

THE RESPONSE OF DIFFERENT IRRIGATION LEVELS TO GROWTH AND YIELD OF DIFFERENT WHEAT (*Triticum aestivum* L.) CULTIVARS

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Abstract: Response of three wheat varieties (i.e. Punjab-96, Faisalabad-85 and Inqlab-91) to different irrigation levels viz; 1, 2 and 3 irrigations were studied under Rabi field conditions during 200-2001. The wheat variety Punjab-96 produced significantly the maximum number of fertile tillers m^{-2} , plant height (cm), number of grains spike^{-1} , thousand grain weight (g), grain yield (kg ha^{-1}), biomass (kg ha^{-1}) and harvest index (%) among the varieties tested. The plots treated with the highest number of irrigation level produced significantly the maximum number of plants m^{-2} , plant height, number of grains spike^{-1} , thousand grain weight, grain yield, biomass and harvest index of variety Punjab-96.

Keywords: Irrigation level, Varieties, Wheat, Yield and Yield Components.

INTRODUCTION

Agriculture is considered as the backbone of Pakistan's economy and wheat (*Triticum aestivum* L.) is occupied a central place in agriculture is used as staple food by a large number of people all over the world. Thus, in order to cope with the increasing pressure of growing population, wheat is found a prime importance in the sector of agriculture. It is grown nearly all over the world. Wheat crop is grown in Pakistan on an area of 8180 thousand hectares with a production of 19023.7 thousand tons of grains having an average yield 2325 kg ha^{-1} [Anonymous 2002] which is far below the maximum potential. The evolution of short statured, fertilizer responsive, disease resistant and high yielding varieties has brought a break through in wheat production, however, still there is a wide gap between potential yield and the yield recorded at farmers' fields. Among many factors responsible for low yield, crop stage and frequency of irrigation are very important. It has been reported that water stress during the months of March and April showed a decrease of 400 kg acre^{-1} [Hussain 2000]. The protein contents of wheat also depend upon suitable moisture regime.

Potential yield of wheat can only be obtained under well-watered conditions together with other suitable cultural practices. Water is required by wheat at different critical growth stages [Frank *et al.* 1973]. Larcher and Wool House [1985] also reported that 540 gm of water is needed to produce 1 gm dry matter of wheat.

For harvesting maximum genetic potential selection of high yielding varieties under particular set of environment is of prime importance. Keeping in view the above considerations, this study was designed to

evaluate different wheat varieties grown under alternate irrigation conditions.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Area, University College of Agriculture, Bahauddin Zakariya University, Multan during the Rabi 2000-2001, on a clayey loam soil. The experiment was laid out in a split-plot design with three replications having a net plot size of 1.8 x 4 m². Three levels of irrigation (1, 2, and 3 irrigations) were randomized in sub-plots and the three wheat varieties i.e. Inqlab-91, Punjab-96 and Faisalabad-85 were randomized in main plots. The crop was sown in 30 cm apart rows with a single row hand drill, using a seed rate of 112 kg ha⁻¹. All other agronomic practices were kept normal and uniform for all the treatments. Fertile tiller in m² per plot were counted and converted to tillers per hectare. At harvesting, ten plants from each plot were selected at random to record the average plant height and number of grains spike⁻¹. Two samples per plot were weighed and averaged to determine thousand-grain weight. The crop from each plot was harvested and weighed separately to record the total biomass and grains were separated and weighed to record grain yield plot⁻¹.

Data collected were analyzed statistically by using Fisher's analysis of variance technique; and LSD test at probability level of 5% was employed to compare the differences among the treatments' means [Steel and Torrie 1984].

RESULTS AND DISCUSSION

Significant differences were observed among the three wheat varieties for fertile tillers m² (Table 1). The variety Punjab-96 produced significantly the maximum number of fertile tillers m⁻² (470.5). While Faisalabad-85 produced lowest number of fertile tillers m⁻² (222.1). Chandra *et al.* [1999] also reported significant differences among wheat varieties for fertile tillers m⁻². The three levels of irrigation also significantly influenced the number of fertile tillers m⁻². The maximum number of fertile tillers m⁻² (394.7) was produced at the highest irrigation level (3 irrigations) and the minimum number of fertile tillers m⁻² (286.4) was produced at the lowest irrigation level (1 irrigation). This significant difference may be attributed to moisture stress at tillering stage. Similar results were also reported by others [Ghazal *et al.* 1998]. The interactions among the varieties and irrigation levels were also found to be significant. This might be due to varying response of different varieties to irrigation at different growth stages.

Plant height also differed significantly (Table 1) and the variety Punjab-96 gained significantly maximum height (91.60 cm), while Faisalabad-85 showed the minimum (65 cm). The application of irrigation levels had also influenced the plant height significantly. The maximum height of 84.7 cm

with three irrigation levels and the lowest with one irrigation (72.2 cm) was observed. Ahmed *et al.* [1997] also reported similar results. The interactions between varieties and irrigations were also significant.

Table 1: The response of different irrigation levels to growth and yield of different wheat (*Triticum aestivum* L.) cultivars.

Treatments	Fertile tillers m ⁻²	Plant height (cm)	Number of grains spike ⁻¹	1000 grain weight (g)	Grain yield (kg ha ⁻¹)	Bio mass (kg ha ⁻¹)	Harvest index (%)
Varieties							
Punjab – 96	470.5 a	91.60 a	52.37 a	39.842 a	6154 a	16588 a	37.10 a
Inqlab – 91	316.4 b	77.58 b	46.00 b	34.941 b	3718 b	10586 b	35.12 b
Faisalabad – 85	222.1 c	65.00 c	35.46 c	31.174 c	2020 c	6361 c	31.78 c
Irrigation levels							
One irrigation	286.4 c	72.18 c	40.8 c	33.66 c	3153.33 c	9100 c	34.65 b
Two irrigations	327.8 b	77.30 b	44.8 b	35.75 b	3857.31 b	10850 b	35.55 ab
Three irrigations	394.7 a	84.66 a	48.2 a	36.54 a	4881.11 a	13585 a	35.93 a
Interaction	**	**	**	N.S	N.S	**	N.S

Means sharing same letters are statistically non-significant at 5% probability level;

** = highly significant; N.S = Non-significant.

All the varieties produced statistically different number of grains spike⁻¹ (Table 1). This might occurred due to genetic make up in different cultivars. The variety Punjab-96 produced significantly highest number of grains spike⁻¹ (52.37) as compared to the lowest number (35.5) in cv. Faisalabad-85. The number of grain spike⁻¹ was also influenced significantly by different irrigations. The plots receiving three irrigations produced maximum number of grains spike⁻¹ (48.2) and lowest number (40.8) in treatments where one irrigation was applied. Significant differences for the number of grains spike⁻¹ were also reported by Ahmed *et al.* [1998]. The interactions between the varieties and irrigation levels were also significant. The varieties varied from one another significantly regarding 1000-grain weight (Table 1). The variety Punjab-96 produced significantly the highest 1000-grain weight (39.84 g) and cv. Faisalabad-85 produced the minimum 1000-grain weight (31.17 g). These findings are in agreement with those of Ahmed *et al.* [1997]. Similarly 1000-grain weight differed significantly at different irrigation levels. The plots given the three irrigations produced significantly the maximum 1000-grain weight (36.54 g) and the plots receiving one irrigation level produced the

minimum (33.7 g). Ahmed *et al.* [1997] had also reported significant effect of different irrigation levels on 1000-grain weight.

Different wheat varieties varied significantly regarding to grain yield (Table 1). The variety Punjab-96 produced significantly the maximum grain yield (6154 kg ha^{-1}) and Faisalabad-85 produced the minimum (2020 kg ha^{-1}). The cv. Punjab-96 gave the highest number of fertile tillers that reflected into the highest grain yield and greater number of grains spike⁻¹. Secondly, the increase in grain weight also contributed towards total grain yield. Samir *et al.* [1997] had also reported significant differences among the varieties for grain yield. Each increase in irrigation also increased yield significantly. The crop grown with the application of three irrigations level produced maximum grain yield ($4881.1 \text{ kg ha}^{-1}$), whereas the crops grown with one irrigation produced the lowest yield ($3153.3 \text{ kg ha}^{-1}$). Chandra *et al.* [1999] also reported similar results.

Different varieties produced significantly different plant biomass (kg ha^{-1}) (Table 1). The variety Punjab-96 produced maximum biomass (16588 kg ha^{-1}) and Faisalabad-85 produced minimum biomass (6361 kg ha^{-1}). The three irrigation levels also varied significantly from one another regarding biomass production. The plots irrigated with three irrigations produced maximum biomass (13585 kg ha^{-1}) and the plots irrigated with one irrigation level produced lowest biomass (9100 kg ha^{-1}). Ahmed *et al.* [1997] had also reported an increase in total biomass by increasing irrigation number. The interaction between varieties and irrigation levels was also significant.

Harvest index is the ratio of grain yield to total biomass of plants. Thus significant differences also occurred among different treatments. Cultivar Punjab- 96 showed the highest harvest index 37.1 which was significantly higher than other varieties. The highest number of irrigation was responded as the highest harvest index (35.9) that was significantly higher than the lowest harvest index of 34.7 that resulted in plots given one irrigation.

CONCLUSIONS

Punjab-96 may be preferred over other varieties included in this study due to its potential to produce maximum grain yield. It is further suggested that three irrigations at minimal may be applied to wheat crop to explore its maximum potential.

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