus* spp. (Bruchidae, Coleoptera) are the major pests in storage. The losses in pulses during post-harvest handling and storing were 8.5% in India (Pingale *et al.,* 1956) and recorded zero per cent germination due to bruchid, *C. chinensis* infestation after six months in stored greengram. The present studies were therefore, conducted to assess the quantitative losses caused by *C. chinensis* in different pulse host-grains.

MATERIAL AND METHODS

The initial culture of *C. chinensis* collected from the fields was brought to laboratory and were transferred into the disinfested pulses. About 250 g of disinfested host-grain were taken in a plastic jar (45x15 cm) and 10 pairs of adults were released for oviposition. The jars were covered with muslin cloth. Seven days were allowed for mating and oviposition. The overlapping generations of *C. chinensis* were maintained by utilizing the eggs laid staggeredly to ensure a constant supply of test insects of known age. The newly emerged adults were changed to another jar and used for the multiplication of culture and also for bioassay studies (Andrewartha, 1961).

Per cent weight loss of host-grains

Whole grain of different disinfested pulses were infested with one day old adults @ 5 pairs per 100 g of produce. Then these plastic jars containing different host-grain samples inoculated with test insect were closed with muslin cloth using rubber bands. Four replications were maintained in each treatment and the damage was assessed at monthly interval. To assess the damage, the damaged and undamaged grains were sorted out, counted and weighed.

The per cent weight loss of grain was calculated by the formula given by Adams and Schulten (1978) as follows,

$$\text{Per cent weight loss} = \frac{(U\ Nd) - (D\ Nu)}{U\ (Nd+Nu)} \times 100$$

Where,

U = Weight of undamaged grains
Nu = Number of undamaged grains
D = Weight of damaged grains
Nd = Number of damaged grains.

Per cent increase in moisture content of host-grain

The moisture content in each host-grain sample infested with test insect was estimated using electronic moisture balance. For the estimation of moisture content, sample size was standardized as 5 g for each host-grain. Four replications were maintained in each treatment and the per cent increase in moisture was estimated at monthly interval for three months.

Per cent number and weight of damaged host-grains

From each test sample of host-grain, a representative sample of 20 g was taken in a plate and the damaged or bored grains were separated. These damaged grains were counted and weighed for calculating the quantitative damage in terms of per cent number and weight of the host-grain (Sonelal, 1990). Four replications were maintained in each treatment and the damage was assessed at monthly interval.

$$\text{Per cent number of grains damaged} = \frac{\text{Number of grains damaged}}{\text{Total number of grains}} \times 100$$

$$\text{Per cent weight of damaged grains} = \frac{\text{Weight of damaged grains}}{\text{Total weight of grains}} \times 100$$

RESULTS AND DISCUSSION

The damage caused by *C. chinensis* on different pulse host-grains in terms of per cent weight loss of grain (Table 1) increased significantly with increase in storage period of 90 days. All the selected host-grains recorded significantly varying per cent weight losses at all monthly intervals of observation. Though no weight loss was recorded at one day after storage (DAS), among all the host-grains, weight loss was maximum (51.55%) in pillipesara followed by redgram (38.53%), bengalgram (31.98%), greengram (22.75%) and blackgram (14.45%).

The weight loss in host-grains is the direct damage caused by the feeding habit of the pulse beetle. The adult beetles, which do not feed on stored produce, are very short-lived (usually not more than 12 days under optimum conditions) and during this time the females lay many eggs (up to 70). Upon hatching, the larvae bites through the base of the egg, through the testa of the grain and into the cotyledons. The developing larva feeds entirely within a single seed, excavating a chamber within the cotyledons as it grows. The present per cent weight loss values were in conformity with the findings of Doharey *et al.* (1987), who reported significant increase in weight loss in greengram due to infestation of *C. chinensis* as 0.62, 16.74 and 25.56% at 30, 60 and 90 days after storage, respectively. The per cent weight loss in cowpea variety EC-528385 infested by *C. maculatus* was 5.28, 12.87 and 16.83% at 30, 60 and 90 DAS, respectively (Jha *et al*., 2008).

As the storage period advanced, the per cent moisture (Table 2) gradually and significantly increased in all the host-grains. Though the per cent moisture content was non significant at one day after storage, it increased significantly with the advancement of storage period. After three months of storage, 14.20% of redgram and 13.88 % of pillipesara, recorded maximum per cent moisture content followed by bengalgram (12.52%) and greengram (12.47%) which were on par with each other, whereas the increase in per cent moisture was minimum in blackgram (10.16%).

The increased moisture content of the stored grains is due to increased population of bruchids and presence of their excreta. The metabolic activity of increased population adds more moisture to seed which further increases seed moisture. Even, Ghosal and Senapati (2007) reported increase in moisture content due to *Callosobruchus analis* infestation in greengram, redgram and bengalgram, which were on par with each other by recording 6.14%, 6.55% and 6.08%, respectively. Whereas blackgram had minimum moisture content of 5.84% at 30 DAS. The moisture content was progressive with increased infestation by insects to 11.2, 12.0, 12.4 and 13.0% in rice and 11.8, 13.0, 13.3 and 13.5% in sorghum at 0, 3, 6 and 12 months after storage, respectively (Pushpamma and Reddy, 1979).

Damage of *C. chinensis* among the selected pulse host-grains in terms of per cent number of grains damaged (Table 3) and weight of damaged grain (Table 4) increased significantly with increase in storage duration. After three months after storage (90 DAS), though it was statistically

Table 1. Per cent weight loss of grains in different pulse host grains by *C. chinensis*.

Treat. No.	Host-grains	Per cent weight loss of grain				SEm (±)	CD (P=0.05)
		1 DAS	30 DAS	60 DAS	90 DAS		
1	Greengram (*Vigna radiata*)	0.00	5.25	16.70	22.75	0.26	0.79
		(0.00)^{4a}	(3.01)^{3b}	(9.61)^{2c}	(13.15)^{1d}		
2	Blackgram (*Vigna mungo*)	0.00	1.23	4.57	14.45	0.30	0.92
		(0.00)^{3a}	(0.71)^{3c}	(2.62)^{2d}	(8.31)^{1e}		
3	Pillipesara (*Phaseolus trilobus*)	0.00	0.63	23.21	51.55	1.11	3.41
		(0.00)^{3a}	(0.36)^{3d}	(13.42)^{2b}	(31.03)^{1a}		
4	Redgram (*Cajanus cajan*)	0.00	15.48	32.53	38.53	0.57	1.77
		(0.00)^{4a}	(8.91)^{3a}	(18.98)^{2a}	(22.66)^{1b}		
5	Bengalgram (*Cicer arietinum*)	0.00	5.31	23.63	31.98	0.28	0.85
		(0.00)^{4a}	(3.04)^{3b}	(13.67)^{2b}	(18.65)^{1c}		
	SEm (±)	0.00	0.07	0.28	1.94		
	CD (P=0.05)	0.00	0.20	0.85	5.84		

DAT- Days After Storage
Values in parentheses are angular transformed values
In each column values with similar alphabet do not vary significantly at P=0.05
In each row with similar number do not vary significantly at P=0.05

Table 2. Quantitative damage by *C. chinensis* in different pulse host-grains in terms of increase in per cent moisture.

Treat. No.	Host-grains	Per cent moisture				SEm (±)	CD (P=0.05)
		1 DAS	30 DAS	60 DAS	90 DAS		
1	Greengram (*Vigna radiata*)	5.58	6.65	11.38	12.47	0.06	0.18
		(2.57)^{2a}	(2.77)^{2b}	(3.52)^{1a}	(3.67)^{1b}		
2	Blackgram (*Vigna mungo*)	5.69	6.06	7.26	10.16	0.05	0.16
		(2.59)^{3a}	(2.66)^{3b}	(2.87)^{2c}	(3.34)^{1c}		
3	Pillipesara (*Phaseolus trilobus*)	5.80	6.14	9.32	13.88	0.05	0.14
		(2.61)^{3a}	(2.67)^{3b}	(3.21)^{2b}	(3.86)^{1a}		
4	Redgram (*Cajanus cajan*)	5.68	7.76	9.04	14.20	0.06	0.18
		(2.58)^{4a}	(2.96)^{3a}	(3.17)^{2b}	(3.90)^{1a}		
5	Bengalgram (*Cicer arietinum*)	5.55	7.01	9.86	12.52	0.07	0.21
		(2.56)^{4a}	(2.83)^{3ab}	(3.30)^{2b}	(3.68)^{1b}		
	SEm (±)	0.06	0.07	0.05	0.03		
	CD (P=0.05)	NS	0.22	0.15	0.10		

DAT- Days After Storage
Values in parentheses are angular transformed values
In each column values with similar alphabet do not vary significantly at P=0.05
In each row with similar number do not vary significantly at P=0.05

Table 3. Quantitative damage by *C. chinensis* in different pulse host-grains in terms of per cent number of grain damage.

Treat. No.	Host-grains	Per cent number of grain damage				SEm (±)	CD (P=0.05)
		1 DAS	30 DAS	60 DAS	90 DAS		
1	Greengram (*Vigna radiata*)	0.00 (0.00)^{4a}	6.71 (3.85)^{3c}	75.63 (49.14)^{2a}	95.09 (71.97)^{1bc}	0.19	0.57
2	Blackgram (*Vigna mungo*)	0.00 (0.00)^{3a}	1.43 (0.82)^{3d}	8.49 (4.87)^{2e}	66.86 (41.96)^{1d}	0.28	0.87
3	Pillipesara (*Phaseolus trilobus*)	0.00 (0.00)^{3a}	0.47 (0.27)^{3d}	33.55 (19.61)^{2d}	97.82 (78.02)^{1a}	0.22	0.68
4	Redgram (*Cajanus cajan*)	0.00 (0.00)^{4a}	27.90 (16.20)^{3a}	53.03 (32.03)^{2c}	94.55 (70.99)^{1c}	0.71	2.18
5	Bengalgram (*Cicer arietinum*)	0.00 (0.00)^{4a}	8.67 (4.97)^{3b}	63.90 (39.72)^{2b}	96.05 (73.84)^{1b}	0.95	2.93
	SEm (±)	0.00	0.31	0.60	0.89		
	CD (P=0.05)	0.00	0.92	1.82	2.69		

DAT- Days After Storage
Values in parentheses are angular transformed values
In each column values with similar alphabet do not vary significantly at P=0.05
In each row with similar number do not vary significantly at P=0.05

Table 4. Quantitative damage by *C. chinensis* in different pulse host-grains in terms of per cent weight of damaged grain.

Treat. No.	Host-grains	Per cent weight of damaged grain				SEm (±)	CD (P=0.05)
		1 DAS	30 DAS	60 DAS	90 DAS		
1	Greengram (*Vigna radiata*)	0.00 (0.00)^{4a}	4.80 (2.75)^{3b}	71.18 (45.38)^{2a}	93.52 (69.26)^{1c}	0.24	0.75
2	Blackgram (*Vigna mungo*)	0.00 (0.00)^{3a}	0.92 (0.53)^{3c}	6.13 (3.51)^{2e}	64.67 (40.29)^{1d}	0.53	1.63
3	Pillipesara (*Phaseolus trilobus*)	0.00 (0.00)^{3a}	0.32 (0.18)^{3c}	27.96 (16.24)^{2d}	95.47 (72.68)^{1a}	0.12	0.36
4	Redgram (*Cajanus cajan*)	0.00 (0.00)^{4a}	23.78 (13.76)^{3a}	39.08 (30.22)^{2c}	94.31 (64.57)^{1b}	0.40	1.25
5	Bengalgram (*Cicer arietinum*)	0.00 (0.00)^{4a}	5.04 (2.89)^{3b}	61.12 (37.67)^{2b}	93.81 (69.73)^{1c}	0.57	1.77
	SEm (±)	0.00	0.17	0.29	0.75		
	CD (P=0.05)	0.00	0.51	0.86	2.26		

DAT- Days After Storage
Values in parentheses are angular transformed values
In each column values with similar alphabet do not vary significantly at P=0.05
In each row with similar number do not vary significantly at P=0.05

significantly different, the per cent number of grains damaged and weight of damaged grain was more than 90% in all the pulses except in blackgram.

Grain size of pillipesara being smaller, the weight of each grain is less and number of grain per unit weight will be more. The more number of eggs per each grain of pillipesara resulted in more adult emergence, thereby increase in the per cent number of grain damage and per cent weight of damaged grains.

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