COMPARATIVE STUDY ON SPENT WASH AND WATER SEED PRIMING ON GERMINATION AND EARLY GROWTH TRAITS OF SORGHUM (*Sorghum bicolor L.*)

Aijaz Ahmed Soomro[1], Toqeer Ahmed Shaikh[2], Lal Chand[2], Majeeduddin Solangi[3], Ghulam Mustaffa Laghari[1]

[1]Department of Agronomy, Sindh Agriculture University, Tandojam, Pakistan
[2]Agriculture Extension Wing, Agriculture, Supply and Prices Department, Government of Sindh, Pakistan
[3]Department of Horticulture, Sindh Agriculture University, Tandojam, Pakistan
Email of corresponding author: professoraijazahmed@gmail.com
Contact #: 00923023473482

ABSTRACT: *Since long the real farming community has been facing the issue of low crop production. To overcome this issue many techniques have been introduced. Seed priming is one of them. Therefore, this study was carried out in complete randomized design (CRD) with three replications and four treatments. The seed of sorghum variety Sarokartuho was primed for two hours before sowing with four treatments including unprimed/un-soaked (control), primed in drinking water, spent wash with prepared concentrations of 50% and 100% respectively. The results indicated that water seed priming has significant effects on seed germination %(60.67%), root length (6.25 cm,) shoot length (8.36 cm) as well as root-shoot weights. The maximum shoot fresh weight (0.22 mg per plant) and root fresh weight (0.02 mg) were recorded under seed priming with water.*

Key words: Sorghum, spent wash, water, priming, germination, root, shoot

INTRODUCTION

Sorghum bicolor L.) ranks as the main cereal crop next to the wheat, rice and maize in the world. It is widely grown in Africa, India, China, the United States, Australia, Argentina, Mexico, Central and South America. The heat and drought resistance are two important features of the sorghum [1]. The substitute common names of sorghum are sweet sorghum, sorgo forrajero (Spanish), durra (Africa), guinea corn, black amber, chicken corn, shatter-cane, wild cane, broom corn, grain sorghum, forage sorghum, Sudan grass [2]. Furthermore, its subspecies are divided into four groups like grain sorghum e.g. milo, grass sorghum (pasture and hay), sweet sorghum (formerly called "Guinea corn", used to produce sorghum syrups) and broom corn (for making of brooms and brush). The name "sweet sorghum" is used to identify the species *Sorghum bicolor* that is sweet and juicy. Sorghum is used as a food for human being, feed for animals as well as used for the production of alcoholic beverages. This is an important food crop in Africa, Central America and south Asia [3]. Sorghum species choking the weeds, suppress nematodes and penetrates compacted sub-soil [4]. Sorghum biomass composition and agronomic evaluation studies revealed that sorghum forages could produce high biomass yields over a wide number of years using theoretical estimates for ethanol productions and the top ranged forage hybrids could average 6,146 L ha^{-1} of renewable fuels (bio-fuel) with a maximum production of 8,422 L ha^{-1}. These valuable findings and sorghums diversity as a feedstock for renewable fuels production has potential to serve alternative energy production strategies [5].

Spent wash is produced during production of alcohol, which is unwanted residual liquid [6]. At present, spent wash is released approximately 40,720,000 m tones from India alone annually while brewery produced. The spent wash is acidic in nature with pH 3.94 to 4.30 and contains organic as well as inorganic salts, therefore, it has high EC (30-45 dS/m). As it is a plant origin, therefore, it also contains a significant amount of plant nutrients and organic matter. It possesses nitrogen (N) ranges from 1660-4200 mg/l, phosphorus (P) Sorghum (from 225-3038 mg/l and potassium (K) from 9600-17,475 mg/l. Besides these all nutrients, it has calcium (Ca), magnesium (Mg), sulfate (SO) and chlorine (Cl) are also present in significant amounts. Thus, it can be effectively utilized well as a plant nutrient source and as a soil conditioner. Recently, the plant growth regulating agents like gibberellic acid (GA) and indole acetic acid (IAA) also detected present in an amount that is significant which further enhanced the nutritional value of spent wash [7]. High concentrations of Ca in spentwash (2050 7000 mg / l) may have potential in alkaline soil recovery similar to the impacts of gypsum [8].

The betterment of the physical constraints in cultivation of sorghum is beyond the control of resource farmers in rain-fed farming systems. On farm seed priming has been promised a solution to this problem. Therefore, Harries (1996) [9] had proposed seed priming with water, because it is low cost, low risk intervention, appropriate for all farmers, irrespective of farmers' socio-economic status. Similarly, while seed was primed (treated) with spent wash caused increased root-shoot length, biomass production as well as vigor [10]. Therefore, this highly important study has been carried out to assess the comparative effects of spent wash and water seed priming on seed germination and early growth traits of sorghum in order to release the valid source of seed priming for getting ideal initiation of the sorghum (Sorghum bicolor L.).

MATERIALS AND METHODS

The experiment was conducted at seed testing laboratory, Department of Agronomy, Sindh Agriculture University Tando Jam, Pakistan. The sorghum (*Sorghum bicolor L.*) seed of 'Sarokartuho' variety was received from Agriculture Research Institute, Sindh, Tando Jam and spent wash was provided by Mirpur khas Sugar Mills pvt. (Ltd). The study was carried out in completely randomized design (CRD) with three replications and 4 treatments including T1= unprimed/un-soaked (control), primed/soaked in drinking water, distilled spent wash with prepared concentrations of

50% and 100% respectively. The seed was primed with treatments for 2 hours before sowing. The treated seed of sorghum (*Sorghum bicolor L.*) was sown in Petri dishes on sterilized sand media then the germination% (10 days after seed sowing) and early growth traits (21 days after seed sowing) such as root-shoot length, root-shoot fresh weight and root-shoot dry weight were recorded. The data was statistically analyzed after getting the raw data with MSTAT-C to assess the significant effects of different concentrations of spent wash and water.

RESULTS

Seed germination (%)

The results for seed germination% in table 1 showed that the seed priming sources significantly affected on seed germination percentage of sorghum. The data in table indicated that maximum seed germination % (60.67) seed priming with water followed by 39.33 priming seed treated with 50/50 % water. While, distilled spent wash showed 38.67 seed germination % further results indicated that non-soaked seed (control) had adverse effects on seed germination% found 30 % respectively.

Table 1: Spent wash seed priming effects on germination (%) of sorghum (*Sorghum bicolor L.*)

Treatments	Germination %
Non soaked seed (Control)	30 C
Soaked seeds in drinking water	60.67 A
Soaked seeds in spent wash+water=50:50	39.33 B
Soaked seeds in undistilled spent wash=100%	38.67 B

SE= 0.5183, **LSD** 5% 1.794, **A,B,C,D**= Ranking (Grading) of seed germination according to its percentage,
S.E.= Standard Error, **LSD**= Least Significant Difference

Shoot length (cm)

The results for shoot length (cm) presented in table 2 that the seed priming sources significantly affected on shoot length of sorghum. The table showed maximum shoot length at 8.36 cm seed priming with drinking water followed by 6.61 cm was observed under non-soaked seed. While, distilled spentwash with 50% concentration showed 5.47 shoot length. Furthermore, results indicated that soaked seed with 100% concentration had adverse effects on shoot length found as 5.13 respectively.

Table 2: Spent wash seed priming effects on shoot length (cm) of sorghum (*Sorghum bicolor L.*)

Treatments	Shoot length (cm)
Non soaked seed (Control)	6.61 B
Soaked seeds in drinking water	8.36 A
Soaked seeds in spent wash+water=50:50	5.47 C
Soaked seeds in undistilled spent wash=100%	5.13 C

SE: 0.1722, LSD 5% 0.5960, cm= centimeter
A,B,C,D= Ranking (Grading) of seed germination according to its percentage, S.E.= Standard Error
LSD= Least Significant Difference

Root length (cm)

The results for root length (cm) of sorghum presented in table 3 and revealed that the seed priming sources significantly affect on root length of sorghum. The table indicated that the maximum root length was recorded 6.25 seed priming with water followed by 4.15 was observed by non-soaked seed (control) treatment. While, seed priming with 50% distilled spent wash showed 3.49 root length. Whereas, further results showed that 100% seed priming with spent wash had adverse affect on root length found as 3.09 respectively.

Table 3: Spent wash seed priming effects on root length (cm) of sorghum (*Sorghum bicolor L.*)

Treatments	Root length (cm)
Non soaked seed (Control)	4.15 B
Soaked seeds in drinking water	6.25 A
Soaked seeds in spent wash+water=50:50	3.49 C
Soaked seeds in undistilled spent wash=100%	3.09 D

SE: 0.06325, LSD 5% 0.2189, cm= centimeter
A,B,C,D= Ranking (Grading) of seed germination according to its percentage,
S.E.= Standard Error, LSD= Least Significant Difference

Shoot fresh weight (mg)

The results for shoot fresh weight (mg) presented in table 4 and showed that the seed priming sources significantly affect on shoot fresh weight of sorghum. The table showed maximum shoot fresh weight was 0.22 under seed priming with water followed by 0.13 was observed by priming seed treated with water only. While, distilled spent wash with 50% and 100% concentrations showed 0.10 and 0.10 shoot fresh weight respectively.

Table 4: Spent wash seed priming effects on shoot fresh weight (mg) of sorghum (*Sorghum bicolor L.*)

Treatments	Shoot fresh weight (mg)
Non soaked seed (Control)	0.13 B
Soaked seeds in drinking water	0.22 A
Soaked seeds in spent wash+water=50:50	0.10 C
Soaked seeds in undistilled spent wash=100%	0.10 C

SE: 0.005774, LSD 5% 0.01998, mg= milligram
A,B,C,D= Ranking (Grading) of seed germination according to its percentage
S.E.= Standard Error, LSD= Least Significant Difference

Root fresh weight (mg)

The results for root fresh weight (mg) presented in table 5 and showed that the seed priming sources non-significant affect on root fresh weight of sorghum. The table showed that the maximum root fresh weight was recorded as 0.02 seed priming with water followed by 0.01 was observed with non-soaked seed (control) condition. While, distilled spent wash with 50% and 100% concentrations showed 0.01 as minimum root fresh weight respectively. However, all of the treatments were statistically non significant.

Table 5: Spent wash seed priming effects on root fresh weight (mg) of sorghum (*Sorghum bicolor L.*)

Treatments	Root fresh weight (mg)
Non soaked seed (Control)	0.01 B
Soaked seeds in drinking water	0.02 A
Soaked seeds in spent wash+water=50:50	0.01 C
Soaked seeds in undistilled spent wash=100%	0.01 D

SE: 0.005774, LSD 5% , mg= milligram
A,B,C,D= Ranking (Grading) of seed germination according to its percentage, S.E.= Standard Error, LSD= Least Significant Difference

Shoot dry weight (mg)

The results for shoot dry weight (mg) presented in table 6 indicated that the seed priming sources non significantly affect on shoot dry weight of sorghum. The table showed maximum shoot dry weight was 0.009 seed priming with water followed by 0.007 was observed under non-soaked seed (control) treatment. Furthermore, results indicated that distilled spent wash with 50% and 100% concentrations showed 0.004 and 0.003 respectively that had adverse affect on shoot dry weight.

Table 6: Spent wash seed priming effects on shoot dry weight (mg) of sorghum (*Sorghum bicolor L.*)

Treatments	Shoot dry weight (mg)
Non soaked seed (Control)	0.007 B
Soaked seeds in drinking water	0.009 A
Soaked seeds in spent wash+water=50:50	0.004 C
Soaked seeds in undistilled spent wash=100%	0.003 D

SE: 0.005774, LSD 5%, mg= milligram
A,B,C,D= Ranking (Grading) of seed germination according to its percentage, S.E.= Standard Error
LSD= Least Significant Difference

Root dry weight (mg)

The results for root dry weight (mg) presented in table 7 and showed that the seed priming sources significantly affect on root dry weight of sorghum. The table showed maximum root dry weight 0.003 seed priming with water followed by 0.001 was observed under non-soaked (control) treatment. While, distilled spent wash with 50% concentration showed 0.001 root dry weight. Furthermore, results indicated that distilled spent wash with 100% concentration had adverse affect on root dry weight found as 0.001 respectively. However, all the treatments were statistically non significant.

Table 7: Spent wash seed priming effects on root dry weight (mg) of sorghum (*Sorghum bicolor L.*)

Treatments	Root dry weight (mg)
Non soaked seed (Control)	0.001
Soaked seeds in drinking water	0.003
Soaked seeds in spent wash+water=50:50	0.001
Soaked seeds in undistilled spent wash=100%	0.001

SE: 0.005774 , LSD 5%, mg= milligram
A,B,C,D= Ranking (Grading) of seed germination according to its percentage, S.E.= Standard Error, LSD= Least Significant Difference

DISCUSSION

The results of this study have witnessed that seed germination % and seedling establishment for better grain and fodder production of sorghum directly dependent variable upon water seed priming. Therefore, the germination% and early growth traits of the unprimed seeds were comparatively lesser than water primed seeds at significant level. The shoot-root length, shoot-root fresh weight and shoot-root dry weight resulted from water primed seed was significantly higher than those of control as well as different concentrations of spent wash. These findings are in agreement with those of Ramamurthy et al., (2005) [11] who had also recorded that water seed priming improved germination. In terms of other early growth traits such as shoot-root length, shoot-root fresh as well as dry weights were also significantly higher at water primed seed. Besides these parameters, it has also been observed that seedlings from water primed seeds were comparatively looking fresh and healthier than other environmental conditions. These findings are in similarity with those of Farooq et al., (2006)[12]; Sangare (2012) [13]their findings also tell that water primed seeds were better in terms of quantity and quality. The effects of spent wash on germination and early growth traits of sorghum are comparatively poor which proved that spent wash has negative effects upon all stages of the crop if it is used for seed priming source. Therefore, spent wash can be utilized as a source of fertilizer to the crops rather than seed primer Aijaz and Ayaz (2015)[14].

CONCLUSION

It is concluded from the findings that highest values for the parameters like seed germination%, shoot-root length, fresh and dry weight of shoot, fresh and dry weight of root were recorded for sorghum seed priming with water. But, the effective utilization of spent wash for agricultural purposes should be studied in scientific experiments to explore its ways and applied with other low concentrations. The usage of this valuable resource of agriculture has no any environmental threats and will play vital role in the mitigation of climate change.

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