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Research Paper

Effect of seed priming practices on yield and economics of winter (*rabi*) sorghum (*Sorghum bicolor*)

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 2017–18 and 2018–19 under rainfed condition at Dharwad, Karnataka, to evaluate the effects of different seed-priming practices on growth, yield and economics of winter (*rabi*) sorghum [*Sorghum bicolor* (L.) Moench] under rainfed conditions. The experiment was laid out in randomized complete-block design with 6 treatments and 4 replications. Significantly higher germination (91.2%) and dry matter at harvesting (179.5 g/plant) were recorded with KNO_3 (0.5%) seed priming. Seed priming with KNO_3 (0.5%) resulted in significantly higher grain yield (3.03 t/ha) which higher by 16.4, 9.0 and 4.5% over the control, seed priming with water and seed priming with $CaCl_2$ (2%)-RPP respectively. The higher grain yield was mainly attributed to higher 100-grain weight (2.472 g), ear weight (62.0 g/plant) and grain yield/plant (35.5 g). The same treatment realized higher gross returns (₹76.7×10^3/ha), net returns (₹45.1 × 10^3/ha) and benefit: cost ratio (2.43) as compared to the other seed priming practices.

Key words: Incremental cost, Incremental net returns, *Rabi* sorghum, Seed priming, Yield

Winter (rabi) sorghum is an important staple foodgrain for human beings and fodder crop for livestock of India. It is preferred over rainy season (*kharif*) sorghum owing to its superior quality of grain and fodder. As it mostly cultivated under rainfed conditions, the crop is prone to moisture stress in the event of low rainfall and drought. Its effect is still more in light, shallow soils and medium-deep soils due to their low moisture-holding capacity, resulting in lower crop productivity. *Rabi* sorghum is poor man's crop cultivated under low input management under rainfed conditions. Crop-stand establishment is of primary importance for optimizing production. However, at suboptimal environmental conditions, poor seed germination and subsequent poor field establishment is a common phenomenon and is one of the major obstacles in achieving higher yields (Mwale *et al*., 2003). Seed priming could play an important role in rapid germination and emergence for successful crop establishment. It is an effective technique to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield. The literature indicates that seed priming with nitrate salts could manipulate the yield-determining parameters successfully in many diverse environments and crops (Sharma *et al*., 2009). Seed priming treatment can lead to better germination and crop establishment in many crops such as maize, wheat and canola (Barsa *et al*., 2005). The present study was therefore carried out with an objective to evaluate the effect of different seed priming practices on growth, yield and economics of *rabi* sorghum under rainfed conditions.

The field experiment was conducted for 2 years during the winter (*rabi*) seasons of 2017–18 and 2018–19 under rainfed condition at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (15^{o}29' N, 74^{o}59' E, 689 m above mean sea level) and it comes under Northern transition zone (Zone-8) of Karnataka. The soil was clay loam, medium in organic carbon (0.57%), low in available nitrogen (251 kg/ha), medium in available phosphorous (21.46 kg/ha), high in available potassium (362.56 kg/ha) and calcareous in nature (8.15% free-$CaCO_3$ content), with *p*H 7.5. The experiment was laid out in randomized complete-block design with 4 replications. There were 6 treatments, consisting of the control, seed priming with water @ 1.5 litres/kg seed for 8 hours (overnight soaking), seed priming with $ZnSO_4$ (0.5%), seed priming with KNO_3 (0.5%), seed priming with KH_2PO_4 (0.5%) and seed priming with $CaCl_2$ (2%) for 8 hours (overnight soaking)- RPP (Recommended package of practice). Sorghum variety

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'SPV 2217' was sown at 45 cm × 15 cm spacing using a seed rate of 7.5 kg/ha. Before sowing, the seeds were soaked overnight in the solutions of $ZnSO_4$ (0.5%), KNO_3 (0.5%), KH_2PO_4 (0.5%) and $CaCl_2$ (2%). Then the seeds were dried under shade and used for sowing. A fertilizer dose of 50 kg and 25 kg N and P_2O_5/ha was applied in the form of urea and diammonium phosphate at the time of sowing. The other recommended package of practices were followed to raise a healthy crop. The Furadon 3G granules @12 kg/ha were applied to whorls of crop followed by Cymbush 10 EC spraying @ 10 ml/15 litres water to control shootfly and stem-borer. The crop was sown on 11 September 2017 and 21 September 2018 and harvested on 23 February 2018 and 14 February 2019. The data collected on different parameters at the harvesting were statistically analysed as described by Gomez and Gomez (1984) for better interpretation of results.

The results revealed that, the germination, growth, yield parameters and yield of *rabi* sorghum varied significantly due to different seed-priming practices (Table 1). The seed priming with KNO_3 (0.5%) resulted in significantly higher taller plants compared to rest of the except seed priming with $ZnSO_4$ (0.5%). The 100-grain weight was significantly higher in seed priming with KNO_3 (0.5%) over the control and was at par with rest of the seed-priming practices. Further the ear weight and grain yield/plant were significantly higher with KNO_3 (0.5%) seed priming (Table 1). Seed priming with KNO_3 in forage sorghum increased seedling emergence, cell-division and thus enhanced the plant height, leaf area and dry-matter production (Shehzad *et al*., 2012). The increase in ear weight was to an extent of 17.5 and 13.5% over the control and seed priming with water, respectively. Similarly, the grain yield/plant was 16.4 and 9.0% higher over the control and seed priming with water respectively. Increase in yield components and yield owing to seed priming with KNO_3 was reported by Singh *et al*. (2015) in sorghum. The seed priming with KNO_3(0.5%) produced resulted in significantly higher grain yield than all the seed priming practices and the control except the seed priming with $CaCl_2$ (2%)-RPP with which it was at par. These results confirm the findings of Rhaman et *al.* (2020). The increase in grain yield was to the tune of 16.4, 9.0 and 4.5% over control, seed priming practice with water and seed priming practice with $CaCl_2$ (2%)-RPP, respectively (Table 1). The higher grain yield was mainly attributed to higher values of yield parameters, *viz.* 100-grain weight, ear weight and grain yield/plant. The seed priming with KH_2PO_4 (0.5%) resulted in significantly higher fodder yield of 5.90 t/ha over the control (5.04 t/ha) and seed priming with $ZnSO_4$ (0.5%) resulted in 5.38 t/ha fodder yield and was at par with rest of the seed-priming practices. The harvest index was highest in seed priming with KNO_3 (0.5%) and lowest in seed priming with KH_2PO_4 (0.5%) as compared to rest of the seed-priming practices and the control. Vazirimehr *et al*.(2014) reported the highest germination, grain yield, fodder yield and harvest index owing to seed priming with KNO_3(0.5%) in maize. This was attributed to accelerated germination, shortening in the time of seed emergence and prevention of biotic and abiotic factors and also improved dry matter partitioning to grain.

The results indicated that the gross returns, net returns and benefit: cost ratio differed significantly with different seed-priming practices (Table 2). The data revealed that significantly higher gross returns (₹76.7 × 10^3/ha), net returns (₹45.1 × 10^3/ha) and benefit: cost ratio (2.43) were realized in seed-priming practice with KNO_3(0.5%) compared to all other seed-priming practices except seed priming with $CaCl_2$ (2%) (₹74.1×10^3/ha, ₹42.2×10^3/ha and 2.33). It could be mainly attributed to the higher grain and fodder yield. The per cent increase in net returns with seed priming practice with KNO_3(0.5%) was to an extent of 18.0 over the control and 14.8 over the seed priming with water. Similar results were reported by Chivasa *et al.*(2000)

Table 1. Yield and yield components of winter (*rabi*) sorghum as influenced by seed-priming practices (pooled data of 2 years)

Treatment	Germination (%)	Plant height (cm)	Dry-matter production (g/plant)	100-grain weight (g)	Ear weight (g/plant)	Grain yield /plant(g)	Grain yield (t/ha)	Fodder yield (t/ha)	Harvest index (%)
Control	66.3	230.4	141.5	2.24	54.5	29.3	2.53	5.04	31.5
Seed priming with water	73.1	230.2	154.2	2.43	57.9	30.7	2.76	5.54	30.8
Seed priming with $ZnSO_4$ (0.5%)	90.3	235.2	175.6	2.46	59.2	31.4	2.87	5.38	31.2
Seed priming with KNO_3 (0.5%)	91.2	237.5	179.5	2.47	62.0	35.5	3.03	5.62	31.7
Seed priming with KH_2PO_4 (0.5%)	88.8	230.0	164.8	2.53	61.5	33.3	2.68	5.90	29.0
Seed priming with $CaCl_2$ (2%)- RPP	90.1	232.8	174.9	2.46	60.5	35.2	2.89	5.82	29.9
SEm±	0.4	1.3	1.5	0.05	1.7	0.7	0.05	0.14	0.4
CD (P=0.05)	1.2	4.2	4.5	0.17	5.2	2.2	0.14	0.42	1.3

RPP, Recommended package of practice