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Effect of Priming Treatment to Enhance Seed Quality of Sorghum

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ABSTRACT: With a view to find out the effect of priming on germination and seedling vigour on sorghum (*Sorghum bicolor* L.) seeds, experiments were conducted during *Kharif* 2018 in Seed Technology Laboratory, Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar (Haryana), India.The seed of two forage sorghum variety (HC 136 and HJ 541) were evaluated under five priming treatments *viz*. T_1: Untreated (control), T_2: Hydration -dehydration (6 h,T_3:Hydration – dehydration (6 h) + 0.25 % thiram treatment.T_4: Hydration with GA_3 (50 ppm for 6 h),T_5:Hydration with sodium molybdate (500 ppm for 6 h) in complete randomized block design and replicated thrice.Maximum germination percentage and seedling length were observed when seeds primed withT_4:Hydration with GA_3 (50 ppm for 6 h), followed by Hydration – dehydration + 0.25 % Thiram treatment (T_3)similar trend was also observed in all parameters. Among the treatments T_1 Untreated (control) recorded minimum germination %, Seedling Length, seedling dry weight, Seed Vigour index and dehydrogenase activity. Among all the priming treatments T_4 Hydration with GA_3 (50 ppm for 6 h) was found to be the best priming treatment. Moreover, priming treatments have more pronounced effect on HJ541 maintained highest quality parameters followed than HC136 of sorghum seeds.

Keywords: Sorghum, Seed priming, GA_3, Thiram, Vigour index

Sorghum [(*Sorghum bicolor* (L.)Moench] is the fifth major cereal crop in the world and occupies fifth position in acreage after wheat, rice, maize and barley. It is grown as a staple food crop throughout the Asian and African regions, besides as a forage and fodder crop for livestock in the developed countries like USA, Europe and Japan. Major producers of sorghum in the world are Nigeria, USA, India, Mexico, Argentina, Sudan, Ethiopia, Brazil, China and Australia. It has been classified under family poaceae, tribe Andropogonae and genus sorghum, Sorghum is considered to be one of the drought tolerant crop. The sorghum is cultivated as dual purpose crop ranking fourth among all cereals. Sorghum possesses a variety of anatomical, morphological, and physiological features that enable it to survive in water-limited environments [1]. The fodder sorghum is grown in 8.3 million ha mainly in Western UP, Haryana, Punjab, and Rajasthan and fulfils over two third of the fodder demand during *Kharif* season. The area under fodder cultivation is estimated to be about four per cent of the gross cropped area, which remained static for the last four decades. The traditional grazing lands are gradually diminishing because of urbanization, expansion of cultivable area, grazing pressure and industrialization etc. These factors resulted in severe shortage of feed and fodder to the extent of 26 per cent in dry-crop residues, 35.6 per cent in green fodder and 41 per cent of concentrates. To reduce the demand and supply gap, the production and productivity of fodder crops needs to be enhanced. As per an estimation only 25-30 per cent of required quantity of quality seed is available in cultivated fodders and <10 per cent in range grasses and legumes in India. Presently, the seed demand of cultivated forages, range grasses and legumes is increasing tremendously. Now, with the development of a number of improved and high yielding varieties in forage crops, it has become important that quality seed should be readily available and supplied to the tanners at reasonable price (http://www.igfri.res.in/publications). Seed is considered as one of the important basic agricultural inputs for obtaining higher yield. Good quality seed acts as a catalyst for realizing the potential of all other inputs in agriculture. Without good seed, the investment on fertilizer, water, pesticides and other inputs will not play the desired dividends. Its importance has been realized with the passage of time and greater realization that efficiency is the key factor to be competitive in all the agricultural ventures. Therefore, the availability of quality seed to the farmer at an affordable price and in time is considered crucial for enhancing and sustaining the agricultural productivity. Therefore, production of quality seed and maintenance of high seed germination is of utmost importance in a seed programme. Seeds are practically worthless if upon planting they fail to germinate and give adequate plant stand in the field in addition to healthy and vigorous plants. The great quality seed is pre-essential to improve the production and yield. It has been affirmed to understand that utilization of value seeds broadened efficiency of yield increased by 15-20 percent[2]. Seed possesses maximum viability and vigour at physiological maturity [3], thereafter, seeds gradually aged and decline in viability and vigour. Seed deterioration leads to reduction in seed quality, performance and stand establishment. Higher moisture content along with high temperature of storage environment, the sooner is the loss of viability [4].Seed ageing causes regular deterioration in all vital cellular components causing thereby advanced loss of viability. Lipid auto-oxidation has also been proposed to be one of the causes of seed ageing [5], which involve the production of free radicals. Such problems convey severe threat to agriculture; hence require management to sustain viability and vigour[6-8].The most sensitive stages, for many crop species submitted to the stress conditions, are seed germination and early seedling growth [9].

Heydecker [10] reported that seed priming is one of the most important developments to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environmental conditions. Seed priming has presented promising and even surprising results, for many crop seeds. Primed seeds usually show improved germination parameters [11]. Seed priming with nitrate solutions gave better seed quality and field establishment in maize [12]. Potassium permanganate has oxidizing properties and can act as ethylene neutralizer or an antiseptic. It helped in germination of some legume seeds stored for 20 - 44 years [13]. It is found that on-farm' seed priming with KH_2PO_4 improved fertilizer- use efficiency and increased yield and profit for different crops grown on Pdeficient soils [14].Priming in its traditional sense, is soaking of seeds in water before sowing, has been the experience of farmers in India in an attempt to improve crop stand establishment but the practice was without the knowledge of the safe limit of soaking duration. On-farm seed priming involves soaking the seed in water, surface drying and sowing the same day. The rationale is that sowing soaked seed decrease the time needed for germination and allow the seedling to escape deteriorating soil physical conditions, However it's the investigated research, effect of priming treatments viz., Untreated (control), Hydration -dehydration (6 h), Hydration -dehydration (6 h) + 0.25% thiram treatment, Hydration with GA_3 (50 ppm for 6 h) Hydration with sodium molybdate (500 ppm for 6 h) and evaluate seed quality parameters *viz*., germination per cent, seedling length, seedling dry weight and dehydrogenase activity of sorghum.

MATERIALS AND METHODS

The present investigation on seed invigouration aspects of sorghum was conducted during 2017-18 in the laboratory Department of Seed Science and Technology, CCSHAU, Hisar. The details of the materials used and methods adopted for the conduct of various experiments on seed invigouration are described hereunder.

Source of seeds: Seed material consist of two varieties *viz*. HC136, HJ541 of sorghum crop were taken. Three seed lots of each variety include-fresh, one year and two year old seed stored under ambient conditions. The seed were collected from the Forage Section, Department of Genetics & Plant breeding, CCS Haryana Agricultural University, Hisar.

Treatment details

For this experiment, natural aged seeds of both the varieties were treated with following priming treatments;T_1: Untreated (control), T_2: Hydration - dehydration (6 h (, T_3: Hydration – dehydration (6 h) + 0.25 % thiram treatment, T_4: Hydration with GA_3 (50 ppm for 6 h), T_5: Hydration with sodium molybdate (500 ppm for 6 h). After each treatment seed were dried back to original moisture content. Then different test was directed on the treated seeds to find out the viability percentage of the seed lot.

Observations recorded

The different observations recorded were

I. Final count germination (%)

II. Total seedling length (cm)

III. Total seedling dry weight (mg)

IV. Seedling vigour index –I (Germination percentage × Seedling length)

V. Seedling vigour index –II (Germination percentage × Seedling dry weight)

VI. Dehydrogenase activity test

Standard Germination (%)

100 seeds of each variety with three replications were placed in between adequate moistened rolled towel papers (BP) and kept at 25°C in seed germinator. The first count was taken on 4^{th} day and last count on 7^{th} day and only normal seedlings were considered for percent germination giving to the rules of International Seed Testing Association [15].

Seedling length (cm)

Ten normal seedlings were randomly selected from each replication of both the varieties at the time of final count of standard germination and average seedling length was calculated and expressed in centimetres.

Dry weight per seedling (mg)

Seedling dry weight was evaluated after the final count in the standard germination test (7^{th} day.) The 10 seedlings of each variety replicated thrice were taken. Seedlings dried in a hot air oven for 24 h at 80±1°C. The dried seedlings of each replication were weighted and average seedling dry weight of each variety was calculated.

Seedling vigour index

Seedling vigour indices were calculated according to the method suggested by [16]

I. Vigourindex-I= Standard Germination (%) × Average seedling length (cm)

II. Vigour index-II =Standard Germination (%)× Average seedling dry weight (mg)

Dehydrogenate activity (O D g^{-1} ml^{-1})

In DHA test, the basic principle for topographical tetrazolium test for seed viability is the reduced of 2, 3, 5-Triphenyl tetrazolium chloride to red formazan by dehydrogenase enzyme in seed embryo. It is a quantitative method which may be used to determine varying dehydrogenase activity between seeds of similar viability and therefore, it is measure of seed vigour. Sample of one gram seed of each variety in three replications were ground and passed through a 20 mesh screen. 5 ml of 0.5% tetrazolium solution was used to soak 200 mg flour for 3-4 h at 38°C. Then centrifugation was done at 10000 rpm for 3 minutes and the supernatant was poured off. 10 ml acetone was used to extract the formazan for 16 h followed by centrifugation and spectrophotometer was used to determine the absorbance of the solution at 480 nm. These observations were indicated as optical density (O.D.) and thisprocedure as per procedure suggested by [17].

RESULT AND DISCUSSION

Priming improved the germination per cent and vigour of sorghum seed significantly over no-priming. The response of low vigour (aged) seeds to seed priming was much higher when compared to high vigour (unaged) seeds. Data showed in table 1 to 3 reveal that all the treatmentsimproved the standard germination, seedling length and seedling dry weight in all the seed lots and varieties. The freshly harvested seed lot (L_1) was observed highest germination percentage and seedling length as compared toOne year old (L_2) and Two year old(L_3). The HJ541 variety performed better than HC136 with each priming treatments. The treatment GA_3 (T_4) showed highest improvement in germination percentage and seedling length among varieties and seed lots followed by Hydration- dehydration + 0.25% thiram (T_3) and the lowest improvement was observed in untreated (T_1). The dry matter was increased in all the lots and varieties after treatments. The maximum dry matter was observed under the GA_3 (T_4)treatments as compared to control (T_2), hydration-dehydration (T_3), hydration-dehydration + 0.25% thiram (T_5) and hydration with sodium molybdate (500 ppm) in all lots and varieties. Variety HJ541 found more responsive than HC136 in all the priming treatments and treatment GA_3 (T_4) found more effective than others.Similar finding were also reported inmustard seedby[18], in sunflower seeds by [19]and in sesame seed by [20].Data presented in table 4-6reveal that all the treatments improved the vigour index-1 in all the lots of both the variety. However, lot L1 showed maximum improvement and lot L3, showed minimum improvement within lots when treated with different priming treatments. In both the varieties HJ541 (V2) perform better and HC136 (V1) showed minimum performance. Treatment with GA_3 (50 ppm) showed maximum improvement in both varieties and all three lots.Data presented in Table 5 reveal that the results of

Table 1. Effect of pre-sowing treatments on standard germination (%) of natural aged seed of sorghum

Table 1 (a). Interaction between varieties and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	60.33	61.33	64.22	69.11	61.56	63.31
	(51.41)	(52.08)	(53.97)	(57.36)	(52.26)	(53.41)
HJ541 (V_2)	71.33	74.00	75.11	80.78	74.33	75.11
	(58.044)	(59.92)	(60.63)	(64.65)	(60.20)	(60.69)
Mean	65.83	67.67	69.67	74.94	67.94	
	(54.73)	(56.00)	(57.30)	(61.00)	(56.23)	
CD (P = 0.05)	V= 0.349, T= 0.551, V × T= 0.780					

Values in parenthesis are angular transformed

Table 1 (b). Interaction between treatments and seed lots

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	82.21	85.00	85.00	91.59	84.17	85.58
	(65.51)	(67.24)	(69.21)	(73.12)	(67.55)	(68.52)
One-year-old (L_2)	73.83	75.00	78.50	84.00	77.83	77.83
	(59.22)	(59.99)	(61.39)	(64.91)	(61.04)	(61.31)
Two-year-old (L_3)	41.45	43.00	45.50	49.33	41.83	44.22
	(39.45)	(40.76)	(41.31)	(44.98)	(40.10)	(41.32)
Mean	65.83	67.67	69.67	74.94	67.94	
	(54.73)	(56.00)	(57.30)	(61.00)	(56.23)	
CD (P = 0.05)	L=0.427, T=0.551, L × T=0.955, V × L × T=1.350					

Table 2. Effect of pre-sowing treatments on seedling length of natural aged seed of sorghum

Table 2 (a). Interaction between varieties and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	30.01	30.72	32.38	33.77	31.98	31.77
HJ541 (V_2)	30.57	32.00	32.88	34.94	33.27	32.73
Mean	30.29	31.36	32.63	34.36	32.62	
CD (P = 0.05)	V=0.077, T=0.121, V × T=0.171					

Table 2 (b). Interaction between treatments and seed lots

Seed lots	T_1	T_2	T_3	T_4	T_5	Mean
Fresh seed (L_1)	31.14	33.95	35.66	37.05	35.61	34.68
One year old (L_2)	31.54	31.70	32.72	35.55	33.15	32.93
Two year old (L_3)	28.20	28.43	29.50	30.49	29.10	29.14
Mean	30.29	31.36	32.63	34.36	32.62	
CD (P = 0.05)	L=0.094, T=0.121, L×T=0.210, V× L×T=0.297					

all treatments found promising in improving vigour index-II for both the variety and all the seed lots. However, freshly harvested seed lot (L_1) show maximum improvement in vigour Index-II followed by one year old seed lot (L_2), two year old seed lot (L_3). Among treatments GA_3 treatment (T_4) show maximum improvement in vigour index -II followed by Hydration – dehydration + 0.25% Thiram treatment (T_3) and Hydration - dehydration (T_2).

Table 3. Effect of pre-sowing treatments on seedling dry weight of natural aged seed of sorghum

Table 3 (a). Interaction between varieties and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	12.04	12.07	12.14	12.34	12.08	12.13
HJ541 (V_2)	12.358	12.43	12.47	12.67	12.45	12.48
Mean	12.20	12.25	12.35	12.51	12.26	
CD (P = 0.05) V=0.012, T=0.019 V x T=0.027						

Table 3 (b). Interaction between treatments and seed lots

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	13.62	13.43	13.50	13.80	13.44	13.51
One year old (L_2)	12.50	12.55	12.61	12.81	12.56	12.60
Two year old (L_3)	10.73	10.77	10.81	10.92	10.78	10.80
Mean	12.20	12.25	12.31	12.512	12.26	
CD (P = 0.05) L=0.015, T=0.019, L x T=0.034, V x L x T=0.048						

Table 4. Effect of pre-sowing treatments on vigour Index-I & II of natural aged seed of sorghum

Table 4 (a). Interaction between varieties and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	1,870.18	1,941.05	2,108.02	2,395.69	2,059.48	2,074.88
HJ541 (V_2)	2,221.37	2,393.24	2,496.82	2,837.49	2,480.76	2,485.93
Mean	2,045.77	2,167.15	2,302.42	2,616.59	2,270.12	
CD (P = 0.05)	V=17.089, T=27.020, V x T=38.212					

Table 4 (b). Interaction between treatments and seed lots

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	2,765.67	2,886.98	2,997.87	3,235.19	2,914.84	2,960.11
One year old (L_2)	2,304.36	2,378.03	2,569.66	2,928.25	2,593.52	2,554.76
Two year old (L_3)	1,067.30	1,236.42	1,339.73	1,686.33	1,302.00	1,326.36
Mean	2,045.77	2,167.15	2,302.42	2,616.59	2,270.12	
CD (P = 0.05)	L=20.930, T=27.020, L x T=46.800, V x L x T=66.185					

In both the varieties HJ 541 (V_2) shows maximum improvement whereas the minimum improvement was recorded in HC 136 (V_1) when treated with different treatments. Data presented in Table 6 revealed that the resultsall the treatments enhanced the dehydrogenase enzymes activity in both variety and all the seed lots of sorghum. The maximum increase in dehydrogenase enzymes activity was reported in variety (HJ541) followed by (HC136). Among different seed lot fresh year seed lot (L_1) show maximum increase in enzyme activity followed by one year old seed lot (L_2) and two year old seed lot (L_3). The GA_3 (T_4) treatment shows highest improvement in dehydrogenase enzyme activity in two varieties and each seed lot followed by Hydration – dehydration + 0.25 % Thiram treatment (T_3) and Hydration with sodium molybdatetreatment (T_5). These observations were parallel to those already depicted by various workers in different crop such as [21] in cotton; [22]in *Brassica juncea*; [23]in maize; and [24] in Pearl millet. Toselli and Casenave[25]reported that hydro-priming and osmo-

Table 5. Effect of pre-sowing treatments on vigour Index-II of natural aged seed of sorghum

Table 5 (a). Interaction between varieties and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	752.014	772.061	793.158	844.06	781.022	788.463
HJ541 (V_2)	894.706	929.652	962.058	1,032.35	940.214	951.797
Mean	823.36	850.857	877.608	938.207	860.618	
CD (P = 0.05)	V=4.076, T=6.445, V x T=9.114					

Table 5 (b). Interaction between treatments and seed lots

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	1,106.830	1,142.000	1,181.340	1,255.630	1,155.570	1,168.27
One year old (L_2)	923.515	953.897	980.715	1,042.990	955.540	971.332
Two year old (L_3)	439.735	456.673	470.767	515.998	470.747	470.784
Mean	823.360	850.857	877.608	938.207	860.618	
CD (P = 0.05)	L=4.992, T=6.445, L x T=11.163, V x L x T=13.243					

Table 6. Effect of pre sowing treatment on dehydrogenase enzyme activity of natural aged seed of sorghum

Table 6 (a). Interaction between variety and treatments

Varieties	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
HC136 (V_1)	0.449	0.452	0.456	0.465	0.451	0.455
HJ541 (V_2)	0.505	0.511	0.518	0.527	0.511	0.514
Mean	0.477	0.482	0.487	0.496	0.481	
CD (P = 0.05)	V=0.001, T=0.002, V x T=0.003					

Table 6 (b). Interaction between seed lot and treatments

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	0.586	0.595	0.606	0.619	0.594	0.600
One year old (L_2)	0.460	0.464	0.466	0.474	0.463	0.466
Two year old (L_3)	0.385	0.387	0.388	0.395	0.387	0.388
Mean	0.477	0.482	0.487	0.496	0.481	
CD (P = 0.05)	L=0.001, T=0.002, L x T=0.003, V x L x T=0.0					

priming increase the germination and vigour index.Similar findings were reported by [26]in sunflower seed and in sorghum seeds by [27].

CONCLUSION

Significant amount of variation was observed in both of the varieties and all the seed lots for all characters.All priming treatments enhance the seed quality considerably in case of all physiological constraints in natural aged seed lots.Among several priming treatments, hydration with GA_3 (50 ppm for 6 h) was discovered predominant for improving seed quality in both the variety of all the lots of sorghum seed. HJ541 was recorded superior variety established on majority of the germination and vigour constraints results whereas HC 136 was recorded inferior.Priming of the seeds with different treatments was found effective to enhance the seed value in fresh as well as marginal seed lot *i.e.* one year seed lot. GA_3 (50ppm for 6 h) was discovered well priming treatment for improving the quality of seeds followed by hydration-dehydration (6 h) + 0.25% thiram treatments. All the priming treatments indicated maximum effect on HJ 541 followed by HC136.

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