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Survey of rural wheat storage conditions and farmers' knowledge about stored grain pests and their management in southern Haryana

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Abstract
Studies were carried out during 2013 to assess the status of wheat grain storage conditions as well as people's knowledge about stored grain pests and their management in the rural areas of Mahendergarh district of Haryana, India. Wheat stores of 50 farmers of each of the six selected villages were visited and farmers were interviewed with the help of an Interview Schedule prepared for this purpose to document the wheat storage practices adopted by the farmers as well as farmer's knowledge about stored grain pests and their management. It was found that the highest percentage (70) of farmers stored wheat in metallic bins, followed by gunny bags (21.67) and open bulk storage (8.33). On an average 52.33 per cent farmers were able to differentiate *T. granarium* infestation from infestation by other stored grain pests. About 80 per cent farmers adopted a combination of 3-4 pest management practices such as sun drying of grain, treatment of storage structures, fumigation of grain with insecticide and mixing of dried neem leaves in the grain.

Keywords: *Trogoderma granarium*, stored grain pests, management, wheat storage conditions

Introduction
Some important and most common coleopteran insect pests attacking stored wheat in Haryana are *Trogoderma granarium*, *Rhyzopertha dominica*, *Sitophilus oryzae* and *Tribolium castaneum* (Chaudhary and Mahla, 2001) [1]. Among these, *Trogoderma granarium* Everts (Coleoptera: Dermestidae), commonly known as khapra beetle, is the dominant pest of stored wheat in southern Haryana, where the environment is relatively hot and dry, as compared to other parts of the state. According to Mahla (2001) [9], *T. granarium* incidence and its population was found significantly higher in southern parts and lowest in northern parts of Haryana. Hadaway (1956) [6] reported that all stages in the life cycle of *T. granarium* are resistant to heat and dryness. Beside the quantitative loss, the insect infestation in wheat grains reduce germination and produce unpleasant odour, dirty appearance and abhorrent taste due to contamination with insect fragments and excrement (Khare *et al*., 1974) [7]. In addition to this, high stored grain pests' infestation in stored wheat is also reported to result in substantial changes in contents of calcium, phosphorus, zinc, iron, copper and manganese (Jood *et al*., 1992) [5], and substantial losses in thiamin, riboflavin and niacin (Jood and Kapoor, 1994) [4]. It is expected that with the continual efforts of various extension agencies over several decades, there must have been some improvement in the farmers' knowledge about safe storage of food grains. Therefore, the present studies were carried out to assess the status of wheat grain storage conditions as well as farmer's knowledge about stored grain pests and their management in the rural area of Mahendergarh district of Haryana, India.

Materials and Methods
Wheat stores of 50 farmers of each of the six selected villages, namely, Bhagdana and Bucholi (Block Mahendergarh), Maghanwas and Sigda (Block Kanina), and Maghot Hala and Maghot Binj (Block Nangal Chaudhary) were visited during October-November, 2013 to document the wheat storage practices adopted by the farmers. Further, response of the farmers with respect to adoption of various practices to prevent/manage damage by *T. granarium* and other stored grain pests was recorded with the help of an Interview Schedule prepared for this purpose. Information on the following aspects was sought from the farmers: type of storage structure used by the farmers; farmers' knowledge about storage pests; and adoption of pest

management practices such as sun drying of grain, cleaning, treatment of storage structures/material, use of plant based material including neem leaves in the grain, fumigation of receptacle, mixing of inert and other materials, etc. Thus, a total of 300 farmers were interviewed during the study period. Per cent farmers adopting different practices were worked out.

Results and Discussion

Adoption of wheat storage structures/practices by the farmers

When storage of wheat grain in different storage structures/practices was compared it was found that the highest percentage (70) of farmers stored wheat in metallic bins, followed by gunny (jute) bags (21.67) and open bulk storage (8.33) (Table 1). Among different Blocks highest percentage of metallic bin storage was recorded in Kanina Block (74), followed by Mahendergarh (72) and Nangal Chaudhary (62). Among the three Blocks, greater percentage of farmers adopted for gunny bag storage in Nangal Chaudhary (27), followed by those in Mahendergarh (21) and Kanina (17). About 8.33 per cent farmers stored their wheat in the rooms as open bulk storage. The present findings do not match with the studies conducted by earlier workers on the wheat storage pattern of Haryana farmers. Dass (1977) [2] found that metal bin storage in Haryana was 2.1 per cent only while jute bag storage was 40 per cent. Later studies by Dharam Singh and Yadav (1995) [3] reported that the use of different storage structures in Haryana in descending order was jute bags (29.3%), metal bin (26.3%), room (16.7%), *kothi* (8.7%), mud bin (*bukhari*) (8.0%), *parchhatti* (5.7%), and *thekka* (5.3%). In the present studies the highest percentage of farmers has been found to use metal bins for storing wheat. It indicated that farmers' storage practices have undergone considerable change during the last 3-4 decades which is a good sign for safer storage of food grains and a reflection of faster adoption of latest technology by the Haryana farmers. On the other hand, studies by Kumawat (2007) [8] revealed that in Rajasthan storage structure adopted by the farmers were gunny bags (41.5%), bulk storage in room (18.1%), *pucca bhukari* (16.7%), metal bin (11.1%), *kuthla* (5.6%), *kothi* (4.2%) and *matka bin* (2.8%). Such differences in storage pattern may probably be due to the differences in the socio-economic conditions of the farmers of the two states. The present studies showed that no farmer in Mahendergarh district was found to use the older storage structures such as *pucca kothi*, *kuthla*, *kothi* and *matka bin* etc for storing wheat. Though 70 per cent farmers stored their wheat in metallic bins, yet about 30 per cent of the farmers still stored their wheat in gunny bags or as open bulk storage. Such farmers need to be educated for the use of metallic bins so that loss caused by different stored grain pests could be further reduced.

Farmers' knowledge and parameters employed for identifying various stored grain pests

While assessing the farmers' knowledge about stored grain pests' infestation it was observed that on an average 52.33 per cent farmers of the area were able to differentiate *T. granarium* infestation from other pests' infestation (Table 2). Similarly, 31.67 per cent farmers were able to identify *T. castaneum* infestation. However, only 8.33 and 7.67 per cent farmers could identify *R. dominica* and *S. oryzae* infestation in wheat, respectively. Among different Blocks, greater percentages (59) of farmers of Nangal Chaudhary Block were able to identify *T. granarium*, followed by Mahendergarh (52) and Kanina Block (46). Likewise, per cent farmers identifying *T. castaneum* was 37, 31 and 27 with respect to Kanina, Mahendergarh and Nangal Chaudhary, respectively. However, no information on this aspect is available in the literature to discuss the results.

When farmers' knowledge with respect to identification of damage by *T. granarium* was evaluated it was found that the farmers of Mahendergarh district made use of different cues for this purpose. As high as 49.33 per cent farmers were able to identify damage by this pest taking into consideration the germ portion eaten, and the presence of insect exuvae (Table 3). Another important parameter used by 47 per cent of the farmers was the movement of pest larvae in and around storage structure. Further, 3.67 per cent farmers could identify the pest damage just by taking a handful of grain from the store and noticing the presence of grain powder sticking to their hands. Similar parameters of identifying *T. granarium* damage in wheat were adopted by farmers of all the three Blocks. Per cent farmers basing their pest identification on damaged grain and the presence of exuvae were 53, 52 and 43 in Mahendergarh, Kanina and Nangal Chaudhary, respectively. Similarly those using pest larval movement as indicator of *T. granarium* infestation was 51, 47 and 43 per cent in Nangal Chaudhary, Kanina and Mahendergarh, respectively. However, no information on these aspects is available in the literature.

Pest management practices in stored wheat adopted by farmers

Data on various pest management practices in stored wheat adopted by farmers of different Block of Mahendergarh district are presented in (Table 4). The data revealed that most of the farmers of Mahendergarh district adopted more than one management practices to control pests' infestation in stored wheat. However, a small percentage of farmers used only single such practice. The highest percentage of farmers (48.33) adopted a combination of three pest management practices, *i.e.*, sun drying of grain, treatment of storage structures and fumigation of grain with insecticide. Another popular strategy adopted by 31.67 per cent farmers was sun drying of grains+treatment of storage structures+mixing of dried neem leaves in the grain+fumigation. Thus, about 80 per cent farmers of district used a combination of 3-4 pest management practices such as sun drying of grains, treatments of storage structures, mixing of dried neem leaves in the grain and fumigation for preventing damage by stored grain pests in the stored wheat. About 11.33 per cent farmers went for fumigation of grain alone while 7.67 per cent farmers adopted mixing of dried neem leaves in the grains. However, only a few farmers (*i.e.*, < 1%) used other material such as mixing of match sticks in the grain. However, no information on these aspects is available in the literature.

Table 1: Adoption of various wheat grain storage tructures/practices by farmers in different Blocks of Mahendergarh district

Storage structure/practice	Farmers (%) adopting particular storage structure/practice in different Blocks			
	Mahendergarh	Kanina	Nangal Chaudhary	Mean
Metallic bin	72	74	64	70.00
Gunny bags	21	17	27	21.67
Bulk storage	7	9	9	8.33

Table 2: Farmers' knowledge about wheat grain infestation by different coleopteran pests during storage in different Block of Mahendergarh district

Pest	Farmers (%) capable of identifying the pests in different Blocks			
	Mahendergarh	Kanina	Nangal Chaudhary	Mean
Trogoderma granarium	52	46	59	52.33
Rhyzopertha dominica	9	11	5	8.33
Sitophilus oryzae	8	6	9	7.67
Tribolium castaneum	31	37	27	31.67

Table 3: Farmers' parameters for identification of *T. granarium* and its damage in different Blocks of Mahendergarh district

Parameter	Farmers (%) adopting parameters for identification			
	Mahendergarh	Kanina	Nangal Chaudhary	Mean
By observing movement of the pest (larvae)	43	47	51	47
By observing damaged grain and exuvae	53	52	43	49.33
Grain powder sticking to hand when handful of grain was taken	4	1	6	3.67

Table 4: Pest management practice(s) adopted by farmers of different Blocks of Mahendergarh district

Pest management practice	Farmers (%) adopting specific pest management practice(s) in different Blocks			
	Mahendergarh	Kanina	Nangal Chaudhary	Mean
i. Sun drying of grain	0	0	0	0
ii.Cleaning and winnowing	0	0	0	0
iii. Treatment of storage structure (exposure of metallic bin/empty gunny bags to sun, or insecticide spray on gunny bags)*	0	0	0	0
iv. Use of neem leaves	8	6	9	7.67
v. Fumigation of grain with Aluminium phosphide	11	9	14	11.33
vi. Mixing of other material	2	1	0	1
vii. Combination of i, iii, v	43	56	46	48.33
Viii. Combination of i, iii, iv, v	36	28	31	31.67

***** Less than 2% farmers adopted the practice of spraying gunny bags with insecticides

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