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INFLUENCE OF SOWING DATE AND IRRIGATION LEVELS ON GROWTH AND GRAIN YIELD OF WHEAT

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A field study was conducted during 1999-2000, at the Agronomic Research Area, University of Agriculture, Faisalabad, to determine the influence of sowing date and irrigation levels on the growth and yield of wheat. Both 15 November sowing and increasing level of irrigation (6 irrigations) enhanced leaf area index and dry matter accumulation over 15 December sowing and lower levels (0, 2 or 4 irrigations) of irrigation. The higher grain yield (5486 kg ha") in IS November sowing was due to increase in yield components as compared to 15 December sowing, and this response was significantly greater with 6 irrigations than less irrigations or nil irrigation. The results suggest that there is a considerable scope to exploit the yield potential of wheat in the irrigated areas of Pakistan.
Key words: leaf area index, total dry matter, grain yield, sowing date, irrigation levels, wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the staple food for a large part of world population including Pakistan. In this country it is grown on 8394.5 thousand hectares with an average yield of2371 kg ha"l (Anonymous, 1999), which is far below than that of most of the countries of the world. Sowing date influences the growth and yield of wheat by affecting its environment. Early sown crops produce higher yields because they intercept more solar radiation over an extended period of growth (Ali, 1999). Singh and Uttam (1994) reported that delay in sowing of wheat from 20 November onward decreased grain yield @ 39 kg ha" day",
According to Reddi and Reddi (1995), both sowing date and irrigation are interrelated for better productivity. Irrigation water is essential for cell turgidity which is related to photosynthesis, growth of tissues and plant organs. Earlier research showed that irrigation consistently increased wheat yield in Pakistan (Bajwa et al., 1993; Hussain et al., 1997), This paper examines the effect of different sowing dates and irrigation levels on the growth, yield and yield attributes of wheat under semiarid conditions of Faisalabad.

MATERIALS AND METHODS

A factorial experiment comprising two sowing dates (15 November and 15 December) and four irrigation treatments i.e. I_0 (control), I_1 (2 irrigations), I_2 (4 irrigations) and I, (6 irrigations) was laid down as a split plot design with three replications at the Agronomic Research Area, University of Agriculture, Faisalabad during 1999-2000 season. The plot size was 5 m x 1.2 m having six rows in each subplot. The N and P fertilizers were applied at sowing @ 120 and 100 kg ha" respectively. The irrigation treatments were designed to induce maximum soil moisture deficit during growth. A control treatment (I_0, no irrigation), two irrigations (I_1 one at crown root stage (CRS) and the second at booting stage), four irrigations (I_2, 2 irrigations as I" third at anthesis and fourth at grain development) and full irrigation (I", irrigation at all definable growth stages i.e. CRS, tillering, booting, earing, anthesis and grain growth) throughout the season. Data on various growth and yield attributes were recorded by using standard procedures. All the data were analysed using Fisher's analysis of variance technique and the least significant difference (LSD) test at 5% probability level was used to test the significance of treatment means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

DEVELOPMENT

The 15 November sowing took 10 days to full emergence while plants sown on 15 December took IS days to complete the emergence. From seedling emergence to ear emergence the crop took 90 and 76 days respectively. From ear emergence to anthesis it took 8 and 5 days respectively. Thereafter from anthesis to maturity, the 15 November sowing took 50 days, whereas 15 December sowing matured in 33 days. Total growth duration (sowing to maturity) was 158 days in 15 November and 128 days in IS December sowing. Sharif (1999) reported that physiological maturity of the wheat crop sown on 11 November was attained in 142 days after sowing (DAS), whereas final harvesting was done at 155 DAS, depending upon the prevailing weather conditions.

GROWTH:

Leaf Area Index (LA I): The IS November sowing significantly enhance LAI than the IS December sowing at 1st February and 22 March harvests, whereas 15 December enhanced LAI over 15 November sowing at 24 February harvest significantly (Table 1). Maximum LAI of 5.9 reached first February in the IS November sowing compared to 15 December sowing where the value was 3.1 only. Irrigation treatments significantly increased LAI over control treatments throughout, exhibiting a linear trend (Table I). The data also indicated that control (nil) treatment consistently reduced LAI from I February onward till 12 March harvest as compared to irrigated treatments, where LAI increased up to 24 February harvest; thereafter it declined towards the final harvest.. A significant interaction between sowing date and irrigation levels showed that 15 November sowing enhanced LAI over 15 December sowing, and this response was significantly higher in fully irrigated (6 irrigations) plants than the control (nil) or partially irrigated (2 or 4 irrigations) crops. Significant effect of irrigation

Table I. Effect of sowing dates and irrigation levels on leaf area index

Treatment	Leaf area index		
	Harvest I (01 Feb.)	Harvest II (24 Feb.)	Harvest III (22 Mar.)
Sowing dates			
15 November	5.86	4.40	3.51
15 December	3.09	5.19	3.25
LSD (5%)	0.03	0.05	0.04
Irrigation levels			
I_0 = control	4.05	3.74	3.18
I_1 = 2 irrigations	4.17	4.75	3.75
I_2 = 4 irrigations	4.63	5.17	3.90
I_3 = 6 irrigations	5.06	5.53	3.90
LSD (5%)	0.01	0.01	0.004
Mean	4.48	4.80	3.38

Table 2. Effect of sowing dates and irrigation levels on yield and yield components of wheat

Treatment	TOM (t ha")	Spike m-2	Grains Spike"	1000-grain weight (g)	Harvest Index (%)	Grain yield (kg ha")
Sowing dates						
15 November	13.0	500	27.5	42.0	36.6	4875
15 December	9.8	385	27.9	29.7	31.8	3117
LSD (5%)	0.38	13	NS	4.2	0.3	105
Irrigation levels						
10 = control	10.1	390	23.4	30.9	31.8	3497
1I = 2 irrigations	10.8	430	26.5	35.1	34.0	3749
12 = 4 irrigations	11.9	465	29.6	36.9	34.5	4137
13 = 6 irrigations	12.5	485	23.1	40.4	36.4	4601
LSD (5%)	0.43	16	4.1	2.2	4.8	171
Mean	11.4	424	27.7	35.8	34.2	3996

treatments on LAI is similar to the results of Cortazar et aJ. (1995) who concluded that moisture stress reduced LAI.

Yield Components: The number of spikes m^{-2} was significantly higher in 15 November sowing, and this response was greater in 1_3 compared to 15 December sowing (Table 2). Sowing date had no effect on the number of grains per spike. In contrast, 1_3 (6 irrigations) treatment produced significantly higher number of grains per spike than 1_2 or 1_1 treatments. The 1000-grain weight decreased significantly as sowing was delayed (Table 2). There was, however, significant effect on grain weight between irrigation treatments. Both 1_1 and 1_2 treatments were, however, at par in mean seed weight. The data (Table 2) indicated that 15 November sowing gave the highest harvest index than 15 December sowing (36.57% vs 31.78%), and this response was significantly higher in 1_3 (6-irrigations) treatment. The lowest harvest index of 31.73% was given by control (nil) treatment.

Grain Yield: There were significant yield differences among the sowing dates. The mean yield was 4875 kg ha"^{l} on 15 November sowing and 3117 kg ha-Ion 15 December sowing time. There were also differences among sowing times as to the response of grain yield to irrigation treatments. In the 15 November sowing, grain yield was greater in 1_3 (6 irrigations) than 1_2 (4 irrigations) or 10 (nil). The grain yield increased with increasing irrigation number. The crop sown in mid November produced the highest yield, mainly because it had the maximum spikes or grains per unit area, and heavier grains over December sowing. The crop sown in mid December had lower yield. Its spikes population or mean seed weight did not compensate for the increases in the yield of earlier sowing. Except for I, irrigation and 10 (control), all other irrigation treatments (12 and 1_3) increased grain yield primarily by increasing spike population or seed numbers. These results are consistent with the pattern of irrigation levels in a serniaridenvironment, where increasing levels of irrigation usually produce higher yields. Similar results were reported by Reddi and Reddi (1995), Hussain et aJ. (1997) and Sharif (1999), who reported higher grain yield of wheat with enhanced irrigation frequency.

The results showed that full irrigation (13) treatment enhanced grain yield in early sowing over late sowing by improving the growth (LAl) of the crop plants, enabling to intercept more radiation over control (10) or partially irrigated crops (I], 1_2). The response to' grain yield between sowing dates was also differential. Therefore, strategies must be developed to improve water use efficiency of the irrigated crops. This indicates that there is a considerable scope to exploit the yield potential of wheat in the irrigated region of Pakistan, depending upon the prevailing climatic conditions.

REFERENCES

Ali, R. 1999. Radiation interception, growth and yield of wheat as affected by sowing date and nitrogen application. M.Sc. Thesis (Agronomy), University of Agriculture, Faisalabad.

Anonymous. 1999. Agricultural Statistics of Pakistan (1997-98), Govt. of Pakistan, Ministry of Agri. Food & Livestock, Economic Wing, Islamabad.

Bajwa, MA, M.H. Choudhry and A. Sattar. 1993. Influence of different irrigation regimes on yield and yield components of wheat. Pak. J. Agri. Res. 14: 361-365.

Cortazar, R.M., A.U. Munoz, OJ.L. Rodriguez and A.L. Hemandez. 1995. Transpiration dynamics and efficiency in three genotypes of wheat under water stress. Revista Fitotenia Mexicana. 18(2): 151-162 (Wheat, Barley and Triticale Abst. 14(2): 856, 1996).

Hussain, A., M. Maqsood, A. Ahmad, A. Wajid and Z. Ahmad. 1997. Effect of irrigation during various development stages on yield, components of yield and harvest index of different wheat cultivars. Pak. J. Agri. Sci. 34: 104-107.

Reddi, G.H.S. and T.Y. Reddi. 1995. Irrigation of principal crops. In Efficient Use of Irrigation Water, 2nd ed. Kalyani Pub., New Delhi. 229-259.

Sharif, M. 1'999. Effect of irrigation at different growth stages on growth and yield performance of wheat cultivars. M.Sc. Thesis (Agronomy), University' of Agriculture, Faisalabad.

Singh, V.P.N. and S.M. Uttam. 1994. Performance of wheat *(Triticum aestivum* L.) cultivars under limited irrigation and fertility management. Indian J. Agron. 38: 386-88.

Steel, R.G.D. and lH. Torrie. 1984. Principles and Procedures of Statistics, 2nd ed. McGraw Hill Book Co., New York.