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PLANT WATER RELATIONS AND YIELD OF DIFFERENT WHEAT (*TRITICUM AESTIVUM*) GENOTYPES UNDER CONSERVED SOIL MOISTURE CONDITION

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An experiment was conducted during 2001-02 and 2002-03 to evaluate the plant water status as a selection criterion of drought-tolerant genotypes of wheat (*Triticum aestivum*) by subjecting genotypes under natural water stress on conserved soil moisture condition. The plant water relation parameters recorded in fourteen wheat genotypes at anthesis stage indicated that genotype AP 928 maintained highest Ψ_L followed by AP 962 and AP 968. The CTD was highest in AP 928 followed by AP 962, AP 968 and AP 989. The plant height and number of productive tillers were highest in genotype C 306. Genotypes AP 928 and AP 962 yielded highest grain yield. The higher grain yield of AP 928 and AP 962 was mainly attributed to their higher Ψ_L, plant water retention, transpirational cooling, test weight and higher partitioning efficiency (harvest index). The biological yield was recorded highest in C 306 followed by AP 951. The partitioning efficiency in terms of HI was best in AP 928 and AP 962. The grain yield of wheat under moisture stress was found significantly associated with CTD (r=0.68), Ψ_L (r=0.63), water retention (r=0.51), biological yield (r=0.86) and harvest index (r=0.57).

Keywords : CTD; Drought tolerance; Genotypes; Water potential; Wheat; Yield.

Drought is a major stress factor, which limits crop production. Even temporary drought can cause substantial losses in crop yield. Wheat production is hampered by moisture stress of varied degree and duration and is one of the most common constraints to wheat productivity in rainfed areas with limited or lack of irrigation. Drought stress can be managed by improving the availability of conserved soil moisture and or development of high yielding drought tolerant genotypes. Developing wheat genotypes with high yield potential through identifying stress tolerance is important for increasing yield in tropical environments [1,2]. Moreover, the genotypes and the environment determine production efficiency of the plant. Though most of the breeding programme depends upon the disease and yield as major criterion, there is consensus that physiological basis complimenting empirical selection is likely to accelerate identification of stress tolerant genotypes in future. The response of moisture stress at genotype level on morpho-physiological characters in general and grain yield in particular have to be understood in wheat[3]. Therefore, the present investigation was carried out using some of these traits to determine the relative tolerance of wheat genotypes to moisture stressed rainfed condition.

A field experiment was conducted under rainfed conditions during *rabi* (winter) season of 2001-2002 and 2002-2003 at Crop Physiology Field Lab of CCS Haryana Agricultural University, Hisar (29°10'N latitude, 75°46' E longitude and 215 M altitude), India. Fourteen genotypes

Table 1. Plant water relation parameters of wheat genotypes at anthesis under rainfed situation.

Genotypes	Ψ_L (-MPa)	Tc (°C)	CTD (°C)	Water retention (%)
AP 989	1.90	29.9	0.7	65.4
AP 968	1.88	29.6	-0.9	69.7
WH 711	2.13	30.2	0.1	60.5
AP 962	1.80	30.1	-1.0	71.1
WH 533	2.05	30.2	-0.3	60.7
WH 750	2.60	30.0	0.7	58.4
C 306	2.46	29.8	-0.3	64.3
AP 985	2.30	30.4	0.7	65.8
AP 975	2.38	31.1	0.2	59.2
PBW 175	2.60	30.7	-0.2	60.3
AP 988	2.33	30.8	0.3	64.6
AP 967	2.35	30.9	0.1	66.3
AP 951	2.45	29.9	-0.1	61.0
AP 928	1.75	30.5	-1.2	69.0
Mean	2.21	30.3	-0.1	64.0
CD at 5%	0.50	NS	0.6	3.3

Table 2. Yield attributes and yields of wheat genotypes under rainfed situation.

Genotypes	Plant height (cm)	Productive tillers plant^{-1}	Spike length (cm)	#Spikelets spike^{-1}	Test weight (g)	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Harvest Index (%)
AP 989	89.0	3.1	8.5	15	37.1	8330	2970	35.7
AP 968	86.0	3.6	10.0	21	45.1	9010	3320	36.8
WH 711	82.5	3.4	9.0	17	42	8420	3030	36.0
AP 962	93.0	3.2	9.5	19	44.9	9440	3520	37.3
WH 533	92.5	2.9	9.5	15	41.6	7780	2780	35.7
WH750	90.5	3.0	8.5	17	40.2	7220	2210	30.6
C 306	129.5	4.1	8.5	15	36.6	10280	3310	32.2
AP 985	87.5	3.5	8.0	15	38.5	8330	2530	30.4
AP 975	97.5	3.3	8.5	15	34.4	8330	2730	32.8
PBW 175	95.0	3.5	9.0	17	38.1	7780	2520	32.4
AP 988	88.0	3.8	8.0	15	35.9	9450	3110	32.9
AP 967	88.5	3.1	9.0	17	42.7	8970	3300	36.8
AP 951	96.5	3.4	9.0	17	42.4	9670	3360	34.7
AP 928	93.5	3.7	10.5	21	45.0	9460	3540	37.4
Mean	93.8	3.4	8.9	16.7	40.3	8790	3010	34.2
CD at 5%	6.5	0.4	1.2	2.3	3.1	572	233	2.8

of wheat (*Triticum aestivum*) were taken from Wheat Improvement programme, CCS Haryana Agricultural University, Hisar. The soil of the experimental field was sandy loam in texture with 0.4% organic carbon, slightly alkaline in reaction (pH 8.0) and medium in fertility (available N 184 kg ha^{-1}, available P 17 kg ha^{-1} and available K 325 kg ha^{-1}). The available soil moisture at the time of sowing in one meter profile was 12.0 ± 0.5 cm. The rainfall received during crop season was 35.3 and 40.8 mm, respectively. The experiment was laid out in randomized block design with three replications. All other cultural practices were followed as per recommended practice. Five representative plants were harvested for recording yield components at maturity. The grain and biological yield were recorded from the crop harvested at ground level within a net plot area of 1.6 m x 3.0 m one week after sun drying and expressed in kg ha^{-1}. The plant water relation parameters were recorded at anthesis stage between 1200 to 1400 h. The leaf water potential (Ψ_L) was measured by Pressure Chamber (PMS Instrument Co., Oregon, USA), plant water retention (%) of leaf by Pannu *et al*[4] and transpirational cooling *i.e.* canopy temperature depression (CTD) using Infra-red thermometer (Model AG-42, Teletemp Corp. Fullerton, CA). The statistical analysis was done as per the standard method.

The plant water relation parameters recorded at anthesis stage indicated that the crop was in severe stress as visible from the mean value of Ψ_L (-2.2 MPa) and canopy temperature *i.e.* 30.3°C (Table 1). The variation among the genotypes showed that AP 928 maintained highest Ψ_L followed by AP 962 and AP 968. Interestingly, these genotypes maintained significantly higher plant water status than checks (C 306 and PBW 175). The canopy temperature (Tc) among different genotypes was non-significant, but CTD was highest in AP 928 followed by AP 962 and AP 968. The water retention was highest in AP 962 followed by AP 968, AP 928 and AP 967 which was significantly higher than other tested genotypes. Enhanced water content helped the plant to perform various physiological processes more efficiently even under low soil moisture content[5]. The lower value of CTD and Ψ_L in various genotypes was because of maintenance of higher plant water status. Cooler canopy of these genotypes may be associated with better water uptake due to efficient root system, thus maintaining higher leaf conductance and transpiration which resulted in higher rate of net photosynthesis as reported by Sharma *et al*[3] and El- Hafid *et al*[6]. The plant height and number of productive tillers were highest in genotype C 306. However, length of spike, number of spikelets per spike and test weight was significantly higher in AP 928 and AP 968 over other tested genotypes except AP 962 and AP 967, which were statistically at par. The highest grain yield of AP 928 and AP 962 was mainly attributed to their higher

Ψ_L, water retention, transpirational cooling, spike length, number of spikelets per spike, test weight and higher partitioning efficiency i.e. harvest index. Karim *et al*[7] also reported the similar increase in yield attributing character which ultimately contributing to the final grain yield. These two genotypes yielded significantly higher than all other genotypes except AP 951, AP 968, C 306, and AP 967, which were statistically at par. The biological yield was recorded highest in C 306 followed by AP 951. The partitioning efficiency in terms of HI was best in AP 928 and AP 962. The grain yield of wheat under moisture stress was found significantly associated with CTD (r=0.68), Ψ_L (r=0.63), water retention (r=0.51), biological yield (r=0.86) and harvest index (r=0.57). The significant positive association of CTD, Ψ_L and water retention with grain yield indicated that these parameters had direct bearing on yield formation with better plant water status under moisture stress. These parameters could be used as screening traits to large number of genotypes for drought tolerance.

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