Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(3): 3221-3223
Received: 01-03-2018
Accepted: 05-04-2018

SK Chongtham
Potato Research Station, SDAU, Deesa, Gujarat, India

SK Jain
Sorghum Research Station, SDAU, Deesa, Gujarat, India

PR Patel
Sorghum Research Station, SDAU, Deesa, Gujarat, India

Correspondence
SK Chongtham
Potato Research Station, SDAU, Deesa, Gujarat, India

Effect of production resource constraints on yield and economics of *Kharif* sorghum in the Northern Gujarat region

SK Chongtham, SK Jain and PR Patel

Abstract
A field experiment was conducted at Sorghum Research Station, SDAU, Deesa during *Kharif* season in 2015 essential to evaluate the effect of production resource constraints in sorghum production. Application of full package of practice with improved hybrid or local cultivar markedly improved yields (grain and stover) and economic remuneration. In case of labour shortage, full package of practice without thinning in improved hybrid did not significantly affect yield and economic returns. Fertilizer, weed control and plant protection were the vital key inputs for sorghum production respectively, on the order of priority.

Keywords: fertilizer, plant protection, sorghum, weed control, yield

Introduction
Sorghum is a versatile crop which is used for grain, feed and fodder. It forms a dietary staple for million populations in the world, especially in the subtropical and semi-arid regions of Asia and Africa. Generally, it is an important source of food and fodder, mostly in the traditional, smallholder farming sector. Recently, it holds a significant place in the commercial farming sector as a feed crop, and is rapidly growing as a biofuel crop (Hariprasanna and Rakshit, 2016) [3].

Owing to its fast growth and adaptability to different environmental conditions and palatable nutritious fodder to the animals, sorghum is being cultivated across the country in both *kharif* and *rabi* season. Traditionally, sorghum has been known for being nutrient-use efficient and managed with low fertilizer rates. However, the productivity of sorghum genotypes is low because of poor management and least resource allocation. Adequate management of inputs like application of balanced fertilizers, bio-fertilizers and manures, proper management of weeds, insect-pests and diseases, timely and adequate water management are the key factors for optimization of crop production. However, under shortage of resources especially under dryland areas, economically weak farmers are compelled to omit some of the important inputs in crop production. So, it is essential to evaluate the effect of production resource constraints in sorghum production and prioritise inputs in the north Gujarat region.

Material and Methods
Experimental site and weather details
A field experiment was conducted at Sorghum Research Station, SDAU, Deesa (Gujarat) during *Kharif* season in 2015. The soil of the experimental site was loamy sand in texture, low in organic carbon (0.25%), pH (7.83), available nitrogen (N) (155.12 kg N/ha), medium in available phosphorus (P) (26.18 kg P_2O_5/ha) and available potassium (K) (270.30 kg K_2O/ha). The site has semi-arid and sub-tropical climate with hot dry summer and severe cold winter. The amount of rainfall during the crop period was 1071.6 mm with 13 rainy days was obtained with maximum in July (Fig.1).

Treatments details and crop management
The experiment comprised of eight treatments namely, Control (only improved hybrid without any input), Full package of practice (FPP) = Fertiliser (Recommended dose of fertiliser) + Weed control (herbicide and weeding) + Plant protection (application of insecticide and fungicides including seed treatment with fungicides) + Seed treatment with PSB and *Azospirillum* + Thinning + Improved hybrid, FPP minus fertilizer, FPP minus Weed control, FPP minus Plant protection, FPP minus seed treatment with PSB and *Azospirillum*, FPP minus Thinning and FPP minus improved hybrid (use local cultivar of the region).

These treatments were laid out in randomized block design and replicated thrice. Recommended dose of fertilizers for forage sorghum was 80:40:0 kg N: P_2O_5:K_2O/ ha. Half dose of N and full doses of P were applied basally during final land preparation and the remaining dose of nitrogen was applied at 30 days after sowing. Seeds of improved hybrid CSH-16 and local variety GJ-39 were sown at the rate of 10 kg/ha with spacing of 45 cm x 15 cm in 24th July, 2015. Sources of nitrogen and phosphorus were urea and single super phosphate. The crop was harvested at 123 days after sowing. Biometric attributes of sorghum like days to 50% flowering, plant height (cm), plant stand/m^2, number of panicles/m^2, and number of grain/panicle at harvest were recorded. Grain and stover yields of sorghum were recorded from net plot and then expressed in q/ha. Grain and stover productivity were calculated by using formula:

$$\text{Grain/Stover productivity (kg/ ha/day)} = \frac{\text{Grain/Stover yield (kg/ha)}}{\text{Total crop duration (days)}}$$

Economics like cost of cultivation and net return were worked out by using prevailing market prices of inputs during the period of investigation. Net return was estimated by subtracting total cost of cultivation from gross return. Benefit-cost ratio (BCR) was worked out by using the formula:

$$\text{Benefit-cost ratio (BCR)} = \frac{\text{Net return (₹/ha)}}{\text{Total cost of cultivation (₹/ha)}}$$

Return per day of forage sorghum was evaluated by using the formula:

$$\text{Return per day (₹/ha/day)} = \frac{\text{Net return (₹/ha)}}{\text{Crop duration (days)}}$$

Data of the experiment was statistical analysed by using OPSTAT software designed by HAU, Hisar.

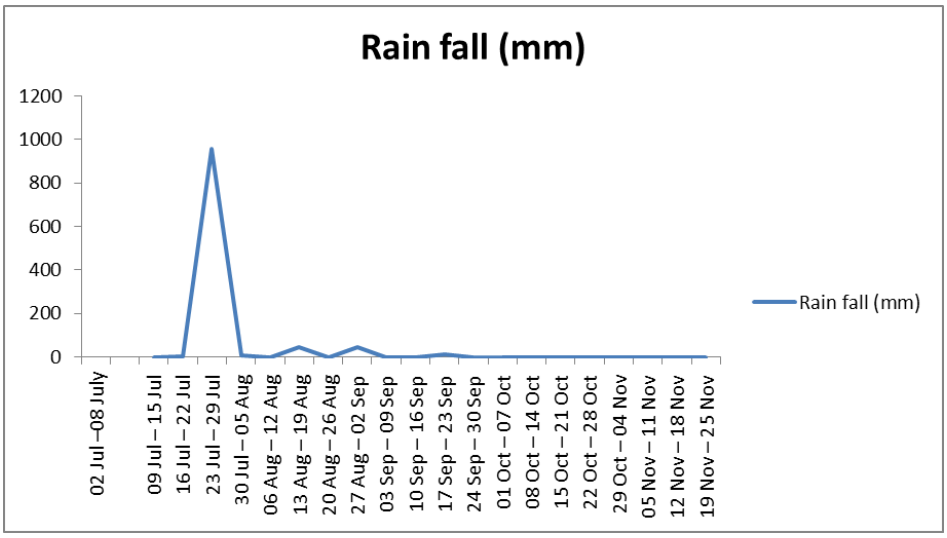

Fig 1: Weekly rainfall distribution during *kharif* season 2015.

Results and Discussions

Biometric attributes and yields

Results clearly showed that all biometric attributes of sorghum varied significantly due to various treatments (Table. 1) FPP minus improved hybrid had significantly tallest plant (189 cm), which was followed by FPP. Highest plant stand was recorded under FPP minus thinning (28/m^2), which was statistically better than rest of treatments except FPP, FPP minus plant protection, FPP minus improved hybrid. Maximum value of number of panicles/m^2 was noted under FPP (24.70/m^2), which was significantly higher than rest of treatments except FPP minus seed treatment with PSB and *Azospirillum*, FPP minus thinning and FPP minus improved hybrid. Application of FPP recorded highest number of grain/panicle (1550.23/panicle), which was statistically at par with FPP minus seed treatment with PSB and *Azospirillum*, and both were significantly better than the rest of treatments. In all the cases, treatments FPP minus fertilizer, FPP minus weed control and FPP minus plant protection had significantly lower biometric attributes over FPP. Earliest days to 50% flowering was noted under FPP minus plant protection and FPP minus seed treatment with PSB and *Azospirillum* (65 days), which was closely followed by rest of treatments except, control, FPP minus fertilizer and FPP minus weed control.

Perusal of the data presented in table 1 clearly indicated that FPP had highest grain yield (20.29 q/ha) which was statistically at par with FPP minus seed treatment with PSB and *Azospirillium*, FPP minus thinning and FPP minus improved hybrid. This may be attributed to due to better biometric attributes like plant stand, number of panicles/m^2 and number of grain/panicle. Adoption of high yielding varieties along optimum fertilizer and bio-fertilizer application, proper irrigation, weed and disease management are essential for obtaining for vigorous growth and improved yield attributes and ultimately realising into higher yield of field crops. Similar findings were reported by Abdullahi *et al.* (2016) [1], Amiri et *al.* (2014) [2], Kausalye *et al.* (2017) [4] and Reddy *et al*. (2003) [5].

Highest decrement in grain yield was recorded under FPP minus fertilizer (67.96%), which was followed by FPP minus Weed control (52.69%) and FPP minus Plant protection (39.53%) as compared to FPP. Highest straw yield was registered under FPP minus improved hybrid (85.71 q/ha), which was statistically at par with FPP and FPP minus thinning. Highest decrement in grain yield was recorded under FPP minus fertilizer (41.45%), which was followed by FPP minus weed control (37.08%) and FPP minus plant protection (29.38%) as compared to FPP.

Table 1: Growth and yield attributes of sorghum as influenced by different treatments

Treatment	Plant height (cm) at harvest	Plant stand/m^2 at harvest	No. of panicles/m^2	No. of grain/panicle	Days to 50% flowering	Grain yield (q/ha)	Straw yield (q/ha)	% yield decrement over FPP	
								Grain yield	Stover yield
Control	98.25	20.66	19.58	1149.93	82.33	4.31	37.48	78.76	49.67
Full package of practice (FPP	169.12	26.64	24.70	1550.23	66.00	20.29	74.47	-	-
FPP minus fertilizer	126.78	22.66	20.29	1183.57	81.67	6.50	43.60	67.96	41.45
FPP minus Weed control	129.10	18.00	16.03	1169.00	79.00	9.60	46.86	52.69	37.08
FPP minus Plant protection	143.50	24.66	20.75	1166.33	65.67	12.27	52.59	39.53	29.38
FPP minus seed treatment with PSB and *Azospirillum*	161.67	23.34	22.23	1306.67	65.00	16.60	62.16	18.19	16.53
FPP minus Thinning	158.77	28.00	24.68	1288.10	65.00	17.36	71.21	14.44	4.38
FPP minus improved hybrid	189.00	26.66	24.52	1186.33	67.33	18.90	85.71	6.85	-15.09
SEd	5.52	1.818	1.25	112.87	1.58	1.83	5.06	-	-
CD (p=0.05)	11.95	3.94	2.72	244.44	3.43	3.96	10.95	-	-

Productivity and economics

Productivity and economics of sorghum were significantly influenced by different treatments (Table. 2). Highest grain productivity was noted under FPP (16.49 kg/ha/day), which was significantly better than rest of treatments except FPP minus seed treatment with PSB and *Azospirillum* and FPP minus improved hybrid. In case of stover productivity, FPP minus improved hybrid (60.55kg/ha/day) was significantly better than rest of treatments, except FPP and FPP minus thinning. Highest net return (₹ 23.64 x 10^3/ha), BCR (0.94) and return per day (₹ 192.17/ha/day) were recorded under FPP minus improved hybrid which was closely followed by FPP and FPP minus thinning. Lowest net return, BCR and return per day were observed under FPP minus fertilizer, FPP minus weed control and FPP minus plant protection, respectively.

Based on above findings, it may be inferred that application of full package of practice with improved hybrid or local cultivar should be followed to obtain higher yield and economic remuneration. In case of labour shortage, full package of practice without thinning can also be followed without significantly affecting yield and economic profit. Fertilizer, weed control and plant protection were identified as resources that lead to severe reduction in yield and remuneration. Thus, on the order of priority, fertilizer, weed control and plant protection are the vital key inputs for sorghum production respectively, under the Northern Gujarat region.

Table 2: Productivity and economics of sorghum as influenced by different treatments

Treatment	Grain productivity (kg/ha/day)	Dry fodder productivity (kg/ha/day)	Net return (10^3 x ₹/ha)	BCR	Return per day (₹/ha/day)
Control	3.51	30.47	3.63	0.26	29.53
Full package of practice (FPP	16.49	60.55	22.09	0.91	179.61
FPP minus fertilizer	5.29	35.45	0.54	0.03	4.42
FPP minus Weed control	7.80	38.10	4.87	0.23	39.58
FPP minus Plant protection	9.97	42.75	9.30	0.44	75.65
FPP minus seed treatment with PSB and Azospirillum	13.50	50.54	14.30	0.60	116.27
FPP minus Thinning	14.11	57.90	19.23	0.84	156.33
FPP minus improved hybrid	15.36	69.68	23.64	0.94	192.17
SEd	1.49	4.11	3.94	0.17	32.04
CD (p=0.05)	3.22	8.90	8.54	0.36	69.39

References

1. Abdullahi S, Ghosh Gautam, Dawson Joy. Effect of Different Weed Control Methods on Growth and Yield of Maize (*Zea mays* L.) Under Rainfed Condition in Allahabad. IOSR Journal of Agriculture and Veterinary Science. 2016; 9(4):44-47.
2. Amiri M, Mojaddam M, Shokouhfar A. The effect of nitrogen management on the yield and yield components of grain sorghum (*Sorghum bicolor* L. Moench). International Journal of Biosciences. 2014; 4(1):272-278.
3. Hariprasanna K, Rakshit S. Economic Importance of Sorghum. In: Rakshit S., Wang YH. (eds) The Sorghum Genome. Compendium of Plant Genomes. Springer, Cham, 2016, 1-25.
4. Kausalye SP, Aundhekar RL, Solunke SS, Kalpande HV. Optimisation of production factors in Rabi grain sorghum under resource constraints. Agriculture Update, 2017; 12:1201-1203.
5. Reddy BVS, Reddy PS, Bidinger F, Blummel M. Crop management factors influencing yield and quality of crop residues. Field Crops Research. 2003; 84:57-77.