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Assessment of Post Harvest Wheat Losses in D. I. Khan

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Abstract: Assessment of losses was carried out in various stores of wheat grains in D. I. Khan. A total of 220 samples were collected from different localities in 4 directions (East, West, North and South) of D.I. Khan. The study was conducted by using two methods i.e count and weigh and thousand grain mass methods. During 5 months storage period, average of losses determined by C&W and TGM method were found 3.40 and 6.53%, These losses also include black pointed grains, Broken/Shriveled grains and Green/Immature grains which were computed as 0.61, 3.08 and 0.67% respectively while an average amount of foreign matter was found 30.26%. On an average 1.93% grains were found infested with *Tribolium* spp., *Rhyzopertha dominica* and *Trogoderma granarium*.

Key words: Wheat, losses, assessment, *Tribolium* spp., *Rhyzopertha dominica* and *Trogoderma granarium*

Introduction

Wheat (*Triticum aestivum* L.) is a major source of subsistence food for the population of the whole country. It is the major source of energy especially for the low income classes, who cannot afford protein rich food like meat and pulses. It ranks first in acreage as well as in production amongst all the cereals grown in Pakistan. Wheat is grown in all of the provinces of Pakistan. Punjab is its major producer and supplier of wheat (7.5 million tones during, 1984-85). Sindh is self sufficient (2.1 million tones) while NWFP and Baluchistan are deficit by 0.9 and 0.11 million tones respectively and mostly meet their demand from Punjab province. Wheat is stored at farm levels in different types of storage like jute bags, mud bins, metallic boxes etc. Private traders also store wheat in bags for a short period. As the commodity is stored in large quantity and for a longer period, therefore, the grain is subjected to various losses. Calculating the damage at a very conservative rate of 2% of the total loss under storage condition will amount to millions of rupees. Various researchers estimated that as much as 50% of all foods in the tropics is lost during storage, shipping and marketing, particularly in wet or very humid weather. Rehman (1942) reported 2.5% grain losses of total production in Punjab. Hafiz and Hussain (1961) recorded 10.18% losses due to insects, rats and mold in Pakistan. *Tribolium castaneum*, *Rhyzopertha dominica*, *Trogoderma granarium*, *Sitophilus oryzae*, *Sitotroga cerealella* and *Ephestia cautella*, caused loss in weight which varied from 7.0 to 22.0% during six months storage in Uttar Pradesh, India (Girish et al., 1975). Khan and Cheema (1978) determined 2.32% storage loss of wheat in some part of Punjab, Pakistan. Khapra beetle, lesser grain borer, rice weevil and granary weevil were responsible for 10-15% losses to wheat grains in storage condition (Ahmad, 1980).

According to Yadav and Nathan (1980) 9.5% moisture contents favored the development of *S. oryzae* and majority of wheat samples were infested by this pest. *R. dominica* was present in 8.2% of samples and *T. granarium* for which high level of humidity is known to be unfavorable, was present in only 2.8% of the wheat samples. Jilani (1981) reported 10 to 15% post harvest losses of food grains and insect pests were among the various contributing factors to such losses in Pakistan. Ahmad and Afzal (1984) recorded 22.7% post harvest losses of wheat in Pakistan, out which 9.5% occurred during storage period and the remaining 13.2% during harvesting and threshing practices. Farmanullah (1985) recorded 0.22% handling & spoilage losses and 2-33% quality loss of stored wheat in public sector godowns at D. I. Khan (Pakistan). Mohammad (1986) stated that in Pakistan losses of wheat grains stored for 4 months in house type godowns were 2.03, 8.18 and 1.35% determined by S.V.W, TGM and G.M. methods of loss assessment respectively. The respective figures for 7 months storage period were recorded as 3.02, 9.41 and 2.06%. Six months wheat storage resulted in average weight losses of 1.99, 6.33 and 2.01%, determined by S.V.W, TGM and G.M. methods respectively in stores of food Deptt, Peshawar, Pakistan (Khan, 1986). Baloch (1986) reported 4% and 7% annual storage losses at farm level and in the public sector, respectively depending upon ecological conditions (humidity and temperature) biological factor (insects, molds, rodents and birds), storage type, storage management, etc.

The objective for this research study was to determine post harvest losses in wheat due to various factors i.e., insect infestation, foreign matter, black pointed grains, broken/shriveled grain, green/immature grain.

Materials and Methods

Qualitative and Quantitative losses of wheat grains were estimated by studying samples collected from four directions (East, West, North, South) of D. I. Khan, (NWFP). For this purpose total 220 samples were collected from June to October 1999 (Five months) from farmer's stores in different villages i.e., long Khair Shah, Panyala, Mithapur, Musazai, Tatar Khail, Paroa, Rammak, Himmat, Paharpur, Behlol Khail, Ratta Kulachi, Research Institute D. I. Khan, Rakh Zandani farm, Food Godowns, PASSCO and Ratta Kulachi seed farm. These samples were brought to the Entomological laboratory, Faculty of Agriculture Gomal University D. I. Khan and the losses caused by the various agencies with special reference to insect pests of stored grains were assessed by the following methods.

Method for Sample collection: Sample (1 kg) was collected from the store just after the commodity is stored, while the subsequent samples were collected from the same stores every months till October, 1999. The samples were collected from different stores by using different methods i.e., from top surface in case the grains were stored in wooden box, in case of bag storage each bag was sampled from all sides with bag spear, in some cases from bottom vent (out let) of store. In case where grains were stored on the floor, samples were taken from upper, lower and other sides of bulk. All these primary samples were thoroughly mixed on plastic sheet and weighed to 1kg. These samples were placed in plastic bag to make it able to retain moisture contents of grain and avoid contamination. The following information were noted on each sample:-

Date of collection, Date of storage, Age of store, Type of storage structure, Capacity of storage facility, Reference number of sample, Insecticidal treatments, if any, Method of sample collection, Other commodities stored (mixed or separate).

The samples with all above mentioned information were enclosed in plastic bag and then plastic bags were putted into cotton bag to protect it from any damage and brought to laboratory for analysis.

Laboratory analysis: All the samples were accurately weighed with the help of electronic balance in the laboratory. After weighing, the entire sample was sieved and for this purpose 5, 10 and 20 meshes sieves were used to remove the dust and some weed seeds. While food grain and other foreign matter like weeds seeds and straw were removed by hand picking. All foreign matters were separated, accurately weighed and recorded on project dairy. The figures of each friction were converted into g/kg. Moisture contents of samples was determined with the help of "Electric oven". For this purpose initial weight of samples was taken and then placed in the oven at 72° C for 48 hours and then again weight was taken. The moisture content was determined as,

Moisture content = $\frac{\text{Initial weight of sample} - \text{Final weight of sample}}{\text{Initial weight of sample}} \times 100$

The stages of insect species dead/alive in the sample were identified and counted. The data obtained were recorded on laboratory analysis form for further guidelines. Two sub-samples were obtained with the help of Boerner's grain divider. One sub-sample was used to determine thousand

Khan and Kulachi: Post harvest losses in wheat

grain mass (TGM). This sample was reduced to 60g of working samples, its exact weight was recorded and then the grains were counted. Dry TGM was calculated by using the following formula.

$$\text{DRY TGM} = \frac{10x M (100-H)}{N}$$

Where

M, Weight of working sample

N, Number of grains in W. Sample

H, Moisture content of the grains

Now for Qualitative analysis, the 2nd sub-sample was reduced to a working sample of about 15g. This sample was accurately weighed, grain were counted and data were recorded. The qualitative losses were determined by count and weigh method. For this purpose the following types of damaged grains were separated, these were weighed and counted.

Broken and shriveled grains, Green and immature grains, Insect damaged grains, threshed grains, Black pointed grains.

Results and Discussion

Insect species: Table 1 shows that *Tribolium* spp. was missing, while *R. dominica* and *Trogoderma granarium* were recorded in the samples of wheat (1 kg) collected in the month of June. The average number of *Tribolium* Spp., *R. dominica* and *T. granarium* were found 0.70, 2.58, 5.8 in July, 6.68, 5.37, 50.16 in August, 10.01, 10.10, 68.05 in September, 13.70, 14.03, 111.33 in October, respectively.

Comparative population densities of different Insects: Results of five months studies regarding the number of different insects species recorded in different samples are presented in Table 2. The average number of insects per kg of the wheat sample, recorded in the month of June, July, August, September & October were 0.00, 1.00, 2.69, 9.18 in the localities of East direction, 0.13, 2.33, 8.74, 14.13, 26.05, in the localities of West direction, 00.00, 0.31, 1.08, 5.08, 9.44 in the localities of North direction 0.59, 5.46, 49.70, 60.06, 92.65 in the localities of South direction. Overall, average number of insects/kg in the selected localities in the four directions of D. I. Khan was found 0.18 in June, 2.28 in July, 15.55 in August, 22.11 in September and 38.52 in October.

Foreign matter: The samples collected in the months of June, July, August, September and October 1999 showed the amount of foreign matter which were 26.18, 27.97, 31.90, 36.90 and 37.10 g/kg in the localities of East direction, 16.32, 24.70, 17.38, 28.42 and 29.21 in the localities of West direction, 24.12, 20.95, 18.80, 29.78 and 26.22 in Northern localities and 35.70, 36.55, 42.94, 47.60 and 46.42 in the Southern localities of D. I. Khan (Table 3). The average amount of foreign matter in collected samples was recorded 25.58, 27.54, 27.76, 34.78 and 35.63 g/kg during June, July, August, September and October, respectively.

Insect infestation: Table 4, shows the weight (%) of insect damaged grains in the samples collected from selected localities. Amount of the insect damaged grains recorded in the localities of East, West, North and South directions of D. I. Khan were determined month wise. The amount of insect damaged grains recorded in study period of June to October in Eastern localities of D. I. Khan were 0.16, 0.33, 2.66, 5.08 and 6.5%, respectively. The amount of damaged grains during the respective months in Western localities were 0.08, 0.14, 0.71, 1.50 and 3.90%, while in Northern localities, were 0.5, 0.08, 0.90, 1.20 and 1.41% and in Southern localities were 0.0, 0.73, 1.64, 5.15 and 6.36%, respectively. The average amount of insect damaged grains in the selected area was found 0.07, 0.32, 1.48, 3.23 and 4.54% during June, July, August, September and October, respectively.

Black pointed grains: Table 5 shows that percentage of black pointed grains ranged from 0.13 to 1.75% in Eastern localities of D. I. Khan, during June to October 1999. While this percentage ranged from 0.16 to 0.52% in the Western localities of D. I. Khan during this study period of 5 months (June-October) In Northern localities, it ranged from 0.46 to 0.92% and in Southern localities, it ranged from 0.27 to 0.82% during this period. The averages of black pointed grains for D. I. Khan were calculated 0.35 in June, 0.78 in July, 0.93 in August, 0.45 in September and 0.55% in October 1999.

Broken and shriveled grain: The percentage of broken and shriveled grains

(Table 6) were noted as 4.17, 4.67, 5.67, 3.58 & 3.33% in Eastern localities during June, July, August, September & October respectively, in western localities. This percentage was found 1.90, 2.90, 3.90, 2.56 and 2.75% during June to October, respectively. The corresponding figures during the respective period for Northern localities were recorded as 2.16, 2.18, 1.67, 2.44 and 2.61%. These figures in respect of the above mentioned period were noted as 4.03, 3.76, 2.67, 2.12 and 2.48% in southern localities. The total of averages of these localities from June to October were found 3.07, 3.38, 3.48, 2.68 and 2.79%, respectively.

Green/immature grains: Table 7 shows the percentages of green/immature grains as 1.33, 1.00, 0.58, 0.35, and 0.50% in the samples collected during June, July, August, September and October, respectively in Eastern localities of D. I. Khan while 1.31, 0.39, 0.76, 0.83 and 0.84% green / immature grains were recorded in the samples collected from Western localities, 1.56, 0.33, 0.26, 0.38 and 0.44% in Northern localities and 1.33, 0.42, 0.36, 0.33 and 0.06% in Southern localities of D. I. Khan. The average percentage of green/immature grains from June to October were noted as 1.38, 0.54, 0.49, 0.47 and 0.46%, respectively.

Moisture contents: As grains are being living things, they respire release heat and absorb moisture from the environment. The moisture content of samples of stored grains collected from different localities is summarized in Table 8. The results show that moisture content for eastern localities of D. I. Khan were found 4.15, 6.13, 7.30, 7.80 and 7.65%, for western localities 3.26, 5.82, 5.91, 6.48 and 6.86%, for northern localities 4.60, 6.02, 6.61, 7.48 and 7.78%, for southern localities, these values were found 3.54, 5.08, 5.29, 6.31 and 6.83% during June, July, August, September and October, respectively. The average percentage of moisture contents in east, west, north and south localities of D. I. Khan was computed as 6.61, 5.66, 6.41 and 5.41, respectively. Overall average percentage of moisture content on monthly basis was recorded as 3.78, 5.76, 6.27, 7.02 and 7.28 in the months of June, July, August, September and October respectively with total average amount of 6.02%.

Thousand grain mass (TGM) : The TGM values of the grains were determined for each sample of each locality of D. I. Khan. TGM values for four localities are given in Table 9. The results show that TGM values for Eastern localities of D. I. Khan were found 34.54, 35.07, 33.85, 32.15 and 32.06g, for Western localities 38.29, 38.70, 35.67, 34.78 and 34.70g, for Northern localities 38.16, 37.84, 35.83, 35.97 and 39.20g while for Southern localities, these values were recorded 38.14, 36.97, 36.45, 35.27 and 35.46g, during June, July, August, September and October respectively. The average amount of TGM of stored wheat on monthly basis was obtained as 37.28, 37.15, 35.45, 34.54 and 35.36g for June, July, August, September and October, respectively.

Weight loss (Count and Weigh Method) : The total weight losses were calculated by two methods of loss assessment (Count and weigh, TGM) at different stores of different localities in the four directions of D. I. Khan which were figured out as 3.61% by Count and weigh method and 6.53% by TGM. method (Table 10). Monthwise weight losses of stored wheat grain in farmer's stores were calculated (Table 11) by count and weigh method at different localities of four selected directions (East, West, North, South) of D. I. Khan. These weight losses were found 2.37, 3.39, 4.32, 5.83, and 5.19% in Eastern localities, 3.13, 3.68, 4.39, 5.25 and 4.27% in Western localities, 0.64, 1.88, 0.60, 1.30 and 4.54% in Northern localities and 2.94, 4.28, 2.21, 2.59 and 5.20% in Southern localities of D. I. Khan in the samples collected during June, July, August, September & October, respectively. Minimum loss (0.60%) was found in Northern localities in August while maximum loss (5.83%) was found in Eastern localities in September. Quantitative weight losses in the above mentioned localities East, West, North and South) were recorded 4.22, 4.14, 1.79, 4.31 and 3.61%, respectively. The average quantitative loss for the whole areas was obtained as 3.61%.

The losses in stored wheat grain in different localities of four directions of D. I. Khan were determined on the basis of different quality factors which include insect damaged, broken/shriveled, black pointed & green / immature grains. A few insect Spp. i.e., *Tribolium* spp., *Rhyzopertha dominica* and *Trogoderma granarium* were observed during the analysis of wheat samples in the laboratory. *Tribolium* spp, *Rhyzopertha dominica* and *Trogoderma granarium* were found 0.00, 0.30, 0.39; 0.20, 2.58, 25.8; 6.68, 5.37, 50.16;

Khan and Kulachi: Post harvest losses in wheat

Table 1: Number of different insect species/Kg of wheat sample (During June to October, 1999) in different localities of D. I. Khan

Months 1999	Insect Species	Survey Area Localities of D. I. Khan				Mean
		East	West	North	South	
June	<i>Tribolium</i> Spp.	0.00	0.00	0.00	0.00	0.00
	<i>R. dominica</i>	0.00	0.38	0.00	0.82	0.30
	<i>T. granarium</i>	0.00	0.00	0.00	1.55	0.39
July	<i>Tribolium</i> Spp.	0.00	1.19	0.00	1.63	0.70
	<i>R. dominica</i>	0.00	6.25	0.46	3.64	2.58
	<i>T. granarium</i>	0.00	1.88	0.77	16.55	5.80
August	<i>Tribolium</i> Spp.	0.00	16.25	0.00	10.45	6.68
	<i>R. dominica</i>	0.00	11.50	1.23	8.73	5.37
	<i>T. granarium</i>	10.75	7.19	3.08	179.63	50.16
September	<i>Tribolium</i> Spp.	0.00	19.69	0.00	20.36	10.01
	<i>R. dominica</i>	0.00	24.69	4.62	11.09	10.10
	<i>T. granarium</i>	36.75	12.13	14.62	208.73	68.05
October	<i>Tribolium</i> Spp.	0.00	22.38	0.00	32.45	13.70
	<i>R. dominica</i>	0.00	28.69	6.53	20.90	14.03
	<i>T. granarium</i>	103.75	53.13	31.23	257.19	111.33

Table 2: Average Number of insects (per Kg.) recorded in stored wheat at various stores of D. I. Khan District

Sample sites	Months				
	June	July	August	September	October
East	0.00	1.00	2.69	9.18	25.14
West	0.13	2.33	0.74	14.13	26.05
North	0.00	0.31	1.08	5.08	9.44
South	0.59	5.46	49.70	60.05	92.65
Average	0.18	2.28	15.55	22.11	38.52

Table 3: Average amount (g/Kg) of foreign matter recorded in stored wheat at various stores of D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	26.18	27.97	31.90	36.90	37.10
West	16.32	24.70	17.38	28.42	29.21
North	24.12	20.95	18.80	26.22	29.78
South	35.70	36.55	42.94	47.60	46.42
Average	25.58	27.54	27.26	34.78	35.64

Table 4: Average amount (%) of insect damaged grains recorded in stored wheat at various stores of D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	0.16	1.37	2.66	5.09	6.50
West	0.08	0.14	0.71	0.50	3.90
North	0.05	0.08	0.90	1.20	1.41
South	0.00	0.73	1.64	5.15	6.63
Average	0.07	0.32	1.48	3.23	4.54

Table 5: Average amount (%) of black pointed grains recorded in stored wheat at various stores of D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	0.50	1.67	1.75	0.22	0.13
West	0.16	0.24	0.40	0.37	0.52
North	0.46	0.56	0.74	0.70	0.92
South	0.27	0.64	0.82	0.51	0.64
Average	0.35	0.78	0.93	0.45	0.55

Table 6: Average amount (%) of broken/shrinkled grains recorded in stored wheat at various stores of D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	4.17	4.67	5.67	3.58	3.33
West	1.90	2.90	3.91	2.56	2.75
North	2.16	2.18	1.67	2.44	2.61
South	4.03	3.76	2.67	2.12	2.48
Average	3.07	3.38	3.48	2.68	2.79

Table 7: Average amount (%) of green/immature grains recorded in stored wheat at various stores of D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	1.33	1.00	0.58	0.35	0.50
West	1.31	0.39	0.76	0.83	0.84
North	1.56	0.33	0.26	0.38	0.44
South	1.33	0.42	0.36	0.33	0.06
Average	1.38	0.54	0.49	0.47	0.46

Table 8: Average amount (%) of moisture contents recorded in stored wheat at various stores in D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	4.15	6.13	7.30	7.80	7.65
West	3.26	5.82	5.19	6.48	6.86
North	4.16	6.02	6.61	7.48	7.78
South	3.54	5.08	5.29	6.31	6.83
Average	3.78	5.76	6.27	7.02	7.28

Table 9: Values of TGM (g) of wheat recorded in different stores in D. I. Khan

Sample sites	Months				
	June	July	August	September	October
East	34.54	35.07	33.85	32.15	32.06
West	38.29	38.70	35.67	34.78	34.70
North	38.16	37.84	35.83	35.97	38.20
South	38.14	36.97	36.45	35.27	35.46
Average	37.28	37.15	35.45	34.54	35.36

Table 10: Percent weight losses of stored wheat (By "Count and Weigh" Method) in D. I. Khan

Method	Months				
	East	West	North	South	Average
Count & weigh	4.22	3.39	4.32	5.83	3.40
TGM	7.18	9.38	2.52	7.02	6.53

Table 11: Percent weight losses of stored wheat (By "Count and Weigh" Method) in D. I. Khan during 1999

Sample sites	Months				
	June	July	August	September	October
East	2.37	3.39	4.32	5.83	5.19
West	3.13	3.68	4.39	5.25	4.27
North	0.64	1.88	0.60	1.30	4.54
South	2.94	4.28	2.21	2.59	5.20
Average	2.27	3.30	2.88	3.74	4.80

10.01, 10.10, 68.05; 14.03, 111.33 in Wheat samples collected during June to October, respectively. Results of present studies indicated that insect infestation increased continuously from June to October. In the month of

Khan and Kulachi: Post harvest losses in wheat

June, the insects infestation was very low (0.67%), but it increased gradually with the passage of time and reached to 34.50% in the month of October. These results are in agreement with those obtained by Simwat and Chahal (1984) who reported that adult population of *Tribolium* spp. and *S. oryzae* increased from 2.8 to 6.37% during 6 months storage period. Khan (1986) recorded 18-39% increase in individuals of *Tribolium* spp., *R. dominica*, *Sitophilus* spp. and *O. surinamensis*. Yadav and Nathan (1980), Al. Saffar and Kansouh (1981), Ahmad (1983) reported *Tribolium* spp., *Rhyzopertha dominica* and *Trogoderma granarium* in wheat storage which confirm our results. The quantitative losses in wheat samples collected from D. I. Khan showed the average amount of foreign matter which was 2.56 to 3.56% with an average of 3.02%. Farmanullah (1985) quoted 2-33% quality loss in stores of public sector. In the present studies 0.61 and 3.08% black pointed and Broken/shriveled grains were recorded, respectively during five months storage period. Khan (1986) recorded 10.65 and 11.00% moisture content of the grain, respectively. Average amount of TGM (g) was obtained as 33.80g. Mohammad (1986) and Khan (1986) recorded 29.98 and 31.80g, respectively. Two methods of loss assessment i.e., TGM and C.W were adopted to estimate the quantitative and qualitative losses of wheat grains, which gave 6.53 and 3.40% weight loss, respectively. Mohammad (1986) reported average losses in wheat as 6.33 and 2.01%, 9.41 and 2.06 by TGM and C.W method during 6 and 7 months storage period respectively. These results are somewhat in agreement to our findings. Chaudry (1980) reported 6.46%, Girish *et al.* (1975) 2.9%. Ahmad and Afzal (1984) recorded 22.7% loss in stored wheat in Pakistan. Pingale (1964) determined 83% loss during 12 months storage period. Hamidullah (1967) obtained 17.5%. Koura and Holfany (1974) reported 24.2 - 47.8% losses in silos / Bins.

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