RESEARCH ARTICLE

Assessment of wheat varieties' seed quality parameters under accelerated ageing: implications for storability and vigour

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Using accelerated ageing, this study sought to assess the seed quality parameters of four wheat types (VL-802, VL-829, VL-892, and UP-1109). For 15, 30, and 45 days, seeds were exposed to controlled degradation at 45°C and 100% relative humidity in addition to a control group. To evaluate initial count, standard germination, root and shoot length, fresh and dried weights, and moisture content, laboratory studies were carried out. The findings showed that there were notable variations in seed quality metrics between cultivars and aging times. VL-892 established itself as a dependable stored under ambient conditions by demonstrating a greater capacity to preserve seed quality during accelerated ageing. On the other hand, VL-802 had worse storability than VL-829 and UP-1109, which both showed intermediate storability. Overall, there was a decline in all measured parameters with an increase in the ageing period.

Key Words: *Wheat varieties; Accelerated ageing; Seed quality; Storability test; Moisture content*

INTRODUCTION

The world's most significant crop is wheat (*Triticum aestivum* L.), which accounts for 20% of the energy in food produced for humans among the other three cereal crops of rice, maize, and barley [1,2]. One of the main sources of carbohydrates, which make up 20% of the world's dietary calories and are a staple diet for humans, is wheat. It has roughly 1.8% minerals, 2.2% crude fiber, 2% fat, 12% proteins, and 70% carbs [3]. It also contains additional nutrients that aid in digestion, energy production, and the development and repair of muscle tissue, such as carbohydrates, protein, fiber, vitamins B and E, and minerals [4].

The ability of a seed lot to germinate under a variety of environmental conditions is largely dependent on its seed vigor. To assess the vigor of a crop's seeds, various factors are considered, including seedling length, dry weight, electrical conductivity, cool test, cold test, accelerated aging, and dehydrogenase activity. This physiological stress test allows seeds to be exposed to high temperatures and high relative humidity levels (over 90%) while still allowing for regulated seed degradation [5]. It is regarded as a prediction test for seed storability because it exposes seeds to higher temperatures (40-450) and greater relative humidity levels (99-100% RH) in a shorter amount of time, causing changes in the seeds at the cellular level that occur during long-term storage [6].

MATERIALS AND METHODS

Four wheat varieties VL-802, VL-829, VL-892, and UP-1109 seed samples were collected in muslin cloth bags for the accelerated ageing test. The desecraters were already filled with water when these muslin cloth bags were placed on top of them, with the seed spaces inside the bags sitting two to three centimeters above the water. Desecraters have tape covering their lids and rubber bands fastening them. After aging for 15, 30, and 45 days, these desecraters were put in an incubator with 45°C temperature and 100% relative humidity. The seeds were then used for a germination test. To determine the quality of the seeds, these were further used in a lab experiment. CRD was used to assess how well different kinds performed over the course of the aging process. The two-factor ANOVA method was utilized to ascertain the performance of the varieties across the aging period. One factor in the two-way ANOVA was variety, and the other was age. On the basis of CD differences at 1%, tests of significance were reported.

RESULTS AND DISCUSSION

Effect of accelerated ageing on the first count (%) in wheat varieties

The first count's greatest mean value (77.75%) was recorded by VL-892, which was followed by VL-829 (69.66%), VL-802 (65.00%), and UP-1109 (61.91%). For the initial count (%), there was a substantial difference in the interaction between variety and accelerated aging duration (Table 1). The initial count (%) decreased from AA1 to AA4 in the following ways: In VL-802, 82.66 to 53.66, in VL-829, 85.00 to 66.66, and in UP-1109, 70.66 to 52.33. A notable decrease in the initial count (%) was noted in AA2 aged seed, with the lowest being in VL-892 (1.17%) and the highest in UP-1109 (9.42%) compared to AA1. VL-829 (35.08%) had the largest drop in first count (%) at AA4 aged seed, followed by UP-1109 (25.94%), VL-802 (23.24%), and VL-892 (21.57%).

TABLE 1

Impact of faster aging on wheat variety initial count (%)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	71.66	82.66	85	70.66	77.5
15	69.33	77.33	84	64	73.66
30	64	65	75.33	60.66	66.25
45	55	53.66	66.66	52.33	56.91
Mean	65	69.66	77.75	61.91	68.58
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.38	0.38	0.76		
CD (5%)	1.1	1.1	2.21		

Effect of accelerated ageing on the standard germination (%) in wheat varieties

Diversity in terms of standard germination, VL-892 had the greatest mean value (83.74%), followed by UP-1109 (80.75%), VL-829 (80.33%), and VL-802 (70.41%). For conventional germination (%), there was a substantial variation in the interaction between variety and accelerated ageing duration (Table 2). The standard germination (%) decreased in VL-802 from AA1 to AA4 by 82.66 to 58.00, in VL-82987.33 to 79.00, and in UP-1109 from 84.66

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to 71.00. A notable decrease in the standard germination percentage (%) over AA1 was noted in AA2 aged seed, with the lowest being UP-1109 (0.38%) and the highest being VL-802 (12.49%). Maximum standard germination (%) drop at AA4 aged seed was seen in VL-802 (29.83%), followed by UP-1109 (16.3%), VL-829 (9.53%), and VL-892 (8.36%) over AA1.

TABLE 2

Impact of faster aging on the percentage of standard germination of different wheat kinds

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	82.66	83.66	87.33	84.66	84.57
15	72.33	82.33	86	84.33	81.24
30	68.66	78.66	82.66	83	78.24
45	58	76.66	79	71	71.16
Mean	70.41	80.33	83.75	80.75	78.81
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.68	0.68	1.36		
CD (5%)	1.96	1.96	3.39		

Effect of accelerated ageing on the shoot length (cm) in wheat varieties

Variety VL-829 showed the largest mean value of shoot length (6.37 cm) followed by VL-892 (6.29cm), UP-1109 (6.12 cm) and VL-802(5.90 cm). The interaction due to variety and accelerated ageing period had significant difference for shoot length (cm) (Table 3). Reduction in shoot length (cm) from AA1 to AA4 was 6.33 to 5.77 in VL-802, 7.40 to 5.16 in VL-829, 7.00 to 5.69 in VL-892 and 7.16 to 4.94 in UP-1109. In AA2 aged seed, significant reduction in shoot length (cm) was observed minimum in VL-802 (2.05%) and maximum in UP-1109 (12.01%) over AA1.At AA4 aged seed, maximum reduction in shoot length (cm) UP-1109 (31.00%) followed by VL-829(30.27%), VL-892 (18.71%) and VL-802(8.84%) over AA1.

TABLE 3

Impact of accelerated aging on wheat variety shoot length (cm)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	6.33	7.4	7	7.16	6.97
15	6.2	6.83	6.4	6.3	6.43
30	5.3	6.08	6.06	6.1	5.88
45	5.77	5.16	5.69	4.94	5.39
Mean	5.9	6.37	6.29	6.12	6.17
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.12	0.12	0.24		
CD (5%)	0.35	0.35	0.71		

Effect of accelerated ageing on root length (cm) in wheat varieties

The varieties with the longest mean root length values were UP-1109 (10.85 cm), VL-892 (10.66 cm), VL-829 (10.15 cm), and VL-802 (8.94 cm). For root length (cm), the interaction between variety and accelerated ageing period was not statistically significant (Table 4). The root length (cm) decreased in VL-802 from AA1 to AA4, in VL-829 from 11.99 to 8.83, in VL-892 from 11.98 to 9.93, and in UP-1109 from 11.53 to 10.13. Significant reductions in root length (cm) over AA1 were seen in AA2 aged seed, with minimums in UP-1109 (1.82%) and maximums in VL-829 (13.84%). The lowest drop in root length (cm) at AA4 aged seed was recorded by UP-1109 (12.14%), followed by VL-892 (17.11%), VL-802 (26.35%), and VL-829 (26.35%).

TABLE 4

Impact of accelerated aging on wheat varieties' root length (cm)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	10.36	11.99	11.98	11.53	11.46
15	9.4	10.33	10.54	11.32	10.4
30	8.36	9.46	10.2	10.44	9.61
45	7.63	8.83	9.93	10.13	9.13
Mean	8.94	10.15	10.66	10.85	10.15
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.2	0.2	1.56		
CD (5%)	0.58	0.58	1.16		

Effect of accelerated ageing on fresh weight (g) in wheat varieties

With a mean fresh weight of 0.55 g, variety UP-1109 had the highest value, followed by VL-892 (0.54 g), VL-365 (0.52 g), and VL-829 (0.24 g). For fresh weight (g), the interaction between variety and accelerated aging period was not statistically significant (Table 5). Between AA1 and AA4, the fresh weight (g) was reduced by 0.65-0.24 in VL-365, 0.51-0.43 in VL-829, 0.58-0.51 in VL-892, and 0.61-0.51 in UP-1109. Significant decreases in fresh weight (g) over AA1 were seen in AA2 aged seed, with minimums in VL-892 (1.72%) and maximums in UP-1109 (16.39%). Minimum fresh weight (g) drop at AA4 aged seed was recorded by VL-829 (5.88%), VL-892 (12.06%), UP-1109 (16.39%), and VL-365 (63.07%).

TABLE 5

Impact of accelerated aging on wheat cultivars' fresh weight (g)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	0.65	0.51	0.58	0.61	0.14
15	0.65	0.48	0.57	0.54	0.56
30	0.51	0.51	0.53	0.52	0.51
45	0.24	0.43	0.51	0.51	0.57
Mean	0.52	0.48	0.54	0.55	0.52
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.21	0.21	0.42		
CD (5%)	0.83	0.83	0.16		

Effect of accelerated ageing on dry weight (g) in wheat varieties

With a mean dry weight of 0.55 g, variety VL-829 had the highest value, followed by VL-892 (0.48 g), UP-1109 (0.47 g), and VL-802 (0.42 g). For dry weight (g), the interaction between variety and accelerated ageing period was not statistically significant (Table 6).

TABLE 6

Impact of accelerated aging on wheat varieties' dry weight (g)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	0.27	0.45	0.66	0.52	0.47
15	0.64	0.52	0.36	0.41	0.48
30	0.36	0.51	0.35	0.55	0.44
45	0.42	0.72	0.56	0.42	0.53
Mean	0.42	0.55	0.48	0.47	0.48
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.31	0.31	0.63		
CD (5%)	0.12	0.12	0.24		

Effect of accelerated ageing on moisture content (%) of wheat varieties

The varieties with the greatest mean moisture content values were UP-1109 (12.58%), VL-802 (11.57%), VL-829 (9.95%), and VL-892 (9.11%). For moisture content (%), the interaction between variety and accelerated aging period produced a substantial difference (Table 7). The percentage of moisture content (%) increased in VL-802 from AA1 to AA4, in VL-829 from 8.13 to 12.66, in VL-892 from 8.23 to 10.66, and in UP-1109 from 10.33 to 14.33. Moisture content (%) increased significantly in AA2 old seed compared to AA1, with smallest values in VL-829 (3.44%) and maximum values in UP-1109 (19.36%). Minimum moisture content (%) increased in VL-892 (22.79%) at AA4 aged seed, followed by UP-1109 (27.91%), VL-829 (35.78%), and VL-802 (49%).

TABLE 7

Impact of accelerated aging on wheat cultivars' moisture content (%)

Accelerated ageing period	Varieties				
	VL-802	VL-829	VL-892	UP-1109	Mean
0	9.02	8.13	8.23	10.33	8.93
15	10.33	8.42	8.66	12.33	9.93
30	12.5	10.6	8.87	13.33	11.32

45	14.43	12.66	10.66	14.33	13.02
Mean	11.57	9.95	9.11	12.58	10.8
	Variety	Accelerated ageing	Variety × Accelerated ageing		
SE ±	0.14	0.14	0.28		
CD (5%)	0.4	0.4	0.81		

Discussion

First count, germination %, normal seedling percentage, fresh weight, and seedling dry weight were all significantly impacted by seed aging. These findings concur with studies [7-11] that shown the detrimental impact of aging on germination properties. In all four kinds, the standard germination percentage falls with increasing age. Similar findings were noted for onion [11], Indian mustard seeds [12], onion [13], coriander [14,15], tomato [16,17], wheat [18], and four vegetable seeds (carrot, cucumber, onion, and tomato) by Alhamdan et al., [19], Akhter et al., [20]. These findings suggested that chromosomal aberrations that arise from extended storage conditions may be the cause of the decreased germination characteristics with increased ageing. A gradual loss of seed viability may be the cause of the reductions in root and shoot lengths as well as seed germination brought on by accelerated aging [21]. Reduces in the rate and percentage of seed germination, seedling fresh weight, dry weight, and root shoot length can result from seed aging, which can also induce membrane degradation [22], solute leakage [23], and disruptions in RNA transcription and protein synthesis [24,25] As seed aging advanced, there was a significant drop in the following metrics: germination percentage, germination index, normal seedling percentage, seedling dry weight, and weight of employed (mobilized) seed reserve. The percentage of germination in aged seeds may decrease as a result of denaturation of proteins, decreased carbohydrate levels, and decreased α-amylase activity [26]. Loss of germination, growth of seedlings during rapid aging as a result of increased respiration, O_2 generation, and axes' H_2O_2 concentration.

CONCLUSION

To sum up, the application of accelerated ageing is a useful technique for evaluating the vigor and storability of wheat types' seeds. The results show notable differences in seed quality metrics amongst the tested cultivars at various aging times. The most resilient variety was VL-892, which suggests that it has the capacity to store seeds for longer. The noted decreases in seed quality indicators highlight how crucial it is to use seeds as soon as possible or to store them properly to preserve their vigor. In order to guarantee a sustainable and fruitful wheat crop, this study offers insightful information about how to choose types with improved storability and optimize seed storage conditions.

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