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Response of Irrigation and Weed Management on Productivity of Wheat (*Triticum aestivum* L.) Under Middle Gujarat Condition

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Abstract: The response of irrigation and weed management on productivity of wheat (*Triticum aestivum* L.) was studied under middle Gujarat condition. The results indicated that grain yields of cv. GW496 in order to obtain higher grain yield, the crop should be irrigated either at critical stages of crop growth namely crown root initiation, tillering, late jointing, boot, flowering, milking and dough stage or at 0.9 IW/CPE ratio by irrigating the crop with 8 irrigations each of 50 mm depth including one common irrigation soon after sowing for getting uniform plant stand. Significantly highest water use efficiency (20.28 and 24.07 kg ha^{-1} mm) was recorded under I_2 (0.7 IW/CPE) treatments. However, under weed managements treatments, post emergence application of Isoproturon @ 1.0 kg ha^{-1} (W_4) significantly recorded higher water use efficiency (17.59 and 19.23 kg ha^{-1} mm) then rest of the treatments, respectively during 1997-98 and 1998-99.

Key words: Irrigation, weed management, water use efficiency, productivity of wheat, goradu soils of middle Gujarat, India

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important food grains crop. Next to paddy, it ranks first position in both area as well as productivity amongst the cereals. Irrigation is one of the most important/crucial factors for production of wheat crop. A part from the various approaches advocated for higher water use efficiency, application of irrigation based on climatological data and at critical stages of crop growth, its helps in determining the efficient use of water.

Weeds are the major constraints for the poor yield of wheat crop, because of their severe crop weed competition results in reduction of crop yield to the extent of 18.73%[1]. The most critical period of crop-weed competition for wheat crop is between 30-45 days after sowing [2]. Therefore, the control of weeds at proper stage of crop growth is considered very essential. Hence forth weeds are using more water, nutrient, space and light energy as compared to the crop plant because they are having good competitive ability given by nature. Thus, water and weed management play a pivotal role in boosting up the yield of wheat. Keeping above facts in mind, this study was under taken at college farm, B.A.College of Agriculture, Gujarat Agricultural University, Anand Campus, Anand.

MATERIALS AND METHODS

A field experiment was conducted on loamy sand soil of College Agronomy Farm, Gujarat Agricultural University, Anand Campus, Anand to study the response of irrigation and weed management on productivity of wheat (*Triticum aestivum* L.) under middle Gujarat condition during the year 1997-98 and 1998-99. The treatments comprised of three levels of irrigation (irrigation at critical growth stages and IW/CPE ratio 0.7 and 0.9) relegated to main plots and eight weed management practices viz., pendimethalin @ 1.0 kg ha^{-1} pre-emergence, 2,4-D (Ethyl ester) @ 0.75 kg ha^{-1} as post emergence, sulfosulfuron @ 0.025 kg ha^{-1}, weed free (two hand weeding at 20 and 40 DAS) and unweeded control (weedy check) as assign to sub-plot treatments. The details of treatments are mentioned as below.

Main plot treatments
Water management (I)

I_1 Application of 50mm depth of irrigation water at identified critical growth stages viz., crown root initiation, tillering, late jointing, boot, flowering, milking and dough stage.
I_2 Application of 50mm depth of irrigation water at IW/CPE ratio 0.7 (71.43 mm CPE).

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I_3 Application of 50mm, depth of irrigation water at IW/CPE ratio 0.9 (55.58 mm CPE).

Sub plot treatment
Weed management (W)

W_1 Pendimethalin @ 1.0 kg ha^{-1} as pre-emergence.
W_2 2, 4-D (Ethyl ester @ 0.75 kg ha^{-1} as post-emergence.

W_3 Isoproturon @ 1.0 kg ha^{-1} as pre-emergence
W_4 Isoproturon @ 1.0 kg ha^{-1} as post-emergence.
W_5 Oxyfluorfen @ 0.25 kg ha^{-1} as pre-emergence.
W_6 Sulfo suluron @ 0.25 kg ha^{-1} as post-emergence 25 DAS after sowing
W_7 Weed free (Two hand weedings at 20 and 40 DAS)
W_8 Unweed control

Thus, twenty four treatments combinations were tested in split-plot design with four replications. The recommended dose of 120-60-40 kg ha^{-1} of N-P_2O_5-K_2O were applied common to all the experimental plots. First irrigation should be given between 17 to 22 days after sowing and subsequent 6 irrigations at an interval of 10 to 15 days. The soil of the experimental fields was loamy sand in texture (locally known as Goradu soil) having good drainage and fairly moisture retention capacity with pH ranging from 7.7 to 8.2. The soil was placed in fertility scale of low in total nitrogen, medium in available phosphorus and fairly rich in available potash with alkaline reaction.

RESULTS AND DISCUSSION

Effect of water management: The results presented in Table 1 revealed that difference in grain yield kg ha^{-1} due to different levels of irrigation were found significant during the year 1998-99 and in pooled results. Similar trend was observed during the year 1997-98, through the differences were not perceptible. Among different irrigation levels, I_3 produced significantly higher grain yield (5132 and 5176 kg ha^{-1}), followed by I_1 (5091 and 5150 kg ha^{-1}) and were significantly superior to I_2 (4814 and 4942 kg ha^{-1}) during year 1998-99 and in pooled analysis, respectively. It is very interesting to note that scheduling irrigation at critical stages (I_1) produced yield as high as that of irrigation applied through IW/CPE ratio 0.9 (I_3).

The results recapitulated that grain yield of wheat and did not differ remarkable by application of irrigation water either through critical growth stages or IW/CPE ratio 0.9 (I_3).

Similar positive results or higher rates of irrigation are also reported by Dubey and Sharma[3], Singha and Sharma[4] and Choubey *et al.*[5] that significant increase in grain yield was due to favourable effect of increasing irrigation frequency which may be due to more conversion of sources to sink for the formation of seed.

Lowest yield of wheat crop was recorded under 0.7 IW/CPE ratio (I_2), which received 5-4 irrigation as against 7-7 (I_1) and 7-6 (I_3) irrigation during the year 1997-98 and 1998-99, respectively was due to the moisture stress at various physiological stages of the crop. Mishra *et al.*[6], Sharma[7], Bandopadhyay[8] and Singha and Sharma[4] also advocated similar response to irrigation.

Among water management treatments, I_2 (0.75 IW/CPE) recorded significantly the highest water use efficiency (20.28 and 24.07 kg ha^{-1} mm) as compare to the rest of the treatments during the year 1997-98 and 1998-99, respectively. Similar trend was reported by Khan *et al.*[9] at Morena in Madhya Pradesh.

Effect of weed management: The results indicated in Table 1 that the differences observed in grain yield due to various weed management treatments were found significant during both the years of investigation and in pooled analysis. Among the weed management treatments, the post-emergence application of Isoproturon @ 1.0 kg ha^{-1} (W_4) gave significantly higher grain yield (5430, 5224 and 5327 kg ha^{-1}) over treatments W_2, W_3, W_5, W_6 and W_8 but it was at par with W_1 (5364, 5091 and 5227 kg ha^{-1}) and W_7 (5429, 5075 and 5252 kg ha^{-1}) during the years 1997-98, 1998-99 and in pooled results, respectively.

It is summarized from the results that remarkable higher grain yield can be obtained by controlling weeds through Isoproturon @ 1.0 kg ha^{-1} (W_4) or Pendemethalin (W_1) or keeping weed free condition through out life period of wheat (W_7). These results are in agreement with those reported by Pandey *et al.*[10].

Significantly the lowest grain yield (4791, 4818 and 4805 kg ha^{-1}) was recorded under unweeded control during both the years as well as in pooled results, respectively. However, it was at par with W_6 (4905 kg ha^{-1}) during the year 1998-99 only.

According to Mustafee[11] the reduction in grain yield as wheat due to weed crop competition was to the extent of 10.82%. Weeds mainly compete with crop for space, moisture, mineral and light energy. Consequently the reduction in grain yield depends upon the severity of weeds and their growth habit. In case of weed management treatment during the both the year of experimentation, post emergence application 30 DAS of Isoproturon @ 1.0 kg ha^{-1} (W_4) recorded significantly

Table 1: Mean grain yields (kg ha^{-1}) of wheat as affected by irrigation and weed management treatments

	Grain yield (kg ha^{-1})			Water-use efficiency (%)	
Treatments	1997-98	1998-99	Pooled	1997-98	1998-99
Irrigation (I)					
I_1- At critical crop growth stages	5209.00	5091.00	5150.00	14.88	14.54
I_2-At 0.7 IW/CPE ratio	5070.00	4814.00	4942.00	20.28	24.07
I_3-At 0.9 IW/CPE ratio	5221.00	5132.00	5176.00	14.92	17.10
S.Em±	58.80	59.60	41.83	0.20	0.23
C.D. at 5%	NS	206.10	128.91	0.70	0.80
C.V.%	6.43	6.72	6.58	6.88	7.04
Weed management (W)					
W_1 - Pendimethalin @ 1.0 kg ha^{-1} PE	5364.00	5091.00	5227.00	17.34	18.82
W_2 - 2, 4-D (Ethyl ester @ 0.75 kg ha^{-1} (30 DAS) POE	5059.00	5004.00	5032.00	16.31	18.44
W_3 - Isoproturon @ 1.0 kg ha^{-1}PE	5077.00	4993.00	5035.00	16.43	18.56
W_4 - Isoproturon @ 1.0 kg ha^{-1} (30 DAS) POE	5430.00	5224.00	5327.00	17.59	19.23
W_5 - Oxyfluorfen @ 0.25 kg ha^{-1} PE	5105.00	4989.00	507.00	16.51	18.52
W_6 - Sulfo suluron @ 0.25 kg ha^{-1} (25 DAS) POE	5077.00	4905.00	4991.00	16.40	18.29
W_7 - Weed free (Two H.W. at 20 and 40 DAS)	5429.00	5075.00	5252.00	17.56	18.86
W_8 - Unweed control	4791.00	4818.00	4805.00	15.39	17.84
S.Em±	84.86	56.14	5058.00	0.28	0.22
C.D. at 5%	240.00	158.80	141.74	0.81	0.64
C.V.%	5.69	3.88	4.90	5.98	4.19
Interaction	NS	NS	NS	NS	NS

Table 2: Grain yields (kg ha^{-1}) of wheat as influenced by interaction effect of irrigation and weed management (IXW) during 1998-99

	Grain yield (kg ha^{-1})							
	Weed management (W)							
Irrigation (I)	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8
I_1	5331.00	5103	5000	5432	5097	4891	5060	4815
I_2	4860.00	4617	4877	4850	4866	4887	4938	4619
I_3	5082.00	5292	5103	5391	5004	4938	5226	5021
S.Em±	97.23							
C.D. at 5%	275.01							
C.V.%	3.88							

higher water use efficiency (17.59 and 19.23 kg ha^{-1} mm) then rest of the other treatment.

Interaction effect: The interaction effect between irrigation levels and weed management treatments (IxW) was found significant during the year 1998-99 only.

A close examination of data given in Table 2 revealed that the treatments I_1W_4 recorded significantly higher grain yield (5432 kg ha^{-1}) as compared to rest of the combinations but it was at par with the treatment combinations I_3W_4 (5391), I_1W_1 (5331), I_3W_2 (5292 and I_3W_7 (5226 kg ha^{-1}). Comparatively lower grain yield was recorded under water management treatment I_2 combined with all the weed management treatments.

Results further indicated that the differences in grain yield over years were found significantly in pooled data. Significantly higher grain yield was recorded during the first year over second year.

Based on the results of two years field experiment, it can be concluded that for potential production and higher water use efficiency from wheat cv. GW-496 in loamy sand soil of middle Gujarat, the crop should be irrigated either at critical crop growth stages viz., crown root initiation, tillering, late jointing, boot, flowering, milking and dough stages or scheduling irrigation at 0.9 IW/CPE ratio and maintaining weed free condition either by the application of Isoproturon @ 1.0 kg ha^{-1} as post emergence (30 DAS) or with two hand weeding at 20 and 40 days after sowing. In case of highest water use efficiency (20.28 and 24.07 kg ha^{-1}) recorded under I_2 (0.7 IW/CPE) water management treatment, whereas (17.59 and 19.23 kg ha^{-1} mm), highest water use efficiency reported under post emergence application of Isoproturon @ 1.0 kg ha^{-1} (W_4) under weed management treatment.

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