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Relative Irrigation Requirement of Dwarf Durum and Aestivum Wheats under Water Constraint in Black Soils of Tungabhadra Project

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Abstract

Experiments were conducted to study the relative irrigation requirement of 4 dwarf durum and one aestivum wheat varieties under the Coordinated Agronomic Research Project at Siruguppa for 2 years. The variety Kalyan Sona produced significantly higher yield over dwarf durum varieties at all levels of irrigation. Five irrigations at sowing, crown-root, late tillering, flowering and dough stages produced the higest yield with all varieties. Under conditions of water shortage, irrigations at sowing, crown-root and flowering were most critical. It is indicated that where only one irrigation is available after sowing, it should be applied at crown-root initiation stage. Irrigation at crown-root initiation stage was found to be more important with Kalyan Sona compared to durum varieties. Higher yields with 5 irrigations were mainly because of greater plant population and higher number of grains per panicle.

One of the important constraints for getting high yield of wheat is the availability of adequate irrigation water. Kulkarni *et al.* (1974) reported that the highest grain yields with high yielding varieties of wheat were obtained by giving 5 irrigations at sowing, crown-root initiation, late tillering, flowering and dough stages. Further, satisfactory yield could be obtained by giving 4 irrigations at sowing, crow-root initiation, late tillering and flowering with an average reduction yield to an extent of 7.24 per cent. In tank, well or farm pond irrigation water may be available for giving only a couple of supplementary irrigations. Under such conditions it is essential to decide the critical stages of crop growth to which irrigation water should be applied to obtain high yields. It is presumed that the durum wheat varieties have lesser water requirement and are more tolerant to drought as compared to the aestivum varieties because the durums are being grown on a large scale in dry farming areas.

In order to find out the irrigation requirement of selected durum wheat varieties in relation to Kalyan Sona wheat (aestivum) experiments were conducted under Coordinated Agronomic Research Project at Siruguppa (Bellary district) for 2 years during 1970–71 and 1971–72. The results of these experiments are discussed in this paper.

Material and Methods

Four durum wheat varieties namely, H.D.– 4500, H.D.– 4501, H.D.– 4502 and H. D.– 4503 with Kalyan Sona were tested in the experiment. There were 6 irrigation treatments comprising of no irrigation and 1 to 5 irrigations at different critical stages as noted in the next page.

The experiment was conducted in split plot design with irrigation levels in the main plot and varieties in the subplot. The soil where this experiment was conducted had field capacity of 34.39 per cent, wilting

Treatment No.	Crown root initiation	Different critical stages		
		Late tillering	Flowering	Dough
I_0	—	—	—	—
I_1	+	—	—	—
I_2	—	—	+	—
I_3	+	—	+	—
I_4	+	—	+	+
I_5	+	+	+	+

(+) Denotes irrigation to be applied at that stage.
(—) Denotes no irrigation.

point 18.85 per cent and bulk density 1.3. The soil had 7.8, E.C. 0.80 m mhos/cm, organic carbon 0.81 per cent, available N, P, K, 596, 7.5 and 483 kg/ha respectively. The experiment was conducted in jowar-wheat rotation. A dose of 60 kg N, 60 kg P_2O_5 and 60 kg K_2O per ha was applied uniformly at sowing. Top-dressing of 60 kg nitrogen per ha was applied uniformly at four weeks after sowing.

One common irrigation was applied uniformly to bring the soil moisture to field capacity at sowing. Amount of water applied to each treatmant based on the soil moisture deficit in 0–90 cm to bring the moisture content to field capacity and the rainfall that occurred during growth period of the crop was taken as the estimated water use by the crop. As the rainfall was low (26.5 mm during 1971–72) and soil moisture sampling was done to 0–90 cm depth, the deep percolation and runoff losses were negligible. Average productivity of grain per cm of total water was

TABLE I

Effect of irrigation on plant population, grains per panicle, grain weight and mean grain yield and straw yield (kg/ha) of durum and aestivum wheat varieties

Treatment	Plant population count/m² 1971–72	Average number of grain/panicle 1971–72	Average 1000-grain weight (g) 1971–72	Grain yield			Straw yield		
				1970–71	1971–72	Pooled	1970–71	1971–72	Pooled
Irrigation									
I_0	323	15.9	35.61	583	1265	925	1447	4013	2730
I_1	322	26.4	32.15	973	1763	1368	2433	4712	3572
I_2	318	17.5	39.52	834	1432	1133	2287	4568	3427
I_3	363	27.0	36.22	1602	2652	2127	3596	5363	4480
I_4	352	25.1	38.10	1716	2409	2062	4340	5158	4749
I_5	377	32.9	33.04	2333	2943	2638	4770	6632	5901
S. E. m. ±	32.34	1·92	1.46	113.70	176.24	144.97	113.70	127.92	115.83
C. D. at 5%	97.40	5.42	4.13	320	496	408	320	360	326
C. V.%	42.16	35.68	5.78	37.92	37.92	37.91	16.16	11.27	12.55
Varieties									
Kalyan Sona	419	26.9	32.86	1784	2990	2387	3647	5306	4476
HD–4500	318	24.8	37.49	1490	1905	1698	3301	5414	4441
HD–4501	343	21.7	33.99	1189	1737	1463	3225	4615	3921
HD–4502	311	24.4	37.95	1133	2018	1575	2488	5018	3753
HD–4503	326	23.0	36.59	1105	1737	1421	3067	5018	4042
S. E. m. ±	13.94	0.64	1.40	84.32	153.37	118.84	99.92	103.57	70.71
C. D. at 5%	39.24	1.92	4.21	254	462	358	301	312	213
C. V.%	19.90	12.92	5.53	30.79	36.13	34.03	15.55	9.99	8.39

calculated by dividing grain yield by water use in different treatments. The marginal efficiency of water applied at different stages over corresponding lower level of irrigation was calculated by dividing the additional yield by the quantity of water applied.

Results and Discussion

Yield attributes : The data on plant population count (Table I) revealed that Kalyan Sona had the highest plant population, significantly superior to all the durum varieties. Five irrigations (I_5) produced the highest plant count but the differences were not significant.

Number of grains per panicle was the highest with Kalyan Sona and significantly superior to all HD varieties. HD–4500 was the next variety having significantly higher number of grains per panicle compared to HD–4501. The number of grains per panicle was the highest with 5 irrigations (I_5). There was no significant difference in the number of grains per panicle between one irrigation at crown root irrigation (I_1) and irrigation at crown root + flowering (I_3). The number of grains per panicle was drastically reduced with irrigation at sowing (I_0) and irrigation at sowing + flowering (I_2).

There was no significant difference in 1000 grain weight between the durum varieties. Kalyan Sona had significantly low grain weight as compared to HD–4500 and HD–4502. Irrigation at flowering (I_2) and at crown-root initiation + flowering + dough (I_4) stages produced higher 1000 grain weight and were significantly superior to irrigation at crown-root stage (I_2) and irrigation at all the stages (I_5).

Grain yield : During both the years of experimentation (Table I) wheat variety Kalyan Sona produced significantly higher yield over the other durum varieties. Amongst the durums HD-4500 was found to be significantly superior to the rest during 1970–71 but there was no significant difference during 1971-72. In the combined analysis also, the variety Kalyan Sona produced significantly higher yield (2,387 kg/ha) over the durum wheats (1421 to 1698 kg/ha). Higher grain yield with Kalyan Sona was due to higher plant population and grains per panicle. There was no significant difference in grain yield between the durum varieties. During both the years, the treatment with 5 irrigation (I_5) produced significantly higher yield over the other irrigation levels except I_3 during 1971-72. There was no significant difference between 3 and 4 irrigation (I_3 and I_4) and two irrigations (I_1 and I_2) during both the years. For Kalyana Sona (Table II) irrigation at crown root initiation stage (I_1) was found to be superior to irrigation at flowering stage (I_2) but the difference fell slightly short of significance level. This was not so with the HD varieties. The data indicated that when only one irrigation is available after sowing, it should be applied at crown root initiation. When two irrigations are available they could be applied at crown root and flowering stages.

Straw yield : Kalyan Sona produced significantly higher straw yield (Table II) over the HD varieties during 1970–71, but during 1971–72 the straw yields were on par with HD varieties except HD–4501 which produced the lowest yield. In the combined analysis, Kalyan Sona produced the highest straw yield (4476 kg/ha) closely followed by HD–4500 (4441 kg/ha) which were significantly superior to other varieties (3753 to 4042 kg/ha). Highest straw yield was recorded with 5 irrigations (I_5) during both the years. There was no significant difference in straw yield between 3 and 4 irrigations (I_3 and I_4) and two irrigations (I_1 and I_2) in the combined analysis. With Kalyan Sona wheat however (Table II) 4 irrigations (I_4) produced higher yield (5364 ka/ha) over 3 irrigations (I_3) (4745 kg/ha) but the difference was not significant.

Efficacy of water use: It is observed that the grain production per unit of water (Table III) applied by irrigation was higher

TABLE II

Effect of irrigation levels on the grain and straw yield (Average of 2 years) of durum and aestivum wheat varieties

Irrigation (Main)	Grain yield (kg/ha)						Straw yield (kg/ha)					
	Kalyan Sona	HD 4500	HD 4501	HD 4502	HD 4503	Mean	Kalyan Sona	HD 4500	HD 4501	HD 4502	HD 4503	Mean
I_0	1387	997	657	913	669	925	3076	2616	2324	2662	2470	2630
I_1	2227	1339	934	1232	1107	1368	4009	4073	3306	3277	3196	3572
I_2	1535	1099	978	1145	908	1133	3703	3754	2988	3109	3703	3427
I_3	2799	2119	1823	1996	1896	2127	4745	4723	4352	4042	4745	4480
I_4	2930	2014	2017	1774	1576	2062	5364	4657	4707	4270	4748	4749
I_5	3443	2618	2368	2392	2370	2638	5961	6823	5844	5158	5718	5901
Mean	2387	1698	1463	1575	1421	1709	4476	4441	3921	3753	4042	4126
Irrigation (I)												
S. E. m ±				144.97					115.83			
C. D.				408					326			
C. V. %				37.91					12.55			
Varieties (V)												
S. E. m. ±				118.84					70.71			
C. D. at 5%				358					213			
C. V. %				34.03					8.39			
I × V												
C. D. at 5% for any two irrigations (i) For same variety (ii) For different varieties				798					748			
C. D. at 5% for any two varieties (i) At the same level of irrigation (ii) At different levels of irrigation				716					432			

TABLE III

Quantity of water applied and average productivity per millimeter of water with aestivum and durum wheat varieties

Treatment	Number of irrigation turns	Total water given by irrigation in mm		Water used (Rainfall + Irrigation)		Mean a and b	Average productivity of grain per mm of water		Marginal productivity kg grain/mm of water consumed	
		1970–71	1971–72	1971–72 (a)	1971–72 (b)		*aestivum*	*durum*	*aestivum*	*durum*
I_0	1	76.2	40.1	76.2	66.6	71.4	194	113	—	—
I_1	2	141.7	114.0	141.7	140.5	141.1	158	82	120	49
I_2	2	217.9	194.0	217.9	220.5	219.2	70	47	10	15
I_3	3	263.3	228.5	263.3	254.5	258.9	108	76	49	68
I_4	4	373.9	305.3	373.9	331.8	352.9	83	52	104	61
I_5	5	439.5	373.5	439.5	400.0	419.7	82	58	77	89
Rainfall during growth period (mm)		Nil	26.5	—	—	—	—	—	—	—

with Kalyan Sona as compared to the HD varieties at all levels of irrigation. The highest average productivity of grain per mm of water applied was for irrigation at sowing (I_0) followed by irrigation at crown root initiation (I_1), both in case of aestivum and durum wheat. The next efficient water use was at sowing, crown root initiation and flowering (I_3).

Considering the marginal productivity of additional water applied over basal irrigation, the crown root initiation stage (I_1) followed by crown root + flowering + dough stage (I_4) were found to be most beneficial in case of Kalyan Sona. In case of durum varieties, irrigation at stages other than crown root initiation and flowering were also useful. Irrigation at flowering was found to be least effective both in Kalyan Sona and HD varieties.

Reference

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Effect of different Levels and Methods of Fertilizer Application on Rainfed Groundnut

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Abstract

A field experiment was conducted on sandy loom soils to find out the effect of different levels and methods of fertilizer application on rainfed groundnut. The results indicated that 20 kg N+40 kg P_2O_5/ha was the profit maximization level. Application of entire quantity of fertilizer through soil or part of it through foliage had the same effect. Increased concentration of nitrogen and phosphorus in dry matter increased pod yield. The oil content of kernels was increased by fertilizer application.

Groundnut is an important oil seed crop of India. It is grown over an area of 7.29 million ha with a production of 6.06 million tonnes of pods. Groundnut being a legume, responds well to the application of phosphorus. Nitrogen is also applied to meet the needs of the crop till the nodules are formed. Earlier works (Bhendia and Mann, 1964; Mariakulandai and Morachan, 1965; Pande *et al.*, 1971 and Sandhu *et al.*, 1972) have confirmed the usefulness of nitrogen and phosphorus in increasing the pod yield of groundnut. Under the agroclimatic conditions of Rayalaseema region of Andhra Pradesh, information regarding the optimum dose of