Water Use Management as per Critical Stages in Wheat*

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ABSTRACT

An investigation was carried out during 1969-70 and 1970-71 on the farm of the Gujarat Agricultural University at Junagadh campus, to evaluate the critical stages of crop growth during which wheat yield is likely to be seriously reduced under limited supply of water for irrigation. When irrigations are withheld during any of the crop stages such as milk, boot, late joining, crown root initiation and flowering, wheat yield was adversely affected in that descending order. These stages can be considered as critical so far as the water requirement of wheat is concerned. Application of irrigation at dough stage was of no use to the crop. Wheat yield was drastically reduced by reducing the irrigation frequency below seven irrigations.

INTRODUCTION

GAUTAM and Dastane (1965) observed that at the time of grain filling in wheat, the growth rate is maximum and hence, if moisture is limiting at this stage, yield will be eroded to a greater extent than any other stages. According to Pal (1966), adequate soil moisture is required for normal development of wheat plant during all stages of growth viz., germination, tillering, jointing, heading, grain development and maturation. Dastane (1968) reported that wheat yields were maximum when four irrigations were applied at tiller initiation, boot stage, flowering and grain development. Depending on soil and climatic conditions of different tracts in Gujarat, Gopani (1963) suggested the optimum irrigation frequency of three for Kim and Dabhoi, five to seven for Khowad, Halwad, Thasra and Jamnagar and nine for Kukda and Pilwai. Patel and Patel (1969), recommended 13 irrigations each of about 60 mm for 'NP 710' wheat in addition to presoaking irrigation. It is possible to increase the production by scheduling irrigations at critical stages. This is specially important when water supply is either limited or very costly under the conditions of Gujarat where major area is irrigated by wells. No systematic studies on critical stages of irrigation in Mexican wheat were carried out so far under agro-climatic conditions prevailing in Gujarat and hence this experiment was initiated.

METHODS

The present study was conducted on the farm of the Gujarat Agricultural University at Junagadh campus

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during the winter seasons of 1969-70 and 1970-71 on *Kalyan Sona* wheat. The soil of the experimental plot was clay in texture with fair organic matter content, total nitrogen, available phosphorus and potash. It was slightly alkaline having pH 7.75. Randomized block design with 15 treatments replicated four times was employed. The treatments consisted of withholding irrigation at one or more of crop growth stages as indicated in Table 1. The experimental area was fertilized with nitorgen, phosphorus and potash at the rate of 150, 60 and 40 kg/ha, respectively. 60 kg/ha of N as well as all P and K were applied before seeding by country seed drill and the remaining N was top-dressed in two splits of 60 and 30 kg/ha before first and second irrigation, respectively. Sowing was done in rows spaced at 22.5 cm on Nov. 24, 1969 and Nov. 19, 1970 while the crop was harvested on March 5, 1970 and March 2, 1971 during the respective years.

RESULTS AND DISCUSSION

Data on grain and straw yield for the year 1969-70 and 1970-71 as well as yield attributes for the year 1969-70 are presented in Table 1.

Grain yield :

The average results indicated that there was no significant reduction in yield when out of seven irrigations, one irrigation at dough stage (H) was withheld. Similar results are also reported by Dastane, Singh and Hukkeri (1970) and Chauhan, Hukkeri and Dastane (1970). When six irrigations were applied differently, there was a significant reduction in grain yield due to irrigation either at flowering (F), crown root initiation (B), late jointing (D), boot (E) or milk stage (G). The reduction was 17, 20, 21, 23 and 26 per cent, respectively, as compared to withholding irrigation at dough stage (H). Water stress at late tillering (C) had the same effect as the stress created at the dough stage. Thus it was observed that the most critical stages for moisture stress could be considered as milk and boot stages wherein there was a maximum reduction in yield followed by late jointing, corwn root initiation and flowering.

Under the circumstances when it is possible to schedule only five irrigations, withholding irrigation at two stages viz., late tillering and boot stages (L) drastically reducted the wheat yield by 29 per cent as compared with withholding irrigations at late tillering and dough stages (I). There was no significant difference between the treatments of withholding irrigations at dough and late jointing stages (J) and withholding irrigations at boot and dough stages (K).

When only four irrigations were applied there was a significant reduction in yield due to withholding irrigations during three growth stages viz., late tillering, boot and dough stages (N) as compared with withholding and same number of irrigations during late jointing, flowering and dough stages (O). The difference in grain yield bteween these two treatments was 10 per cent.

From these data it was clear that in general the moisture stress during any of

TABLE—1

Effect of different treatments on grain and straw yeild as well as yield atributes of wheat 'Kalyan Sona'.

Treatment	*Crop growth stages when irrigations were applied*	*Total No of irrigations*		*Productive shoots per 0.9m² 1969-70*	*Grain number per earhead, 1969-70*	*1000 grain weight (g), 1969-70*	*Grain yield*			*Straw yield*		
		1969-70	*1970-71*				*1969-70*	*1970-71*	*Mean*	*1969-70*	*1970-71*	*Mean*
A	CTJBFMD	7	7	274	45	38.74	33.7	38.6	36.2	53.2	60.0	56.6
B	TJBFMD	6	6	207	35	36.04	25.3	31.8	28.6	40.5	47.0	43.8
C	CJBFMD	6	6	253	44	37.42	32.5	37.6	35.0	51.3	57.9	54.6
D	CTBFMD	6	6	214	36	36.59	24.8	31.4	28.1	39.8	46.3	43.0
E	CTJFMD	6	6	212	34	35.66	23.9	30.6	27.3	38.1	44.8	41.5
F	CTJBMD	6	6	234	94	35.60	25.7	33.4	29.6	44.3	50.9	47.6
G	CTJBFD	6	6	223	35	36.03	23.4	29.0	26.2	42.6	49.6	46.1
H	CTJBFM	6	6	272	45	37.96	33.1	38.0	35.6	47.6	54.2	50.9
I	CJBFM	5	5	225	41	36.75	25.5	32.7	29.1	33.0	39.7	36.4
J	CTBFM	5	5	234	41	36.2	24.2	31.2	27.7	33.5	42.7	38.1
K	CTJFM	5	5	234	35	36.08	23.5	30.2	26.9	38.1	44.7	41.4
L	CJFMD	5	5	178	32	32.94	18.2	22.8	20.5	31.0	37.7	34.4
M	CTBMD	5	5	182	33	34.87	19.6	23.6	21.5	32.4	39.1	35.8
N	CJFM	4	4	161	31	31.26	17.0	21.7	19.4	30.1	38.2	34.2
O	CTBM	4	4	186	33	35.10	21.9	26.3	24.1	34.1	43.6	38.9
	SEm ±			13	0.47	0.061	.29	0.62	0.35	0.35	0.48	0.29
	CD at 5%			38	1.33	0.18	0.82	1.76	0.98	0.99	1.36	0.82

			Days				*Days*
C	—	Crown root initiation	*19*	F	—	Flowering	64
T	—	Late tillering	35	M	—	Milk	74
J	—	Late Jointing	43	D	—	Dough	86
B	—	Boot	50				

the crop growth stages of wheat such as milk, boot, late jointing, crown root initiation and flowering, resulted in a substantial reduction in yield which was in that descending order. These results were in confirmity with those reported by Misra, Sharma, Wright and Singh (1969). It would thus appear that losses in grain yield due to moisture stress resulting from delayed irrigations at these stages can not be made up later on even though irrigations at these stages are made good during the rest of the life period of the crop.

Data on the grain yield under different treatments when averaged for the irrigation frequencies indicated that the differences between seven, six, five and four irrigations were significant at each level. The yield at these irrigation frequencies were 36.2, 30.1, 25.1 and 21.8 Q/ha. If we compare the maximum yield under seven irrigations with the yields obtained under six, five and four irrigations, these yields are only 87, 69 and 60 per cent, respectively. This clearly shows that reduction of irrigation frequency below a total of seven irrigations lead to drastic grain yield reductions.

Yield of straw:

The average data on straw yield indicated alomost the same trend of depressing effect of moisture stress at certain critical stages. The highest fodder yield was recorded when no irrigation was withheld (A). It was decreased when water was withheld either at late tillering (C), dough (H), flowering (F) or milk stage. The differences were significant at each level in that descending order. The treatments of withholding water at crown root initiation (B) and late jointing (D) were on par and significantly superior to the rest of the treatments. The lowest straw yield was obtained when water was withheld during three growth stages viz., late tillering, boot and dough (N) which was on par with the treatment of withholding two irrigations at late tillering and boot stages (L).

On an average, the straw yield significantly increased with increase in irrigation frequencies from four to seven.

Yield attributes:

The data on yield attributes for the 1969-70 (Table 1) indicated no significant difference in grain yield between the treatments of not withholding any irrigation (A) and withholding irrigation at dough stage (H) because, the latter did not adversely affect productive shoots and grain number per earhead. The grain and straw yields under the treatment C—withholding irrigation at late tillering—were significantly reduced as compared to the treatment A—not withholding any irrigation—because of adverse effect on 1000 grain weight in the former case. The grain yield depressions under withholding one irrigation at flowering (F), two irrigations at late tillering and dough stages (I) and one irrigation at crown root initiation (B) were the result of reduction in number of productive shoots per unit area, grain number per earhead and 1000 grain weight. Significantly lower fodder yield was recorded because of adverse effect

of the moisture stress at the respective stages on the vegetative growth of the crop which is reflected through the shoots per unit area.

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