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Effect of storage structures on the incidence of pulse beetle, *Callosobruchus chinensis* (L.) infesting ricebean seeds

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Abstract
Four storage structures *viz*., cloth bag, plastic jar, jute bag and bamboo basket were evaluated for their effect on the incidence of pulse beetle, *Callosobruchus chinensis* infesting ricebean seeds in storage. The experiment was conducted in a Completely Randomized Design with 5 replications. The storage structures were evaluated based on per cent infestation and weight loss up to 6 months of storage. The infestation and weight loss up to 6 months of storage ranged from 2.48 to 90.54% and 0.29 to 25.08%, respectively. The per cent weight loss increased significantly with the increase in infestation. The most effective result with the least per cent infestation and weight loss after 6 months of storage was found in plastic jar with 76.65 and 16.20%, respectively. Cloth bag was the least effective with 90.54% infestation and 25.08% weight loss. The effectiveness of the storage structure was found in the order: plastic jar > bamboo basket > jute bag > cloth bag.

Keywords: Storage structures, pulse beetle, ricebean, infestation, weight loss

1. Introduction
Pulses are important food crops providing nutritional needs of diverse human diets. In India, a variety of pulse crops are cultivated across a wide range of agro-climatic conditions which are utilized as a fodder crop and contribute to soil health, in addition to being consumed for their protein content. Among the various pulses, ricebean (*Vigna umbellata*) is an important pulse crop in Nagaland. The ricebean seeds are rich sources of carbohydrates, proteins, minerals and vitamins. However, insect pest infestations in storage are a serious problem causing significant loss both in quality and quantity. Pulses in storage are more susceptible to insects damage (5%) than wheat (2.5%), paddy (2%) and maize (3.5%) (Deshpande and Singh, 2001) [5]. Among the storage pest of pulses, the pulse beetle (*Callosobruchus chinensis*) is a serious pest causing considerable losses in storage (Ahmed *et al*., 2003, Srinivasan *et al*., 2010, Kutbay *et al*., 2011, Pradhan *et al*., 2020) [1, 21, 11, 15].

The storage structures play a critical role in the population build-up of insects and also in decreasing the extent of damage in storage conditions (Roja *et al*., 2021) [18]. In India, farmers usually store seeds in plastic containers, gunny bags, metal containers, polythene bags, *etc*. with little consideration for insect pest attacks throughout storage periods (Kumar *et al*., 2016) [10]. The lack of appropriate storage facilities at farm level leads to significant waste and loss of quality (Ramesh, 1999) [16]. About 60-70% of pulses produced are stored at home level (Kanwar and Sharma, 2003) [9]. Farmers usually uses locally available raw materials to develop traditional structures such as earthen pots and bamboo baskets of different designs, shapes and sizes for short-term storage (Sharon *et al*., 2014) [20]. The amount of time pulses can be safely stored depends on the condition in which they were harvested and the storage mechanisms used. The insect pest infestation in storage varies with different storage structures (Meena and Bhargavam, 2003) [12]. Therefore appropriate storage structure plays an important role in reducing post-harvest losses. Keeping the above aspects in mind the present study was carried out to evaluate the effectiveness of four storage structures *viz*., cloth bag, plastic jar, jute bag and bamboo basket on the incidence of pulse beetle infesting ricebean seeds in storage.

2. Materials and Method
The experiment was carried out in the laboratory of the department of Entomology, School of

Agricultural Science and Rural Development, Nagaland University. Complete Randomized Design (CRD) with 5 replications was used for the study. Four types of storage structures *viz*., cloth bag, plastic jar, jute bag and bamboo basket were evaluated for their effect on the incidence of *C. chinensis* on susceptible cultivar of ricebean. For the study, local ricebean cultivar, *Sipheghonu* was used. Before carrying out the experiment the seeds were disinfested by heating in a hot air oven at 50 °C for one hour.

2.1 Test insects maintenance

The insect pulse beetles, *C. chinensis* were reared in a container on susceptible ricebean seeds for the study. The population of pulse beetle was maintained by adding fresh seeds for egg laying. The containers were observed regularly for adult emergence and were collected for use in the experiment.

2.2 Effect of storage structures on the incidence of pulse beetle

In each storage container, 500g of seed was kept and 10 pairs of freshly emerged *C. chinensis* male and female were released. The mouths of the bags were tightened with the help of thread. Observations on per cent infestation and per cent weight loss were recorded at monthly intervals up to 6 months of storage. Per cent infestation and weight loss were calculated using the formula:

$$\text{Infestation (\%)} = \frac{\text{Number of holed seeds}}{\text{Total number of seeds}} \text{x } 100$$

$$\text{Weight loss (\%)} = \frac{\text{Initial weight of grains} - \text{Final weight of grains}}{\text{Final weight of grains}} \text{x} 100$$

2.3 Statistical analysis

The percentage data observed were transformed into suitable values and analyzed statistically using analysis of variance. The means were compared by Duncan Multiple Range Test (DMRT) at P=0.05 level of significance.

3. Results and Discussion

The observations on per cent infestation and per cent weight loss were recorded for 6 months. The details are presented in Table 1 and Table 2.

After one month of storage, the infestation varied from 2.48 to 3.32%. The infestation in the plastic jar was minimum with 2.48% and the maximum was in bamboo basket with 3.32% followed by cloth bag with 3.31% and jute bag with 3.30%. The weight loss varied from 0.29 to 0.46%. The maximum weight loss was observed in bamboo basket (0.46%) followed by jute bag (0.45%) and cloth bag (0.42%) with no significant difference among them.

After two months of storage, the infestation increased with the highest infestation in cloth bag (25.23%) followed by jute bag (23.95%) and bamboo basket (22.25%) with no significant difference among them. The minimum infestation was found in plastic jar (18.76%). The significant increase in infestation may be due to infestation from the first generation of insects after one month. The per cent weight loss also increased significantly with the increase in infestation. The weight loss varied from 1.89 to 3.21%. The plastic jar recorded the minimum weight loss (1.89%) with a significant difference from the other storage structures. The maximum weight loss was observed in cloth bag (3.21%) followed by jute bag (3.02%) and bamboo basket (2.74%).

Table 1: Effect of storage structures on infestation by *C. chinensis* on ricebean cultivar *Sipheghonu*

Storage structures	*Infestation (%)					
	After 1 month	After 2 months	After 3 months	After 4 months	After 5 months	After 6 months
Cloth bag	3.31^{a} (1.90)	25.23^{a} (14.61)	56.60^{a} (34.47)	69.43^{a} (43.97)	78.95^{a} (52.14)	90.54^{a} (64.87)
Plastic jar	2.48^{b} (1.42)	18.76^{b} (10.81)	37.89^{d} (22.27)	48.39^{d} (28.94)	54.76^{d} (33.20)	76.65^{d} (50.04)
Jute bag	3.30^{a} (1.89)	23.95^{a} (13.86)	47.56^{b} (28.40)	62.23^{b} (38.49)	73.72^{b} (47.50)	87.63^{b} (61.20)
Bamboo basket	3.32^{a} (1.90)	22.25^{a} (12.85)	45.64^{c} (27.15)	59.50^{c} (36.52)	68.69^{c} (43.38)	82.48^{c} (55.57)
SEm±	0.11	0.53	0.23	0.24	0.20	0.18

*Figures in the table are mean values
Figures in the parentheses are angular transformed values
Within column values followed by different letter(s) are significantly different (P=0.05) by DMRT

Table 2: Effect of storage structures on weight loss by *C. chinensis* on ricebean cultivar *Sipheghonu*

Storage structures	*Weight loss (%)					
	After 1 month	After 2 months	After 3 months	After 4 months	After 5 months	After 6 months
Cloth bag	0.42^{ab} (0.24)	3.21^{a} (1.84)	11.58^{a} (6.65)	16.07^{a} (9.25)	23.92^{a} (13.84)	25.08^{a} (14.52)
Plastic jar	0.29^{b} (0.17)	1.89^{b} (1.08)	5.71^{d} (3.27)	9.30^{c} (5.33)	15.63^{d} (8.99)	16.20^{d} (9.32)
Jute bag	0.45^{a} (0.26)	3.02^{a} (1.73)	8.75^{b} (5.02)	12.52^{b} (7.10)	21.32^{b} (12.31)	22.14^{b} (12.79)
Bamboo basket	0.46^{a} (0.26)	2.74^{a} (1.57)	7.85^{c} (4.50)	12.26^{b} (7.04)	18.26^{c} (10.52)	19.27^{c} (11.11)
SEm±	0.03	0.13	0.07	0.08	0.07	0.09

*Figures in the table are mean values
Figures in the parentheses are angular transformed values
Within column values followed by different letter(s) are significantly different (P=0.05) by DMRT

After three months of storage, all four storage structures showed significant differences in per cent infestation. The highest was in cloth bag (56.60%) followed by jute bag (47.56%), bamboo basket (45.64%) and the minimum was in plastic jar (37.89%). Likewise, the per cent weight loss was also found with a significant difference in all the storage structures. The maximum weight loss was found in cloth bag (11.58%) followed by jute bag (8.75%) and bamboo basket (7.85%), while plastic jar recorded the minimum weight loss (5.71%).

After four months of storage, the per cent infestation ranged from 48.39 to 69.43 with the highest in cloth bag and lowest in plastic jar. A similar trend in the increase in per cent infestation was found after five and six months of storage with per cent infestation ranging from 54.76 to 78.95% and 76.65 to 90.54%, respectively with a significant difference among all the four storage structures. After 6 months of storage, the maximum per cent infestation was found in cloth bag, while the minimum infestation was found in plastic jar. The per cent weight loss after four months of storage varied from 9.30 to 16.07 with minimum in plastic jar and maximum in cloth bag. Similar trend was also observed after five and six months of storage with 15.63 to 23.92% and 16.20 to 25.08% weight loss, respectively. The highest weight loss was recorded from cloth bag and the lowest from plastic jar after 6 months of storage.

In the present study, the per cent infestation and weight loss up to 6 months of storage in various storage structures ranged from 2.48 to 90.54% and 0.29 to 25.08%, respectively. The result indicates that all the storage structures were subjected to infestation by pulse beetle and did not show a complete reduction in per cent infestation which resulted in significant weight loss. Up to 3 months of storage the weight loss was negligible but the infestation of the pest increased with an increase in the storage period. Similar result in an increased infestation of pulse beetle in storage was reported by Charjan *et al.* (2006) [4]. Gadewar *et al.* (2011) [6] also reported an increased infestation of 25.10% at 3 months and 59.28% at 6 months of storage. The findings of the present study are in conformity with Sudini *et al.* (2015) [22] who reported that triple-layer bags were more effective than cloth bag in retaining seed weight at four months of storage. Baributsa *et al.* (2017) [3] reported 28.7 per cent weight loss of groundnut stored in woven bags at 6-7 months of storage. Pareek *et al.* (2013) [14] evaluated seven storage structures and reported the effectiveness in the order as: metal bin > plastic fibre bag > cloth bag > polythene bag > gunny bag >*Matka* bin > *Kuthla*. Nehra *et al*. (2021) [13] also reported highest weight loss from cloth bags and jute bags. Ramesh and Vaidya (2001) [17] found that local storage structures such as gunny sacks and bamboo bins resulted in greater weight loss. Howlader *et al.* (2004) [8] and Rolania *et al*. (2021) [19] also reported more insect population, per cent infestation and weight loss in gunny bags compared to plastic bags and metal structures.

Among the storage structures, plastic jar showed lower infestation and weight loss which could be due to air-tight sealing reducing the oxygen availability to the pest affecting its growth and development. The other three storage structures were well aerated in comparison with the plastic jar. The present findings are in similarity with Ganiger *et al.* (2022) [7] who found that decreasing oxygen access by storing green gram seeds in vacuum-packed bags protected green gram seeds for up to 9 months of storage. Ahn *et al*. (2013) [2] and Roja *et al*. (2021) [18] also reported that pulse beetle development is affected in an environment where oxygen is limited and their growth and development can be reduced by storing them in sealed containers.

4. Conclusions

Among the different storage structures after 6 months of storage, the most effective result with was found in plastic jar and the least effective was found in cloth bag. The effectiveness of the storage structure with respect to per cent infestation and weight loss was found in the following order: plastic jar > bamboo basket > jute bag > cloth bag. The plastic jar performed better which could be due to the air-tight sealing resulting in reduction of oxygen availability for the insect for its growth and development while the other structures were well aerated. The present study revealed the potential of plastic jar for storing seeds against pulse beetle infestation in storage. Further studies on the use of plastic jar along with botanical admixtures can be done for effective management of storage pest.

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6. References

1. Ahmed KS, Itino T, Ichikawa T. Duration of developmental stages of *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) on azuki bean and the effects of neem and sesame oils at different stages of their development. Pakistan Journal of Biological Sciences. 2003;6(10):932-335.
2. Ahn JE, Zhou X, Dowd SE, Chapkin RS, Zhu-Salzman K. Insight into hypoxia tolerance in cowpea bruchid: Metabolic repression and heat shock protein regulation via hypoxia-inducible factor. PLoS One. 2013;8(4):57267.
3. Baributsa D, Baoua IB, Bakoye ON, Amadou L, Murdock LL. PICS bags safely store unshelled and shelled groundnuts in Niger. Journal of Stored Products Research. 2017;72:54-58.
4. Charjan SKU, Wankhede SR, Jayade KG. Viability, vigour and mycoflora changes in pulse beetle (*Callosobruchus* sp.) damaged seeds of cowpea produced in dryland condition. In: Economics of Sustainability of Dryland Agriculture, Nagpur, 2006, 5-6.
5. Deshpande SD, Singh G. Long term storage structures in pulses. In: National Symposium on Pulses for Sustainable Agriculture and Nutritional Security, Indian Institute of Pulses Research, New Delhi, 2001, 17-19.
6. Gadewar R, Lambar A, Charjan S, Charde P, Cherian K, Lambat P. Post harvest losses in qualities of pigeon pea due to pulse beetle infestation. In: Proceedings of the International Conference in Agricultural Engineering. Chonburi, Thailand, 2011, 45-51.
7. Ganiger A, Uppar DS, Sugandi JHR. Influence of seed solarization and vacuum packaging on pulse beetle (*Callosobruchus chinensis* L.) infestation and quality of green gram. The Pharma Innovation Journal. 2022;11(1):1298-1306.
8. Howlader MTH, Haque MA, Shahjahan M. Relative abundance of insect pests and loss assessment of rice seeds at different storage conditions. Journal of the

Bangladesh Agricultural University. 2004;2:271-279.
9. Kanwar P, Sharma N. An insight of indigenous crop storage practices for food security in Himachal Pradesh. In: Food and Nutritional Security, Agrotechnology and Socioeconomic Aspects (eds. Kanwar, S.S., Parveen, K., Sardana and Satyavir). SAARM, India, 2003, 175-179.
10. Kumar M, Kumar A, Kumar A, Kumari H. Evaluation of farmers saved seed of green gram and chickpea in Munger district of Bihar. International Journal of Bioresource and Stress Management. 2016;7(4):773-777.
11. Kutbay F, Varol İ, Bayram M, Ozdemir A. The effect of carbon dioxide at high pressure under different developmental stages of *Callosobruchus maculatus* (F.) hosting on chickpeas. African Journal of Biotechnology. 2011;10(11):2053-2057.
12. Meena BL, Bhargavam MC. Effect of plant products on reproductive potential of *Corcyra cephalonica* Stainton (Lepidoptera: Pyralidae). Annals of Plant Protection Sciences. 2003;11(2):196-200.
13. Nehra S, Lekha HS, Chhangani G. Assessment of various packaging materials for pulse storage against pulse beetle (*Callosobruchus chinensis* L.). The Pharma Innovation Journal. 2021;10(9):554-558.
14. Pareek Y, Sharma P, Kumawat KC. Effectiveness of packaging materials and storage containers against pulse beetle, *Callosobruchus chinensis* (Linn.). Indian Journal of Applied Entomology. 2013;27(2):98-101.
15. Pradhan L, Singh PS, Singh SK, Saxena RPN. Biochemical factors associated with resistance against pulse beetle, *Callosobruchus chinensis* (L.) in stored chickpea genotypes. Journal of Experimental Zoology. 2020;23(2):1937-1942.
16. Ramesh A. Priorities and constraints of post harvest technology in India. In: Post harvest Technology in Asia (ed. Y. Nawa), Japan International Research Centre for Agricultural Sciences, Tokyo, 1999, 37.
17. Ramesh L, Vaidya DN. Weight loss in maize grains due to insect infestation in different storage structures. Insect Environment. 2001;7(1):37-39.
18. Roja BL, Venkateswarlu N, Rajesh A, Ramanamurthy B. Evaluation of different storage containers against pulse beetle *Callosobruchus chinensis* (Linnaeus) in blackgram. Andhra Pradesh Journal of Agricultural Sciences. 2021;7(1):13-17.
19. Rolania K, Yadav SS, Singh B, Yadav JL, Kumar N, Pilania S. Assessment of losses due to pulse beetle in chickpea under stored conditions in Southern Haryana. Journal of Agriculture and Ecology. 2021;12:98-105.
20. Sharon M, Abirami CV, Alagusundaram K. Grain storage management in India. Journal of Postharvest Technology. 2014;2(1):12-24.
21. Srinivasan T, Duraimurugan P, Singh SK, Chattopadhyay C. Bruchid infestation in pulses and its management. Indian Farming. 2010;60:13-16.
22. Sudini H, Rao GVR, Gowda CLL, Chandrika R, Margam V, Rathore A, *et al*. Purdue Improved Crop Storage (PICS) bags for safe storage of Groundnuts. Journal of Stored Products Research. 2015;64:133-138.