ON-FARM EVALUATION OF SEED PRIMING TECHNOLOGY IN SORGHUM (*Sorghum bicolor* L.)

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Abstract

Participatory Rural Appraisal techniques were used to identify reasons for low yield in sorghum crop. Poor crop establishment was identified as a major cause of low yield and seed priming was agreed upon as an intervention to circumvent this problem. The effect of on-farm seed priming on sorghum yield was studied in the farmer's fields during kharif 2001 to 2003. Seed priming improved germination and vigour of the crop which helped to establish a good plant stand, which in turn led to significantly higher grain yield (9.5 %) of sorghum over non-primed. The effect of seed priming was maximum in medium deep as compared to shallow as well as deep soils. Cultivars didn't differ significantly in their performance. However, cultivar BJH-117 responded significantly to seed priming in terms of grain yield than CSH-9. Farmer's opinioned that seed priming helped in hastening germination, maturity and harvest and some extent reduced the effect of dry spell as well as pest and disease incidence in sorghum.

Key words: India; On-farm seed priming; Participatory Rural Appraisal; Participatory evaluation; Rainfed sorghum; Vertisols

INTRODUCTION

In the Vertisols and associated soils of the semiarid regions of India and else where, rainfed sorghum is a dominant traditional land use system. Sorghum is grown mainly for its grain for 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. The abiotic factors include low quality seed, inadequate seedbed preparation, abnormal rainfall distribution etc. Resource poor farmers in marginal areas suffer more (Harries, 1992; 1996) than others due to these abiotic constraints. Amelioration of the physical constraints in sorghum cultivation is often beyond the control of resource poor farmers in rainfed farming system. On farm seed priming (soaking seed in water) has been offered as a solution to this problem. 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. 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-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 used by KRIBHCO Indo-British Rainfed Farming Project, West (KRIBP [W]) has been highly successful in empowering farmers to test, develop and adopt seed priming and to appreciate its effects. 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 depended upon the crop species and seasonal rainfall.

This paper reports the results of participatory evaluation of seed priming technology in Kokarda and Kaniyadol villages of Kalmeshwar taluka of Nagpur Dist, Maharashtra, India.

MATERIAL AND METHODS

Location and Agro-climate of the study area

Present study carried out under Technology Assessment and Refinement through Institute-Village Linkage Programme. The villages, where participatory evaluation was conducted is situated at 21^0 20' N Latitude and 78^0 51' E longitude on an altitude ranging from 340m to 360m above MSL.

Agro climatically, the experimental sites are located in the Eastern Maharashtra plateau experiencing hot, dry, sub-humid eco-region (AESR-10.2) and are dominated by Vertisols (deep black soils) and associated soils. Moderate deep-to-deep soils are found in valley, while shallow to medium deep soils are on escarpments. The shallow soils are severely degraded, while deep soils have drainage problems. Vertisols have poor permeability. The soil pH ranges from 8.1 to 8.6. Rainfall varies from over 975mm to less than 800mm per year. Rainfall is received mostly from southwest monsoon from second week of June continues up to October. The maximum rainfall received in the month of July. About 90 per cent rainfall received during June to September (Table. 1). Rainfall covers only 77% of the gross annual water demand, even in normal rainfall year.

The dominant *kharif* (monsoon season) crops are sorghum, cotton and soybean. Chickpea is the main crop grown on residual soil moisture in the *rabi* (winter) season. Farmers have little access to timely, affordable credit and adoption of agricultural inputs including fertilizer is not widespread.

METHODOLOGY

Farmers themselves can prime their seed if they know the safe limits, the maximum length of time for which seed can be soaked. Suggested safe limit for sorghum is 10 hrs (Harries et al.1999).

On –farm trials were conducted in *kharif* 2001 to 2003. There were 30 and 36 on-farm trials in 2001 and 2002, respectively. Both the years, two hybrids (CSH-9 and BJH-117) were tested on shallow (<25 cm), medium deep (25-50 cm) and deep soils (>50 cm) and in each soil, four farmers were selected for recording observations. Impact study was carried out without any direct involvement of implementing agency during *Kharif* 2003. Farmers soaked seeds for specified periods (10hrs), surface dried them and sowed, primed and dry seeds in adjacent plots of their fields using traditional methods. Simple experimental designs were used. The data was analysed by using Split-split-plot design, where soils are taken in main plot, varieties in sub plot and priming in sub-sub plot.

Farm walks and semi structural focus group discussions were used to facilitate evaluation of the trials by the farmers themselves and this concluded with a formal matrix ranking exercise. In these, farmers were asked to make decisions on the merits of seed priming relative to their normal practice in a number of researcher defined, but mutually agreed, categories relating to agronomy, crop development and yield (Fig.2).

RESULTS AND DISCUSSION

Identification of problem

Initial Participatory Rural Appraisal (PRA) exercises identified poor crop establishment in sorghum as a serious constraint in the project area. Patchy plant stands are common and yields are often reduced due to sub-optimal plant population. In addition, plants that emerge often grow slowly and are highly susceptible to stresses such as drought, pests and diseases. Poor crop establishment often forces farmers and their families into heavy debt.

During the analysis of the factors involved in this problem (Fig 1), the farmers identified the reasons for poor crop stand establishment. They include low quality seed, inadequate seedbed preparation, untimely (late) sowing, inadequate soil moisture, poor sowing technique and high temperature coupled with intermittent dry spell. During the process farmers were also able to identify opportunities to improve this situation by adapting seed priming.

'Seed priming', the concept of soaking seeds in water was offered as a solution to the problem. Farmers in the project area were aware of seed priming, but they followed this practice only for gap filling. Some of the farmer's expressed mixed successes of this practice because of lack of knowledge of appropriate priming time, leading to over soaking of seeds, which damaged the seeds. Delayed sowing of sorghum is a common phenomenon in the villages as farmers complete sowing of more important commercial crops like cotton and soybean with the onset of monsoon and then take up the sowing of sorghum. This practice increased the risk of heavy infestation of shootfly and terminal drought stress. Dry spell during the 1st Week July is a common phenomenon and this period usually coincides with the germination period of sorghum (Table. 2). As a result the plant stands are patchy and the surviving plants in a poorly established field seldom get a good start. Harris (1992) demonstrated that sorghum seedlings that germinated and emerged fastest grew most vigorously and that rate of emergence could be increased dramatically by soaking the seeds overnight in water before sowing.

Effect of seed priming on grain yield

On-farm seed priming improved the mean grain yield of sorghum by 10.2 per cent in 2001 as well as 2002 and this increase was significant in both the years (Table 3). However, the effect of seed priming in improving grain yield was not observed in the year 2003. This could be due to a favourable distribution of rainfall during the establishment phase (Table 2) as well as during the entire growing season (Table 1). Which would have off set the beneficial effect of seed priming in speeding up germination and early crop establishment. Thus, on-farm seed priming was more beneficial in years experiencing abnormal rainfall distribution. Similar observations were reported from Zimbabwe in cotton and maize by Murungu et.al (2004). Earlier Harris (2001) reported up to 31 per cent increase in sorghum yield due to seed priming in Pakistan and Zimbabwe.

Effect of soil type on grain yield and its response to seed priming

The grain yield of sorghum was significantly influenced by soil type (depth) in both the years (Table 4). The yield in deep soils was higher than medium and shallow soils by 110 and 63 per cent, respectively. Although the grain yield of sorghum was highest in deep soils in both the years, yet averaged over the year the effect of seed priming in improving yield was maximum on medium deep soils (22 %) followed by shallow (8.1 %) and minimum on deep soils (4.8 %). This interaction between soil type and seed priming was significant in

2002. This difference is mainly because the higher plant available water capacity in deep soils to provide adequate moisture to meet the crop requirement during the post rainy phase of the crop. Gajbhiye and Deshmukh (1992) reported that sorghum grew best on deep black soils (*Typic Haplusterts*).

Effect of cultivars on grain yield and its response to seed priming

There was no significant difference among the cultivars with respect to gain yield (Table 3). However, there was a differential response of cultivar to seed priming and this effect was significant in 2002. Unlike in 2001, the cultivar CSH-9 did not respond significantly to seed priming where as there was a 14.2 per cent increase in the grain yield of cultivar BJH-117 due to seed priming and thus effect was significant.

Participatory evaluation of Seed priming technology

Farmer's opinions on seed priming are quantified at the end of second season of on-farm trials in relation to twelve important criteria (Fig.2). Ease of sowing was considered to be similar or more difficult using soaked rather than dry seed. Most of the farmers reported that they have observed early germination, good plant stand and due to early germination, the crop escaped from attack of shootfly resulting in good plant stand. It was also opined that primed plants didn't show early wilting symptoms unlike that of non-primed. Ear head mould disease, which is aggravated due to high rainfall at the time of physiological maturity of sorghum, is a common phenomenon in the villages. This reduced the grain quality and grains fetched lower price. But, priming overcomes this problem by hastening maturity and ear head mould disease was less in primed plots than unprimed. there was some confusion among the farmers to give score to ear head size, early ear head initiation and quality of grain. Most of the farmers agreed that seed priming helped them to harvest the crop almost one week early with higher yield than non-primed. When asked if they would prime seeds next year, 93 per cent of all the farmers replied that they would. As an impact study, the seed priming activity was monitored in *kharif* 2003.It was observed that 83 per cent of the old farmers (where demonstrations were conducted) and 17 per cent of the new farmers (first time tried) adopted this practice (Fig 2).

The most common difficulty reported was the fact that primed seeds flow less freely and have a tendency to stick to the hollow pipes *(Tiffan*) through which seeds are channeled in to the planting furrow behind the plough as compared to dry seed. More over, if there were continuous rains after sowing, the chances of decay of primed seed was more in deep black soils as these soils remain saturated for a longer period of time.

CONCLUSIONS

On farm seed priming significantly improved the braun yield of sorghum. Priming effect was more pronounced in medium deep soils in drought years by facilitating early germination and good crop establishment. Cultivar differences were not observed but seed-priming effect was significantly higher in medium deep soils than shallow and medium deep soils. Also priming helped to decrease dryspell, pest and disease effect on crop. On-farm seed priming is a non-cash input, which helps to establish good crop stand and increased yields by 9.5 per cent. For rainfed resource poor farmer of Vidarbha region of Maharashtra, seed priming is a key technology to sustain sorghum production. Some modification in seed sowing techniques have to be found out through research to facilitate free flow of primed seeds.

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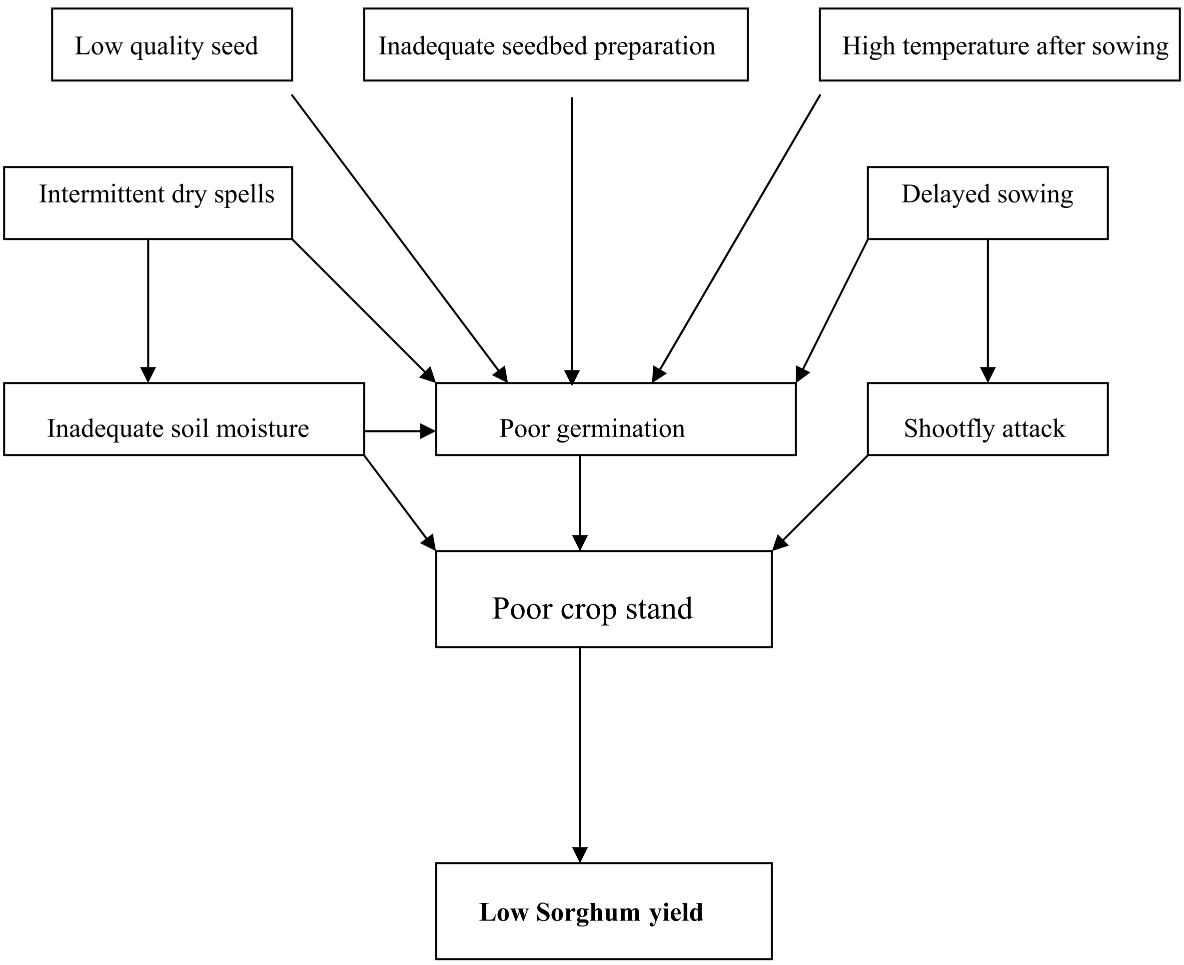
Fig 1: Problem cause diagram drawn during PRA in relation to low yield of sorghum



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Tab. 1: Mean monthly rainfall (1990-99) and monthly rainfall during Experimentation

Rainfall (mm)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean	9.2	4.0	22.8	6.2	4.3	152.6	290.0	207.4	191.6	58.0	16.3	13.3
2001	0.0	0.0	36.8	42.6	3.2	222.8	162.0	282.0	43.0	105.0	8.6	0.0
2002	0.0	7.2	0.0	0.0	0.0	267.4	55.0	352.0	47.0	52.4	0.0	0.0
2003	0.8	39.0	28.6	4.8	0.0	77.8	421.2	330.6	216.0	2.6	10.4	0.0

Tab. 2: Mean (15 years) and weekly rainfall of standard meteorological weeks during crop sowing period

Std. Met. Weeks	Period	Normal (Mean of 15 years)	2001	2002	2003
24	June 11-17	45.6	131.0	68.0	0.8
25	June 18-24	62.9	5.2	101.0	3.8
26	June 25-July 1	49.3	28.0	142.8	107.8
27	July 2-8	49.0	0.0	0.8	82.2
28	July 9-15	67.1	101.4	0.0	17.6
29	July 16-22	68.6	52.6	54.2	69.0

Tab. 3: Grain yield of CSH-9 and BJH-117 sorghum grown in Kokarda and Kaniyadol villages, India, in response to seed priming.

Treatments	Grain yield (q/ha)								
	2001			2002			2003		
	CSH-9	BJH-117	Mean	CSH-9	BJH-117	Mean	CSH-9	BJH-117	Mean
Non-priming	24.0	24.9	24.5	22.1	21.1	21.6	30.0	34.5	32.2
Priming	25.7	28.4	27.0	23.4	24.1	23.8	30.0	35.0	32.5
Mean	24.9	26.6		22.7	22.6		30.0	34.7	
C.D. at 5%	For priming	0.9		0.8			NS		
	For cultivars	NS		NS			NS		
	For priming x cultivars	NS		1.2			NS		

Tab. 4: Sorghum grain yield as influenced by on-farm seed priming and soils in Kokarda and Kaniyadol villages, India, during *Kharif* 2001 and 2002.

Treatments	Grain yield (q/ha)					
	2001			2002		
	Non-primed	Primed	Mean	Non-primed	Primed	Mean
Shallow Soils (<25 cm)	15.8	17.7	16.7	16.1	16.8	16.4
Medium deep soils (25-50 cm)	20.1	23.9	22.0	18.4	23.0	20.7
Deep soils (>50 cm)	37.5	39.6	38.6	30.3	31.5	30.9
Mean	24.5	27.0		21.6	23.8	
C.D. at 5%	For soils	6.0		5.2		
	For priming	0.9		0.8		
	For soil x priming	NS		1.4		

Fig 2: Farmers perception on on-farm seed priming (30 farmers) over non-primed