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Impact of Hydropriming on Fresh and Naturally Aged Seeds of Bottle Gourd (*Lagenaria siceraria* (Molina) Standl)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: An investigation was undertaken to identify the effect of hydropriming on germination, seedling growth and vigour in fresh, one year and two year old seeds of bottle gourd (Pusa Naveen variety and HBGH-35 hybrid).
Study Design: The present experiment was laid in Complete Randomized Design (CRD).
Place and Duration of Study: The study was carried out in the laboratories of the Department of Seed Science & Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during the year 2020.
Methodology: Seeds of both genotypes were soaked in distilled water for 48 hours in half volume of water with respect to seed weight (w:v) at a constant temperature of 25°C. Then after, germination test was performed using 'Between Paper' method to assess the effect of hydropriming on germination and seedling vigour related parameters.

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Results: It was observed that hydropriming treatment significantly enhanced the germination and vigour of fresh and aged seeds of bottle gourd. Fresh seed lot recorded maximum germination (88.00%), shoot length (21.32 cm), root length (16.89 cm), seedling length (38.21 cm) and seedling dry weight (59.30 mg), vigour index I (3363) and vigour index II (5219) as compared to one year and two year old seed. However, effect of hydropriming was more pronounced on aged seeds as compared to fresh seeds. There was an increase in germination percentage in one year old seed to an extent of 9.69%, in two year old seed to an extent of 7.36%, whereas in fresh seeds it was only 2.30% as a result of hydropriming treatment.

Conclusion: It was concluded that one year old seed lot responded better to hydropriming treatment than two year old and fresh seed lot.

Keywords: Hydropriming; germination; seedling vigour; fresh seeds; aged seeds.

1. INTRODUCTION

Food security has now become a challenging issue throughout the world. To meet this challenge, scientists are focusing their efforts in increasing the production of neglected underutilized crops like pulses, millets, cucurbits etc. Bottle gourd (*Lagenaria siceraria* (Molina) Stand) is an important cucurbitaceous vegetable crop grown for its fleshy fruits in tropical and subtropical regions. It is cultivated both in *Kharif* and summer season in western part of the country; whereas in tropical regions it is cultivated round the year under mild temperature conditions [1]. The edible portion of bottle gourd contains a good amount of carbohydrate, protein, fat and minerals, including calcium and phosphorus [2,3]. It is one of the excellent fruit gifted by the nature to human beings having composition of all the essential constituents that are very important for human health. It is also useful in the management of many diseases like cardiac disorders, hepatic disorders and ulcer [4].

In India, bottle gourd consumption has gained popularity over last century. One of the important aspects in bottle gourd production that is often overlooked by many resource limited farmers is seed quality. There is limited and diffused information on seed quality of bottle gourd that determines the performance when the seed is either stored or sown. Storing and preserving the quality seed stock till the next season is equally important as producing quality seeds but some time seeds lose their viability during storage. The seed deterioration during storage leads to various changes apart from quantities losses *viz.,* change or shift in metabolic activity, changes in composition, decrease or change in enzymatic activities, morphological, and cellular changes [5]. Poor seedling emergence and lower seedling vigor cause poor establishment in crop stand. Due to this, various invigouration techniques are used which involves physiological enhancement of seed performance [6].

Among them, hydropriming is basic and simplest approach which entails seed hydration with distilled water to enhance the germination percent, germination speed and uniform crop establishment under unfavourable conditions particularly in areas of water scarcity [7-9]. In hydropriming process, the hydration of seed is done to a moisture content which is enough to commence the metabolic activities prior to germination but not adequate to allow the protrusion of radicle [10]. The amount of water absorbed by seeds in hydropriming is controlled by the length of time it remains in contact with a moist substrate [11] or high relative humidity atmosphere, and subsequent drying. This technique results in increased seed germination and seedling emergence during re-imbibition. Hydroprimed seeds show higher activities of various enzymes such as proteases, α and β-amylase and iso-citrate lyase, which are responsible for mobilisation of stored reserves in seed and play a critical part in the catabolism of macromolecules required for developing embryo, resulting in better and early growth of seedlings [12]. Keeping this in view, the present investigation was conducted to evaluate the influence of hydropriming on seed quality of fresh and aged seeds of bottle gourd.

2. MATERIALS AND METHODS

The experiment was carried out in the laboratories of the Department of Seed Science & Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar (29°9'14.18"N, 75°43'22.58"E). Fresh seeds, one year old and two year old seeds of the Pusa Naveen variety and HBGH-35 hybrid of bottle gourd were obtained from the Department of Vegetable Science, Chaudhary Charan Singh

Haryana Agricultural University, Hisar. To determine the hydropriming effects on germination and seedling growth of two bottle gourd genotypes, seeds were fully immersed in petri plates containing half volume of distilled water with respect to seed weight (w:v). Petri plates were kept at constant temperature of 25°C for 48 hours under controlled conditions. This protocol of hydropriming was standardized in an another experiment (Data not shown). All seeds were removed from petri plates at the same time. Experimental units (Petri plates) were arranged in a completely randomized design with three replications. ‘Between Paper’ method of germination was used for evaluating the seed performance in laboratory under controlled conditions. Dry seeds were taken as control. Hydroprimed seeds were assessed for the seed quality parameters along with the control after 14 days. The observations on the characters *viz.,* Standard germination (%), Shoot length (cm), Root length (cm), Seedling dry weight (mg), Seedling length (cm) and Seedling vigour indices [13] were recorded. The data recorded for each character was subjected to three-way analysis of variance using OP-STAT software to determine the significance of variance (p=0.05).

3. RESULTS AND DISCUSSION

3.1 Standard Germination (%)

The results of the present investigation revealed that hydropriming treatment significantly enhanced the standard germination percentage of fresh seed, one year old seed and two year old seed of Pusa Naveen variety and HBGH-35 hybrid of bottle gourd (Table 2). Fresh seeds recorded maximum germination percentage (88.00%) as compared to one year old seeds (79.33%) and two year old seeds (68.08%).

But aged seeds showed better improvement in standard germination as compared to fresh seeds. According to results (Fig. 1), one year old seeds showed maximum improvement in standard germination (9.69%) followed by two year old seeds (7.36%) and fresh seeds (2.30%). Seeds of HBGH-35 hybrid resulted in maximum germination percentage (79.17%) as compared to seeds of Pusa Naveen variety (77.78%). The improved seed germination of hydroprimed seeds may be attributed to the improved physiologically active state of pre-germinated seeds due to priming [14] as the metabolic process of seeds related to α-amylase activity is activated by water absorption with seed priming and the metabolic potential is preserved in the seed during the dry period after seed priming [15]. Similar results were reported in watermelon [16], okra [17], pea [18], faba bean [19] and cucumber [20].

3.2 Shoot Length (cm)

According to results presented in Table 3, hydropriming treatment resulted in significant higher values of shoot length (17.93 cm) in seeds of HBGH-35 hybrid as compared to seeds of Pusa Naveen variety which had lower values of shoot length (17.06 cm). Among the different lots, fresh seeds produced maximum shoot length (21.32 cm) followed by one year old seeds (16.94 cm) and two year old seeds (14.24 cm). Mean shoot length was maximum in hydroprimed seed (18.22 cm) as compared to control (16.77 cm). Enhancement in shoot length as a result of hydropriming might be due to the higher rate of cell division in the shoot tips incited by the application of hydropriming agent. This is in confirmation of observations made by researchers in maize [21], carrot [22], okra [23] and cucumber [20].

3.3 Root Length (cm)

There was a significant effect of hydropriming treatment on root length (Table 3) as it is apparent from higher mean root length of hydroprimed seed (13.85 cm) as compared to lower mean root length observed in control (12.70 cm). Longer root length was observed in seeds of HBGH-35 hybrid (13.58) as compared to seeds of Pusa Naveen variety (12.97 cm). Comparing the different seed lots, fresh seeds recorded maximum root length (16.89 cm) followed by one year old seeds (12.41 cm) and two year old seeds (10.53 cm). The increase in root length of hydroprimed seed might be due to metabolic repair of damage during hydropriming treatment and changes in enzyme concentration and formation and reduction of lag time between imbibitions and radicle emergence [24]. Another reason for improved root length could be that hydroprimed seeds had stronger embryos that were able to emerge more easily from seeds [25]. Our results are in corroboration with the studies reported in rice [26], carrot [22], barley [27] and cucumber [20].

3.4 Seedling Length (cm)

Seedling length was significantly influenced by hydropriming treatment (Table 3). Higher mean

Table 1. Analysis of variance (ANOVA) for different seed quality parameters

Source of variation	DF	Mean Squares						
		Standard germination	**Shoot length**	**Root length**	**Seedling length**	**Seedling dry weight**	**Vigour index-I**	**Vigour index-II**
Genotype	1	17.36**	6.81**	3.27**	19.54**	4.73**	229946**	145161**
Seed lot	2	1196.69**	153.43**	127.97**	560.35**	1243.21**	8546170**	19687157**
Genotype × Seed lot	2	0.19	0.23**	0.17**	0.77**	0.04	10311*	3784
Treatment	1	200.69**	18.84**	11.83**	60.54**	91.76**	1012883**	1979649**
Genotype × Treatment	1	0.69	0.05	0.07	0.23	0.13*	75	1495
Seed lot × Treatment	2	21.36**	5.52**	3.16**	17.01**	5.92**	203220**	150341**
Genotype × Seed lot × Treatment	2	0.53	0.17**	0.03	0.33*	0.05	1885	2978
Error	24	0.78	0.02	0.02	0.08	0.02	2180	2824

**Significant at 5%, ** Significant at 1%*

Table 2. Effect of hydropriming treatment, genotypes and different aged seed lots on standard germination of bottle gourd genotypes

Standard germination (%)	Pusa Naveen variety (G_1)				HBGH-35 hybrid (G_2)				
	Fresh seed (L_1)	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	86.67 (68.56)	75.00 (59.98)	65.00 (53.71)	75.56 (60.75)	87.33(69.13)	76.33(60.87)	66.33 (54.51)	76.67 (61.50)	76.11 (61.13)
Hydropriming (T_1)	88.00 (69.72)	82.00 (64.88)	70.00 (56.77)	80.00 (63.79)	90.00(71.55)	84.00(66.40)	71.00 (57.40)	81.67 (65.12)	80.83 (64.45)
Mean	87.33 (69.14)	78.50 (62.43)	67.50 (55.24)	77.78 (62.27)	88.67(70.34)	80.17(63.63)	68.67 (55.95)	79.17 (63.31)	
Mean	L_1- 88.00 (69.74)			L_2- 79.33 (63.03)			L_3- 68.08 (55.60)		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	0.45	0.56	NS	0.45	NS	0.79	NS		

#Values in the parenthesis are arc-sine transformed of the original

Table 3. Effect of hydropriming treatment, genotypes and different aged seed lots on seedling growth characteristics of bottle gourd genotypes

Shoot length (cm)	**Pusa Naveen variety (G_1)**				**HBGH-35 hybrid (G_2)**				
	Fresh seed (L_1)	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	20.62	15.00	13.28	16.30	21.82	15.98	13.94	17.25	16.77
Hydropriming (T_1)	20.84	18.23	14.40	17.82	22.00	18.53	15.32	18.62	18.22
Mean (L)	20.73	16.62	13.84	17.06	21.91	17.26	14.63	17.93	
Mean	L_1- 21.32			L_2- 16.94			L_3- 14.24		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	0.10	0.12	0.17	0.10	NS	0.17	0.24		
Root length (cm)	**Pusa Naveen variety (G_1)**				**HBGH-35 hybrid (G_2)**				
	Fresh seed (L_1)	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	16.38	11.02	9.67	12.36	17.22	11.57	10.35	13.05	12.70
Hydropriming (T_1)	16.57	13.44	10.76	13.59	17.38	13.59	11.35	14.11	13.85
Mean (L)	16.48	12.23	10.22	12.97	17.30	12.58	10.85	13.58	
Mean	L_1- 16.89			L_2- 12.41			L_3- 10.53		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	0.10	0.12	0.17	0.10	NS	0.17	NS		
Seedling length (cm)	**Pusa Naveen variety (G_1)**				**HBGH-35 hybrid (G_2)**				
	Fresh seed (L_1)	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	37.00	26.02	22.95	28.66	39.04	27.55	24.29	30.29	29.48
Hydropriming (T_1)	37.41	31.67	25.16	31.41	39.38	32.12	26.67	32.72	32.07
Mean (L)	37.21	28.85	24.06	30.04	39.21	29.84	25.48	31.51	
Mean	L_1- 38.21			L_2- 29.34			L_3- 24.77		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	0.19	0.24	0.33	0.19	NS	0.33	0.47		
Seedling dry weight (mg)	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	58.13	47.53	36.68	47.45	58.86	48.46	37.53	48.28	47.87
Hydropriming (T_1)	59.70	51.90	40.65	50.75	60.49	52.59	41.02	51.37	51.06
Mean (L)	58.92	49.72	38.67	49.10	59.68	50.53	39.28	49.83	
Mean	L_1- 59.30			L_2- 50.12			L_3- 38.97		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	0.10	0.12	NS	0.10	0.14	0.17	NS		

Table 4. Effect of hydropriming treatment, genotypes and different aged seed lots on vigour indices of bottle gourd genotypes

Vigour index I	**Pusa Naveen variety (G_1)**				**HBGH-35 hybrid (G_2)**				**Mean (T)**
	Fresh seed (L_1)	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	
Control (T_0)	3,207	1,952	1,492	2,217	3,410	2,103	1,611	2,375	2,296
Hydropriming (T_1)	3,292	2,597	1,761	2,550	3,544	2,698	1,894	2,712	2,631
Mean (L)	3,250	2,274	1,627	2,384	3,477	2,401	1,753	2,543	
Mean	L_1- 3,363			L_2- 2,338			L_3- 1,690		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	32.13	39.35	55.65	32.13	NS	55.65	NS		
Vigour index II	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_1)**	**Fresh seed (L_1)**	**One year old seed (L_2)**	**Two year old seed (L_3)**	**Mean (G_2)**	**Mean (T)**
Control (T_0)	5,038	3,565	2,384	3,662	5,141	3,699	2,489	3,776	3,719
Hydropriming (T_1)	5,254	4,256	2,846	4,118	5,444	4,418	2,913	4,258	4,188
Mean (L)	5,146	3,910	2,615	3,890	5,293	4,059	2,701	4,017	
Mean	L_1- 5,219			L_2- 3,985			L_3- 2,658		
CD (p=0.05)	G	L	G × L	T	G × T	L x T	G × L × T		
	36.57	44.78	NS	36.57	NS	63.33	NS		

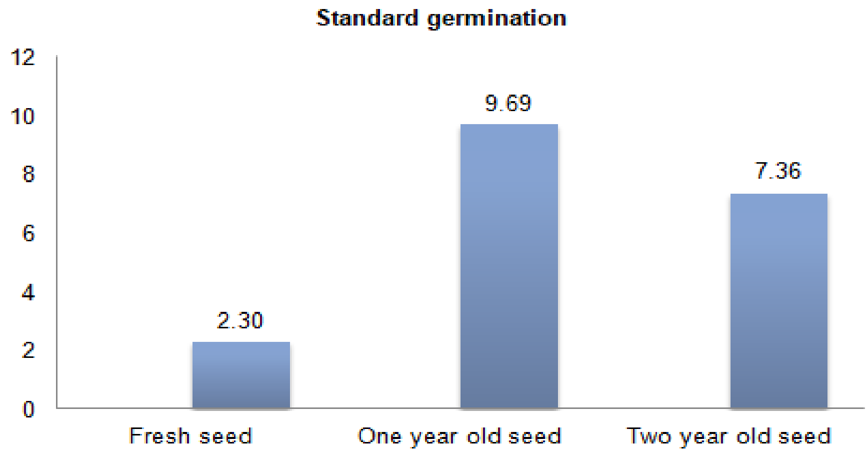

Fig. 1. Percent enhancement in Standard germination percentage of different aged seed lots of bottle gourd by hydropriming

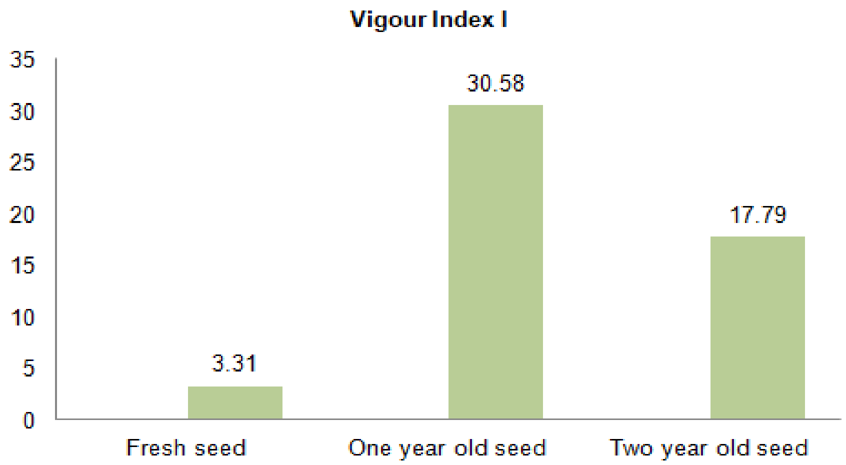

Fig. 2. Percent enhancement in Vigour index I of different aged seed lots of bottle gourd by hydropriming

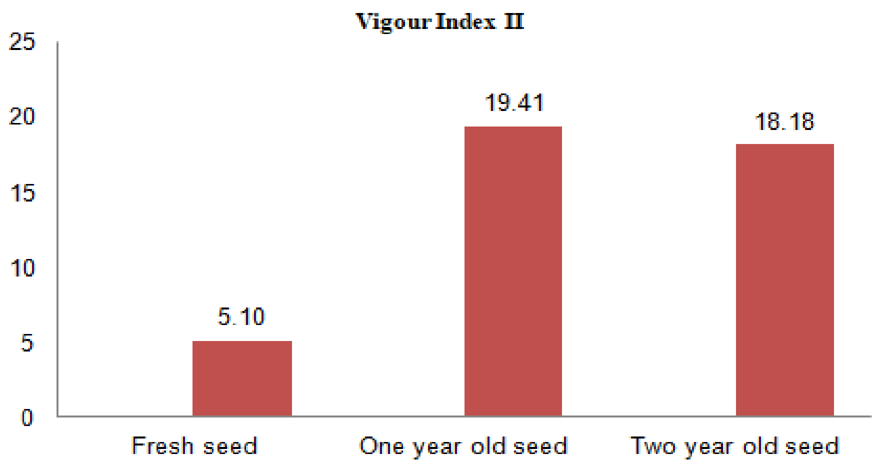

Fig. 3. Percent enhancement in Vigour index II of different aged seed lots of bottle gourd by hydropriming

seedling length was observed in hydroprimed seed (32.07 cm) as compared to mean seedling length in control (29.48 cm). Hydropriming also varied in its effect among different seed lots which is evident from maximum seedling length in fresh seeds (38.21) followed by one year lot (29.34 cm) and two year lot (24.77 cm). Between the genotypes, HBGH-35 hybrid seeds showed greater seedling length (31.51 cm). Similar increase in seedling length due to hydropriming was also reported in rice [26], in cucumber [28, 29] and in bitter gourd [30].

3.5 Seedling Dry Weight

Significant differences were observed in seedling dry weight of seeds subjected to hydropriming (Table 3). Seedling dry weight was maximum in seeds of HBGH-35 hybrid (49.83 mg) compared to seeds of Pusa Naveen variety (49.10 mg). Seeds of fresh lot exhibited highest value for seedling dry weight (59.30 mg) followed by one year old lot (50.12 mg) and two year old lot (38.97 mg). Overall mean seedling dry weight was higher in hydroprimed seed (51.06 mg) than control (47.87 mg). The increase in seedling dry weight of hydroprimed seed can be explained by the fact that that larger seed size had more food storages in their endosperm and increased cell division within the apical meristem, which increased the plant growth [31].

3.6 Seedling Vigour Indices

According to results presented in Table 4, seed hydropriming gave significant higher values of vigour index I and vigour index II in fresh seed lot (3363, 5219) followed by one year old seed lot (2338, 3985) and two year old seed lot (1690, 2658) respectively. However, relative improvement was higher in one year old seed lot (30.58, 19.41%) followed by two year old seed lot (17.79, 18.18%) and fresh seed lot (3.31, 5.10%) for vigour index I and vigour index II respectively (Figs 2 and 3). Between the genotypes, HBGH-35 hybrid seeds were more vigorous as indicated by higher values of vigour index I (2543) and vigour index II (4017). Our results are supported by the previous findings in watermelon [32], carrot [22], okra [17], cucumber [29] and vegetable pea [33].

A perusal of data pertaining to seed germination and vigour clearly indicated that hydropriming treatment differed in its effect when subjected to fresh and aged seed lot of bottle gourd. In present investigation, percent improvement in seed quality due to seed priming in old lot (aged seeds) is more as compared to fresh lot. Aged seeds responded better to hydropriming treatment than fresh seeds with respect to all seed quality parameters. Higher response of aged seeds to hydropriming treatment as compared to fresh seeds is because in seeds of good quality, close to optimum performance, naturally the possibility of improving seed quality is limited as compared to seeds of lower quality with physiological deficiencies. Umesha et al. [34] opined that seed deterioration can be rectified to the great extent by the technique of seed priming. Their study of biochemical investigations on vigour enhancement in aged seeds upon seed priming in onion clearly indicated that priming would reestablish the lost seed vigour in aged seeds due to reactivation of enzyme activity in old seeds. Priming also restored the lost seed vigour in aged seeds due to recurrence of proteins and increased enzyme activity in old seeds. According to Drew et al. [35] slow germinating carrot seed lots were found to benefit more from priming treatment than faster ones. Hydro-priming was found to be a suitable priming technique in canola seeds and was more effective in the low vigour lot [36]. Our results are consistent with the findings in papaya [37,38], carrot [39], onion [40], kabuli chickpea [41].

4. CONCLUSION

Hydropriming is low cost technology which involves soaking of seeds in water to amplify the germination percentage and uniform plant establishment. In bottle gourd, hydropriming enhanced all seed quality parameters in differently aged seed lots of both the genotypes. Hydropriming for 48 hours in half volume of water with respect to seed weight (w:v) at a constant temperature of 25°C showed better results as compared to control. The fresh seeds hydroprimed exhibited significantly higher values of all seed quality parameters followed by one year old lot and two year old lot. But hydropriming alleviated physiological process in aged seeds with higher intensity than in the fresh seeds. So it got more favourable response in the aged seeds as compared to the fresh seeds. Hence, one year old seed lot was recorded with maximum improvement followed by two year old seed and fresh seed lot. Between the genotypes, HBGH-35 hybrid seeds were more responsive to hydropriming than Pusa Naveen variety.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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