

Full Length Research Paper

Role of storage facilities for insect pest control strategies in Punjab, Pakistan

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This research has a mint of importance in Pakistan where a major part of the economy is based on agricultural products. A survey was conducted in the Punjab province to evaluate the types and methods of storage and the pest attack on their storage and their control strategies as well. Questionnaire was designed to collect the information from the local people, gender, including students, landlords, house owners/housewives and farmers. Data indicated the use of chemicals for the control of the pests in their storage best. The most common storage facility is metallic bin. Pest which was reported by people was Red flour beetle, *Tribolium castaneum* Herbst. Main seasons of attack of the pests are summer and rainy. Data gave a lot of other information about storage which can be helpful for further research on the local storage of grains, its pests and their control.

Key words: *Tribolium castaneum*, survey, chemicals, storage.

INTRODUCTION

Nutrients are indeed the obligatory supply of life forms for all organisms living on the earth (Salunke et al., 2009). Agriculture plays a vital and most governing role in the accomplishment and fulfillment of the basic need for the world's escalating population, which is proposed to increase by 8 billion till 2025 (Khush, 1999). Agriculture is always affected by various abiotic, such as weather, climate, input application methods of fertilizers and seeds, method and timings of irrigation, government policies, marketing supplies (Anonymous, 1996) and biotic factors including insects, moulds, birds and rodents (Baloch et al., 1994). Among all these losses, insect pests are the most detrimental which cause about 43% of the total physical and nutritional loss occurring in the developing world, also threatening the living world for food security (Chomchalow, 2003; Jacobson, 1982). The stored grain losses in Pakistan are estimated to reach

about 2.5% in six months (Ahmed, 1983). The losses by insects like bruchids and weevils do not include only the direct consumption of the seeds and food products, but also the other reasons such as the amassing up of insect cadavers, exuviae and webbings, which makes the food and seeds unfit for human consumption (Rajashekar et al., 2012).

For the protection of the stored stock, people have been using chemicals such as, phenyl tablets, phosphine tablets, botanicals including neem, tobacco and eucalyptus leaves and seeds and inert material like sand, salt and ash (Chomchalow, 2003). In southern Punjab, the storage facilities generally used are metal containers (storing dry foods e. g tea or flour), gunny bags (made up of natural fibre), earthen bins (In this type of bin no movement of air) and jute bags (Made up of coarse fabric). The people generally prefer to use chemicals like

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Naphthalene / phenyl tablets as these are cheap and ready to use. Moreover, these are very effective especially in wheat *Triticum aestivum* L. storage to control pest population (Latif et al., 2004). Multan is a major city of Southern Punjab which is spread over an area of 3,721 km². Being a good wheat producing area the Southern Punjab needs special attention to groom up farmers for better crop production and its storage in order to gain maximum benefit for the food security of the country.

A survey was conducted to find out the local conditions of Southern Punjab about the public awareness toward the storage of grains. A questionnaire was designed including all the important information useful for the researcher to guide the local people about problems concerning storage facilities, pests and their control; and to develop better methods of grain storage which the local people would embrace with ease.

MATERIALS AND METHODS

Area

The data were collected from the people living in the Southern Punjab (30° 11' 44 N; 71° 28' 31 E), and the surrounding areas. Southern Punjab has an extreme climate. The extreme temperature of Southern Punjab in summer reaches up to 49°C whereas 1°C in winter. The average rainfall in the area is 127 mm. The average climate of Southern Punjab is hot and dry in summer and hot and humid during the rainy season, which favors the insect growth the most.

Information/ questions

The structured questionnaire was designed to collect the information about four different aspects regarding storage:

1. Socio-demographic status of the interviewees including gender, age, locality and occupation,
2. Information regarding storage of the grains including amount of stock, storage duration and the type of storage facility,
3. Information regarding identification, occurrence, damage of the pests and their season of attack in the storage,
4. Information regarding preventions and control of the insect pests by chemicals, botanicals and physical methods; methods and time of application of chemicals and source of information about the pest control.

Analysis of data

The data were analyzed by the SPSS software (Version 17.0 for windows, SPSS Inc., Chicago, USA). Frequency and percentage were calculated by the software for the comparison and represented in tabular form.

RESULTS

The people targeted/ interviewed were of three age groups, so that the information may be valid and reliable

(not confined to the knowledge of old or young people). Approximately 20.5% of those people included females to remove any kind of bias. The categories interviewed were students, landlords, house owners, shopkeepers and housewives, having different lifestyles and different educational level as shown in Table 1. The data in Table 2 shows the information regarding the storage of the grains including amount of stock, storage duration and the type of storage facility. It show that more than 75% of the people store less than 0.2 Metric tons grains, whereas only about 25% of the people have storage above 0.2 Metric tons. Approximately 47.4% of the people store grains in their houses (mostly in villages), while 28% of the people store grains in their shops and only 24.6% of them store stock in go downs. The duration of storage for 63.5% people is about one year/annual and for 36.5% people, the storage is seasonal. The major storage facility for the people is Metal bins and Bags, which is 32.5 and 15.4% respectively. Other storage facilities are earthen bins and others which make up 6.9% and 9.5 of the total respectively. Many people use 2 of 3 of the described facilities.

Table 3 shows the information regarding identification, occurrence, and damage of the pests and their season of attack in the storage. Among the people interviewed, 86.5% people have the identification of one or more stored grain pests. 65.7% of the people have reported the occurrence of 2-4 pests in their storage, whereas only 6.5% people have reported more than 5 pests in their stock. The most common pest reported was Red Flour Beetle *Tribolium castaneum* (Herbst) (18.7%), followed by rodents (5%), Khapra beetle (2.7%), ants (2.3%) and pulse beetle (1.5%). People mostly faced pest damage in their storage by various pests among which Red Flour Beetle ranks first (24.4%). Other pests including Khapra Beetle (10.3%), Rodents (1.0%) and others (7.3%) are also reported to be damaging. About 41% of the people face pest attack in rainy season, followed by summer (20.6%), and spring (15.4%). Winter was reported to be least in pest attack that was only 5.6% of the total (Table 3).

In Table 4, the information is given about the preventions and control of the insect pests by chemicals, botanicals and physical methods; methods and time of application of chemicals and source of information about the pest control. According to 97.9% of the people, these pests are preventing. For the control of these pests, 48.5% of the people use chemical methods, 26.5% people use both chemical and physical methods, while only 2.7% of the people use botanicals in their storage. 12.9% of the people were also there who do not use any control measure. Among the people who use chemical, 38.7% of the people use phenyl Tablets, 9.7% people use Phosphine tabs and 19.9% people use other chemicals. The methods of application of these chemicals reported were fumigation (7.4%), spraying (4.7%), wrapping/manual putting (10.2%) and sprinkling (20.2%). According to the data, 76.7% of the people apply the control measures at

Table 1. Socio-demographic characteristics of Interviewees.

Parameter	Frequency	Percentage	Cumulative percentage
Locality			
Multan	725	73.7	73.7
Others	259	26.3	100
Gender			
Male	782	79.5	79.5
Female	202	20.5	100
Age group			
17-25 years	454	46.1	46.1
26-40 years	378	38.4	84.6
41-70 years	152	15.4	100
Occupation			
Student	325	33	33
Landlords	236	24	57
Housewife	89	9	66.1
Farmer	96	9.8	75.8
Shop owners	237	24.1	99.9
Unemployed	1	0.1	100

Table 2. Information regarding storage of grains.

Parameter	Frequency	Percentage	Cumulative percentage
Amount of stock			
<0.2 Metric tons	753	76.5	76.5
>0.2 Metric tons	231	23.5	100
Storage duration			
Annually	625	63.5	63.5
Seasonally	359	36.5	100
Storage place			
Home	466	47.4	47.4
Shop	276	28	75.4
Godown	242	24.6	100
Storage facility			
Any of them	16	1.6	1.6
Bags	152	15.4	17.1
Earthen bins	68	6.9	24
Metal bins	320	32.5	56.5
Others	93	9.5	66
Bags, earthen bins	57	5.8	71.7
Bags, metal bins	69	7	78.8
Bags, others	125	12.7	91.5
Earthen bins, metal bins	1	0.1	91.6
Bags, earthen bins,	45	4.6	96.1
Bags, earthen bins, others	20	2	98.2

Table 3. Information regarding the identification, occurrence and damage of pests.

Parameter	Frequency	Percentage	Cumulative percentage
Identification of the pest			
No	133	13.5	13.5
Yes	851	86.5	100
Occurrence of the pests in storage			
Nil	17	1.7	1.7
Red flour beetle	184	18.7	20.4
Khapra beetle	27	2.7	23.2
Pulse beetle	15	1.5	24.7
Ants	23	2.3	27
Rodents	5	0.5	27.5
Others	3	0.3	27.8
2-4 pests	646	65.7	93.5
More than 5 pests	64	6.5	100
Pest damage			
No	60	6.1	6.1
Yes	924	93.9	100
Damaging pests			
Nil	23	2.3	2.3
Red flour beetle	240	24.4	26.7
Khapra beetle	101	10.3	37
Others	72	7.3	44.3
Rodents	10	1	45.3
2-3 pests	351	35.6	80.9
>3 pests	144	14.6	95.5
All	44	4.5	100
Season of attack			
Summer	203	20.6	20.6
Rainy	405	41.1	61.7
Winter	55	5.6	67.3
Spring	152	15.4	82.7
Summer+ Rainy	22	2.2	85
Summer + Winter	4	0.4	85.4
Summer + Spring	47	4.8	90.2
Rainy + Spring	7	0.7	90.9
Summer + Rainy + Winter	1	0.1	91
Summer + Rainy + Spring	89	9	100

the time of storage, 5.5% of the people apply control measures on pest attack and 2.6% of the people apply at the time of heavy pest attack. Some of the people prefer to apply the control measures more than 2 times in their stock. According to the data, the people have come to know about the control measures mainly from the newspaper (15.4%), followed by farmers (8.7%), electronic media (7.3%), some of them have inherited the knowledge (1.5%) and a few of them have come to know by the private companies (0.2%). A majority of the population (66.7%) has come to know about these control

measures by multiple sources (Table 4).

DISCUSSION

The data give us very important information about the storage of grains in Southern Punjab and its surroundings. It is clear from the results that people preferred to store their stock less than 0.2 metric tons for as long as one year. They prefer to store the stock in a place near the fields and less people prefer to save their

Table 4. Information regarding control of the pests.

Parameter	Frequency	Percentage	Cumulative percentage
Are the pests preventable			
No	21	2.1	2.1
Yes	963	97.9	100
Chemicals			
Nil	127	12.9	12.9
Chemical	478	48.5	61.4
Physical	30	3	64.5
Botanicals	27	2.7	67.2
Chemical + Physical	261	26.5	93.7
Chemical + Botanicals	41	4.2	97.9
Misc.	143	14.5	14.5
Phenyl Tablets	381	38.7	53.3
Phosphine Tablets	96	9.7	63.0
Others	196	19.9	82.9
Phenyl Tabs + Phosphine Tabs	12	1.2	84.1
Phenyl Tabs + others	96	9.8	93.9
Phosphine Tabs + others	16	1.6	95.5
Phenyl Tabs + Phosphine Tabs	44	4.5	100
Application time			
Misc.	62	6.3	6.3
At the time of Storage	755	76.7	83
After pest attack	54	5.5	88.5
At heavy pest attack	26	2.6	91.2
Others	27	2.7	93.9
In storage, others	44	4.5	98.4
After pest attack, at heavy pest	10	1	99.4
In pest attack, others	4	0.4	99.8
In heavy pest attack, others	2	0.2	100
Source of information			
Misc	15	1.5	1.5
Company	2	0.2	1.7
Electronic media	73	7.4	9.1
Farmers	86	8.7	17.9
Newspaper	152	15.4	33.3
Multiple	657	66.7	100

stock in the godowns or stocks. It makes the field workers and researchers clear to train the people or farmers in the respective manner, that is, for control measures effectiveness reaches almost a year, the method to store such amount of grains to escape from pest attack. Use of metal bins for storage of stocked and useful for prevention of the pest attack Ali et al. (2009) reported that tin containers and plastic bags proved to be best in storing the wheat grains as compared to the gunny bags and earthen pots. Baloch et al. (1994) reported that jute bags are the reason of high infestation of insects in the grains. This might be the main reason why the majority of

local population prefers to use metallic bins and only a few use bags and earthen bins. The reason of high infestation in jute or gunny bags is that these storage facilities support ventilation and also increase the moisture content of the grains which results in moulding, webbing and insect infestation. In contrast, the plastic bins and metal containers do not allow any air to flow in and also maintain the moisture content, thus keep the insect infestation low (Ali et al., 2009).

The interviews revealed that more than 85% of the people can identify the stored grain pests. More than 90% of the people reported less than 5 pests on their

storage and only 6.5% of people report more than 5 pests. Samuels and Modgil (1999) and Karim (1987) reported rice weevil (*Sitophilus oryzae*), grain moth (*Sitotroga cerealella*) and red flour beetle (*Tribolium castaneum*) as important pests in the storage. Chaudhury and Mahla (2001) accounted 10 insects species as pests which were generally found in the wheat storage and these 3 species were also found as major in storage. The difference in the number of pests might be due to the difference in climate or other cultural/storage practices. Most of the pest attack was reported in rainy and summer season and least attack was reported in spring and winter. This was also due to the fact that high moisture favors high pest population (Ali et al., 2009). Phenyl and phosphine tablets used in their stocks for pest prevention and some use physical measures, such as sand, ash and salt along with chemicals in their storage. In contrast, botanicals use had declined a lot as it takes too much work in drying or crushing the leaves, seeds or bark of the botanicals. This was mainly due to the fact that chemicals such as phenyl/naphthalene were cheap, easily available and most of all, ready and easy to use (Chomchalow, 2003; Kabir et al., 2003; Latif et al., 2004).

Ali et al. (2009) also found phenyl/naphthalene to be most effective among the camphor, neem, sand and naphthalene treated wheat grains which significantly controlled three major pests including red flour beetle. People use Manual putting/wrapping method of the phenyl Tablets and fumigation of phosphine Tablets in the storage rooms. Previous research revealed that phosphine and methyl bromide were the two main grain protectants in storage all around the world (Rajendran and Sriranjini, 2008). Many people report that the application of control measures at the time of the storage results in better control of insect pests which is practiced by almost 75% of the local people. The source of information about the control measures as reported was by multiple factors including media, newspaper and electronic media as well. This information can be helpful in proposing further strategies for a long-term insect-protected storage.

Conclusion

We found that storage conditions of different stocks needs more hygienic places especially in developing countries. The people of Southern Punjab store stocks in their houses and houses do not provide proper protection from environmental factors so it is necessary that houses should be cleaned properly to produce a healthy environment for storage. Metal bins should be used carefully and properly for storage of stocks. Rainy season

was found most favorable for the stored grains pests so special care should be taken in rainy season. Proper integrated pest management program should be initiated in case of stored grain pests. Chemical control gives effective control so it is the most adapted method by people of Southern Punjab but a number of health problems and environmental risks are associated with this chemical control so alternate methods should be evaluated for management of insect pests.

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