Pak. J. Agri. Sci.
26 (3) 284, 1989

GROWTH AND WATER RELATIONS OF WHEAT SEEDLINGS SUBJECTED TO DIFFERENT EXTERNAL WATER POTENTIALS OF POLYETHYLENE GLYCOL (PEG) SOLUTIONS

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A pot study was conducted using Hoagland nutrient solution under green house conditions to measure water relations of two wheat varieties viz; Pak-81 and LU-26S over a range of external water stress (-3 and -6 bar) alongwith growth measurements. Wheat seedlings were subjected to water stress treatments for a period of 7 days. Fresh weight, dry weight, shoot length and relative growth rate decreased significantly with increasing stress level; LU-26S showed less reduction as compared to Pak-81. Water relation parameters decreased significantly with increasing level of stress in both the cultivars, however at higher stress level, Pak-81 maintained higher water potential and turgor pressure than LU-26S.

INTRODUCTION

Water relations, growth and photosynthesis are among the factors most sensitive to stress (Hsiao, 1973). Water potential is the most useful single measurement of the degree of water stress in plants and has gained a wide acceptance among plant physiologists. Sullivan (1971) considered it an important criterion to be used to evaluate drought resistance. In the present study we evaluated the effect of external water stress on growth and water relations of wheat seedlings grown hydroponically using polyethylene glycol as stress development agent.

MATERIALS AND METHODS

Twelve seeds of two wheat varieties Le. Pak-81 and LU-26S were germinated on the nylon nets fixed on the lids provided with a double layer of tissue paper moistened with distilled water. The lids were kept in darkness for three days at a temperature of 20 ± 2°C. After germination, lids were fixed over plastic jars, painted black from external side, containing half strength Hoagland nutrient solution (Hoagland and Arnon, 1950). The solution was continously aerated and renewed after every fourth day. Twenty days old seedlings were subjected to -3 and 6 bar PEG stress, developed by adding 87 and 147 gl/! PEG, respectively in three days Hoagland solution alone servedas control. The data regarding growth and water relation parameters were recorded after 7 days of seedling growth under stress conditions. Relative growth rate was calculated according to the formula described by Meidner (1984):

$$EGR = \frac{2.303\ (\log_{10} W_2 - \log_{10} W_1)}{t_2 - t_1}$$

Where W2 and W1 are the shoot dry weights and t2 and t1 are times, respectively, at the start and end of stress period.

Leaf water potential was measured with water potential apparatus (Chas W. Cook and Sons Birmingham B 42, ITT, England) following the method described by Scholander et al. (1964). The--methods of sap extraction and osmotic pressure determination were similar to Gorham et al. (1984). Turgor pressure was calculated as difference of water potential and osmotic potential. All the analyses were performed on upper most fully expanded leaves of healthy appearance. The data collected were subjected to statistical analysis according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Data on growth parameters of wheat seedlings grown under

T ib le I. *Relative seedling growth (% of control) of wheat genotypes under water stress conditions*

Growth Parameter	Stress level (- bars)			
	3		6	
	LU 26S	Pak-81	LU 26S	Pak-81
Shoot length (cm)	77	62	60	44
leaf area plant $^{-1}$ (cm^2)	68	50	50	38
Plant fresh weight (g 3 plants $^{-1}$)	86	55	62	41
Relative growth rate (mg mg^{-1}. day^{-1})	92	72	49	46

water stress (Table-I) revealed that moisture 'stress, in general, decreased shoot length, leaf area, plant fresh weight and relative growth rate in both the cuJ.tivars and reduction was more at high stress level (-6 bar). Genotype Pak-81 was comparatively more sensitive to drought. The reduction in plant height and fresh weight under increasing stress may be due to impairing of normal growth processes asa result of reduced availability of water. Under drought conditions reduced leaf area seems to be the adaptive mechanism of plant survival related to water economy of the plant (see Day, 1981).

Leaf water, osmotic and turgor potential (Table-Z) also showed a decrease with increasing level of stress in both the cultivars grown. At low stress level (-3 bar, cultivar Pak-81 had lower values of osmotic and water potentials and higher

Table 2. Effect of moisture stress on water relations of wheat genotypes

	Stress level (-bar)					
	0		4		6	
Parameter	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leaf water potential (-bar)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leaf osmotic potential (-bar)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leaf turgor potential (bar)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

turgor pressure as compared to cultivar LU-26S showing its better adaptation to stress environment (see Quarri and Jones, 1979). However, at high level of stress (-6 bar, though the overall trend in changes in water relations was the same, the cultivar Pak-81 had a higher water potential which was probably achieved through reduced transpiration rate as a result of reduced leaf area (Table-I).

Cultivar Pak-81, though maintained higher water potential and turgor pressure than cultivar LU-26S, was affected severly on growth performance basis. Any gain in water status of the plant through reduced leaf surface was at the cost of CO_2 assimilation rate, resulting in poor growth and biomass production. The results of this study suggest that the use of water potential as single criterion to evaluate drought resistance may be misleading. Additional information on growth parameters especially changes in the leaf area may be important in this regard. For a plant to be agriculturally productive a high biomass production rate. coupled with a favourable water relations will be important.

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