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DROUGHT TOLERANCE OF WHEAT GENOTYPES

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Eight different wheat cultivars were exposed to soil moisture stress at preheading stage in a net-house with glass top. On the basis of absolute grain yield, the cultivar LYP-73 was the most tolerant, while R-S was the most sensitive to drought at preheading stage. The genotype R-S suffered about 28% loss in grain yield mainly attributable to decreased grain weight. Polyethylene Glycol (PEG) induced water stress (-6 bar) caused more decrease of fresh weight in LU-20S than Pak-81. The role of osmoregulation in drought tolerance is discussed.

INTRODUCTION

Plants growing in water limited environments adapt and/or acclimatize in a variety of ways via mechanisms that originate at the subcellular level (Jordan, 1983). Osmotic adjustment (large change in cell solute content) occurs in response to soil moisture availability and permits plants to maintain growth on limited soil water when growth otherwise would not occur (Boyer, 1983). Growth is enhanced in plant genotypes having superior osmotic adjustment as soils become dry. About one-third of the total area under wheat in Pakistan falls in the rainfed regions where rainfall, particularly at the preheading stage, is often very low and wheat crop faces water deficit at this critical stage of grain development. The purpose of this paper is to evaluate the differences in drought tolerance of wheat genotypes exposed to water stress at preheading stage.

MATERIALS AND METHODS

Experiment I

Eight wheat varieties (Table 1) were grown in micro plots located in a glass covered net-house. Each plot was 0.2 m^2 consisting of a single row of each variety. The soil of the experimental plots was well drained (water table below 3m), non-saline sandy loam having pH 7.5. The experiment was laid out according to randomized complete block design with three repeats. After germination plant population was adjusted to obtain equal number of plants in each plot. A basal dose of N (100 kg/ha^{-1}) and P(60 kg/ha) was applied as urea and single superphosphate respectively. The water stress was imposed by withholding irrigation at preheading stage uptil maturity.

Experiment II

Six-days old seedlings of wheat varieties Pak-81 and LU-26S were transferred to aerated Hoagland's nutrient solution No. 1 (Hoagland and Arnon, 1950). Four days after transplanting, plants were exposed to two different levels of water stress (0,-8 bar), using polyethylene glycol (PEG) (Johnson and Asay, 1976). Plants were harvested after four weeks of growth period and fresh weight, leaf water potential and osmotic potential were measured.

RESULTS AND DISCUSSION

Response of eight wheat varieties to water stress at preheading stage was evaluated and results are presented in Table 1. Water stress, in general, decreased the grain number and varieties Blue Silver, Pothowar and R-S suffered maximum (20%) grain loss. Grain weights of all the varieties were at par under non-stress conditions, while under stress, varieties LYP-73, LU-26S, R-S, WL 711 and Kharchia produced significantly heavier grain as compared with Blue Silver, Pothowar and Indus-79. Blue Silver appeared to be the most sensitive with 22% loss in grain weight under water stress conditions. Number of tillers (data not presented), however, was not affected significantly as the stress was applied at the stage when most of the tillering had already occurred.

As far as grain yield was concerned, the varieties did not differ significantly among themselves under control conditions. Under stress conditions, the variety LYP 73 gave maximum grain yield and suffered only about 6% loss in grain yield. WL-711, Indus-79 and Kharchia were statistically at par with LYP-73. The variety R-S was the most sensitive with about 28% loss in grain yield. This differential behaviour of the wheat genotypes could be attributed to their variable genetic make up. The water stress probably impaired the physiogical mechanisms of the sensitive varieties more severely than the tolerant ones. These findings are in agreement with those of Rajki (1982) and Monayeri *et al.* (1984).

Table 1. *Response of wheat genotypes to water stress at preheading stage*

Variety	Number of grains/spike		10C-grain weight (g)		Grain yield (tonnes/ha	
	Non-stress	Stress	Non-stress	Stress	Non-stress	Stress
Blue Silver	44.7 ab	36.2 bc	43 a	34 bc	2.4 a	2.0 bc
LYP-73	47.3 ab	46.2 a	42 a	40 a	2.9 a	2.7 a
Pothowar	36.7 c	31.7 c	39 a	33 d	2.2 a	1.7 c
LU-26S	46.7 ab	41.0 ab	45 a	42 a	2.5 a	2 0 bc
Indus-79	45.9 ab	42.7 a	39 a	33 cd	2.6 a	2.4 ab
R-S	42.2 b	33.8 c	44 a	40 a	2.6 a	1.9 bc
WL-711	49.2 a	44.7 a	42 a	39 ab	2.6 a	2.4 ab
Kharchia	46.7 ab	41.7 ab	43 a	41 a	3.0 a	2.4 ab

Table 2. *Seedling growth and water relations of the wheat genotypes under stress and non-stress conditions*

Parameters	Non - stress (0 bar)		Stress (-6 bar)	
	LU-26S	Pak-81	LU-26S	Pak-81
Shoot fresh weight (g/3 plants)	1.1 ba	1.4 a	0.6 c	0.9 b
Water potential (-bars)	5.2 b	4.2 c	8.3 a	7.6 a
Osmotic potential (-bars)	9.9 c	11.7 b	12.0 a	11.9 ab
Turgor pressure (bars)	4.7 b	7.5 a	3.7 c	4.3 b

In order to investigate the relation of osmoregulation to drought tolerance of wheat, two wheat cultivars were exposed to different levels of moisture stress using PEG. The data presented in Table 2 revealed that Pak-81 gave higher fresh weight at low (more negative) water potential of the root medium as compared with LU-26S. This better growth of Pak-81 was related to its superior ability to maintain water balance through better osmotic adjustment. Under water stress, Pak-81 maintained significantly higher leaf water potential and consequently more turgor pressure which was probably responsible for its higher growth rate when exposed to water deficit. The role of osmoregulation in the maintenance of turgor, chloroplast activity and organelle integrity is envisaged (Boyer, 1983).

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