

RESEARCH ARTICLE :

Summer sorghum (*Sorghum bicolor* (L.) Moench) production influenced by irrigation scheduling : A climatological approach

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SUMMARY : A field experiment was conducted during summer of 2010 and 2011 at AICRP on Water Management, Marathwada Krishi Vidyapeeth, Parbhani (M.S.) to study the effect of different irrigation schedules on the productivity of summer sorghum grown on Vertisols. The soil of the experimental site was low in organic carbon and nitrogen, medium in available phosphorus and fairly rich in potassium and slightly alkaline in reaction. The experiment was laid out in randomized block design with four replications. The net plot size was 5.4 m x 3.6 m. The treatments comprising of four irrigation schedules viz., I₁-0.6 IW:CPE, I₂-0.8 IW:CPE, I₃-1.0 IW:CPE and I₄-As per the canal rotation interval. During both years, seeds of summer sorghum Var.SPV-655 were dibbled with spacing of 45 cm x 15 cm on 30th January in flat beds. Scheduling of irrigation was done on the basis of climatological approach (IW:CPE). Depth of irrigation was maintained 60 mm per irrigation in each treatment. The pooled results revealed that summer sorghum performed better throughout the growth stages and significantly higher grain, fodder, *bhoosa*, biological yields and bio-energy values were recorded under irrigation scheduled at 1.0 IW:CPE (15 irrigations) which being on par with 0.8 IW:CPE (12 irrigations), as compared to 0.6 IW:CPE (10 irrigations) and canal rotation interval (10 irrigations) treatment. Whereas, significantly lowest values of economic yields were recorded by canal rotation interval treatment than others. During both the years of study, highest mean daily and total consumptive use of water was recorded with 1.0 IW:CPE, ratio while the lowest values were recorded with 0.6 IW:CPE, ratio however, WUE was decreased with increase in the frequency of irrigation schedules. In addition, summer sorghum plants extracted most of their moisture needs from the uppermost soil layers (0-15 cm and 16-30 cm soil depths) than the lower successive soil layers. The economic yield-irrigation water relations showed that during first and second year; these relationships were quadratic and exponential, respectively, however, on pooling; the results showed linear response. Thus, it is concluded that scheduling of irrigation with 0.8 IW:CPE ratio (12 irrigations) found optimum for cultivation of summer sorghum on Vertisols under assured irrigated conditions of Parbhani (M.S.).

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BACKGROUND AND OBJECTIVES

Sorghum [*Sorghum bicolor* (L.) Moench] is a major source of food for millions of people in the semi-arid tropics (SATs); while in the tropical areas it serves as an important source of food and livestock feed. India is one of the nine major sorghum growing countries in the world. Amongst the cereals, sorghum is the staple food of the people of Maharashtra where it is extensively grown in *kharif* and *rabi* season and far low in summer season. Grain sorghum performance is better in summer season than *kharif* season owing to favourable climatic conditions; particularly optimum temperature and bright sunshine (Ramu *et al.*, 1991). Although, sorghum being a tropical crop and resistant to high temperature, it may suitably adopt to summer season even under relatively limited irrigation water. Scheduling of irrigation on the basis of climatological approach (IW:CPE) showed positive results in sorghum as reported by Kandasamy and Subramanian (1979). Keeping this view in mind, the present investigation was carried out to study the response of summer sorghum to different irrigation schedules on Vertisols of Parbhani (M.S.).

RESOURCES AND METHODS

A field experiment was conducted at AICRP on Water Management, Marathwada Krishi Vidyapeeth, Parbhani (M.S.). The soil (Vertisols) of the experimental site was low in organic carbon and nitrogen, medium in available phosphorus and fairly rich in potassium and

slightly alkaline in reaction. The experiment was laid out in randomized block design with four replications. The net plot size was 5.4 m x 3.6 m. The treatments comprising of four irrigation schedules *viz.*, I₁-0.6 IW:CPE, I₂-0.8 IW:CPE, I₃-1.0 IW:CPE and I₄-As per the canal rotation interval. During both years, seeds of summer sorghum Var.SPV-655 were dibbled with spacing of 45 cm x 15 cm on 30th January in flat beds. Scheduling of irrigation was done on the basis of climatological approach (IW:CPE). Depth of irrigation was maintained 60 mm per irrigation in each treatment.

OBSERVATIONS AND ANALYSIS

The pooled mean data of two years (Table 1) revealed that the grain, fodder, *bhoosa*, biological yields and bio-energy of summer sorghum were significantly higher under irrigation scheduled at 1.0 IW:CPE which being on par with 0.8 IW:CPE, as compared to rest of the irrigation schedules. However, in respect of bio-energy, during second year of study; 1.0 IW:CPE proved significantly better over other irrigation schedules. The cumulative effect of improvement in yield components under higher frequency of irrigation schedules led to maximum production of grain yield which ascribed to more number of irrigations at shorter intervals under these treatments (Mohammad Ikramullah *et al.*, 1996). These results are in consonance with those reported by Kandasamy and Subramanian (1979), Patel *et al.* (1990), Ramu *et al.* (1991), Pujari *et al.* (1992), Singh and Singh

Table 1: Grain, fodder, *bhoosa*, biological yield and bio-energy of summer sorghum as influenced by various irrigation schedules

Treatments	Grain yield (kg ha ⁻¹)			Bio-energy (M Cal)			Fodder yield (kg ha ⁻¹)		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Irrigation schedules:									
I ₁ = 0.6 IW:CPE	1087	1006	1047	5061	4684	4872	2292	2214	2253
I ₂ = 0.8 IW:CPE	1384	1294	1339	6444	6025	6234	2693	2517	2605
I ₃ = 1.0 IW:CPE	1452	1397	1425	6761	6505	6633	2802	2795	2799
I ₄ = As per canal rotation interval	1193	1065	1129	5555	4959	5257	2326	2343	2335
C.D. (P=0.05)	71	107	87	330	384	406	112	281	201
Treatments	<i>Bhoosa</i> yield (kg ha ⁻¹)			Biological yield (kg ha ⁻¹)					
	2010	2011	Pooled	2010	2011	Pooled			
Irrigation schedules:									
I ₁ = 0.6 IW:CPE	545	461	503	3924	3681	3803			
I ₂ = 0.8 IW:CPE	640	524	582	4717	4335	4526			
I ₃ = 1.0 IW:CPE	666	582	624	4920	4774	4847			
I ₄ = As per canal rotation interval	553	488	521	4072	3896	3984			
C.D. (P=0.05)	28	60	46	276	452	343			

Table 2: Water-expense components utilized by summer sorghum crop

Treatments	Irrigation frequency (No.)	Irrigation water applied (mm)	Irrigation interval (Days)	Consumptive-use (mm) (From 0-60 cm soil depth)	Daily water-use (mm day ⁻¹)	Water-use efficiency (kg ha ⁻¹ mm ⁻¹)
2010						
Irrigation schedules:	11	660	12	682.55	6.21	1.59
I ₁ = 0.6 IW:CPE						
I ₂ = 0.8 IW:CPE	12	720	10	809.72	7.36	1.71
I ₃ = 1.0 IW:CPE	15	900	8	983.21	8.94	1.48
I ₄ = As per canal rotation interval	10	600	13	565.51	5.14	2.11
2011						
Irrigation schedules:	10	600	14	668.33	6.08	1.51
I ₁ = 0.6 IW:CPE						
I ₂ = 0.8 IW:CPE	12	720	10	792.85	7.62	1.63
I ₃ = 1.0 IW:CPE	15	900	8	962.72	8.91	1.45
I ₄ = As per canal rotation interval	10	600	14	553.73	4.94	1.92

(1995) and Wani *et al.* (2003).

During both the years of study (Table 2), amongst all the applied irrigation schedules highest mean consumptive-use of water by summer sorghum was recorded with 1.0 IW:CPE ratio followed by 0.8 IW:CPE ratio, while it was lowest with canal rotation interval treatment. Since frequent irrigated crops produced profuse vegetative growth causing more evapo-transpiration losses, so they required higher consumptive-use of water. Similar observations were reported by Pujari *et al.* (1992) and Kadam (1992). On the contrary, during both the years of study, it was observed that water-use efficiency was decreased with the increased frequency of irrigations and it was higher under canal rotation interval treatment. Since the lower WUE obtained under higher moisture supply was due to proportionately more increase in the evapo-transpiration than the increase in grain yield. These results are in conformity with those reported by Kadam (1992), Pujari *et al.* (1992) and Gorad *et al.* (1995).

Conclusion :

Based on two years of study, it is concluded that scheduling of irrigation with 0.8 IW:CPE ratio (12 irrigations) found optimum for cultivation of summer sorghum on Vertisols under assured irrigated conditions of Parbhani (M.S.).

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