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EFFECT OF IRRIGATION DURINGYARIOUS DEVELOPMENT STAGES ON YIELD, COMPONENTS", F YIELD AND HARVEST INDEX OF DIFFERENt'WHEAT CULTIVARS

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Effect of irrigation during different .development stages on grain yield, components of yield and harvest index of several new cultivars of wheat *(Triticum aestivum* L.) was investigated during *1989/90* and *1992/93* seasons. Grain yield of irrigat~crops was 5.13 and 6.31 t ha", respectively, about 8% higher than the yield of unirrigated crops. The in,!?feasen yield due to irrigation was mainly associated with an increase in total dry matter production as th~,~rvest index varied a little whitin each treatment or year. The results also emphasize the flexibility of yield.~tnponents of wheat..

Key words: harvest index, irrigation effect, wheat cultivars

INTRODUCTION

Wheat *(Tciticum aestivum* L.) is a widely adapted crop and is '8 staple food for a large part of human population. Carefully husbanded crops of spring wheat can yield more than 6 t ha" (Whitefield *et el.,* 1'989; Mossedaq and Smith, 1994) and provide a reasonable profit to the grower. Despite the potential represented by good crops in favourable seasons, the major factor restricting the area of the crop grown has been its variability in performance as indicated from experiments conducted by different workers (Muhammad *et al.,* 1984; Whitefield *et el., 1989;* Rashid, 1992; AARI, 1994). There is a need to determine the agronomic factors such as cultivar, irrigation, sowing date, etc. responsible for the fluctuation in yield so that appropriate steps can be taken to improve both the magnitude and consistency of wheat yield. This study reports the effects of Irrigation during different development stages on the grain yield, components of yield and harvest index of new cultivars of wheat under Faisalabad conditions.

MATERIALS AND METHODS

The experiments were conducted on the Agronomic Research Area, University of Agriculture, Faisalabad 011 a sandy clay loam soil in *1989/90* season. The treatments were two wheat cultivars (LU-26s & Pak-81) and four irrigation treatments (control, I_0)., full irrigation (emergence to maturity, E-M), irrigation from emergence to ear emergence (E-E) and irrigation from anthesis to maturity (F-M). In *1992/93* season, the treatments were three wheat cultivars (Pak-81, Pasban-90 & Inqalab-91) and three irrigation treatments (control, I_0)., full irrigation (from emergence to maturity, E-M), and irrigation from emergence to anthesis (E-F). In both seasons, a split plot design was employed with irrigation in the main plot and cultivar in the subplots, respectively. The subplots were 16.0 x 3.0 m in *1989/90* and 12.0 x 2.0 m in *1992/93,* respectively.

In both seasons the seedbed was prepared using standard farm practices. A basal dose of NPK (70-100-100 kg ha') respectively was applied at the time of seedbed preparation, while the remaining half of N (70 kg ha") was applied in February. Sowing rate was 100 kg ha" in both the seasons and the seed was sown in mid November in both seasons with the help of a single-row hand drill. At maturity, an area of 1m^2 from each subplot was harvested discarding appropriate borders. A random sample of 20 plants from each' sample was taken for detailed measurements of yield and yield components. The ears were threshed by hand, and seed yield was determined following drying at 80°C (± 2°C) to a constant weight.

RESULTS

Weather: In both seasons average rainfall was 123 mm and about 70% of it fell between the last week of February and second to third week of April (Table 1). The average temperatures ranged between 12.2°C to about 26°C during the growing seasons and were close to long term means. Relative humidity decreased from 83% in December to about 43% in April during the experimental seasons.

Total Dry Matter. Grain Yield and Harvest Index: In *1989/90,* total dry matter (TOM) was not affected by

Table 1. Effect of irrigation 8ma cl:Jltiw,aon tQtaldry matter (TIDM) at maturity, grain y,ieldaB'd harvest iiaex of wheat

Treatments	TDM (t ha^{-1})	Grain yield (t ha')	Harvest index
1989190			
Irrigation			
le	9.58	4.70	0.49
E-M	10.90	5.0:7	0.47
E-E	10.74	5.23	0.49
F-M	11.19	5.51	0.50
LSD 5%	2.55	1.13	0.02
Cultiv8r			
LU-26s	1'0.79	5.10	0.4-8
Pak-81	1'0.42	5.15	0.4·9
LSD 5%'	1.7,9	0.91	Q.02
Mean	10.60	5.13	0.49
199·2/93			
Irrigation			
l_0	12.90	6.11	0.48
E-M	13.36	6,41	0.48
E-F	14.14	6,41	0,44
LSD 5%	1.31	0.20	0.06
Cultivar			
Pak-81	13.59	6.30	0,46
Pasban-90	13.28	6,42	0,47
Inqalab-91	13.54	6.21	0,46
LSD 5%	0,47	0.25	0.03
Mean	13,47	6.31	0.46

irrigation treatments (Table 1). However, a significant interaction between irrigation and cultivar indicated that Pak-81 had markedly reduced TDM yield than LU-26s in the F-M irrigation treatment. By the final harvest, mean TOM ranged from 9.6t to 11.2t ha^{-1} among different irrigation treatments (Table 1). In 1992/93, irrigation significantly affected TOM production, which ranged from 12.90t to 14.1 Ot ha^{-1} among different irrigation treatments (Table 1). In both years cultivar differences in TOM yield were also non-significant.

Grain yield was not significantly affected by the treatments in both the seasens (Table 1). The average grain yield ranged between ,\4#W£ to~;5.5t ha' in 1989/90 season. CorrespOhding values ranged from 6.11 to 6,41 t ha^{-1}, with a mean value of 6.31t· ha^{-1} in 1992/93 season (Table 1). Grain yield with different treatments was linearly related to their TOM yield, and the percentage variance accounted for was 96.1 %. None of the treatments significantly affected harvest index, in both the seasons. The average value of harvest index was 0.49 in 1989/90 and 0.46 in 1992/93 (Table 1).

Components of Yield: In 1989/90, significant differences were found in the number of spikelets ear' between the cultivars (Table 2). The cv. Pak-81 had 19,42 spikelets compared to 16,44 in LU-26s. Similarly, the number of grains ear' was also higher in the former than in the latter by about 31.3% (47.00 vs 32.25). In contrast, the mean grain weight was approximately 34% higher (38.17 vs 51.05) in ~l;J-26sthar'lPak-81 . Irrigation applied during different development stages did not influence components of yield, except mean grain weight which was significantly reduced in the E-M irrigation treatment than with E-E or F-M treatments.

In 1992/93, all treatments resulted in statistically

Table 2. Effect of irrigation and cultivar on compon~.of grain yield

Treatments	Tillers m^2	Spikel~ts ear'	Grains ear'	1000-grain weight(g)
1989/90				
Irrigation				
$^1_0$	207.5	17.96	39.38	44.60
E-M	390.5	17.88	39.38	42.81
E-E	306.4	17.81	38.75	4·5.08
F-M	293.9	18.42	L!.1.00	45.98
LSD 5%	124.4	1.06	3.99	1.93
Cultivar				
LU-26s	341;'0	16.44	32.25	51.05
Pak-81	~2.4.	19.42	47.00	38.17
LSD 5%	;/ 98.6	0.72	2,48	1.29
Mean	315.2	17.93	39.63	44.61
1992/93				
Irrigation				
$^1_0$	478.4	16.96	40.16	41.99
E-M	519.2	17.14	41.22	46.98
E-F	511.2	16.89	40.80	45.13
LSOi5%	83.9	1.16	4.00	5.00
Cultivar				
Plak-81	505.3	17.11	41.75	44.31
Pasban-90	500.7	16.40	39.33	44.00
Inqa/ab-91	511.9	17,48	41.12	46.00
LSD 5%	76.2	0.82	3.02	3.47
Mean	506.0	17.00	40.73	44.70

similar number of grains ear' and mean grain weight (Table 2). However, the number of spikelets ear' was significantly higher in Inqalab-91 than the Pasban-90 but not higher than those of Pak-81 (Table 2). The average number of spikelets was 17.00 at the final harvest. In both seasons, none of the treatments significantly affected tillers per unit area, which ranged from 315.2 in 1989/90 to 506.0 tillers m^{-2} in 1992/93 (Table 2).

DISCUSSION

The results (Table 1) suggest that under Faisalabad conditions, the TOM yield of wheat can be increased by irrigation. The average increase in TOM with irrigation was about 11% in 1989/90 and 5% in 1992/93. Thus, the general effects of irrigation on the TOM yield were similar as reported by Whitefield *et al.* (1989). It was also indicated that high potential yield of TOM (1992/93) was entirely due to irrigation and favourable weather conditions, All the cultivars produced nearly similar TOM yields (Table 1). These results substantiated the findings of Rashid (1992) who also worked under Faisalabad conditions.

This study also showed that the crops grown in any one season, produced similar grain yield (Table 1). There seemed two reasons for such a behaviour. Firstly, drought was imposed after the establishment irrigation which might have maintained a favourable soil moisture regime due to cooler temperatures during early season growth. Secondly, environmental conditions were not averse, especially rainfall between February-April was adequately distributed. This probably helped to maintain a favourable growth for the production of grains. Many researchers in Pakistan have also reported similar non-significant differences in grain yield due to irrigation during a wet season (Muhammad *et et.,* 1984). Thus, in dry season, when the cumulative water deficit beco~~s much larger than the cumulative rain during the growth, it seems that crop yields are largely dependent upon the quantity of water received.

The average grain yield in this study was 5.13-6.31 t

ha' in the two seasons (Table 1). This *is* similar to other experimental yields (> 5 t ha') reportede_«er in Pakistan (Oari *et et.,* 1990). The higher grain yield of 6.31 t ha' in *1992/93* season may also indicate a potential of these cultivars with better husbaridrv practices and favourable weather conditions. These results corroborate the findings of Mossedaq and Smith (1994) who also reported higher grain yield (.5 to 8 t ha I) in spring wheat.

The present results also showed that insignificant differences in grain yield among different treatments were compensated by various yield components (Table 2). However, there is an evidence that irrigation proved to be better over no-irrigation in ensuring higher grain weight (Table 2l, and thus was indicative of better grain set.

Within each treatment, the harvest index (HI) varied a little in response to irrigation or cultivars (Table 1). Total grain yield was, therefore, determined by TOM production. Donald and Hamblin (1976) also reported that grain yield will increase with increasing TOM when the HI is not changed. The average values of HI ranged from 0.46 to 0.49 in this study, which favourably compared to those (0,43 to 0.48) obtained for standard cultivars in Pakistan (Rashid, 1992). These results showed that increase in grain yield of different cultivars of wheat due to irrigation was associated with increase in TOM production provided the harvest index remained stable.

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