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Effect of Priming Treatments to Enhance Seed Quality of Naturally Aged Seed of Forage Sorghum

Nisha[1*], S. S. Jakhar[1], Axay Bhuker[1] and Satpal[2]

[1]Department of Seed Science & Technology, [2]Forage Section, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India

Corresponding author

A B S T R A C T

The present study was undertaken to find out the effect of priming treatments to enhance seed quality of naturally aged seeds of forage sorghum varieties. The experiment was conducted at Research Farm and Seed technology laboratory, Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar (Haryana), India during *kharif* season, 2018. Three naturally aged seed lots (fresh, one year old and two year old) of two single-cut forage sorghum varieties (HC 136 and HJ 541) were tested with five priming treatments [T_1: Untreated, T_2: Hydration-dehydration (6 hrs.), T_3: Hydration-dehydration (6 hrs.) + 0.25 % thiram treatment, T_4: Hydration with GA_3 @ 50 ppm for 6 hrs, T_5: Hydration with sodium molybdate @ 500 ppm for 6 hrs.]. Among varieties, HJ 541 performed better than HC 136 with each priming treatments. Among naturally aged seed lots, maximum improvement was observed in freshly harvested seed lot (L_1) while, minimum improvement was found in two year old seed lot (L_3) when treated with different treatments. Among priming treatments, T_4 *i.e.* hydration with GA_3 @ 50 ppm for 6 hrs showed highest improvement in speed of emergence in both the varieties and each seed lot followed by Hydration – dehydration + 0.25 % Thiram (T_3) and Hydration with sodium molybdate (T_5). Based on the results, it was concluded that fresh seed lot of HJ 541 variety with priming treatment of hydration with GA_3 @ 50 ppm for 6 hrs proved better on majority of the seed viability and vigour parameters.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench], belonging to family Poaceae, is an important kharif season crop which is widely grown to meet the green fodder, dry fodder and feed requirement of the livestock (Satpal *et al.*, 2015). Besides this, sorghum can be used as an alternate food, source of raw materials bioethanol industry. The nutritional content of sorghum is comparable to maize and rice, having protein content to the tune of 10-11%.

Sorghum has a high nutrient content that is 339 calories and 11.3% protein/100 grams of seeds (USDA, 2011). India faces a net deficit of 36% and 11% of green fodder and dry fodder, respectively (Tokas *et al.*, 2019).

To reduce the demand and supply gap, the production and productivity of fodder crops needs to be enhanced. Sorghum being a very importance fodder crop can help in bridging this gap by providing high productivity of green fodder in summer and *kharif* season. But the availability of quality of forage sorghum varieties is again a cause of concern to the dairy farmers. As per estimates, only 25-30 per cent of required quantity of quality seed is available in cultivated fodders in India.

Presently, the seed demand of cultivated forages 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 farmers at reasonable price. As, it has been affirmed that utilization of high value seed improved the yield by 15-20 per cent (Sindhawani, 1991). Seed possesses maximum viability and vigour at physiological maturity (Meena *et al*., 1994), 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 (Abbas and Lovato, 1999).

Ageing causes deterioration in all vital cellular components of seed thereby advance loss of viability. Lipid auto-oxidation has also been proposed to be one of the causes of seed ageing (McDonald, 1986) which involve the production of free radicals. According to Bortey *et al.,* (2016), seed storage period may affect the viability of seeds, as the reduction in seed viability is directly proportional to the increase of time. This is because it allows the ripening embryo storage period and further accumulation of food that lasts for storage before germinating, these activities led to an increase in the metabolic processes in the seed. Such problems convey severe threat to agriculture; hence require management to sustain viability and vigour. Seed priming is a pre-sowing treatment which leads to a physiological state that enables seed to germinate more efficiently. The majority of seed treatments are based on seed imbibition allowing the seeds to go through the first reversible stage of germination but do not allow radical protrusion through the seed coat. Seeds keeping their desiccation tolerance are then dehydrated and can be stored until final sowing. During subsequent germination, primed seeds exhibit a faster and more synchronized germination and young seedlings are often more vigorous and resistant to abiotic stresses than seedlings obtained from unprimed seeds. Keeping in view, the importance of seed priming, the experiment was conducted to study the effect of priming treatments to enhance seed quality of naturally aged seed of forage sorghum

Materials and Methods

The three factor experiment was conducted during rainy (*kharif*) season of 2018 at Research Farm, Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar (Haryana), India (29°10' N of 75°46' E, at an average elevation of 215.2 m above mean sea level). The site has semi-arid and sub-tropical climate with hot dry summer and severe cold winter.

Average annual rainfall is about 450 mm, 75 per cent of which is received in three months, from July to September during south-west monsoon. Fig. 1 represents the weekly weather parameters *i.e.* temperature ^{o}C (a), relative humidity (%) (b), bright sunshine (h) (c) and rainfall (mm) (d) during the study. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 7.3).

The varieties used in the experiment were HC 136 and HJ 541. The three factor experiment (factor 1: two varieties, factor 2: Three seed lots and factor 3: Five priming treatment) was carried out in three replicates with 100 seeds of each seed lots of each variety include fresh (L_1), one year old (L_2) and two year old (L_3) seed stored under ambient conditions were sown in a factorial randomized block design. The date of sowing of the experiment was 10 July 2018. 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 hrs.), T_3: Hydration- dehydration (6 hrs.) + 0.25 % thiram treatment, T_4: Hydration with GA_3 (50 ppm for 6 hrs.), T_5: Hydration with sodium molybdate (500 ppm for 6 hrs.). The following observations were recorded in the trial.

Speed of emergence index

On each day, the number of seedlings emerged were counted and continued up to the seedling establishment and field emergence index also termed as the speed of emergence was calculated by the method as described by Maguire (1962).

Speed of emergence index

$$= \frac{No.\ of\ seedlings\ emerged}{First\ day\ of\ sowing} + \cdots + \frac{No.\ of\ seedlings\ emerged}{Day\ of\ last\ count\ (15th)}$$

Seedling establishment (SET %)

When the seedling emergence was accomplished or there was no further increase in total seedling emergence, the seedling establishment was evaluated by counting the total number of seedlings (up to 15 days).

Mean emergence time (days)

The mean emergence time was observed for each treatment combination using the formula cited by Ellis and Robert (1977)

Mean Emergence Time $= \sum nt / \sum N$

Where,

n   =   number of seeds newly germinated at time 't'

t   =   days from sowing

N =   Final emergence of seedlings

Results and Discussion

Data presented in Table no 2 reveal that, all the treatments improved speed of emergence considerably in all the seed lots and varieties. However, freshly harvested seed lot (L_1) showed highest improvement whereas two year old seed lot (L_3) showed lowest improvement. The variety HJ 541 (V_2) performed better than HC 136 (V_1) with each priming treatments. The treatment GA_3 (T_4) showed highest improvement in speed of emergence in two varieties and each seed lot followed by Hydration – dehydration + 0.25 % Thiram (T_3) and Hydration with sodium molybdate (T_5).

The results confirmed the earlier findings by Soltani *et al.*, 2009. Data presented in Table no 2 further reveal that improvement in seedling establishment was noticed in both varieties and seed lots of sorghum. However, maximum improvement was observed in freshly harvested seed lot (L_1) while, minimum improvement was found in two year old seed lot (L_3) when treated with different treatments. Among varieties, highest improvement was recorded in variety HJ 541 (V_2) followed by HC 136 (V_1), when treated with different priming treatments. Treatment (T_4) hydration with GA_3 (50 ppm for 6 hrs) showed best results in all the seed lots and varieties followed by Hydration-dehydration + 0.25% Thiram treatment (T_3) and Hydration- dehydration treatment (T_2), respectively.

Similar finding was reported in *Brassica compestris* by Verma *et al.,* 2003, in coriander by Kumar, 2007, in wheat by Singh, 2009. Bobak *et al.,* (2015) suggested that seed ageing for higher duration could significantly decreased seed quality of corn seed. Using seed enhancement treatments like seed priming or application of phytohormone could improve aged and non-aged seed performance especially for higher aged seed. Data presented in Table 3 reveal that mean emergence time (MET) was decreased in all the seed lots and variety with all the treatments. However, fresh year seed lot (L_1) show highest decrease in MET while, lowest decrease was observed in two year old seed lot (L_3) when treated with different priming treatments. Among varieties HJ 541 (V_2) show highest decrease in MET when treated with different treatments. The application of GA_3 treatment (T_4) showed highest decrease in MET followed by Hydration–dehydration + 0.25 % Thiram treatment (T_3) and lowest decrease with Hydration-dehydration (T_2). Similar finding were also reported in caper seeds by Pascual *et al.,* (2006).

Table.1 Effect of pre-sowing treatments on speed of emergence 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	
HC 136 (V_1)	5.95	6.00	6.65	6.89	6.32	**6.36**
HJ 541 (V_2)	7.02	7.28	7.76	8.45	7.60	**7.62**
Mean	**6.48**	**6.64**	**7.21**	**7.67**	**6.96**	

CD (P = 0.05) V=0.017, T=0.027, V x T=0.038

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

Varieties	Seed lots			Mean
	Fresh year (L_1)	One year old (L_2)	Two year old (L_3)	
HC 136 (V_1)	8.83	7.01	3.26	6.36
HJ 541 (V_2)	8.78	7.95	6.12	7.62
Mean	8.80	7.48	4.69	

CD (P = 0.05) V=0.017, L=0.021, V x L=0.030

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

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	7.99	8.43	9.20	9.93	8.46	**8.80**
One year old (L_2)	6.88	6.90	7.55	8.25	7.84	**7.48**
Two year old (L_3)	4.58	4.59	4.89	4.83	4.58	**4.69**
Mean	**6.48**	**6.64**	**7.21**	**7.67**	**6.96**	

CD (P = 0.05) L=0.021, T=0.027, L x T=0.047, V x L x T=0.066

Table.1 (d) Effect of pre-sowing treatments on speed of emergence of different seed lots and varieties of sorghum

Treatments	Effect on seed lots			Effect on varieties	
	Fresh seed (L$_1$)	One year old (L$_2$)	Two year old (L$_3$)	HC 136 (V$_1$)	HJ 541 (V$_2$)
T$_2$-T$_1$	0.44	0.01	0.01	0.05	0.26
T$_3$-T$_1$	1.21	0.67	0.31	0.70	0.74
T$_4$-T$_1$	1.94	1.37	0.25	0.94	1.43
T$_5$-T$_1$	0.46	0.95	0.01	0.37	0.58

V$_1$=HC 136, V$_2$=HJ 541, T$_1$ -Untreated (control), T$_2$ -Hydration-dehydration (6 hrs), T$_3$ -Hydration-dehydration (6 hrs) +0.25% thiram, T$_4$ -Hydration with GA$_3$ (50 ppm for 6 hrs), T$_5$ -Hydration with sodium molybdate (500 ppm for 6 hrs).

Table.2 Effect of pre-sowing treatments on seedling establishment percentage 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$_5$	
HC 136 (V$_1$)	46.00 (41.81)	48.00 (43.16)	49.78 (45.77)	55.11 (46.67)	46.11 (42.097)	**49.00 (43.762)**
HJ 541 (V$_2$)	57.56 (49.435)	59.00 (50.294)	62.00 (52.768)	66.44 (53.566)	60.22 (51.253)	**61.04 (51.463)**
Mean	**51.78 (45.622)**	**53.50 (46.725)**	**55.89 (48.923)**	**60.78 (50.120)**	**53.17 (46.675)**	

CD (P = 0.05) V=0.124, T=0.197, V x T=0.278

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

Varieties	Seed lots			Mean
	Fresh year (L$_1$)	One year old (L$_2$)	Two year old (L$_3$)	
HC 136 (V$_1$)	70.80 (57.37)	60.60 (50.80)	15.60 (23.13)	**49.00 (43.76)**
HJ 541 (V$_2$)	72.73 (59.57)	65.47 (54.01)	44.93 (40.82)	**61.04 (51.46)**
Mean	**71.77 (58.47)**	**63.03 (52.40)**	**30.27 (31.97)**	

CD (P = 0.05) V=0.124, L=0.152, V x L=0.216

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

Seed lots	Treatments					Mean
	T_1	T_2	T_3	T_4	T_5	
Fresh seed (L_1)	68.93 (56.66)	70.50 (57.08)	72.00 (60.03)	77.50 (61.66)	69.00 (56.88)	**71.77 (58.46)**
One year old (L_2)	59.00 (50.17)	61.50 (51.63)	64.67 (53.51)	67.50 (54.47)	62.50 (52.24)	**63.03 (52.40)**
Two year old (L_3)	26.50 (30.03)	28.50 (31.46)	31.00 (33.23)	37.33 (34.23)	28.00 (30.90)	**30.27 (31.97)**
Mean	**51.78 (45.62)**	**53.50 (46.73)**	**55.89 (48.92)**	**60.78 (50.12)**	**53.17 (46.68)**	

CD (P = 0.05) L=0.152, T=0.197, L x T=0.341, V x L x T=0.482

Table.2 (d) Effect of pre-sowing treatments on seedling establishment percentage of different seed lots and varieties of sorghum

Treatments	Effect on seed lots			Effect on varieties	
	Fresh seed (L1)	One year old (L2)	Two year old (L3)	HC 136 (V1)	HJ 541 (V2)
T_2-T_1	0.418	1.459	1.433	1.347	0.859
T_3-T_1	3.372	3.334	3.198	3.269	3.333
T_4-T_1	5.000	4.294	4.203	4.866	4.131
T_5-T_1	0.221	2.07	0.869	0.289	1.818

V_1=HC 136, V_2=HJ 541, T_1 -Untreated (control), T_2 -Hydration-dehydration (6 hrs), T_3 -Hydration-dehydration (6 hrs) +0.25% thiram, T_4 -Hydration with GA_3 (50 ppm for 6 hrs), T_5 -Hydration with sodium molybdate (500 ppm for 6 hrs).

Table.3 Effect of pre-sowing treatments on mean emergence time 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	
HC 136 (V_1)	6.750	6.670	6.687	6.634	6.730	**6.706**
HJ 541 (V_2)	6.363	6.323	6.253	6.161	6.323	**6.195**
Mean	**6.557**	**6.527**	**6.470**	**6.398**	**6.527**	

CD (P = 0.05) V=0.008, T=0.013, V x T=0.018

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

Varieties	Seed lots			Mean
	Fresh year (L$_1$)	**One year old (L$_2$)**	**Two year old (L$_3$)**	
HC 136 (V$_1$)	5.761	6.659	7.699	**6.706**
HJ 541 (V$_2$)	5.295	6.233	7.327	**6.195**
Mean	**5.528**	**6.446**	**7.513**	

CD (P = 0.05) V=0.008, L=0.010, V x L=0.014

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

Seed lots	Treatments					Mean
	T$_1$	**T$_2$**	**T$_3$**	**T$_4$**	**T$_5$**	
Fresh seed (L$_1$)	5.613	5.573	5.490	5.388	5.573	**5.528**
One year old (L$_2$)	6.508	6.475	6.420	6.355	6.473	**6.446**
Two year old (L$_3$)	7.548	7.532	7.500	7.450	7.533	**7.354**
Mean	**6.557**	**6.527**	**6.470**	**6.398**	**6.527**	

CD (P = 0.05) L=0.010, T=0.013, L x T=0.022, V x Lx T=0.055

Table.3 (d) Effect of pre-sowing treatments on mean emergence time of different seed lots and varieties of sorghum

Treatments	Effect on seed lots			Effect on varieties	
	Fresh seed (L$_1$)	**One year old (L$_2$)**	**Two year old (L$_3$)**	**HC 136 (V$_1$)**	**HJ 541 (V$_2$)**
T$_2$-T$_1$	-0.04	-0.033	-0.016	-0.02	-0.04
T$_3$-T$_1$	-0.123	-0.088	-0.048	-0.063	-0.11
T$_4$-T$_1$	-0.225	-0.153	-0.098	-0.116	-0.202
T$_5$-T$_1$	-0.04	-0.035	-0.035	-0.02	-0.04

V$_1$=HC 136, V$_2$=HJ 541, T$_1$ -Untreated (control), T$_2$ -Hydration-dehydration (6 hrs), T$_3$ -Hydration-dehydration (6 hrs) +0.25% thiram, T$_4$ -Hydration with GA$_3$ (50 ppm for 6 hrs), T$_5$ -Hydration with sodium molybdate (500 ppm for 6 hrs)

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. Application of GA$_3$ (50 ppm for 6 hrs.) was found to be the best priming treatment for improving the quality of seed followed by hydration- dehydration (6 hrs.) + 0.25% thiram treatments. All the priming treatments indicated maximum effect on HJ 541 followed by HC 136.

Acknowledgement

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