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Studies on Irrigation Regimen and N Rate on Grain Sorghum

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Experiment conducted to assess the irrigation requirement and nitrogen response of sorghun 'swarna' during the summer seasons of 1972 and 1973 showed that irrigation at 50 per cent available moisture throughout crop growth recorded highest yield. Water use efficiency was maximum with 25 and 0 per cent during preflowering and postflowering stages respectively. The straw yield was low at initial moisture stress. One hundred kg N/ha was found optimum.

INTRODUCTION

It is generlly recognised that fertilisation increases grain yield of sorghum. However, effect of soil moisture coupled with fertilisation has not been fully investigated. Since sorghums are largely grown with limited water supply a knowledge of the effects of moisture stress at different stages of growth and N fertilisation is considered important.

Brown and Shrader (1959) reported that water use efficiency for grain production increased as the amount of moisture increased. Musick *et al* (1963) observed curvilinear yield relation with number of irrigations and increments of applied nitrogen. Painter and Leamer (1953) recorded significant response to nitrogen as well as for moisture.

MATERIALS AND METHODS

The experiments were conducted at the Tamil Nadu Agricultural University Research Station, Bhavanisagar, during 1972 and 1973 summer seasons. The soil was sandy loam with pH 7.2 Available nitrogen was low while phosphorus and potassium availability were medium high. The field capacity varied from 18 to 20 per cent and the wilting percentage from 6.5 to 8.5

Randomised blocks design, replicated three times with gross plot size 4.5 × 3.0 m and net plot size 4.1 × 2.4 m, was adopted during both the years. During 1972 summer the experimental variables included three water regimen during two stages of crop growth to form nine treatments (3^2) The moisture regimen were allowing irrigation to bring the first 30 cm soil layer to field capacity when the available moisture reached 0 per cent (I_1), 25 per cent (I_2) and 50 per cent (I_3). The two stage of crop growth were : (i) preflowering (S_1) and (ii)

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post flowering (S_2). Sorghum variety "Swarna" was sown on 11 February, 1972 with 30 × 10 cm spacing and harvested on 23 June, 1972. Forty five kg each of N, P_2O_5 and K_2O/ha. were applied as a basal dose and 45 kg nitrogen as top dressing on the 30th day after sowing.

Three moisture levels and four nitrogen rates formed the variables for 1973 season. Based on the results of 1972 season the moisture regimen were changed as 25 per cent (I_1), 50 per cent (I_2) and 75 per cent (I_3), since irrigation at 0 per cent available moisture recorded low yields. The N rates were 0, 50, 100 and 150 kg/ha. Sorghum var. "Swarna" was sown with the same spacing (30 × 10 cm) on 29 January, 1973 and harvested on 12 June, 1973. Nitrogen which formed one of the variables, was applied as per treatmental specification; half the dose during sowing and the rest on the 30th day after sowing. The soil moisture determined by gravimetric method, by taking soil sample in the rows in between plants at two layers (first and second 15 cm layers) (Dastane, 1970). The rainfall was taken into account while scheduling irrigations.

RESULTS AND DISCUSSION

1972 Summer season: The irrigation levels during per-flowering significantly influenced the grain yield while the yield was not sigificantly affected by the post-flowering irrigation levels (Table 1).

TABLE 1. Effect of irrigation regimen on the sorghum grain yield kg/ha – 1972 summer.

Post-flowering stage (available moisture)	Preflowering stage (available moisture)			
	0 %	25 %	50 %	Mean
0 %	3513 [6]*	4569 [7]	4563 [11]	4215
25 %	3638 [9]	4502 [10]	5270 [14]	4470
50 %	3878 [12]	4868 [13]	5315 [17]	4687
Mean	3676	4646	5049	

L. S. D. (5%) For comparing Preflowering 807

" " N. S.

Interaction N. S.

* Flugres in bracket indicate number of irrigat ons.

During pre-flowering stage allowing irrigation at 50 per cent soil moisture availability was on par with irrigation at 25 per cent. Both leveis were superior to irrigation at 0 per cent available moisture in increasing the grain yield. Interaction was absent. However, irrigation at 50 per cent available moisture throughout crop growth recorded highest yield of 5315 kg grain/ha. Water use efficiency was highest 8: 6 kg grain/ha.cm. with 25 per cent and 0 per cent during first and second stage respectively (Table 2).

TABLE 2. Yield and water use for sorghum 1972 summer

Treatment (S_1)	Treatment (S_2)	Yield (kg/ha.) Grain	Yield (kg/ha.) Straw	Water consumption a. m.	Water use efficiency (kg/ha/cm)
I_1	I_1	3513	8638	58.7	59.4
I_1	I_2	3638	9146	72.7	49.8
I_1	I_3	3878	10501	77.1	50.3
I_2	I_1	4569	11855	55.7	81.6
I_2	I_2	4502	11347	69.7	64.3
I_2	I_3	4868	11636	74.1	65.8
I_3	I_1	4563	11178	64 0	71.3
I_3	I_2	5270	13380	78.0	67.6
I_3	I_3	5315	15243	82.4	64.5

The number of irrigations given for maximum yield was 17 (I_3I_3) and for maximum efficiency 7 (I_2I_1). The straw yield was low at initial moisture stresses exhibiting the same trend as that of grain yield.

1973 Summer season : Irrigation at 50 per cent available moisture give maximum yield of 4066 kg/ha and was on par with irrigation at 75 per cent moisture availability and superior to that 25 per cent soil moisture availability (Table 3). 50 per cent available moisture treatment consumed 55.1 cm. of water.

TABLE 3. Efficiency of irrigation levels and N rate on sorghum grain yield (kg/ha) 1973 summer

Irrigation at available moisture	Nitrogen levels (kg/ha) 0	50	100	150	Mean
25 %	1873	3350	4404	4805	3608
	[35]*	[63]	[82]	[90]	
50 %	1649	3919	5065	5629	4065
	[30]	[71]	[92]	[102]	
75 %	1589	3640	5141	5119	3872
	[34]	[77]	[109]	[108]	
Mean	1704	3636	4870	5184	

L. S. D. (5%)	For nitrogen levels	370
"	For irrigation levels	320
Interaction		N. S.

* Figures in bracket indicate irrigation efficiency grain kg/ha.

Applied nitrogen favourably influenced the sorghum grain yield. Even-though the increase in yield was maintained upto 150 kg/N/ha yield increase beyond 100 kg N/ha was only marginal. The results are in line with the observations of Patil *et al.* (1969) who had reported irrigation at 50 pet cent available moisture and application of 100 kg N/ha to be the optimum for sorghum "CSH 1 ". The irrigation efficiency was maximum with the treatmental combination 100 kg N/ha and

irrigation at 75 per cent available moisture. The straw yield increased with irrigation at increased moisture availability. Applied nitrogen also increased the straw yield.

TABLE 4. Effect of moisture and nitrogen levels on sorghum straw yield 1973 summer season

Irrigation at available moisture	Straw yield (kg/ha)	Nitrogen levels (kg/ha)	Straw yield (kg/ha.)
25 %	5895	0	4728
50 %	6763	50	5803
		100	7333
75 %	6884	150	7867

In both the years maximum grain yield was recorded with irrigation at 50 per cent moisture availability. Irrigation earlier than this moisture availability resulted in increased straw yield at the expense of grain yield. Irrigation at moisture stress beyond 50 per cent availability resulted in decreased yield.

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