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STORABILITY OF WHEAT HARVESTED BY DIFFERENT METHODS

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Abstract: Wheat was harvested through combine harvester or thresher. Labor shortage and timely completion of harvesting operation attracts farmers to harvest wheat crop through combine harvester. This facilitates to make land available for next crop sowing operation. The damage loss of wheat grain is the main disadvantage of harvesting machinery utilization. The research was carried out on six months storage of wheat obtained by combine harvester and thresher considering mechanically damaged seeds; percent weight loss, moisture content, germination percent, vigor index, pest population and percent grain damage. Wheat obtained from thresher has minimum mechanical damage (1.5 to 2.7%) and moisture content (7.70 to 7.83%) at the time of harvest as well as minimum storage loss (1.13 to 2.57%), pest population (2.78 to 4.17) and damage percent due to pest infestation (10.83 to 19.94 %) after six months of storage. Threshed grain has higher germination percentage (94.10 to 95.22%) and vigor index (212.44 to 222.98) after six months of storage.

Key words: *wheat, storage, harvesting, pest, germination, vigor*

INTRODUCTION

Wheat is an important cereal crop in India. Wheat when stored is often attacked by number of pests, viz., lesser grain borer, angoumois grain moth, khapra beetle, rice weevil etc. (Baloch, 1999)[2]. Traditionally, the wheat crop is harvested by sickle and

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prepared by thresher is a common practice. Now a day, farmers are using combine harvester for harvesting wheat crop and the use of combine harvester is increasing day by day on account of labors problem and convenience of time saving. During harvesting of wheat by combine harvester, it was observed that considerable wheat grains are damaged due to improper alignment and malfunctioning of machine parts. Moreover, the harvesting by combine harvester is generally having a slightly higher moisture content to prevent shattering losses. The mechanically damage seeds or higher moisture content encourage the infestation of pests. Very little information is available on pest incidence in storage of wheat harvested by combine harvester. Hence, it is important to find out the cause of damage of wheat crop harvested by combine harvester. Looking to the requirement, comparative study was carried out for storage of wheat obtained by thresher and combine harvester during the year 2007, 2008 and 2009.

MATERIAL AND METHODS

Wheat prepared from three different combine harvester and thresher was procured from different farmer's fields and stored in gunny bags at room temperature in laboratory. Experiment was carried out in CRD design with four replications. Bimonthly observations were recorded to find out entomological, and physical changes occurred during storage. The observations were recorded from wheat samples of 500 g.

Percent Mechanical Damage

A mechanically damage grain was sorted out and counted from 100 randomly selected grains per sample from each replication and worked out percent mechanical damage grain.

Moisture content

The moisture content was determined by an oven method, which is a direct method. The grain was weighed and dried, then weighed again according to standard procedures. The moisture content was calculated using the moisture content equations.

Grain moisture content was expressed as a percentage of moisture based on wet weight (wet basis).

$$M = \frac{w - d}{w} \times 100 \quad (1)$$

Where:

w [kg] - wet weight,

d [kg] - dry weight,

M [%] - moisture content.

A representative sample was obtained to provide a useful moisture content evaluation.

Weight loss

Initial weight of wheat at storage time W_a and weight of wheat after six months d_b was noted and calculated as per following formula.

$$\% \text{Weight loss} = \frac{w_a - d_b}{w_a} \times 100 \quad (2)$$

Where:

w_a [kg]- initial weight of wheat,

d_b [kg]- weight of wheat after six months.

Percent Germination

One hundred grain of each stored wheat sample were placed and soaked on blotting paper in the Petri dish. Each treatment was repeated eight times. After a period of 72 hours, number of germinated seeds in each Petri dish was counted. The experiment was conducted under Completely Randomized Design (CRD). The initial germination percentage of respective sample was calculated by using the following formula.

$$\text{Germination \%age} = \frac{\text{No. of germinated seed}}{\text{Total No. of seed soaked in each petridish}} \times 100 \quad (3)$$

Same procedure was followed after a period of three months to record the final germination % age for grains of wheat.

Determination of the infestation % age

Initial and final infestation % age in each treatment was calculated by counting the number of un-germinated seeds in each replication of the respective treatment. Then from mean values, initial and final infestation % age in the respective sample was determined by using the formula: Same procedure was followed after a period of three months.

Germination percent was determined by taking randomly sample of 10 grain from each replication. The seed were kept in a 20 cm sterilized Petri dishes fitted with blotting paper soaked with distilled water and kept at room temp. Number of germinated seed were counted and recorded for germination percent.

Vigor Index

Vigor index was determined by percent germination of seed multiply root length (cm) of germinated seed after six days.

Pest population

A number of adult of pest was counted from each randomly selected sample from each replication and recorded for pest population per sample.

Percent Damage grain

A damage grain by pest was counted from 100 randomly selected grains from each samples and recorded percent grain damage.

RESULTS AND DISCUSSION

The data regarding percent mechanically damaged grains, initial moisture content and moisture content after six months storage, and percent weight loss after six months storage are given in Tab. 1. The pooled data of three years indicated that the average mechanically damaged grain was found significant in different treatments. The mechanically damaged percent of grain was found more (3.58 to 8.36 %) in wheat harvested by combine harvester treatments as compared to thresher treatments (1.59 to 2.70%).

Table 1. Percent mechanically damaged grain, moisture content and weight loss during storage

Sr. No.	Treatments	mechanically damaged grain at storage time [%]	Moisture content [%]		Weight loss of wheat after six months [%]
			at storage time	after six months	
1	(i)Combine harvester wheat I	10.91* (3.58)**	8.13	7.92	3.37
2	(ii) Combine harvester wheat II	13.93 (5.80)	7.93	7.65	4.50
3	(iii)Combine harvester wheat III	16.81 (8.36)	8.08	7.86	5.15
4	(iv) Thresher wheat I	7.24 (1.59)	7.78	7.69	1.13
5	(v) Thresher wheat II	8.61 (2.24)	7.70	7.58	2.24
6	(vi)) Thresher wheat III	9.46 (2.70)	7.83	7.77	2.57
	S.Em. for T	0.55	0.06	0.08	0.15
	CD at 5% for T	1.56	0.17	NS	0.42
	S.Em. for Y	0.37	0.04	0.04	0.09
	CD at 5% for Y	1.05	0.11	0.11	0.25
	S.Em. for TXY	0.91	0.09	0.09	0.22
	CD at 5% for TXY	NS	NS	0.026	NS
	CV%	16.32	2.32	2.35	13.97

* Arc sin transformation

** Figures in parenthesis are retransformed values

The initial moisture content at storage time was found significantly higher (7.93 to 8.13 %) in combine harvester wheat as compared to (7.70 to 7.83%) in thresher treatment. The moisture content after six months was found non significant. The percent weight loss in wheat after six months of storage was found significantly maximum in combine harvester treatment as 3.37 to 5.15% as compared to minimum in thresher

treatment as 1.13 to 2.57%. This may be due to moisture content decrease and pest damage.

It was concluded that combine harvester results significantly higher mechanical damage to wheat grain as well as higher moisture content at the time of harvest.

The data regarding initial and after six months storage period, wheat germination percentage and vigor index are given Table 2. The pool data of three years showed that germination percent was found significant at storage time. The germination percent was higher (94.10 to 95.22%) in thresher wheat as compared to combine harvester wheat (92.42 to 93.22%). The germination percent was found significant after six months of storage. The germination percent was higher (73.32 to 80.00%) in thresher wheat as compared to combine harvester wheat (59.18 to 66.99%), after six months of storage. Germination percent was decreased after six months of storage, which may be due to pest infestation. Payne T.S. (2002) [8] reported the reduction in germination due to attack of pest. Results were supported by Mahmood *et al.* 2011; Manickavasagan *et al.* 2007 and Al-Yahya 2001 [5,6,7].

Table 2. Germination and vigour index of wheat

Sr. No.	Treatments	Germination [%]		Vigor Index	
		Initial at the storage time	After six months storage period	Initial at the storage time	After six months storage period
1	Combine harvester wheat I	74.91* (93.22)**	54.93* (66.99)**	280.98	191.01
2	Combine harvester wheat II	74.13 (92.52)	52.95 (63.70)	278.47	187.19
3	Combine harvester wheat III	74.02 (92.42)	50.29 (59.18)	277.75	171.90
4	Thresher wheat I	77.38 (95.22)	63.44 (80.00)	290.83	222.98
5	Thresher wheat II	75.94 (94.10)	60.24 (75.36)	278.61	219.03
6	Thresher wheat III	76.67 (94.68)	58.90 (73.32)	284.95	212.44
	<i>S.Em. for T</i>	0.87	0.70	5.72	3.68
	<i>CD at 5% for T</i>	2.47	1.98	NS	10.43
	<i>S.Em. for Y</i>	0.56	0.45	3.93	2.52
	<i>CD at 5% for Y</i>	1.58	1.27	11.11	7.13
	<i>S.Em. for TXY</i>	1.37	1.11	9.62	6.16
	<i>CD at 5% for T x Y</i>	NS	NS	NS	NS
	<i>CV%</i>	3.63	3.90	6.82	6.14

* Arcsin transformation

** Figure in parenthesis are retransform value

The vigor index was found non-significant at storage time and it was significant after six months of storage. The vigor index was higher (212.44 to 222.98) in thresher wheat as compared to combine harvester wheat (171.90 to 191.01) after six months of storage.

From the results in the table, it can be seen that percentage germination decreased when mechanical grain damage increased. The percentage germination was inversely related to the moisture content. Vigor index at the harvest time is non-significant but after six months storage period it was significant with higher in threshed grain with lower moisture content.

The data regarding pest population and grain damage after four months and six months of storage period are given Table 3. The pool data of three years revealed that population buildup was found significant after four months of storage. The pest population (number of adult per sample) was found comparatively higher 2.81 to 6.16 and lower 1.32 to 2.32 in combine harvester and thresher wheat, respectively, after four months of storage. The population buildup was also found significant after six months of storage. The pest population (number of adult per sample) was found comparatively higher 5.40 to 7.62 and lower 2.78 to 4.17 in combine harvester and thresher wheat, respectively, after six months of storage.

Table. 3 Pest population (Rust red flour beetle) and grain damage of wheat

Sr. No.	Treatments	Average number of adult/sample		Grain damage [%]	
		after 4 months	after 6 months	after 4 months	after 6 months
1	Combine harvester wheat I	1.82* (2.81)**	2.43* (5.40)**	15.65# (7.28)##	31.53# (27.35)##
2	Combine harvester wheat II	2.24 (4.52)	2.59 (6.21)	20.45 (12.21)	34.65 (32.33)
3	Combine harvester wheat III	2.58 (6.16)	2.85 (7.62)	25.02 (17.89)	41.25 (43.47)
4	Thresher wheat I	1.35 (1.32)	1.81 (2.78)	9.77 (2.88)	19.21 (10.83)
5	Thresher wheat II	1.57 (1.96)	2.02 (3.58)	11.93 (4.27)	24.13 (16.71)
6	Thresher wheat III	1.68 (2.32)	2.16 (4.17)	13.21 (5.22)	26.52 (19.94)
	<i>S.Em. for T</i>	0.08	0.09	0.57	0.71
	<i>CD at 5% for T</i>	0.22	0.24	1.61	2.00
	<i>S.Em. for Y</i>	0.05	0.06	0.37	0.44
	<i>CD at 5% for Y</i>	0.14	0.17	1.04	1.24
	<i>S.Em. for TXY</i>	0.12	0.14	0.91	1.07
	<i>CD at 5% for TXY</i>	NS	NS	NS	NS
	<i>CV%</i>	13.29	12.37	11.32	7.24

* $\sqrt{X+0.5}$ transformation value

** figure in parenthesis are retransformed value

arcsin $\sqrt{\text{percentage}}$ transformation value

figure in parenthesis are retransformed value

The data showed that damaged percent of grain due to pest infestation was found significant after four months of storage. The damage percent was found higher (7.28 to 17.89 %) and lower (2.88 to 5.22 %) in combine harvester and thresher wheat, respectively, after four months of storage.

The damaged percent of grain due to pest infestation was found significant, after six months of storage. The damage percent was found higher (27.35 to 43.47 %) and lower (10.83 to 19.94 %) in combine harvester and thresher wheat, respectively, after six months of storage.

The pest population showed highly significant but negative correlation with germination percentage at both initial and after six months of storage of experiment.

From the above mentioned results it can be concluded that wheat harvested through combine harvester results with higher mechanical damage which are responsible for higher pest population. These pests are responsible for the reduction in germination of wheat grains. These findings are in line with those of Zachavatkin (1941) [9], who reported that pest population affects the germination of the grains directly through damaging the growing tips. The present studies can be compared with those of Ashfaq *et al.* (1995) [1] who revealed 15-20 % germination loss in grains of wheat, maize and mung collected from Mansehra District due to pests after three months of storage. Similarly negative correlation between pest population and the germination was reported by Ashfaq and Wahla (1989) [2]. Bashir *et al.*, (2009)[3] also revealed that with the increase in pest population the germination of the seeds reduces. Based on these results it can be concluded that pests are mainly responsible for the germination loss in the stored grains.

CONCLUSIONS

It was concluded that combine harvester results significantly higher mechanical damage to wheat grain as well as higher moisture content at the time of harvest. The percentage germination decreased when mechanical grain damage increased. The percentage germination was inversely related to the moisture content. Vigor index at the harvest time is non-significant but after six months storage period it was significant with higher in threshed grain with lower moisture content. The pest population showed highly significant but negative correlation with germination percentage at both initial and after six months of storage of experiment. The pests were mainly responsible for the germination loss in the stored grains.

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SPOSOBNOST ZA SKLADIŠTENJE PŠENICE POSLE RAZLIČITIH METODA ŽETVE

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Ključne reči: *pšenica, skladištenje, žetva, štetočina, klijanje, vigor*

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