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Studies on Irrigation at Critical Stages of Growth in Sorghum

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Experiments were conducted at Tamil Nadu Agricultural University, Coimbatore in summers of 1974 and 1975 to study the effect of irrigation at critical stages of growth in sorghum. In both the seasons, irrigation at 50 percent available moisture was found to give the highest yield but in areas of limited water supply irrigation at seedling, vegetative flowering and grain formation stages in addition to the sowing irrigation can be adopted without very much loss in yield. Skipping irrigation at the seedling stage affected establishment and growth of the crop.

Over 75 per cent of sorghum is cultivated in India under dry farming conditions. Irrigated sorghum is restricted mainly to the summer season. The water requirement of sorghum has been reported to be 450 to 500mm (Mahindra Singh *et al.*, 1971). Kaliappa *et al.* (1974) reported that for grain sorghum irrigation at 50 per cent available moisture throughout the crop growth period was the best. In areas where water availability is limited it may not be possible for the farmer to irrigate at 50 per cent available moisture level. Larger area can be brought under sorghum in summer season if the number of irrigations could be reduced without much affecting the yield by irrigating the crop at critical physiological stages. Hence, with a view to study the effect of irrigation at critical stages of growth in sorghum, experiments were conducted in the summers of 1974 and 1975 in the Millet Breeding Station of the Tamil Nadu Agricultural University, Coimbatore.

MATERIALS AND METHODS

In 1974, nine irrigation treatments were tried (Table I) with sorghum entry, Co. H. 2 (Koilpatty tall) in a randomised block design with three replications.

TABLE I. Irrigation treatment schedule for 1974 experiment

Treatments	Seedling (15-20 days)	Vegetative (35-40 days)	Flowering (55-60 days)	Grain formation (75-80 days)
I_1	✓	✓	✓	✓
I_2	x	✓	✓	✓
I_3	✓	x	✓	✓
I_4	✓	✓	x	✓
I_5	✓	✓	✓	x
I_6	x	x	✓	✓
I_7	✓	x	x	✓
I_8	✓	✓	x	x

I_9 Irrigation at 50 percent available moisture

✓ = Irrigation x = Skipping irrigation

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The crop was sown on 13-3-74 and harvested on 17-6-74. The harvested plot size was 5.0 x 3.6 m. A fertilizer level of 90 kg N, 45 kg P_2O_5 and 45 kg K_2O/ha was adopted. A spacing of 45 x 15 cm was adopted in both seasons. In 1975, six irrigation treatments (Table II) were tried with two entries, CSH. 5 and CSV. 4 and three levels of nitrogen viz. 45, 90 and 135 N kg/ha.

TABLE II. Treatment Schedule for 1975 experiment

Treatment	Seedling (15-20 days)	Vegetative (35-40 days)	Flowering (55-60 days)	Grain formation (75-80 days)
I_1	✓	✓	✓	✓
I_2	x	✓	✓	✓
I_3	✓	x	✓	✓
I_4	✓	✓	x	✓
I_5	✓	✓	✓	x

I_6 Irrigation at 50 percent available moisture

Sub-plot	Entries-2	N levels-3
V_1	CSH 5	N_1 45 kg N/ha
V_2	CSV 4	N_2 90 kg N/ha
		N_3 135 kg N/ha

✓ = Irrigation x = Skipping irrigation

Half of N was applied as basal dressing and remaining half was applied 30 days after sowing. Phosphorus and potassium at 45 kg each/ha were uniformly applied to all the plots. The experiment of 1975 was conducted in split plot design with irrigation levels in the main plot and N and varieties in the sub plots. There were three replications. The crop was sown on 19.2.75 and harvested on 31 . 5 . 75. The harvested plot size was 3.15 x 2.0 m. The total rainfall received in the cropping period was 14.86 mm in 1975. The soil of the experimental sites was red sandy loam with a pH of 7.2, medium available N (292 kg/ha), P (18.5 kg/ha) and high available K (640 kg/ha). The plots were irrigated for a constant time to wet the first 30 cm layer in all the treatments except irrigation at 50 per cent available moisture. Field capacity of the soil was 20.0 per cent and wilting point 6.5 per cent. For irrigation at 50 per cent available moisture, the number of irrigations given was twelve in the 1974 season and 9 in 1975 season. All plots were uniformly irrigated at the time of sowing in addition to the treatments.

RESULTS AND DISCUSSION

The results of 1974 experiment are presented in Table III. From the data

TABLE III. Yield of (Co.H.2.) grain and straw (kg/ha) in 1974

	Grain yield	Straw yield
I_1	4700	7552
I_2	2000	5793
I_3	2556	5699
I_4	4272	7042
I_5	2117	6553
I_6	2050	5653
I_7	2111	4300
I_8	2811	5189
I_9	4545	7969
S. Ed.	1046	1470
C. D. (5%)	2215	3015

it could be seen that irrigation at the four critical stages was on par with irrigation at 50 per cent available

moisture. Skipping irrigation either at the seedling stage or vegetative stage decreased the yield by about 32 and 41.5 per cent respectively. Skipping the irrigation at flowering stage reduced the yield only by about 10 per cent when compared to irrigation at 50 per cent available moisture. Skipping two irrigations at seedling and vegetative stages resulted in stunted growth and poor yield. In the case of straw yield also a similar trend was noticed.

From the results of 1975 experiment (Table IV) it was observed that irrigation at 50 per cent available moisture and 3 irrigations, skipping seedling stage, was on par and better than all other treatments. The treatments in which irrigation was given at seedling stage recorded lower yields, since a rainfall of 84.9 mm was received in four rainy days just after irrigation resulting in water logging and stunted growth. Among the two entries tried, CSH. 5 was significantly superior to CSV. 4. Among the nitrogen levels, 90 kg N/ha was superior to both 135kg N/ha and 45kg N/ha. Interactions were also significant. For both the varieties, 90 kg N/ha gave higher yield. Since, the available N status of the soil was judged to be medium, it is evident that there was response only upto 90 kg N/ha.

TABLE IV. Yield of grain and straw (kg/ha) in 1975

	Grain yield							Straw yield						
	CSH. 5			CSV 4				CSH 5			CSV 4			
	N_1	N_2	N_3	N_1	N_2	N_3	Mean	N_1	N_2	N_3	N_1	N_2	N_3	Mean
I_1	3093	3439	3410	1193	1368	2622	2521	5192	5093	5379	5057	5113	5416	5208
I_2	2859	3503	3397	3235	3881	2228	3184	6631	5481	6831	5784	6591	5873	6199
I_3	1291	3222	2889	2304	1672	1222	2100	7531	6598	7062	6558	6097	6762	6768
I_4	2487	3831	2513	1881	2008	1069	2298	5458	5946	5129	4951	5580	5133	5366
I_5	1653	3571	2984	1326	1556	1042	2022	4925	5544	5406	5182	5333	4863	5209
I_6	2542	3503	3191	2127	4130	5050	3424	6933	7315	6549	7569	6301	7700	7061
Mean	2321	3512	3064	2011	2436	2206		6112	5996	6059	5850	5836	5958	

	S. E.	C. D. (5%)	S. E.	C. D. (5%)
Irrigation	368.3	819.00	52.246	116.508
Variety	47.619	95.238	—	N. S.
Nitrogen level	58.73	117.46	—	N. S.
V x N	57.142	161.587	—	N. S.
V at I	82.38	232.698	—	N. S.
I at V	268.88	842.003	—	N. S.
N at I	101.587	286.984	—	N. S.
I at N	258.73	730.00	—	N. S.

N. S. - Not Significant

When the crop was irrigated at 50 per cent available moisture, N levels 90 kg/ha and 135 kg/ha, were on par. but in all the treatments receiving three irrigations N at 90 kg/ha was always superior. Hence, it appears that under moisture stress the response to N is restricted. Musick *et al.* (1963) also reported that efficiency of 'N' increased as the moisture stress decreased. Kaliappa *et al.* (1974) also reported a similar finding.

In comparing the performance of the two varieties under different irrigation treatments, it was observed that CSH. 5 performed better than CSV. 4 in all the treatments receiving three irrigations skipping either vegetative, flowering or grain formation stage. This indicates that the hybrid is able to withstand moisture stress better than the variety.

In the case of straw yield also a similar trend was noticed with regard to irrigation treatments. There was no significant difference between entries or N levels in the case of straw yield.

Summarising the results of both the seasons it can be stated that sorghum could be profitably raised with limited irrigations. Skipping irrigation at seedling stage may affect the establishment and growth of the crop resulting in lower yields. Though irrigation at 50 per cent available moisture gave the best results in both the seasons, in areas of limited water supply four irrigations at seedling, vegetative, flowering and grain formation stages, in addition to the sowing irrigation would not affect the yield much, and by adopting this method the farmer can raise a successful crop of sorghum on a larger area.

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