GROWTH, YIELD COMPONENTS AND HARVEST INDEX OF WHEAT (*TRITICUM AESTIVUM* L.) AFFECTED BY DIFFERENT IRRIGATION REGIMES AND NITROGEN MANAGEMENT STRATEGY.

Muhammad Asif[1]*, Muhammad Maqsood[2], Amjed Ali[1], Syed Waseem Hassan[1], Arif Hussain[2], Shahbaz Ahmad[2] and Muhammad Arshid Javed[1]

[1]University College of Agriculture, University of Sargodha, Sargodha.

[2]University of Agriculture, Faisalabad.

*Corresponding author Email: amjed_786@hotmail.com

ABSTRACT: A field experiment was conducted to study the effect of different levels of irrigation and nitrogen on growth and radition use efficiency of wheat crop. The results exhibited that the Crop growth rate **(***g* $m^{-2}d^{-1}$*), Leaf area index, Leaf area Duration (days),Number of fertile tiller unit*$^{-1}$ *area, Number of grains spike*$^{-1}$*and Harvest index(%)were significantly increased by increasing the number of irrigation and nitrogen levels. Among irrigation levels, highest value (37.34) for harvest index was achieved in treatment* I_4 *(irrigation at tillering + booting +anthesis + milking + dough) and the highest value for for harvest index (36.35) was recorded for treatment* N_2 *(150 kg N ha*$^{-1}$*). This was formed the best combination for having maximum harvest index of the variety SH-*2002.

Key words: irrigation, nitrogen, harvest index.

INTRODUCTION

Wheat (*Triticum aestivum* L.) belongs to family poaceae.Water is vital to every stage of wheat plant development from seed germination to plant maturation. Irrigation applied at sensitive stages would be a valuable management practice for improving yield (Jana *et al*. [1], Garabet *et al*., [2].Water stress experienced by a wheat crop during growth is known to have cumulative effect expressed as a reduction in total biomass compared to well water potential. Decreased growth rate is caused primarily by reduction in radiation use efficiency when drought was imposed at various growth stages such as tillering, booting, earing, anthesis and grain development stages. Best performance of crop depends upon availability of water during these stages .Efficient water supply during the early growing season increases the leaf area of the crop; enable it to intercept most of the incoming radiation [Sharif, 3]. Nitrogen occupies a conspicuous place in plant metabolism. Nitrogen is an important constituent of chlorophyll and plays a vital role in metabolic process. It increase LAI by increasing leaf production and expansion rate that effect interception of photosynthetically active radiation (PAR) and consequently the final dry matter production (Whitefield and Smith) [4]. Insufficient availability of N to wheat plant results in low yield and significantly reduced profit compared to properly fertilized crop.

In view of the importance of the irrigation and nitrogen for crop production, present study was planned to determine the optimum water and nitrogen requirement of the wheat crop. To identify the growth stages in wheat more sensitive to water deficit Conditions and to determine the effect of different levels of irrigation and nitrogen on growths, radiation use efficiency (RUE) and yield of wheat.

Material and methods

To assess the effect of different levels of irrigation and nitrogen on growth radiation use efficiency (RUE) and yield of wheat cv-SH-2002 a field trial was conducted at the Research Area of Department of Agronomy, University of Agriculture, and Faisalabad during 2005-06. The experiment was laid out in a randomized complete block design (RCBD) in a split plot arrangement with three replications. Irrigation levels were kept in main plots and nitrogen levels in subplots. Net plot size was 2.2m × 5m. The experiment was comprised of following treatments of nitrogen levels, N_0= 0 (control), N_1= 75 Kg ha^{-1}, N_2= 150 Kg ha^{-1} and irrigation levels were; I_1=One irrigation (at tillering), I_2=Two irrigations (tillering+anthesis), I_3=Three irrigations (Tillering + anthesis + grain development), I_4= Five irrigations (one irrigation at tillering + booting + anthesis + milking + dough stage). The crop was sown at the rate of 125 kg ha^{-1} during the month of November with the help of a single row hand drill with 22 cm apart rows. Phosphorus at the rate of 100 kg ha^{-1} was applied to all plots at the time of sowing. Half nitrogen was side dressed with the help of single row hand drill at the time of sowing and remaining half was applied with first irrigation. All cultural practices were same for all treatments. The observations recorded were; Growth rate, Leaf area index, Leaf area Duration, number of fertile tiller unit^{-1} area, number of grains spike^{-1}, Harvest index.

Weather data for during growth period of crop was collected from the meteorological observatory of the experimental site and the amount of intercepted radition was calculated. The data collected for growth, yield and yield components was analyzed statistically by using Fisher's Analysis of Variance Techniques and Least Significant Difference (LSD) test at 5% probability level was applied to compare the treatment means (Steel et al.,) [5].

Results and discussion

Growth rate (g m^{-2}day^{-1}).

The data regarding the crop growth rate as influenced by irrigation and nitrogen levels presented in figures 1 & 2. The analysis of variance indicated significant difference for irrigation at all growth stages but non-significant difference for nitrogen at early growth stage and 105 DAS but had significant difference at all other growth stages. Interaction between I×N was significant only at 75, 120, 150 DAS. Irrigation applied at tillering, booting, anthesis, milking and dough stages (I_4) markedly enhanced the CGR over all other treatments except 60, 105 DAS where it is statistically at a par with (I_3).This was followed by crop irrigated at tillering, anthesis, grain development stages (I_3) increase CGR over I_2 when crop was irrigated at tillering, grain development at several growth stages except 60,120 and 120 DAS at which it is statistically at a par with $I_{2,}$ I_2 and I_3. Treatment I_1 produced minimum CGR at all growth stages except 45 and 105 DAS at which it is statistically at a par with I_2, $I_{3,}$ respectively. The lowest CGR sowing was recorded in I_1 and the maximum CGR when crop was irrigated at tillering + anthesis + stem elongation + grain decelopment stages.

Comparison of treatment means in case of nitrogen levels indicated that CGR increase with increasing levels of nitrogen but non significant results are obtained after 60 and 105 days after sowing. Mean value of CGR in case of 150 kg N ha^{-1} (N_2) at 60, 75, 90, 105, 120 and 150 DAS, N_2 (12.71)is statistically at a par with N_I at 105 DAS. Minimum CGR was recorded in case of control (N_0) treatment after 75, 90, 120, 150 DAS, respectively. Warrich *et al* [6] also found that CGR increase with increasing levels of nitrogen.

In comparison of interaction means between irrigation and nitrogen levels (I×N) were only significant at 75, 105, 120 and 150 DAS. Maximum growth rate was recorded in Interaction $I_4 \times N_2$ in which five irrigation (at tillering, booting, anthesis, milking and dough stages) and 150 kg N ha^{-1} was applied after 75, 120 and 150 days of sowing. Interaction $I_4 \times N_1$ is also at a par with $I_4 \times N_2$ after 75, 120, 150 days after sowing. Minimum crop growth rate was recorded at 75, 120, 150 DAS, respectively) in interaction of $1_1 \times N_0$.

Leaf area index (LAI).

The difference in LAI among different level of nitrogen was also non significant at early growth stage but highly significant at later growth stages. However the I×N interaction was significant at 90 and 105 days after sowing (DAS) (fig 3 &, 4).

In comparison of irrigation means all treatments were non significant at 45 days after sowing (DAS). At 60 days after sowing for treatment I_3 the value of LAI is statistically at a par with the I_4.All other irrigation treatments effected in between highest and lowest throughout the growth season except 45 DAS where all treatments are non significant , Sharif [3] also Sreported increase LAI over control with increasing irrigation. In Comparison of means in case of nitrogen levels indicate that LAI was non significant at early growth stage but increase significantly with increasing level of nitrogen.

I×N interaction was significant at 90, 105 DAS. The highest LAI was produced by interaction $I_4 \times N_2$ when five rrigation (at tillering, booting, anthesis, milking and dough stage) and 150 kg N ha^{-1} nitrogen was applied. While the lowest were recorded at 90, and 105 DAS, respectively with interaction of $I_1 \times N_0$.

Leaf area duration (LAD).

The analysis of variance indicated highly significant difference both for irrigation and nitrogen levels but interaction was non-significant. In relation to the irrigation means, maximum leaf area duration 257 days was recorded in treatment (I_4) where, five irrigations (at tillering, booting, anthesis, milking and dough stage) were applied followed by 234.2 days in treatment ($I_{3\ )}$ when three irrigations were applied (at tillering, anthesis, grain developmen). Shortest leaf area duration was observed in treatment ($I_{1)}$ at only one irrigation level at tillering.

When compared the mean for nitrogen levels highest leaf area duration 234.8 days was produced, when 150 kg N ha^{-1} (N_2) was applied while the minimum leaf area duration was 211.9 days when 0 kg N ha^{-1} (N_0) was given. Similar findings have also been reported by Sharif [3] and Basit [7].

Number of Fertile tillers m^{-2}.

Among irrigation level, maximum number of fertile tillers m^{-2} (356.4) was obtained in treatment($I_{4)}$ where Five irrigation (at tillering, booting, anthesis, milking and dough stage) were applied, followed by treatment (I_3)where three irrigation (tillering, anthesis, grain development) were applied, produced (327.9) fertile tillers m^{-2}. when two irrigations (at tillering, anthesis) were applied produced 318.4 fertile tillers m^{-2}. Where only one irrigation was applied at tillering stage produced 298.1 fertile tillers m^{-2}. Ghazal *et al*. [8] also reported that number of spike m^{-2} increased as irrigation increased.

Regarding the effect of nitrogen levels, the fertile tillers m^{-2} significantly different among different treatment. Treatment N_2 (150 kg N ha^{-1}) produced the maximum number of fertile tillers m^{-2} (358.8) followed by (325.3) N_1 (75 kg N ha^{-1}). The minimum number of fertile tillers (291.7) were produced by N_0. Maqsood *et al.* [10] also reported that irrigation at critical growth stages and the application of 150 kg N ha^{-1} gave the highest number of productive tiller. These results are quite in line with those of Islam *et al*. [9].The interaction between irrigation and nitrogen was also significant for fertile tillers m^{-2}. The combination of I_4 (five irrigation) and N_2 .

Number of grain $spike^{-1}$

The analysis of variance indicated highly significant difference both for irrigation and nitrogen levels. Among irrigation levels number of grain $spike^{-1}$ increased significantly with increase in irrigation levels. In case of treatment I_4 when five irrigation (at tillering + booting + anthesis + milking + dough stage) were applied, the number of grain $spike^{-1}$ were maximum (40.89) followed by (40.28) in case of I_3 (tillering + anthesis + grain development) which was statistically at a par with (40.04) in treatment I_2 (at tillering + anthesis). The lowest number of grain $spike^{-1}$ were recorded in treatment I_1 (irrigation at tillering). Maqsood *et al.* [10] also reported that application of irrigation at the crown root, booting and anthesis stage gave the highest number of grains $spike^{-1}$ but these results are in contrast with the results of Ghazal *et a*l. [8], who reported that irrigation was less important than nitrogen on kernals $spike^{-1}$.

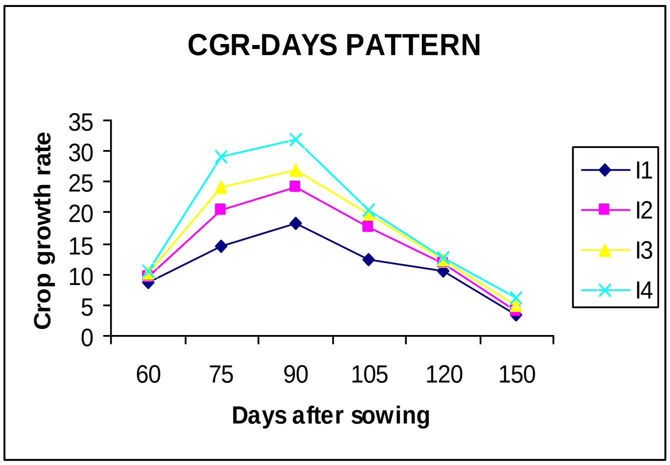
Harvest index (H.I) %.

The analysis of variance for grain yield indicated highly significant difference among irrigation and nitrogen treatments. Comparison of treatment means in case of irrigation, the highest value (37.34) for harvest index was achieved in treatment I_4 (irrigation at tillering + booting+ anthesis + milking + dough stage) which is statistically at a par with treatment I_3 (irrigation at tillering + anthesis + grain development) and I_2 (at tillering + anthesis) in which 35.03% harvest index was recorded. Minimum harvest index (32.40) was recorded in case of I_1 (irrigation at tillering) treatment I_1 (irrigation at tillering) was statistically at a par with treatment I_2 (at tillering + anthesis) with 33.85% harvest index. The results of Rajput *et al.* [11] collaborate the results obtained.

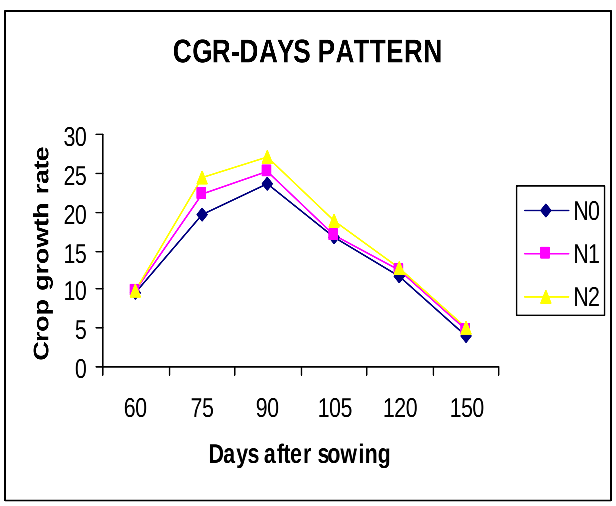
Among the nitrogen levels, the highest value (36.35) was recorded in treatment N_2 (150 kg N ha^{-1}) followed by 34.51%, 33.11% of harvest index in treatment N_1 (75 kg N ha^{-1}) and N_0 (control) respectively. All the treatments enhanced the harvest index over the control (N_0). These results are in confirmity with those of Islam *et al.* [9].The interaction between Irrigation and nitrogen was found to be non significant with respect to harvest index.

Conclusion:

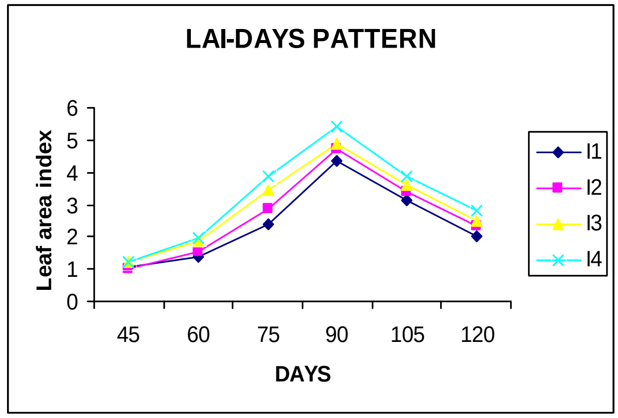
Different irrigation and nitrogen levels affected the growth and yield components of wheat significantly. Number of fertile tiller $unit^{-1}$ area, number of grains $spike^{-1}$ and harvest index were significantly increased by increasing the number of irrigation and nitrogen levels..Graphical representation of crop growth rate, leaf area index and leaf area duration of wheat affected by different levels of Irrigation and Nitrogen.



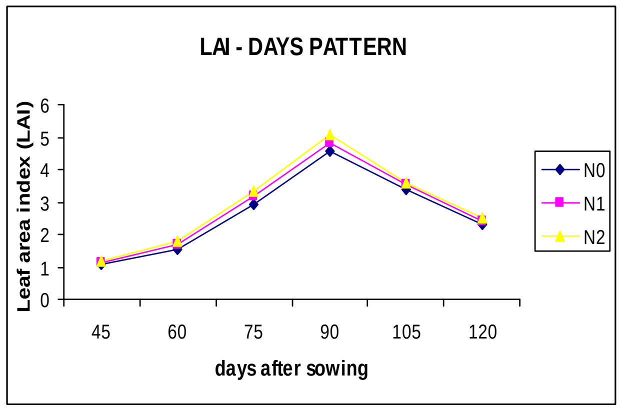
Fig#1: Crop growth rate (g $m^{-2}d^{-1}$) as influenced by irrigation levels



Fig#2: Crop growth rate (g $m^{-2}d^{-1}$) as influenced by nitrogen Levels.



Fig#3: Leaf area index as influenced by irrigation levels



Fig#4: Leaf area index as influenced by nitrogen levels

Treatments (Irrigation levels)+Nitrogen levels (kg ha^{-1})	No. of fertile tillers/ area	Number of grains per spike	Harvest index (%)
I_1	298.1d	38.76 c	32.40 c
I_2	318.4 c	40.04 b	33.85bc
I_3	327.9 b	40.28 b	35.03ab
I_4	356.4 a	40.89 a	37.34 a
N_0= 0	291.7 c	38.55 c	33.11 c
N_1= 75	291.7 c	40.50 b	34.51 b
N_2= 150	291.7 c	40.93 a	36.35 a

REFERENCES:

[1] Jan, P.K., A.K. Mitra, N.C. Mandal, M.K. Dasgupta, D.C. Ghosh, S.K. Mukhopadhgay, D.D. Gupta and O.K. Majumadar. Effect of irrigation growth, yield and consumptive use efficiency of wheat in teroi Soils of North Bengal. *Proc. of National Sympo. Held at Visva Bharti, Sriniketa, West Bengal,* on 18-21 Feb: 180-184, 1995.

[2] Garabet, S., M. Wood and J. Royan. Nitrogen and water effects onwheat yield in Mediterranean type climate-I. Growth, water use and nitrogen accumulation. Field-crop Res., **57**(3): 309-318, 1998.

[3] Sharif, M. Effect of irrigation at different growth stages on growth and yield performance of wheat cultivars. M.Sc. Agri. Thesis, Univ. Agric., Faisalabad, 1999.

[4] Whitefield, D.M and C.J. Smith. Effect of irrigation and nitrogen ongrowth light interception and efficiency of light conversion in wheat. *Field crop Res.*, **20**: 279-295, 1989.

[5] Steel, R.G.D., J.H. Torrie and D. A Dickey. Principles and procedures of statistics: *A biometerical approach. 3rd ed. Megraw Hill book Co. Inc. New York*: 400-428, 1997.

[6] Warriach, E.A., N. Ahmed, S.M.A. Basra and I. Afzal. Effect of nitrogen on source-sink relationship in wheat. *Int. J. Agri. Bio*., **4**(2): 300-302, 2002.

[7] Basit, A. Growth, Development and yield of wheat (*Triticum aestivum* L.) under different levels of irrigation and nitrogen. M.sc. Thesis, Dept. Agron., Univ. Agric., Faisalabad, 2003.

[8] Ghazal, H.M., M.Z. Wassouf, M.M. Nachit and A.A. Jaradat. 1998. Yieldand yield components of durum wheat as influenced by irrigation and nitrogen fertilization. Proc. of the 3rd int.Nat. Triticeae Symp, Aleppo, Syria, 4-8 may:445-449 (CAB.Absts.,1998).

[9] Islam, Z.U., S. Khan, J. Bakht and W.A. Frequency of various N levels, lodging and seed quality in wheat. *Asian J. Plant Sci*., **1**(5): 510-512, 2002.

[10] Maqsood, M., A. Ali, Z. Aslam, M. Saeed and S. Ahmad. Effect of irrigation and nitrogen levels on grain yield and quality of wheat. *Int. J. Agri. and Bio*. **4**(1): 164-165. 2002.

[11] Rajput, M.K.K., A.H. Ansari, S.A. Rao, K.A. Mahar and Z.M. Shaikh. Influence of irrigation frequencies on the growth and grain yield of bread wheat varieties. Pak. *J. Agri., Agric. Engg. Vet. Sci.* , **10**(1-2): 64-69, 1994.