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Interactive Effect of Water Stress and Nitrogen on Plant Height and Root Length of Wheat (*Triticum aestivum* L.)

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Abstract: Interactive effect of water stress and nitrogen on plant height and root length of wheat varieties Inqulab-91 and Parwaz-94 were investigated. Urea as nitrogen fertilizer was applied before imposition of water stress in plots and water stress was imposed 25, 35 and 45 days after germination. The data reveal that sporadic stress and urea fertilizer have highly significant response. The effects of water stress were mostly reduced to greater extent at high nitrogen level (98 gm / plot) Nitrogen applied at higher rates had effectively balanced the adverse effects of water stress.

Key words: Water stress, nitrogen fertilizer, wheat

Introduction

Wheat (*Triticum aestivum L.*) is an important cereal of Pakistan and enjoys a unique position among cultivated crops. Wheat plant is a member of the grass family poaceae. All wheat varieties either wild or cultivated belong to the genus triticum. Wheat is planted annually in Pakistan on an area of 7795 thousand hectares with a total production of 14657 thousand tons giving an average of 1880 kg ha^{-1}.

One third of wheat cultivations is on rain fed area where the crop often suffers from severe moisture stress. Much of the remaining area which is canal irrigated also encounters drought especially critical stages of plant like tillering and grain filling thus reducing the national yield. (Anonymous 1991).

According to Yaidav (1991) increasing water supply form 0.4-0.8 (iwcpe) increased yield from 2.97 to 3.8 tons ha^{-1}.

Water stress ceases cell enlargement (Vaadia *et al.* 1961)

Due to water stress stem length reduces by inhibiting the elongation of internodes and also reducing tillering capacity of plants (Aspinall *et al.* 1964).

Drought also hastens the leaf area senescence and in general the more severe the stress the greater the reduction in leaf area have also resulted in lower root and most shoot ratios than found in well watered controls an well as significant yield reductions(Dayer and Stewart. 1987).

Lahiri. (1976) has reported that under sporadic drought conditions the application of nitrogenous fertilizer urea has beneficial effects on plant growth.

Major *et al.* (1988) suggested that number of spikes, number of grains/spike increased with increased nitrogen and water supply.

Arnon (1975) suggested that under conditions of limited soil moisture, nutrient deficiency may have adverse effects on plants. Fertilizer often induced increase in water use during the early vegetative period. Several researchers have reported that moisture stress at any growth stage reduces crop yield. (Sarwar *et al.* 1991, Hussain *et al.*,1992)

The objective of present study is to evaluate the compensating role of nitrogen fertilizer in relation to drought stress on the growth and yield of wheat varieties Inqulab-91 and Parwaz-94.

Materials and Methods

The experiment was conducted in the experimental area of Department of Botany , University of Agriculture, Faisalabad during 1997 to study the interactive effect of nitrogen and water stress on two wheat (Triticum aestivum L.) varieties namely Inqlab-91 and Parwaz-94. the seeds were obtained form the Department of Agronomy, University of Agriculture, Faisalabad.

Urea as a nitrogen fertilizer was applied. The experiment was laid out in a split plot design with three replications having seven treatments including control and a plot size of 90 × 30 sq. ft. water stress was imposed 25, 35 and 45 days after germination. Nitrogen fertilizer was applied one day before stress. The entire experimental area was divided into three replications. Each sub-plot had seven treatments having an area of 5 × 8 sq. ft. each.

The following schedule was observed.

T_0 = Control(normal watering + normal N_2)
T_1 = Nitrogen level 49 gm/sub plot and water stress after 25 days.
T_2 = Nitrogen level 49 gm/ sub plot and water stress after 35 days.
T_3 = Nitrogen level 49 gm/sub plot and water stress after 45 days.
T_4 = Nitrogen level 98 gm/sub plot and water stress after 25 days.
T_5 = Nitrogen level 98 gm/sub plot and water stress after 35 days.
T_6 = Nitrogen level 98 gm/sub plot and water stress after 45 days.

The data collected were analyzed statistically and treatment means were compared using LSD(Least significant difference) test following the procedure adopted by Steel and Torrie (1984).

Result and Discussions

Plant height (cm): Data regarding plant height as influenced by different nitrogen levels and water stress are presented in Table 1. As indicated by the data different treatments significantly reduced plant height except T_5 as compared to control. Maximum plant height of 90.74 cm was observed in control while a minimum value of 63.50 cm was recorded in T_1 where the plants were subjected to earlier water stress and received low nitrogen level. A minimum decrease in plant height of 1.23% was noted in T_5 where water stress was applied 35 days after germination and full nitrogen was supplied. Maximum reduction in plant height 30.01% which was recorded in T_1.

V × T interaction was non-significant which means that the two varieties responded in a similar fashion to different treatments. It is evident from the data water stress applied during earlier growth stages was more deleterious as compared to its later

Table 1: Effect of water stress and Nitrogen on plant height of two wheat (T. Aestivum) Inqalab 91 and Parwaz 94.

Varieties means		Treatment means						
V_1	V_2	T_0	T_5	T_4	T_3		T_6	T_1
74.674a	75.844b	90.74a	89.62A	77.32B	73.67C	66.79d	65.17De	63.50E

Any two means having the same letter are statistically non-significant

Table 2: Effect of water stress and Nitrogen root length of two wheat (. Aestivum) varieties Inqalab 91 and Parwaz-94.

Varieties Means		Treatment Means						
V_1	V_2	T_0	T_5	T_4	T_3	T_2	T_6	T_1
10.690a	10.119b	16.42a	13.83B	12.25bc	11.17Cd	9.75de	8.50E	7.92F

Any two means having the same letter are statistically non-significant.

application and different nitrogen levels could not alleviate the situation on the other hand water stress application at later stages was over come by nitrogen application. These findings are in agreement with those of Lahiri (1978) and Jamal *et al.* (1981) who arrived at similar conclusions.

Root length (cm): The maximum root length (16.42 cm) was observed in T_0 (control) and minimum Root length value (7.91 cm) was noted in T_1 where water stress was imposed 25 days after germination. Non-significant differences were observed between treatments T_6, T_3, T_3 and T_4, and T_4 and T_5.

A minimum decrease of 15.77% was recorded in T_5 where plants were subjected to water stress 35 days after germination and received full dose of nitrogen while a maximum decrease of 51.78% was calculated for T_1 where plants were subjected to more water stress and given half N_2. It is clear form the data that water stress applied during earlier growth stages had more severe effects as compared to its application at later stages. Full nitrogen levels applications 25 DAG and 35 DAG could compensate the situation to some extent. Similar results were reported by Barraclough *et al.* (1989) and Singh and Das (1986).

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