Effect of storage structures on grain damage and weight loss of pigeon pea against *Callosobruchus chinensis* L. in storage

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Abstract: An experiment was conducted on the effect of various storage structures on grain damage and weight loss by *Callosobruchus chinensis* during 2020-2022 at RPCAU, Pusa, Bihar. Different storage containers *viz*., plastic jar, PLJB, PP bag, HDPE bag, cloth Bag, earthen pot and jute bag as control were used and replicated thrice. Among the various storage structures evaluated for assessing the damage and weight loss of pigeon pea caused by *Callosobruchus chinensis* for a period of four months, maximum grain damage was recorded in jute bag i.e., 19.84 and 30.91 % at 2 and 4 months, respectively while least damage was recorded in Polythene lined jute bag (PLJB) with 7.64 and 9.98 % at 2 and 4 months, respectively. Similarly, per cent weight loss was found to be highest in jute bag both in 2 and 4 months with values 11.61 and 19.05 %, respectively and up to 4 months of storage period PLJB still performed the best with minimum weight loss (5.05%).

Key words: Storage, *Callosobruchus,* weight loss, Polythene lined jute bag.

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1.Introduction

Pigeon pea (*Cajanus cajan* L.) is one of the most important pulse crop mainly cultivated for its edible seeds. Besides, being rich source of dietary protein, the crop aids in improving fertility to soil due to their nitrogen fixing capability [1]. In India, it is cultivated in an area of 4.65 million ha with total production and productivity of 4.29 million tonnes and 800 kg/ha, respectively [2]. Pigeon pea production is mostly hindered by both abiotic as well as biotic factors. Among the various constraints in production, bruchids are of the main importance causing damage both in field as well as storage. In India, storage losses due to infestation by insect pests accounts for 20-30 % [3]. Post harvest losses due to insect pests is mainly viewed as an important drawback to pulse production. After harvest, pulses are normally stored for a period of six months and improper storage systems can lead to huge economic decline due to both qualitative and quantitative losses. Around 15 % losses in pigeon pea is due to storage loss which includes losses due to improper storage structures [4]. In a developing country like India, where there is exploding population the demand for food grains also increases and reducing the post harvest losses could be a solution to expand food production and combat hunger[5]. Food shortage can be solved to some extent if storage losses is reduced. Storage structures plays a vital role in reducing the population-build up degree of damage done by pulse beetles in storage and In this context, an attempt has been made with a view to explore the most suitable packaging materials for storage of pigeon pea that can reduce damage caused by *Callosobruchus chinensis.*

Materials and Methods: For evaluating the effectiveness of various storage structures against pulse beetle, an experiment was conducted using seven treatments namely Plastic jar, Polythene lined jute bag (PLJB), Polypropylene (PP) bag, High Density Polyethylene (HDPE) bag, Cloth bag, Earthen pot and Jute bag (control). The experiment was laid out in completely randomised block design and each treatment were replicated thrice. Pigeon pea grains were procured from Directorate of Seeds and Farms, Tirhut College of Agriculture, Dholi, Muzaffarpur and all the packaging materials were obtained from local market. 1kg of clean and healthy pigeon pea seeds were filled in each treatment and kept in room temperature. The data on per cent grain damage and weight loss was recorded and calculated at 2 and 4 months after storage.

Effect on grain damage: A representative sample of 25g were taken randomly from each treatment. Damaged and undamaged grains were sorted out carefully using magnifying glass and then subjected to the formula given by Quitco. and Quindoza [6]

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

Effect on weight loss: Weight loss assessment was worked out from 25 g sample from each treatment. Damaged and undamaged grains were counted and then weighed separately. Per cent weight loss was calculated using the formula Adams and Schulten [7].

Per cent weight loss = $\frac{\{(UNd)-(DNu)\}}{\{U(Nd+Nu)\}}$ ×100

Where,

U= weight of undamaged grain
Nu= Number of undamaged grains
D= weight of damaged grains
Nd= Number of damaged grains
Data obtained were subjected to analysis of variance (one-way ANOVA) using OPSTAT data analysis tool.

Results and Discussion

The findings on per cent grain damage by *Callosobruchus chinensis* on pigeon pea stored in various storage structures differed significantly ranging from 9.08 to 20.16 % and 6.21 to 19.52 % during the first year (2020-2021) and second year (2021-2022), respectively at 2 months after storage. Maximum damage was observed in jute bag with 20.16 and 19.52 % during the first and second year, respectively while lowest damage was recorded in PLJB with 9.08 % followed by plastic jar (9.41%) during the first year (2020-2021). During the second year (2021-2022), PLJB recorded least damage (6.21%) followed by plastic jar (8.61%) and earthen pot (9.92%) as against check (19.52%). A perusal of comparative data of both the years concluded that PLJB performed the best with least damage done by the bruchids (7.64%) followed by plastic jar (9.01%), earthen pot (10.64%). HDPE bag and PP bag were found to be at par with intermediate degree of damage with 12.44 and 15.26 % and maximum damage was observed in jute bag (19.84%). All treatments were superior over control (19.84%) as shown in Table 1. Similar trend in per cent damage was observed at 4 months after storage. The best treatment was recorded as PLJB with least damage 10.94 and 9.01 % in the first year (2020-2021) and second year (2021-2022), respectively while maximum damage was recorded in jute bag taken as check in both the years *viz*., 31.88 and 29.95 per cent, respectively. During the first year (2020-2021) PP bag and HDPE bag was found to be statistically at par with values 19.27 and 18.00 %, respectively. Pooled mean data of the two years after 4 months resulted that maximum damage was recorded in jute bag (30.91%) followed in descending order by cloth bag (26.17%), PP bag (18.46%), HDPE bag (16.63%), earthen pot (14.30%), plastic jar (12.16%) and lowest grain damage was recorded in PLJB (9.98%) and all treatments were significantly superior in reducing damage over control (30.91%) as shown in Table 1.

Table 1 Effect of different storage structures on per cent grain damage of pigeon pea

Treatment	Treatments	*Per cent grain damage					
		2 MAS			4 MAS		
		2020-2021	2021-2022	Pooled	2020-2021	2021-2022	Pooled
T1	Plastic jar	9.41 (15.50)**	8.61 (14.31)	9.01 (14.91)	13.04 (21.15)	11.27 (19.59)	12.16 (20.38)
T2	PLJB	9.08 (13.97)	6.21 (11.89)	7.64 (12.97)	10.94 (19.30)	9.01 (17.44)	9.98 (18.39)
T3	PP Bag	16.46 (19.65)	14.05 (19.22)	15.26 (19.44)	19.27 (26.02)	17.66 (24.83)	18.46 (25.43)
T4	HDPE Bag	12.77 (18.93)	12.12 (17.83)	12.44 (18.39)	18.00 (25.08)	15.27 (22.97)	16.63 (24.04)
T5	Cloth Bag	18.26 (23.48)	16.19 (22.50)	17.23 (22.99)	27.05 (31.31)	25.30 (30.16)	26.17 (30.74)
T6	Earthen pot	11.37 (16.67)	9.92 (16.16)	10.64 (16.42)	15.01 (22.78)	13.58 (21.60)	14.30 (22.20)
T7	Jute Bag (Control)	20.16 (26.36)	19.52 (25.36)	19.84 (25.86)	31.88 (34.36)	29.95 (33.16)	30.91 (33.76)
S.Em (±)		(0.38)	(0.44)	(0.38)	(0.50)	(0.56)	(0.52)
CD (P=0.05)		(1.18)	(1.36)	(1.17)	(1.54)	(1.72)	(1.61)
CV		3.48	4.24	3.54	3.39	4.02	3.66

MAS Months After Storage
*Average of three replications
**Values in parentheses are angular transformed values

Similarly, the results on per cent weight loss of pigeon pea grains stored in different storage structures revealed that weight loss caused by *Callosobruchus chinensis* increased with increase in storage period and at 2 months of storage period it varied from 4.06 to 12.20 % during the first year (2020-2021) and 3.25 to 11.02 % during the second year (2021-2022). PLJB performed the best in reducing weight loss in both the study period i.e., 4.06 and 3.25 % and was found to be at par with plastic jar (4.54%) during the first year (2020-2021) while during the second year (2021-2022), all the treatments were statistically different and maximum weight loss was recorded in pigeon pea grains stored in jute bag with 12.20 and 11.02 % both in first (2020-2021) and second year (2021-2022), respectively. The overall pattern of weight loss after pooled analysis of two years data together (Table 2) inferred nearly same trend. PLJB (3.65%) performed as the best storage structure followed by plastic jar (4.33%), earthen pot (5.51), HDPE bag (6.76%), PP bag (8.82%), cloth bag (10.20%) and all treatments were superior over control (11.61%). Similarly, at 4MAS in the first year (2020-2021), PLJB recorded lowest per cent weight loss (5.85%) followed in increasing order of weight loss by plastic jar (7.15%), earthen pot (8.24%), HDPE bag (10.55%) which was at par with PP bag (11.32%). Similar trend was observed during second year (2021-2022) with highest and lowest weight loss in jute bag (18.36%) and PLJB (4.25%), respectively. It is apparent from the pooled data of the two years (2020-2021) and (2021-2022) that minimum weight loss was recorded in PLJB (5.05%) followed by plastic jar (6.63%), earthen pot (8.00%), HDPE (9.97%), PP bag (11.09%), cloth bag (15.29%) all treatments were recorded to be superior over control (19.05%) as shown in Table 2.

From the above results , it can be concluded that Polythene lined jute bag performed as the best storage structure in reducing the grain damage and weight loss caused by *Callosobruchus chinensis* while maximum damage as well as weight loss was observed in pigeon pea grains stored in jute bag taken as check. The possible reason for minimum grain damage and weight loss in PLJB could be due to less availability of oxygen and air tightness in PLJB and in case of jute bag, passage of air as well as favourable temperature allows suitable microclimate for the development of bruchids thereby increasing the population and eventually more grain damage as well as weight loss of the grains. The results are in accordance with the work done by Patel [8] who recorded zero damage of pigeon pea stored in Polythene lined jute bag. Also found maximum grain damage in black gram stored in jute bag. Similar findings were reported by Sharma et al.[9] and Regmi and Dhoj [10]. Nehra *et al*. [11] also reported maximum weight loss of pulse grains stored in jute bags which supported the present findings.

Table 2 Effect of different storage structures on per cent weight loss of pigeon pea

Treatment	Treatments	*Per cent weight loss					
		2 MAS			4 MAS		
		2020-2021	2021-2022	Pooled	2020-2021	2021-2022	Pooled
T1	Plastic jar	4.54 (12.29)**	4.12 (11.70)	4.33 (12.00)	7.15 (15.50)	6.12 (14.31)	6.63 (14.91)
T2	PLJB	4.06 (11.61)	3.25 (10.34)	3.65 (11.00)	5.85 (13.97)	4.25 (11.89)	5.05 (12.97)
T3	PP Bag	9.71 (18.14)	7.93 (16.34)	8.82 (17.26)	11.32 (19.65)	10.87 (19.22)	11.09 (19.44)
T4	HDPE Bag	7.07 (12.41)	6.45 (6.45)	6.76 (15.06)	10.55 (18.93)	9.39 (17.83)	9.97 (18.39)
T5	Cloth Bag	10.93 (19.29)	9.47 (17.91)	10.20 (18.61)	15.90 (23.48)	14.68 (22.50)	15.29 (22.99)

T6	Earthen pot	6.20 (14.40)	4.83 (12.67)	5.51 (13.56)	8.24 (16.67)	7.75 (16.16)	8.00 (16.42)
T7	Jute Bag (Control)	12.20 (20.42)	11.02 (19.31)	11.61 (19.90)	19.74 (26.36)	18.36 (25.36)	19.05 (25.06)
S.Em (±)		(0.27)	(0.38)	(0.24)	(0.38)	(0.44)	(0.38)
CD (P=0.05)		(0.85)	(0.85)	(0.75)	(1.18)	(1.36)	(1.17)
CV		3.02	3.41	2.76	3.48	4.24	3.54

MAS Months After Storage
*Average of three replications
**Values in parentheses are angular transformed values
Conflicts of Interests: None declared

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