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Short Communication

Influence of Packaging and Storage Duration on Seed Quality of Wheat (*Triticum aestivum* L.) Varieties

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Wheat (*Triticum aestivum* L.) is one of the most important cereal crops cultivated globally, covering about 224.49 million hectares with a production of 792.4 million tons (FAO, 2024). In India, wheat occupies nearly 32 million hectares and produces around 112 million tons, ranking second after rice. Seed quality plays a crucial role in achieving higher productivity and profitability. However, as a living entity, seed quality deteriorates gradually over time due to biochemical and physiological changes, particularly when storage conditions are unfavorable. Environmental factors such as temperature, humidity, and packaging material significantly influence seed longevity and vigor (Thakur *et al.*, 2021; Kibar and Yucesan, 2021). Proper packaging helps maintain seed quality by minimizing fluctuations in temperature and moisture. High-Density Polyethylene (HDPE) bags are known for their moisture-resistant properties and have shown better performance than traditional gunny bags in maintaining seed viability (Bhanu *et al.,* 2021; Badwai *et al.*, 2017; Shafat *et al.*, 2025; Selemani *et al.,* 2025). Khandai *et al.* (2025) showed that super grain bags reduces post harvest losses and enhances seed quality in rice. Lentil and paddy seeds stored in super grain bags maintained high germination rates and grain milling quality in Bihar (Kumar *et al.,* 2020).

Therefore, the present study was undertaken to evaluate the effect of packaging material and storage period on seed quality parameters of wheat varieties WH 1105 and WH 1124 under the conditions of Himachal Pradesh. For this study, certified seeds of wheat varieties WH 1105 and WH 1124 were stored for a period of 18 months, from April 2019 to November 2020, in two types of packaging materials gunny bags and HDPE bags under ambient conditions at the Department of Seed Science and Technology, CSKHPKV, Palampur. The experiment was laid out in a Completely Randomized Design (CRD) factorial with four replications. Observations were recorded at monthly intervals for various seed quality parameters such as germination percentage, first count, seedling vigor index I and II, field emergence, final plant stand, moisture content, and time taken for 2 mm radical emergence. Germination and vigor indices were calculated as per ISTA (1999) and Abdul-Baki and Anderson (1973). Field emergence and final plant stand were assessed using 400 seeds per treatment in well-prepared field plots, and moisture content was determined using a non-destructive moisture meter (PM 600).

Significant varietal differences were observed in all seed quality parameters (Table 1). WH 1124 exhibited higher

germination (93.68%), vigor index-I (2137.05), vigor index-II (1366.88), and field emergence (84%) compared to WH 1105. WH 1124 also maintained lower moisture content (14.34%) and showed faster radical emergence (9.81 hours). These results indicate that WH 1124 possesses better seed storability and physiological strength than WH 1105, which is consistent with the findings of Rahouma *et al.,* (2021), who reported varietal variation in seed storability and vigor among barley genotypes.

Table 1: Main effects of variety, packaging material and storage period on seed quality parameters in wheat

Treatment	First Count (%)	Germination (%)	Seed Vigour index -I (G% × Seedling length)	Seed Vigour Index - II (G% × Seedling dry wt.)	Field Emergence (%)	Final Plant Stand (%)	Moisture Content (%)	Time to 2 mm Radicle (h)
Variety (V)								
V1 (WH 1105)	90.05 (71.85)	90.21 (72.02)	1919.50	1200.43	79.62 (63.73)	79.62 (63.73)	14.43	9.93
V2 (WH 1124)	93.52 (75.35)	93.68 (75.52)	2137.05	1366.88	84.00 (66.77)	84.00 (66.77)	14.34	9.81
Packaging (P)								
P1 (Gunny bag)	90.89 (72.79)	91.07 (72.95)	1993.54	1267.91	80.46 (64.29)	80.46 (64.29)	14.49	9.96
P2 (HDPE bag)	92.68 (74.43)	92.82 (74.59)	2063.01	1299.39	83.17 (66.21)	83.17 (66.21)	14.29	9.78
Storage period (S)								
S0	94.00 (75.85)	94.06 (75.92)	2113.48	1337.42	88.38 (70.06)	88.38 (70.06)	7.76	9.65
S6	93.19 (74.93)	93.19 (74.93)	2083.60	1314.73	–	–	14.54	10.09
S12	92.19 (73.82)	92.44 (74.09)	2055.35	1289.27	–	–	–	–
S18	85.69 (68.00)	86.06 (68.34)	1751.86	1140.81	–	–	–	–
CD (P=0.05)	0.43	0.44	9.56	6.92	0.36	0.36	0.038	0.036

The type of packaging material also had a significant influence on seed quality. Seeds stored in HDPE bags maintained superior quality over those stored in gunny bags. HDPE bags recorded higher germination (92.82%), vigor index-I (2063.01), and vigor index-II (1299.39), while seeds stored in gunny bags showed comparatively lower values. The seeds in HDPE bags also exhibited reduced moisture absorption (14.29%) and slower deterioration. These results confirm the superiority of HDPE bags in maintaining seed quality, as also reported by Badwai *et al.,* (2017) and Siedy *et al.* (2020), who found that polyethylene packaging effectively reduced moisture uptake and preserved seed viability during long-term storage.

Seed quality parameters declined gradually with the advancement of the storage period. Germination percentage decreased from 94% initially to 86.06% after 18 months of storage. Seedling vigor indices and field emergence followed a similar declining trend, while moisture content increased to 14.54%, and the time taken for radical emergence extended to 10.09 hours. Despite this deterioration, germination remained above the minimum standards prescribed by the Indian Minimum Seed Certification Standards (IMSCS), indicating that the wheat varieties retained acceptable viability and vigor for up to 18 months. The decline in seed quality with prolonged storage may be attributed to degradation of cellular membranes, enzymes, and nucleic acids, leading to loss of metabolic efficiency (Roberts, 1972).

Interaction effects among variety, packaging material, and storage period were also significant. The variety ×

packaging interaction (Table 2) revealed that WH 1124 stored in HDPE bags recorded the highest first count (90.75%), germination (91.50%), vigor index-I (2063.30), vigor index-II (1294.75), and field emergence (79.25%). Similarly, the variety × storage period interaction indicated that WH 1124 retained higher germination and vigor even after 18 months of storage, while WH 1105 deteriorated more rapidly. The packaging × storage interaction showed that HDPE packaging significantly reduced the rate of deterioration and moisture gain compared to gunny bags. The three-way interaction among variety, packaging, and storage period confirmed that the combination of WH 1124 stored in HDPE bags for 18 months recorded the highest values for all seed quality parameters.

Table 2: Interaction effects of variety and packaging on seed quality parameters in wheat

Interaction	First Count (%)	Germination (%)	Seed Vigour Index I	Seed Vigour Index -II	Field Emergence (%)	Final Plant Stand (%)
V1P1	88.74 (70.74)	88.93 (72.02)	1875.06	1179.19	78.58 (63.01)	78.58 (63.01)
V1P2	93.05 (73.01)	91.49 (75.52)	1963.95	1221.67	80.67 (64.45)	80.67 (64.45)
V2P1	91.37 (74.84)	93.21 (72.95)	2112.02	1356.63	82.33 (65.57)	82.33 (65.57)
V2P2	93.99 (75.85)	94.16 (74.59)	2162.08	1377.12	85.67 (67.96)	85.67 (67.96)
CD (P=0.05)	0.20	0.20	4.38	3.18	0.42	0.42

V_1 - WH 1105;V_2-WH 1124;P1 - Gunny bag; P2 - HDPE bag; S0 – initial month of storage, S6 – 6 months of storage; S12 – 12 months of storage; S18 – 18 months of storage.Figures in parenthesis are arcsine transformed value.

From this study, it can be concluded that both packaging material and storage period have a significant impact on the maintenance of seed quality in wheat. Among the two varieties tested, WH 1124 exhibited better storability and maintained higher germination, vigor, and field emergence than WH 1105. HDPE bags proved to be superior to gunny bags in preserving seed quality by minimizing moisture absorption and delaying the onset of deterioration. Although seed quality declined with an increase in storage duration, germination and vigor remained within acceptable limits even after 18 months of storage. The combination of WH 1124 stored in HDPE bags performed the best across all parameters, suggesting that HDPE packaging can be recommended for long-term storage of wheat seed up to 18 months without compromising quality.

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Authors Contribution

KCD, RK, RKK – Conceputilzation, Data Analysis, Reviweing of manuscript, AJ & AT – Writting and reviweing of manuacript.

Conflict of interest

None

Declaration

The authors declare no conflict of interest.

Generative AI or AI Assisted Technolgies use in manuscript prepration

No

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