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Assessment of Quantitative and Qualitative losses Caused by Pulse Beetle (*Callosobruchus Chinensis)* during Storage of Chickpea grains in various Storage Structures

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Abstract
The present study was carried out in Jabalpur district of Madhya Pradesh, which is a major Chickpea growing district in M.P., with the objective of assessing quantitative and qualitative losses caused by Pulse Beetle (Callosobruchus chinensis) during storage of Chickpea grains (cultivar JG 315) in various storage structures, where it was found that, still farmers are using traditional storage structures like kuthla, bunda, jute bags, etc. inspite of scientific structures like warehouses. Further, it was found that, low infested seeds (7.25 to 9.70%) with less moisture content (12.30 to 13.80%) showed better germination (72.30 to 87.00%) and had minimum weight loss (0.28 to 2.20%). Out of all the storage structures used, metallic bins were found to have less qualitative and quantitative losses of seed/grains.
Keywords: *Chickpea; Callosobruchus chinensis; Storage structures; qualitative losses; quantitative losses; metallic bins.*

1. Introduction

Grain legumes are classified under the family Leguminaceae[1] are unique crops which have in-built mechanism to fix atmospheric nitrogen in their root nodules [2]. Also, they are rich in protein and suitable for various cropping systems and complement the cereal crops in several aspects [3]. Among all the legumes, Chickpea (*Cicerariet-inum*) is considered to be best food for vegetarian population in South Asia, West Asia and Southern European countries and is used in a range of different preparations in our cuisine and has a good source of energy i.e. 416 calories/100 gm chickpea [4] along with protein (18-22%), carbohydrate (52-70%), fat (4-10%), minerals (calcium, phosphorus, iron) and vitamins [5]. It is deliberated as a good source of lowering cholesterol level [6].

Despite of the all such advantages, we are unable to protect it from post-harvest losses, which occur during harvesting, threshing, winnowing, bagging, transportation, storage, and processing before they reach the consumer. Ramesh (1999) [7] reported that higher wastage and loss in value are due to lack of storage infrastructure at the village level. The losses during storage are in quantity and quality both for which insects, rodents, mites, birds and microorganisms, moisture, etc. are responsible. Insects cause severe damages to stored grains, which are about 20-35% and 5-10% in tropical and temperate zones, respecttively [8].

Many insect pests including red flour beetle, grainary weevil, lesser grain borer, damage chickpea in storages, however, pulse beetle *Callosobruchus chinensis* L., belonging to the family chrysomelidae, is the most damaging

damaging crop pests[9] to the stored legume industry due to their generalized legume diets and wide distribution.[10]. It is a cosmopolitan pest, attacking grain legumes during both pre and post harvest stages all over the world[11]. It enters inside grains by making holes and start feeding until full damage. Normally infestation starts in the field because adult beetles can easily fly and lay eggs on the chickpea pods. Infestation is caused by grubs as well as adults [12] and normally 6-8 overlapping generations are observed in a year[13]. In India Gujar and Yadav (1978) [14] recorded 32.2 to 55.7 per cent loss in seed weight and 17.0 to 53.5 per cent loss in protein content. In case of severe infestation cent per cent damage is caused by the pest [15].

The insects spends its entire immature stage in individual legume seeds, where they cause weight loss, decrease in germination potential increase in moisture, free fatty acid levels, decrease in protein contents, etc, resulting in total quality and quantity loss, thus, diminishing the market as well as nutritional value of the commodity, fetching low prices to farmers [16].

Keeping in mind, the importance of chick pea and intensity of damages caused by *Callosobruchus chinensis* during storage in structures like kuthla, open bunda, underground bunda, jute bags, earthern pots, warehouse and metallic bins, objective of the present study was set as "Assessment of quantitative and qualitative losses caused by pulse beetle (*Callosobruchus chinensis)* during storage of chickpea grains in various storage structures".

2. Material and Methods

The present study was conducted in Jabalpur district (Madhya Pradesh), during rainy and winter seasons of 2011-12 and 2012-13, under Government M.H. college of Home Science and Science for Women.

2.1 Selection of district and villages

District Jabalpur was selected, as, it is a major chickpea growing district in Madhya Pradesh. It comprises of seven blocks namely, Sihora, Majholi, Patan, Shahpura, Panagar, Jabalpur and Kundam. Two villages in each block of the district were selected by using SRSWOR (Sample Random Sampling Without Replacement) for the study. A comprehensive list of chickpea growers of each selected villages was prepared and 30 farmers were selected from the universe of two villages in every block of the district. The respondents were divided into three groups viz., small farmers (2.0ha), medium farmers (2.0 – 4.0ha) and large farmers (>4.0ha) based on their land holdings. Thus, 70 small, 70 medium and 70 large farmers were selected randomly in proportion to their total number in each farm size group. 5 farmers of each category were randomly selected for the study. Hence, a total of 210 farmers from 7 blocks 14 villages were selected for the purpose investigation.

2.2 Collection of information regarding storage structures

A pre validated and pre tested semi structured interview schedule was used to collect the data on storage structures used by them. Direct face to face contact was made for the purpose. Further, a list of all the used storage structures was prepared for the research to study the existence of storage structure in Jabalpur district of Madhya Pradesh.

2.3 Estimation of losses

For the assessment of quantitative and qualitative losses caused by pulse beetle during storage under untreated condition, the seed samples were drawn from seed/ grain stored in existing storage structures after rainy season from each selected farmers of the present study. The observations were recorded on oviposition, survival and seed damage caused by beetles. Quantitative and qualitative losses due to storage structures were determined from by taking ten samples in each category of storage structures under various heads viz. moisture content, per cent infestation, weight

loss and germination percentage and were calculated as:

i. Moisture content in percentage

The moisture content in seed was recorded in 100 seeds of chickpea. The fresh seed were collected and weighted in grams. These seeds were dried at 103^0C for 2hr and weighted again in grams. The loss in weight was determined as moisture content in seed in percentage.

ii. Per cent infection

The damaged seeds, which were separately counted and weighed were divided by the total number of seeds and then multiplied by 100 for recording the infection percentage according to the following formula:

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

iii. Weight Loss

The grains were separated into damaged (grains with characteristic holes) and undamaged groups. The grains in each group were then counted and weighed by using the electronic balance to measure weight. Percent weight loss was calculated using the formula given by Adams (1976) as follows:

$$\text{Weight loss in percentage} = \frac{(UNd) - (DNu)}{U\,(Nd + Nu)} \times 100$$

Where,

U- the weight of undamaged grains

Nu - the number of undamaged grains

Nd - the number of damaged grains

D- the weight of damaged grains

iv. Germination percentage

The germination percentage was calculated by using following formula

$$\text{Germination percentage} = \frac{\text{Seeds germinated} \times 100}{\text{Total seeds}}$$

3. Result and Discussion

3.1 List of storage structures used

When all the selected 210 farmers from 7 blocks (Sihora, Majholi, Patan, Shahpura, Panagar, Jabalpur and Kundam) and 14 villages were investigated, it revealed that, the farmers were using mainly eight storage structures viz. open bunda, underground bunda, Jute bag, earthen pot, Kuthla, metallic bin, storage in straw and warehouse. Further, it was found that, among all the storage structures, *kuthla* was used by maximum farmers (35.75%) for storage purpose, followed by jute bag (29%) and storage in straw (15.25%). Also, open bunda and warehouse were in least use (1.75%).

3.2 Estimation of losses

Later, the losses caused by pulse beetle (bruchid) of chickpea grains were estimated after 6 months of storage under various heads viz. moisture content, per cent infestation, weight loss and germination percentage. The extent of qualitative and quantitative losses in grains after six months of storage varied with storage structure.

i. Moisture content in percentage

The moisture content in stored seed was estimated in per cent based on seed samples collected from the farmers. It was found that, lowest moisture content was in metallic bin however, it was highest in open bunda condition [Table 1].

Table 1: Moisture content of grains in different storage structures

S. No.	Name of storage structure	Number of samples examined	Average moisture content (%)
1	Open bunda	10	13.90
2	Underground bunda	10	14.70
3	Jute bag	10	13.90
4	Earthen pot	10	13.00
5	Kuthla	10	13.70
6	Metallic bin	10	12.30
7	Storage in straw (Bhusa)	10	13.80

ii. Infestation Percentage

It was recorded that, the lowest infestation was in chickpea grain stored in metallic bin (9.70%) followed by kuthla (11.15%) and storage in straw (12.80%), while, highest infestation (16.20%) was in open bunda followed by underground bunda

(16.10%) and earthen container (14.95%) [Table 2].

Table 2: Level infestation of bruchid on grains of chickpea in various storage structures

S. No.	Name of storage structure	Number of samples examined	Level of infestation (%)
1	Open bunda	10	16.20
2	Underground bunda	10	16.10
3	Jute bag	10	15.40
4	Earthen pot	10	14.95
5	Kuthla	10	11.15
6	Metallic bin	10	9.70
7	Storage in straw (Bhusa)	10	12.80

iii. Weight loss

[Table 3] reveals the extent of average weight loss in grains after six months of storage varied with storage structure. Lowest weight loss was observed in earthern pot (1.06%), followed by metallic bin (2.20%), however, it was highest when grains were stored in straw (4.20 %).

Table 3: Weight loss of grains in different storage structures

S. No.	Name of storage structure	Number of samples examined	Average weight loss (%)
1	Open bunda	10	3.70
2	Underground bunda	10	2.40
3	Jute bag	10	3.06
4	Earthen pot	10	1.06
5	Kuthla	10	3.65
6	Metallic bin	10	2.20
7	storage in straw (Bhusa)	10	4.20

iv. Germination Percentage

Coming to the germination percentage, which is a major characteristic of a quality seed, in the present study, it was found that Seeds stored in metallic bin showed the highest germination (72.30%), on the other hand, seed stored in straw bin showed the lowest germination (35.60%) [Table 4].

Table 4: Percentage germination of grain stored under different storage structure

S. No.	Name of storage structure	Number of samples examined	Germination (%)
1	Open bunda	10	61.30
2	Underground bunda	10	62.30
3	Jute bag	10	63.80
4	Earthen pot	10	64.20
5	Kuthla	10	68.00
6	Metallic bin	10	72.30
7	storage in straw (Bhusa)	10	35.60

Conclusion

It can be concluded that the seeds those were low infested (7.25 to 9.70%) and had minimum weight loss (0.28 to 2.20%) with less moisture content (12.30 to 13.80%) showed better germination (72.30 to 87.00%). On the other hand, the lowest germinated (35.60 to 48.90 %) seeds had high percentage of moisture, thus more infestation and weight loss. Therefore, from the research it was investigated that, seeds stored in metallic bins possesses the optimum germination percentage, having less moisture content and less infestation.

Thus, from the present study, it can be concluded that most of the farmers in district Jabalpur, prefer storing their grains/seeds in *khutla*, out of all the seven storage structures viz. open bunda, underground bunda, Jute bag, earthen pot, Kuthla, metallic bin and storage in straw but the quality and quantity losses were found least in metallic bin.

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