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Standardisation of seed priming technique to enhance the production of maize (*Zea* mays L.) under dryland conditions

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Abstract
The effect of seed priming practices on growth, yield and economics of maize under rainfed conditions in south east Rajasthan on a clay loam soil was studied with various treatment seed priming treatments in *kharif*. Results reveals that, seed priming with KH_2PO_4 @2% for 6 hours recorded significantly higher maize grain yield (3059 kg ha^{-1}) followed by with K_2SO_4 @2% (3025 kg ha^{-1}) which were 24.15 and 22.75 percent higher over no priming (2464 kg ha^{-1}), respectively . The net monitory returns under these treatments were also obtained higher (Rs 50542 ha^{-1} and Rs 50584 ha^{-1}, respectively) with benefit cost ration (3.07 and 3.05, respectively). Similarly, KH_2PO_4 @2% recorded highest RWUE (5.036 kg grain ha^{-1} and Rs.69.75 ha^{-1} per mm rainfall). Seeds primed with KH_2PO_4 @ 2% for 6 hour was significantly increased plant height (8.7%), dry weight of plant (41.5%), number of grains per cob(15.5%), cob length (17.69%), grain weight per cob (19.05%) and test weight (12.6%) in comparison to no priming.

Keywords: Seed priming, KH_2 PO_4, germination, vigour seedling

Introduction

Maize (*Zea mays* L.) is the third important cereal next only to rice and wheat in the world as well as in India. In India, it is grown in an area of 7.59 million/ ha with a production of 15.1 million tonnes (Anonymous. 2008) [2] and the average productivity is 1938 kg ha^{-1} (Anonymous. 2007) [1]. By 2020 AD, the requirement of maize in various sectors will be around 100 million tonnes. It is a great task for the agriculturists to increase the maize production from the present level of 34 to 100 million tonnes (Seshaiah, 2000) [17] The option is to increase the maize productivity and production in per unit area and time, which can be achieved through selection of genotype and application of proper production management techniques.

Water scarcity is becoming an increasingly important issue in many parts of the world. Since agriculture is the major water user, efficient use of water in agriculture is needed for conservation of this limited resource. Increase in water use-efficiency for enhanced drought tolerance can be achieved by different strategies such as change of crops capable of producing acceptable yields under deficit irrigation or rainfed situations (Zwart and Bas Tiaanssen, 2004; Basu, *et al*., 2005 and Farre and Faci, 2006) [20, 4, 6] or by strategies involving agronomic practices like different seed-priming methods (Harris *et al*., 1999) [7] particularly at on-farm level. Significant yield losses in maize (*Zea mays* L.) from drought are expected to increase with global climatic change in key traditional production areas. Maize often suffers from drought stress between flowering and grain filling (40-80% yield loss). So drought is considered to be a major factor affecting plant growth and yield in rainfed areas. In southern Rajasthan, maize is a major crop cultivated in rainfed areas of Bhilwara, Chittorgarh, Rajsamand, Udaipur, Pratapgarh, Dungarpur and Banswara district. In Bhilwara disrict, maize covers more than 50 per cent area of the agricultural land during *kharif* season. It is a high water demanding crop, and can produce high grain yields (4–6 Mg ha^{-1}) when water and nutrients are not limiting. However, maize is sensitive to water stress and other environmental stresses around flowering period (Cakir, 2004 and Pandey et. Al., 2000) [5, 13].

Poor crop stand is one of the major abiotic constraints encountered by resource-poor farmers in marginal areas in India (Harris *et al*. 1999). Reasons for this include, low quality seed, inadequate seedbed preparation, untimely sowing, poor sowing technique, inadequate soil moisture, adverse soil properties (e g crusting) and high temperatures. Effective amelioration of these physical constraints is often beyond the control of resource-poor farmers in rainfed farming systems. Harris, *et al*., 2001 [8] reported that a simple, low-cost, low-risk intervention; on-farm seed priming can, if refined and developed using farmer-participatory approaches, make a positive impact on farmers livelihoods by increasing the rate of crop emergence, thus increasing rates of crop development, reducing crop duration and raising yields. Nowadays, seed priming has been identified as an integrated common seed treatment to reduce the time between seed sowing and seedling emergence and the synchronization of emergence (Parera and Cantliffe, 1990) [15]. Seed priming is a controlled hydration process that involves exposing seeds to low water potentials that restrict germination, but permits pre-germinative physiological and biochemical changes to occur (Khan, 1992) [10]. Basra, A.S., Bedi and Malik, 1988 [3] Found that priming of corn seed using potassium salts (K_2HPO_4 or K_2SO_4) resulted in accelerated germination even at a chilling field temperature (10 °C). Priya, *et al*., 2011 [12] in maize found that hydro priming of seeds with water had advanced the germination and emergence leading to improved crop stand. Several other literatures in various crops. Basu, *et al*.; Rashid, *et al.* and Windauer, *et al*., 2007 [4, 16, 19] also revealed that seed priming could advance the process of germination, improve the initial quality characters, improve field emergence, better establishment, crop stand and increase yields in many diverse environments. Present study was taken up with the objective of evaluating different seed-priming practices and their effect on growth and yield of maize.

Materials and Methods

The field experiment was conducted during the rainy (*kharif*) season of 2010-12 at Dryland Farming Research Station Arjia, Bhilwara a unit of Maharana Pratap University of Agriculture and Technology, Udaipur. Bhilwara is situated 29º20'N latitute, 74º40' longitute at 463 m above mean sea level. During 2010-2012 the experiment was carried out with three replications in Randomised Block Design. The experimental field prior to experimentation was low in organic carbon (0.36), available (nitrogen 207 kg/ha), phosphorous (31.6 kg/ha) and high in potash (224 kg/ha) with alkaline reaction (pH 7.87). The soil texture was sandy loam with good water-holding capacity. To study the effect of different seed priming practices on growth and yield of maize, the full mature seeds of maize having 95% germination were taken and experiment comprising twelve (12) treatments *viz.*, T_1- No priming, T_1- Water socked, T_3- KCI @ 1%, T_4- KCI @ 2%, T_5- K_2SO_4 @1%, T_6- K_2SO_4 @ 2%, T_7- CaCl @ 1%, T_8-CaCl @ 2%, T_9- KH_2PO_4 @ 1%, T_9- KH_2PO_4 @ 2%, T_{11}-Thiourea @ 500 ppm and T_{12}-Thiourea @ 1000 ppm. The seeds were soaked in double the volume of solutions for 6 hours. After priming, the seeds were removed from the solutions, rinsed in water, shade dried at room temperature and subjected to germination test as outlined by ISTA, 1999 [9]. The rainwater use efficiency (RWUE) calculates by the formulas given below:

RWUE (Rainwater use efficiency) kg grain ha^{-1} mm^{-1} rainfall

$$= \frac{\text{Grain yield (kg ha−1)}}{\text{Rainfall during crop duration in mm}}$$

RWUE (Rainwater use efficiency) Rs. ha^{-1} mm^{-1} rainfall

$$= \frac{\text{Net monetary returns (Rs ha − 1)}}{\text{Rainfall during crop duration in mm}}$$

The unprimed seeds were used as control. The treatments were laid out in randomized block design with three replications. The data obtained from experiments were analysed by the 'F' test of significance following the methods described by (Panse and Sukatme, 1985) [14].

Results and Discussion

Effect on growth components of maize

Plant population is not significantly influenced by seed priming of maize. Plant height is being influenced by environmental conditions and management practices, seed priming of maize by KH_2PO_4 @ 1 percent solution for 6 hours plant height (191.1 cm) of maize was significantly increased followed by K_2SO_4 @ 2 percent (189.7 cm) and KH_2PO_4 @ 2 percent (188.1 cm) in comparison to no priming of seed (175.8 cm). The data pertaining to the effect of priming on number of days to 50 per cent silking were also significantly influenced and seed priming of maize by KH_2PO_4 @1 percent solution for 6 hours significantly reduced the days to silking followed by K_2SO_4 @ 2 percent and KH_2PO_4 @ 2 percent in comparison to no priming of seed (Table 1). Similar trend were also recorded by significantly increase the dry weight of plant. The beneficial effect of seed priming persisted upto harvest because early emergence and vigour seedling growth improve the plant height, improve the flowering behaviour (days to 50 per cent flowering), number of grains per cob, cob length, grain weight per cob and test weight of seed of maize. These findings support the views of (Murungu, *et al. m 2004;* Subedi and Ma, 2005) [11, 18].

Effect on yield components and Yield of maize

Crop yields are influenced by growth and yield components. During the present investigation in all three years, seed priming of maize significantly increased the grain and stover yield of maize. However, seed priming by KH_2PO_4 @ 1 percent solution for 6 hours significantly increased the maize grain yield (3059 kg/ha) followed by K_2SO_4 @ 2 percent (3025 kg/ha) and KH_2PO_4 @ 2 percent (2958 kg/ha) and resulted in yield increases to the tune of 24.15 per cent, 22.77 percent and 20.05 per cent, respectively as compared to no priming of seed (2464 kg/ha) Table 2. Similarly, seed priming by KH_2PO_4 @ 1 percent solution for 6 hours significantly increased the maize stover yield (5998 kg/ha) followed by K_2SO_4 @ 2 percent (5952 kg/ha) and resulted in yield increases to the tune of 14.42 per cent and 13.54 percent, respectively as compared to no priming of seed (5242 kg/ha) while rest of the treatment were at par with no priming (Table 2). The significant variations in yields attributed to variations in the yield components of crops under study. Cob length of maize was significantly influenced due to priming. Priming of maize seed by KH_2PO_4 @ 1 percent solution for 6 hours significantly increased the cob length (18.11 cm) followed by K_2SO_4 @ 2 percent (17.51 cm kg/ha) and KH_2PO_4 @ 2 percent (17.29 cm) as compared to no priming of seed (15.02 cm) Table 1. Further, number of grains per cob was also significantly influenced due to priming. of seed priming by KH_2PO_4 @ 1 percent solution for 6 hours obtained significantly higher number of grains per cob (358) followed by K_2SO_4 @ 2 percent (347) and remaining priming treatment at par in comparison to no priming of seed (289) Table 1. Similar trend were also observed in grain weight per cob and test weight due to seed priming of maize (Table 1). The results are in conformity with the findings reported by Priya, *et al*., 2011 [12].

Seed Priming Practices Economics of Maize

Economics of maize was influenced by priming treatments. However, seed priming by KH_2PO_4 @ 1 percent solution for 6 hours obtained highest gross return (Rs. 66997 ha^{-1}) followed by under K_2SO_4 @ 2 percent (Rs. 66339 ha^{-1}) which obtained additional benefit Rs. 12003 and Rs. 11345 per hectare as compared to no priming (Rs. 54994 ha^{-1}), respectively. Similarly, seed priming by KH_2PO_4 @ 1 percent solution for 6 hours obtained highest net monitory return (Rs. 50542 ha^{-1}) followed by under K_2SO_4 @ 2 percent (Rs. 50184 ha^{-1}) with benefit cost ratio 3.07 and 3.05, respectively. Whereas, under seed priming by KH_2PO_4 @ 1 percent recorded highest rainwater use efficiency (RWUE) in term of 5.036 kg grain ha^{-1} mm^{-1} rainfall and in term of Rs. 69.75 ha^{-1} mm^{-1} rainfall. Similar results were reported by Priya, *et al*., 2011 [12].

Table 1: Growth characters and yield attributes of maize as influenced by different seed priming chemicals (Plood-2010-2012)

Treatments	Plant population per plot (24.0sqm)	Plant height (cm)	Days to 50% silking	Dry weight of plant (g)	Cob length (cm)	No. of grains per cob	Grain weight per cob (g)	Test weight (g)	Harvest Index
No priming (Control)	96.00	175.8	70.67	93.28	15.03	289	110.73	187.73	30.64
Water Soaking	93.33	176.7	70.00	96.80	15.36	297	111.06	192.28	31.08
KCL @1%	101.33	175.5	68.67	101.20	16.72	310	124.65	201.44	30.57
KCL @2%	101.33	179.2	68.33	110.00	15.91	316	113.04	198.73	30.97
K_2SO_4 @1%	98.33	186.9	67.67	119.68	16.85	347	169.43	201.58	30.91
K_2SO_4 @2%	98.67	189.7	66.67	129.80	17.51	328	177.63	212.43	31.19
$CaCl_2$ @1%	101.33	184.7	69.67	123.20	16.68	320	121.20	204.71	30.72
$CaCl_2$ @2%	96.00	184.3	69.00	112.20	16.06	311	129.52	216.60	31.01
KH_2PO_4 @1%	98.67	191.1	66.77	132.00	18.11	358	181.83	217.26	30.91
KH_2PO_4 @ 2%	98.67	188.1	66.33	125.40	17.29	334	175.93	210.94	31.29
Thiourea @ 500 ppm	98.67	185.5	68.67	110.44	16.74	319	133.72	194.38	30.74
Thiourea@ 1000 ppm	96.00	181.3	69.33	103.84	16.40	313	121.96	192.84	31.14
S. Em±	4.26	4.3	1.016	4.454	0.611	15.5	4.733	7.76	0.68
C.D. (P=0.05)	NS	12.7	2.974	13.039	1.789	45.4	13.855	23.05	NS

Table 2: Yield and economics of maize as influenced under different priming agents (pooled-2010-12)

Treatment	Grain yield (kg/ha)				Stover yield (kg/ha)				CC (Rs./ha)	GR (Rs./ha)	NR (Rs./ha)	BCR	RWUE (kg grain/ ha/mm)	RWUE Rs./ha/mm rainfall
	2010	2011	2012	Pooled	2010	2011	2012	Pooled						
No priming(Control)	2350	2312	2731	2464	5337	4215	6175	5242	16075	54994	38919	2.42	4.057	54.18
Water Soaking	2420	2403	2805	2543	4665	4493	6217	5125	16225	56044	39819	2.45	4.187	55.36
KCL @1%	2320	2611	2897	2609	4325	4847	6587	5253	16285	57486	41201	2.53	4.295	57.21
KCL @2%	2913	2646	2915	2825	5191	4805	6500	5499	16345	61772	45427	2.78	4.651	62.90
K_2SO_4 @1%	2760	2673	3054	2829	4649	4965	6824	5479	16335	61792	45457	2.78	4.658	62.94
K_2SO_4@2%	2970	2792	3314	3025	4710	5944	7203	5952	16455	66639	50184	3.05	4.980	69.27
$CaCl_2$@1%	2694	2701	3163	2853	4820	5027	7131	5659	16300	62649	46349	2.84	4.697	64.14
$CaCl_2$@2%	2849	2673	2941	2821	4853	4777	6543	5391	16375	61435	45060	2.75	4.644	62.40
KH_2PO_4@1%	2850	2937	3389	3059	4744	5673	7576	5998	16455	66997	50542	3.07	5.036	69.75
KH_2PO_4 @2%	2903	2764	3206	2958	4921	5152	7042	5838	16685	62048	45363	2.72	4.870	62.79
Thiourea @ 500 ppm	2823	2528	2881	2744	5142	4784	6488	5471	16375	60326	43951	2.68	4.518	60.89
Thiourea@ 1000 ppm	2463	2458	2845	2589	4945	4666	6292	5301	16525	57266	40741	2.47	4.262	56.51
S.Em±	124	183	173	67.1	308	168	359	236.8						
C.D. (P=0.05)	364	547	515	196.8	902	492	1067	694.5						
Rainfall (mm)	712.0	592.0	518.2	607.4										

Conclusion

Seed priming of maize in KH_2PO_4 @ 2 percent solution for 6 hours, significantly increase plant height, dry weight of plant, cob length, number of grain per cob, grain weight per cob, test weight and finaly recorded the 24.15 percent higher maize grain yield followed by 22.75 percent higher with K_2SO_4 @ 2 percent solution over no priming (2464 kg ha^{-1}), respectively. The net monitory returns under these treatments were also obtained higher with benefit cost ration (3.07 and 3.05, respectively). Similarly, KH_2PO_4 @2% recorded highest RWUE (5.036 kg grain ha^{-1} per mm rainfall and Rs.69.75 ha^{-1} per mm rainfall).

References

1. Anonymous. Agricultural statistics at a glance. Directorate of Economics and Statistics, New Delhi, 2007.
2. Anonymous. State wise estimates of value of output from agriculture and allied activities. Central Statistical Organisation, Ministry of Statistics and Programme implementation, Government of India, 2008.
3. Basra AS, Bedi S, Malik CF. Accelerated germination of maize seeds under chilling stress by osmotic priming and associated changes in embryo phospholipids. Ann. Bot. 1988; 61:635- 639.
4. Basu S, Sharma SP, Dadlani M. Effect of hydro priming on field emergence, crop performance and seed yield of maize parental lines during winter and spring-summer season. Seed Res. 2005; 33:24-27.
5. Cakir R. Effect of water stress at different development stages on vegetative and reproductive growth of corn. Field Crops Research. 2004; 89:1-6.
6. Farre I, Faci JM. Comparative response of maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* L. Moench) to deficit irrigation in a Mediterranean environment. Agriculture Water Management. 2006; 83:135-143.
7. Harris D, Joshi A, Khan PA, Gothkar P, Sodhi PS. On-farm seed priming in sem-arid agriculture: Development and evaluation in maize, rice and chickpea in India using participatory methods. Experimental Agriculture. 1999; 35:15-29.
8. Harris D, Pathan AK, Gothkar P, Joshi A, Chivasa W, Nyamudeza P. On-farm seed priming: Using

participatory methods to revive and refine a key technology. Agriculture Systems. 2001; 69(1, 2):151-164.
9. ISTA. International Rules of Seed Testing. Seed Sci. & Technol. 1999; 27:27 - 32.
10. Khan AA. Preplant physiological seed conditioning. Hort. Rev. 1992; 13:131-181.
11. Murungu FS, Chiduza C, Nyamudeza P, Clark LJ, Whalley WR. Effect of on-farm seed priming on emergence, growth and yield of cotton and maize in semi-arid areas of Zimbabwe. Experimental Agriculture. 2004a; 40:23-36.
12. Priya P, Patil VC, Arvind Kumar BN. Effect of Seed Priming Practices on Growth, Yield and Economics of Maize (*Zea mays* L.) Based Cropping Systems under Rainfed Conditions in Northern Karnataka. Research Journal of Agricultural Sciences. 2011; 2(3):502-508.
13. Pandey RK, Maranville JW, Admon A. Deficit irrigation and nitrogen effects on maize in a Sahelian environment. I. Grain yield and yield components. Agriculture Water Management 2000; 46:1-13.
14. Panse VG, Sukatme PV. Statistical Methods for Agricultural Workers. ICAR publication, New Delhi, 1985, 359.
15. Parera CA, Cantliffe DJ. Improved stand establishment of *shrunken-2* sweet corn by seed treatments. Proc. Fla. State Hort. Sci. Soc. 1990; 103:153157.
16. Rashid A, Hollington PA, Harris D, Khan P. On farm seed priming for barley on normal, saline and saline-sodic soils in North West Frontier Province, Pakistan. Europ. J Agronomy. 2006; 24:276-281.
17. Seshaiah MP. Sorghum grain in poultry feed. In: Technical and institutional options for sorghum grain mould management; Proc. Intl. Consulation, Chandrasekaran, A., R. Bundyopadhyay and H.I. Hall (Eds.). ICRISAT, Patencheru, Andhra Pradesh, India, 2000, 240-241.
18. Subedi KD, Ma BL. Seed priming does not improve corn yield in a humid temperate environment. Agronomy Journal. 2005; 97:211-218.
19. Windauer L, Altuna A, Arnold RB. Hydrotime analysis of *Lesquerella fendleri* seed germination responses to priming treatments. Industrial Crops and Products. 2007; 25:70-74.
20. Zwart SJ, Bas Tiaanssen WGM. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Agriculture Water Management. 2004; 69:115-133.