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On-farm' seed priming with water- A cost-effective way to increase the sorghum yields of resource poor farmers

Rao P. S.[1], Rajasri M.[2], Sudharani M.[3] and Ankaiah R.[4]

ABSTRACT: *Crop establishment is often poor in the semi-arid tropics regions particularly under sub optional soil conditions. The effect of on-farm seed priming on sorghum yield was studied on sorghum cv M 35-1 in the farmers' fields at 9 different locations across 3 districts viz., Ranga Reddy, Mahabubnagar and Kurnool of Andhra Pradesh, India during rabi, 2010 and 2011 under rainfed situation in red loamy soils. Seed priming improved germination and vigour of the crop which helped to improve a good plant stand, which in turn led to record significantly higher grain yield (11%) of sorghum over non-primed condition. Priming significantly improved the mean germination per centage (93), field emergence (89 %) and final plant stand (26) over control. Farmers opinined that seed priming helped in improving the crop establishment i.e., hastening germination, maturity and harvest and reduced the effect of dry spell as well as pest and disease incidence. On-farm seed priming is a non-cash input, which helps to establish good crop stand and increased yields by 14.3 per cent. For resource poor farmers of low rainfall regions and marginal lands of Ranga Reddy, Mahabubnagar and Kurnool districts of Andhra Pradesh, seed priming is a key technology to sustain sorghum production.*

Keywords: *Seed priming, Participatory evaluation, Rainfed sorghum, Stand establishment*

Sorghum is a warm season crop growing well in tropical and subtropical climates. The optimum temperature for germination of sorghum is between 23^0 and 25^0 C. One of the major problems in the production of crops, especially in dry and semi-arid regions is poor establishment (Aboutalebian *et al*. (2012). Poor germination is common at sub - optimal temperature conditions. In India and elsewhere, rain fed sorghum is a dominant traditional land use system. Sorghum is grown mainly for its grain consumption and its stalks are utilized to meet fodder requirement of animals. Poor crop establishment is one of the major constraints reported by the farmers cultivating sorghum. The factors responsible for poor crop stand establishment may be biotic and abiotic stresses. The abiotic factors include low quality seed, inadequate seedbed preparation, abnormal rainfall distribution etc. Resource poor farmers in marginal areas suffer more (Harris 1992; 1996) than others due to these abiotic constraints. On farm seed priming (soaking seed in water) has been offered as a solution to this problem. The principle of priming is based on the fact that it is possible to hydrate seed in some ways at a moisture level sufficient to initiate the early events of germination but not sufficient to permit radical protrusion. Water uptake during hydro priming is governed only by the affinity of the seed tissue for water. Seeds are imbibed on moistened blotters or soaked in water. Because water is not limited, seeds can eventually germinate assuming that they are viable, not dormant, and optimal conditions are provided. Therefore, in uncontrolled systems the process must be arrested at a specific time to prevent radical protrusion. Harries (1996) proposed this low cost, low risk intervention termed on-farm seed priming that would be appropriate for all farmers, irrespective of their socio-economic status. Harris *et al*. (2001) observed that on-farm seed priming improved the rate of crop establishment reduced crop duration and increased yields in rice, maize and chickpea. Murungu *et al*. (2004) reported that the effect of priming depend upon the crop species and seasonal rainfall. Seed priming is not a new technology and has been a recommended practice in many crops in India. But farmers do not appreciate the wide range of benefits from this low-cost, low-

* Seed Research & Technology Centre, ANGRAU, Hyderabad 530 030 (A. P.) India, *E-mail:sampalrao@gmail.com*

risk practice unless they are given the opportunity to experiment for themselves. If, this technology is refined and developed using participatory approaches, it will have a positive impact on the livelihood of resource poor farmers. The participatory approach carried out by Ramamurthy *et al.* (2005) under Technology Assessment and Refinement through Institute-Village Linkage Programme was successful to sustain sorghum production of rain fed resource poor farmer at Vidarbha region of Maharashtra.

The current study reports the results of participatory evaluation of seed priming (Hydro priming) technology in nine locations constituting three villages of each district of Ranga Reddy, Mahabubnagar and Kurnool of Andhra Pradesh, India.

MATERIALS AND METHODS

Seed material

The villages, where participatory evaluation was conducted are located at 16^0 30′ and 18^0 20′ of North Latitude and 77^0 30′and 79^0 30′ of East Longitudes of Ranga Reddy; 16° 73′ N and 77° 98' E of Mahbubnagar and between Latitude 14.15-15.11 N Longitude 76.53-78.25 E of Kurnool district. The sorghum cv M 35-1 which had a germination per cent of above minimum seed certification standard (80%) is utilized for the study. The experiment was conducted during *rabi* (2010-11) in red loamy soils. The seed material was sterilized by using 30% sodium hypochlorite for five minutes and then washed three times with distilled water. Half of the seed was subjected to hydro priming using water (1:1). The seed was placed in wet sand for 16 hours at 25^o to 30^o C and sieved to separate seed. The seed material was shade dried till it reaches its original moisture. The treatments used were: Hydro-priming (T1) and non-soaked and non-dried treatment as control (To) rabi seasons (2010 and 2011). The rainfall pattern during experimentation in three districts of Andhra Pradesh state during *rabi* (Oct-Dec) for the years 2010 and 2011 presented in figure 1.

Methodology

On–farm trials were conducted at farmer's fields in nine villages viz., Kodangal, Peddemul, Anantharam Thanda of Ranga Reddy; Machanpalli, Gurukunta, Ayyavaripally of Mahbubnagar and Tanguturu, Mithnala and Nandupally villages of Kurnool district respectively during rabi 2010 and 2011.

S. No.	*Name of the Village & Mandal*	*District*
1	Kodangal	Ranga Reddy
2	Peddemul	Ranga Reddy
3	Anantharam thanda	Ranga Reddy
4	Machanpalli	Mahbubnagar
5	Ayyavaripally, Midgin mandal	Mahbubnagar
6	Gurakunta, Navabpet mandal	Mahbubnagar
7	Tanguturu village, Banaganapalii	Kurnool
8	Mithnala village, Pandyam(M),	Kurnool
9	Nandupally, Nandyal	Kurnool

During the years, the sorghum cv. M 35-1 was tested in each village on medium deep (25-50 cm) red soils. Three farmers from each village were selected for recording observations. Farmers were trained to prime the seed and allowed to take up sowing in extent of 0.5 acre of land with hydro primed seed and other 0.5 acre using non- primed seed. The package of practices followed for both the plots were absolutely same during the season. The data were analyzed by using Factorial Randomized Block (FRB) design.

RESULTS AND DISCUSSION

Effect of seed priming on Germination

Hydro priming of sorghum seed significantly improved the mean germination percent during *rabi* 2010 (93%) as well as 2011 (83%) over non primed seed which recorded as mean germination percent of 88 and 78, respectively among the nine locations demonstrated. Nouman *et al.* (2012) reported that priming improves the germination and plant vigour of rangeland grasses. Harris *et al.* (1999) found that hydropriming enhanced seedling establish-ment and early vigour of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields.

Effect of seed priming on Field emergence

Similarly hydro priming of sorghum seed reflected in significant improvement in field emergence during the study period. The primed seed plots recorded a mean field emergence of 89 per cent while it was 83 percent in untreated control during 2010. Similar improvement in field emergence was also observed during 2011 in all the nine locations tested; many locations showed significant improvement is field emergence. The primed plots recorded a mean field emergence of 77% while non primed plots showed lower field emergence (70%). Harries *et al.* (2001) reported that priming was effective to improve mineral content of the seed which can be attributed to the early emergence and improved growth.

Effect of seed priming on Final plant stand

The final plant stand showed numerical superiority of primed plots over control during 2011 (Table 2) and significant improvement was noticed during 2010, where the mean plant stand was 26 hills/ sq.m while the non primed control recorded 20 hills/sq m. Earlier workers (Nagar *et al*. (1998) showed hydropriming of maize seeds had rapid seedling emergence and improved field stand. Similarly, Mumtaz Khan *et al*. (2003) reported that primed seeds have more protein metabolism ability, enzyme activity. Rowse (2001) reported that hydro primed corn seeds had better germination and establishment due to reduction in time of water absorption. According to results of Aboutalebian *et al.* (2012) only priming treatments had significant effect at 1% on speed and percentage emergence.

Effect of seed priming on Grain yield

As seen in Table 1 and 2 priming of sorghum cultivar M 35-1 realised numerical superiority with respect to mean grain yield among the nine locations (20.60 q/ ha) over control (18.09 q/ha) during 2010. Similarly during 2011 also priming realised higher grain yield of 18.47 q/ha while control recorded (16.12q/ha) across the locations. Harries *et al*. 2007 reported that seed priming with Zinc sulphate and water loss incurred the grain yield of maize respectively 27% and 14% that is convening with the results of the study. Further Harries *et al*. 2004 reported 16% wheat yield incurred by on farm seed priming with zinc sulphate solutions.

Farmer's opinions on seed priming are quantified at the end of second season of on-farm trials. Most of the farmers reported that they have observed early germination and good plant stand. It was also noticed that primed plants did not show early wilting symptoms unlike that of non-primed. The farmers agreed that seed priming helped them to harvest the crop almost one week early with higher yield than non-primed. When they were asked if they would prime seeds next year, 60 per cent of all the farmers replied that they would.

Table 1
Sorghum (M 35-1) germination, final plant stand, field emergence and grain yield as influenced by on farm seed priming during *rabi* 2010

Location	*Germination (%)*			*Field emergence (%)*			*Plant stand (m^{-2})*			*Grain yield (q/ha)*		
Treatment	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*
1	90	99	94	85	91	88	12	15	13.5	14.80	17.64	16.22
2	86	97	91	80	92	86	13	14	13.5	23.82	27.30	25.56
3	85	89	87	79	84	81	13	16	14.5	13.86	16.00	14.93
4	90	96	93	86	93	89	24	28	26.0	18.80	19.85	19.32
5	93	95	94	86	92	89	24	27	25.5	17.43	20.40	18.91
6	92	93	92	87	90	88	32	36	34.0	19.45	21.48	20.46
7	78	83	81	73	80	76	17	22	19.6	18.75	20.73	19.74
8	86	94	90	89	92	90	24	27	25.5	17.81	21.26	19.54
9	90	94	92	83	89	86	21	25	23.0	18.11	21.25	19.68
Mean	88	93		83	89		20	26		18.09	20.66	
CD(0.05)			3.16			3.82			3.12			6.63

To: Unprimed seed T1: Primed seed

Table 2
Sorghum (C-35-1) germination, final plant stand, field emergence and grain yield as influenced by on farm seed priming during *rabi* 2011

Location	*Germination (%)*			*Field emergence (%)*			*Plant stand(m^{-2})*			*Grain yield (q/ha)*		
Treatment	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*	*To*	*T1*	*Mean*
1	80	89	84	72	80	76	11	13	12	13.00	14.64	13.82
2	75	87	81	70	79	74	12	11	11	20.82	22.30	21.56
3	75	79	77	65	85	75	13	15	14	12.84	15.95	14.39
4	81	86	83	70	73	71	26	24	25	17.02	17.84	17.43
5	83	86	84	75	82	78	20	29	24	16.24	18.43	17.33
6	80	84	82	73	76	74	20	24	22	16.14	20.26	18.20
7	68	73	70	64	70	67	20	20	20	16.65	19.64	18.15
8	76	84	80	69	72	70	22	25	23	15.81	17.94	16.87
9	81	83	82	77	80	78	30	35	32	16.54	19.25	17.89
Mean	78	83		70	77		19	22		16.12	18.47	
CD(0.05)			4.11			5.38			4.01			4.48

To: Unprimed seed T1: Primed seed

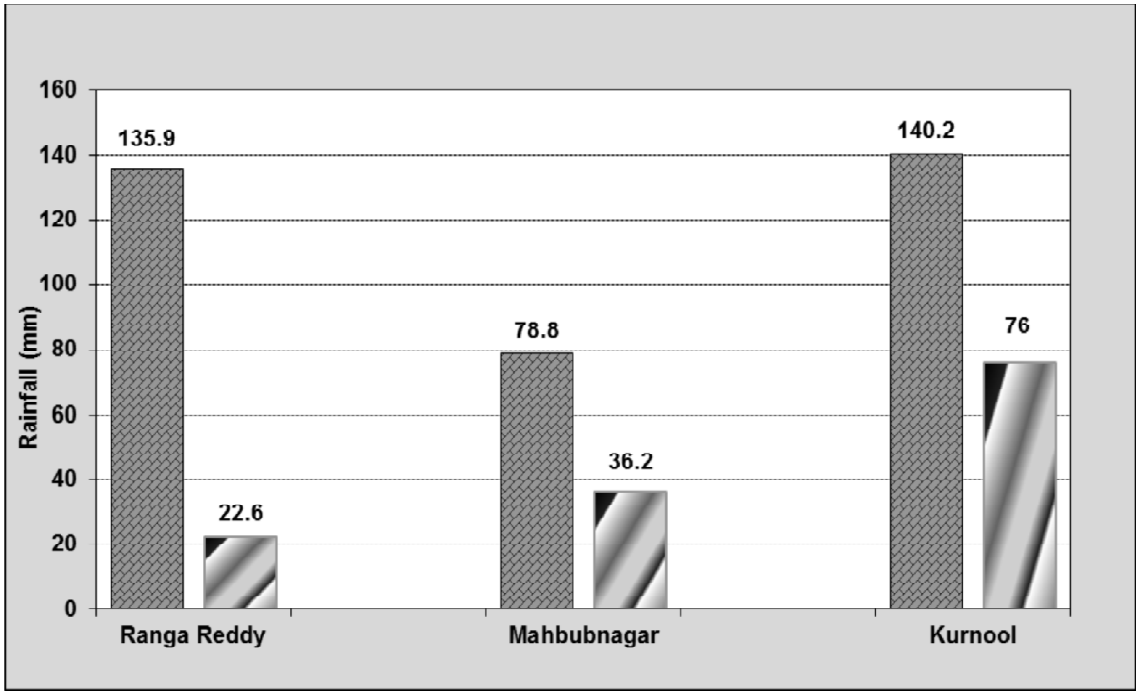

Figure 1: Rainfall pattertn during experimentation in 3 districts of Andhra Pradesh during rabi (Oct-Dec) 2010 & 2011

SUMMARY

Crop establishment is often poor in the semi-arid tropics. However, good crop stand establishment is essential for the efficient use of water and light, and a uniform stand is a pre-requisite for cropping success. Seeds that germinate quickly produce viable seedlings that are not dependent on rapidly declining moisture in the soil that may occur in rain fed systems. Soaking seeds in water before sowing gives the germinating seeds a head start and speeds up seed establishment with a corresponding increase in survival rates and yields. Thus, on-farm seed priming is a key technology to improve the livelihoods of resource-poor farmers in marginal environments.

CONCLUSIONS

On farm seed priming improved the grain yield of sorghum. Seed-priming effect was significantly higher in medium deep soils than shallow and medium deep soils. On-farm seed priming is a non-cash input, which helps to establish good crop stand and increased yields by 14 per cent. For resource poor farmer of low rain fall regions of Ranga Reddy, Mahabubnagar and Kurnool districts of Andhra Pradesh, seed priming is a key technology to sustain sorghum production.

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