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Product Quality and Safety

Effect of different storage materials on the seed temperature, seed moisture content and germination of wheat under farmer's field condition of Kailali district, Nepal

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Abstract. *A study was conducted at four Village Development Committees (Masuriya, Udashipur, Basauti and Pahalmanpur) of Kailali district, Far western Region, Nepal in 2016/17 to find out the effect of different storage materials on the seed moisture content and germination percentage of wheat. Seeds of wheat were packed using five storage materials (metal seed bin, earthen pot, purdue improved crop storage / Pics/ bag, gunny bag and super grain bag). The stored seed samples were drawn at three-month intervals starting from May 2016 to January 2017. The experiment was arranged in Randomized Complete Block Design (RCBD) in four replications. The results of analysis of variance revealed that the effect of storage materials was significant (P≤0.05) on seed moisture content and seed germination of wheat. After nine months of storage, the seeds stored in Pics bag recorded the lowest moisture (13.3%) and temperature (26.4°C), and the highest germination percentage (91.75%). The lowest quality performance (high moisture and temperature, low germination) of stored seeds was observed in an earthen pot. From the results obtained, it was concluded that wheat seed could be stored for a long time in Pics bag without deteriorating its quality parameters.*

Keywords: germination, temperature, moisture, storage materials, wheat seed

Introduction

Wheat is the third important cereal crop of Nepal after rice and maize both in area and production. At present, wheat sown area is about 735850ha, with a total production of nearly 1879191t (CBS, 2018). The productivity has steadily increased from 2.23 t/ha (2007/08) to 2.55 t/ha (2016/17) in the last ten years. Even though wheat is the third important crop of Nepal, it is the second important for Kailali district. It is cultivated in 34530ha and the average productivity is 2.95 t/ha (MoALD, 2018). There are several technical constraints associated with the low productivity of wheat in Nepal. Poor crop stand due to low quality seed is one of the major causes of the low productivity of wheat in Nepal (Mudbari et al., 1997). Hence, to maintain quality of seed, seed should be scientifically stored in a storage to have good seed viability.

Grain storage occupies a vital place in the economies of developed and developing countries (Ellis et al., 1992). Proper grain storage in developing countries plays an important role in the maintenance of their economy. Most of the researchers noted reduction in germination percentage from 5.2-10.7%, if wheat seed is sown immediately after harvesting. Singh et al. (2000) observed 5-17% reduction in seed germination when grain was stored approximately for five months. They further noted that, when seed stored in concrete bins, the seed germination was higher against metal bins. However, Sinha and Sharma (2004) established maximum changes in wheat quality when stored in jute bags compared to metal bins. The fluctuations in temperature, dampness during storage and its longevity results in significant nutrient losses (Shah et al., 2002). Prolonged storage period with high seed moisture percentage also causes reduction in germination, seedling vigor, accelerates seed aging, increases germination time, electrical conductivity, insect infestation and finally loss in seed weight (Mersal et al., 2006).

A large number of Nepalese farmers are storing wheat seed in rainy season in ambient condition, when there is high temperature and high rainfall, which accelerates quality degradation of stored seed in such condition. Due to high temperature and high rainfall, most of the farmers are sowing poor quality seed, which may be one of the main causes of low productivity of wheat in Nepal (Thapa, 2005). For instance, a survey conducted by Seed Quality Control Centre (SQCC) of Nepal identified germination quality status of farmers' saved wheat seed which showed that only 36% samples were within standard, whereas 64% samples were below standard (Shrestha and Mishra, 2001). Keeping in view these facts, this study was carried out to investigate the changes of temperature, moisture content and germination capacity of wheat seed during storage under different storage materials.

Material and methods

The present study was carried out to investigate the effect of different storage materials on the seed moisture

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and germination capacity of wheat seed. The experiment was conducted in four Village Development Committees (VDC) (Masuriya, Udashipur, Pahalmanpur and Basauti) of Kailali District, Nepal during 2016-17. Grains of wheat were packed in five selected storage materials viz: metal bin, earthen pot, purdue improved crop storage (Pics) bag, gunny bag and super grain bag and were placed on godown for nine months from May 2016 to January 2017. In every VDC, each treatment was replicated twice in Randomized Complete Block Design. Each storage materials contained 50kg of wheat.

The ambient temperature, seed moisture and germination percentage were monitored and recorded every 3 months during the storage period of 9 months. Wile 65 grain moisture meter was used for seed moisture and temperature determination.

For measurement of germination percentage, 100 randomly selected grains were placed on Petri dish lined with filter paper and placed into a germination chamber for 3 days maintained at a constant temperature of 25°C. The filter paper was moistened every day with distill water to facilitate germination. The number of germinated seeds after 3 days was recorded as the germination percentage. All recorded data were analyzed through GENSTAT statistical package and treatment means were compared using least significant difference (LSD) test at P≤0.05.

Results and discussion

Seed moisture percentage

Seed moisture content is the most important factor that regulates the longevity of seed in storage. Higher moisture content in the seed enhances seed deterioration, which reduces the quality of seed. The results revealed that the effect of different storage materials on seed moisture was significantly differed at different storage period (Table 1). Among the different treatments, Pics bag followed by super grain bag had recorded the lowest seed moisture during storage period. While, the highest seed moisture was observed from earthen pot (farmer's practice). After nine months of storage, Pics bag recorded 13.3% seed moisture followed by 13.9% of super grain bag, 14.1% of metal seed bin, 14.3% of gunny bag and highest 14.7% of earthen pot. All improved seed storage materials viz; Pics bag, super grain bag, metal seed bin and gunny bag recorded the lowest seed moisture throughout the storage period compared to farmers' practice (earthen pot).

The seeds of earthen pots came to the contact with air and their moisture contents were increased more than the other storage materials from initial moisture content. As tin container and plastic pots were more or less airtight and the seeds of these containers could not come to the contact with the ambient room air therefore, resulting in lower change in their moisture contents. Moisture content of seed has been increased gradually with increase of storage time. Similar result was found by Miah et al. (1992), Uddin (2005) and Quais et al. (2013).

Table 1. Effects of storage materials on seed moisture percentage during storage period

Storage materials	Seed moisture, %		
	After 3 months	After 6 months	After 9 months
Pics bag	9.9	11.8	13.3
Super grain bag	10.4	12.4	13.9
Metal seed bin	10.9	12.6	14.1
Gunny bag	11.0	12.8	14.3
Earthen pot	11.3	13.2	14.7
F-Test	**	**	**
LSD (0.05)	0.37	0.15	0.2
CV, %	3.3	1.1	1.0
Grand mean	10.7	12.6	14.1

** Denotes significant at 1% level of significance

Seed germination percentage

Germination is the most important function of a seed as an indicator of its viability and worthiness as seed (Akter et al. 2014). Germination of wheat seeds was found to be affected by storage materials during the storage period (Adly et al., 2011 and Chattha et al., 2015). The results of the present study showed that germination percentage of wheat seeds was found decreased with the increase of storage time (Table 2). Seed stored in Pics bag retained the highest seed germination for longer time than in an earthen pot. The germination percentage of the seeds, stored in an earthen pot, gunny bag, metal seed bin, super grain bag and Pics bag decreased slightly during the storage period as follows: from 85.25 to 79.88%, from 84.62 to 82.75 %, from 88.12 to 86.25 %, from 92.12 to 90.38% and from 93.75 to 91.75%, respectively. The results of the present study confirmed the data of Chattha et al. (2012), who reported that germination capacity of wheat grains remained relatively high when they were stored in different types of packing. Germination percentage decrease was closely related with the high moisture contents of the seeds. Due to high moisture content of seeds in earthen pots, germination percentage decreased more rapidly than tin container and plastic pots stored seeds with lower moisture contents. These results were consistent with the findings of Akter et al. (2014).

Table 2. Effects of storage materials on seed germination percentage during storage period

Storage materials	Seed germination, %		
	After 3 months	After 6 months	After 9 months
Pics bag	93.75	92.8	91.75
Super grain bag	92.12	91.4	90.38
Metal seed bin	88.12	87.2	86.25
Gunny bag	84.62	85.5	82.75
Earthen pot	85.25	83.9	79.88
F-Test	**	**	**
LSD (0.05)	2.72	2.48	2.54
CV, %	2.9	2.7	2.8
Grand Mean	88.78	88.2	86.2

** Denotes significant at 1 % level of significance

Interaction effect of different storage materials and locations showed non-significant (P≤0.05) variation on the germination percentage of wheat seed after nine months of storage period (Table 3). However, in Masuriya, Pics bag recorded the highest germination percentage (93.5%) followed by Udashaipur (92.0%), Pahalmanpur (91.5%) and Basauti (90.0%). The lowest germination percentage of wheat seed (78.0%) was obtained from an earthen pot at Udashipur after nine months of storage. Overall, Pics bag performed well, while earthen pot recorded the lowest germination percentage of wheat in all locations.

Table 3. Germination percentage of wheat seed after 9 months of storage at four locations under different storage materials

Storage materials	Germination (%) after 9 months of storage			
	Masuriya	Udashipur	Pahalmanpur	Basauti
Pics bag	93.5	92.0	91.5	90.0
Super grain bag	89.5	90.5	90.5	91.0
Metal seed bin	89.5	86.5	86.5	82.5
Gunny bag	81.0	83.0	83.5	83.5
Earthen pot	78.5	78.0	79.5	83.5
F-Test	ns			
LSD (0.05)				
CV, %	2.8			
Grand Mean	86.2			

*ns denotes non significant

Wheat grain temperature

Analysis of variance indicated significant (P<0.05) differences in grain temperature affected by storage materials. The data collected on the temperature of wheat grain stored in different types of packing materials are presented in Figure 1. The results indicated that the maximum grain temperature 30°C was recorded from grain stored in earthen pot. Whereas, the lowest grain temperature 26.4°C was from grain stored in Pics bag after 9 months of storage period. The grain temperatures of earthen pot, gunny bag and metal seed bin were slightly higher than that in the Pics bag and super grain bag. This may be due to high moisture content, higher rate of respiration of grain and no air movement through the earthen pot and metal bin. Kaddus and Douglass (1992) reported that the temperature of the wheat grains inside the structures increased slowly during the experiment. Seeds lost their viability with the increase of temperature because of almost no air movement through the metal and earthen bins.

Conclusion

Based on the grain temperature, seed moisture and seed germination percentage, purdue improved crop storage (Pics) bag is the best storage material followed by super grain bag and metal seed bin for storing of wheat seed in safe condition

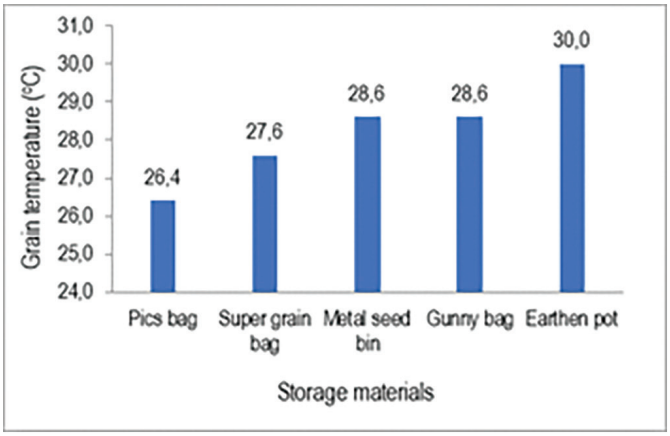

Figure 1. Wheat grain temperature after nine months of storage under different storage materials

for a long time. However, super grain bag and metal seed bin could be used instead of earthen pot for satisfactory storage. Earthen pot could not help much in improving the post harvest quality of wheat.

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