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ASSESSMENT OF SPRING WHEAT GENOTYPES ON PHYSIO-MORPHIC ATTRIBUTES UNDER WATER DEFICIT MILIEU

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Wheat has a significant position among all the cereals for its nutritional quality and usage all over the world. With rising world population, demand of wheat is also increasing. The changing climate endangers the wheat grain yield with abiotic and biotic factors. One of the sternest factors is shortage of water. The study was planned to collect large quantity of germplasm and scrutinized it on physio-morphic traits. The experiment was conducted in normal and deficit moisture. Among 200 wheat genotypes Aas 2011, Chakwal 86, 9787, 9846, 9860, 9864 and Manthar 2003 maintained root-shoot ratio and RWC%. The genotypes performed consistently in normal and water deficit milieu and can directly be selected for water deficit tolerant and can also be further investigated in breeding programs.
Keywords: Cereal, abiotic stress, germplasm, water deficit stress, physio-morphic attributes.

INTRODUCTION

Among all the cereals wheat has momentous position. People use wheat in making different kind of food products due to its nutritional value (Ginkel and Ortiz, 2018). With increase in world population and specific regions, where wheat is used as staple food the demand is progressively increasing (Murgan and Kannan, 2017). In present scenario including other abiotic and biotic factors, the most imperative is water deficit (Zhao *et al*., 2015). The situation of water is worse in Pakistan and becoming shoddier with the passage of time (Anonymous, 2017). In response to this problem, it is very critical to evaluate the existing germplasm for water deficit tolerance (Murgan and Kannan, 2017). The evaluation of germplasm will help in suggesting wheat cultivars for water deficit areas. Some morphological and physiological characters have been reported as very useful for identification of different genotypes in water shortage environment (Gornicki and Faris, 2014). In this regard a study was planned to screen out a large germplasm in water dearth conditions to check performance of different genotypes on the basis of morphological and physiological attributes.

MATERIALS AND METHODS

The experiment was conducted at experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad in two factor factorial experimental design with three replications. The germplasm was composed of 200 wheat genotypes. These germplasm were collected from Wheat Research Institute, Faisalabad (WRI), Barani Agriculture Research Institute Chakwal (BARI), Arid Zone Research Institute Bhakkar (AZRI), Regional Agriculture Research Institute Bahawalpur (RARI), International Maize and Wheat Improvement Centre (CIMMYT) and University of Agriculture, Faisalabad (UAF). In this experiment, germplasm screening was conducted in normal moisture and insufficient moisture condition. Wheat genotypes were implanted in the polythene bags. The size of the bags was 30×15 cm. Bags were packed with sand and placed in screen house. Pressure membrane apparatus (Gugino *et al.*, 2009) was used to estimate the field capacity of the sand. Plants in normal moisture milieu were watered at 100% FC and plants in inadequate moisture were watered at 50% FC after seven days interval. Hoagland solution was used as a source of nutrients. Hoagland solution's composition was made according to Bussler and Epstein (1972). Five seedlings were maintained for each genotype per replication. Water was withheld after 40 days. After seven days, data were recorded for root-shoot ratio and relative water contents.
Root shoot ratio was calculated using following formula:

$$\text{RS ratio} = \text{Root length}/\text{Shoot length}$$

Relative water contents were calculated using following formula:

$$\text{RWC\%} = [(\text{Fresh shoot weight} - \text{Dry shoot weight}) / (\text{Turgid weight} - \text{Dry shoot weight})] \times 100$$

Remarkable contrast, between 200 wheat cultivars was determined by processing data through analysis of variance according to Steel *et al.* (1997). Analysis of variance was performed at 5% and 1% level of significance.

RESULTS

Exceedingly momentous variability was noted in normal and

Table 1. Mean Square values from analysis of variance for seedling traits under normal and control irrigation.

S.O.V	D.F	RL	SL	R/S	FW	DW	RWC%
Replications	2	3.20	0.04	0.00422	0.00005	7.779	14.7
Genotype	199	26.93**	15.77**	0.04800**	0.00051**	1.195 **	1108.6**
Treatments	1	543.53**	6436.58**	1.90000**	0.38300**	0.003**	19767.4**
G×T	199	3.79*	7.40**	0.00983**	0.00043**	1.340**	869.8 **
Error	798	1.38	0.02	0.00153	0.00010	5.358	329.7

=Values showing ***** and ****** stand for significance at 0.05 and 0.01 probability level, respectively

inadequate water condition (Table 1).

Root shoot ratio**:** The results illustrated that genotypes 26-4IBSN, 230-4SIBW, 1135EWYT, Manthar 2003, 9864, 9860, 9846, 9787, Chakwal 86 and Aas 2011showed maximum resistance to change in their root shoot ratio in both normal and water deficit conditions. The genotype 26-4IBSN indicated highest value of root shoot ratio 0.90 and 0.94 among the top ten in both normal and water deficit environment respectively. The Aas 2011 indicated minimum root shoot ratio 0.65 and 0.71 among top ten best performers in both moisture environments. The mean values presented in Table 2. Comparatively performance of genotypes for root shoot ratio under normal and water dearth conditions presented in Figure 1.

Table 2. Mean Values of R/S and RWC% of genotypes in normal and water deficit milieu.

Sr.	Genotypes	R/S		Genotypes	RWC%	
		N	D		N	D
1	26-4IBSN	0.90	0.94	9522 UAF	79.9	61.7
2	230-4SIBW	0.83	0.86	Chakwal 86	75.1	61.3
3	1135EWYT	0.82	0.86	AS-2002	73.4	60.3
4	Manthar 2003	0.81	0.87	9860UAF	71.8	59.6
5	9864 UAF	0.78	0.88	9787 UAF	69.7	55.5
6	9846 UAF	0.76	0.81	9864 UAF	66.7	52.4
7	Chakwal 86	0.73	0.79	Aas 2011	64.0	50.1
8	9787 UAF	0.69	0.79	9846 UAF	63.0	48.5
9	9860 UAF	0.69	0.79	PB 85	59.2	45.2
10	Aas 2011	0.65	0.71	Manthar 2003	56.5	29.9

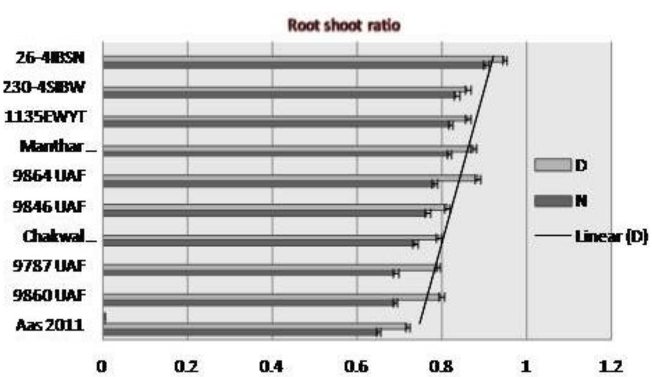

Figure 1. Root shoot ratio of top ten best performer genotypes under normal and water deficit conditions.

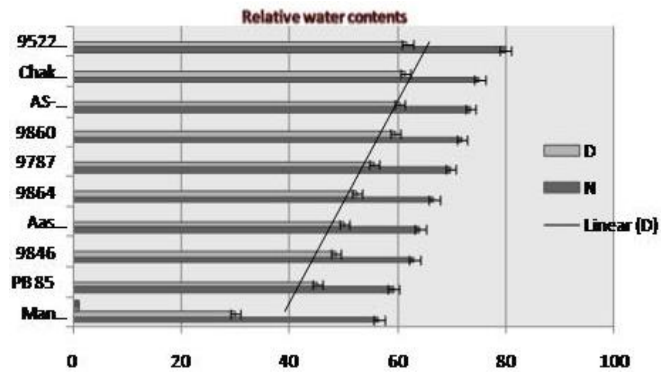

Figure 2. Relative water contents of top ten best performer genotypes under normal and water deficit conditions.

Relative water contents**:** Final investigation indicated that 9522 UAF, Chakwal 86, AS-2002, 9860, 9787, 9864, Aas 2011, 9846, PB 85 and Manthar 2003 were leading wheat genotypes for relative water contents. The line 9522 showed highest value of RWC% 79.9 in normal and 61.7 in deficit moisture while Manthar 2003 indicated minimum relative water contents 56.48 in normal and 29.9 in deficit moisture environment. The mean values presented in Table 2. Graphical comparison is presented in Figure 2.

DISCUSSION

In order to indentify the wheat genotypes desirable for breeding program for development of water deficit tolerance and high yielding cultivars, root length is distinguish and appropriate trait for choice (Ginkel and Ortiz, 2018)). Wheat plant has two types of root systems. Seminal root system starts right after germination. After germination adventitious roots that appear from the basal nodes. When seed germinates root bursts through coleorhizae and followed by emergence of 4-5 lateral seminal roots. Nodal roots appear with tillering (Ginkel and Ortiz, 2018). In water shortage plant adjusts itself through changing its different pathways (Wahid *et al.*, 2007; Chaves *et al.*, 2009). It has been reported that environmental change can affect the genotypic behavior of plants for all the considered morphological and physiological attributes (Jaskani *et al.*, 2006; Haider *et al.*, 2015; Nafees *et al.*, 2015; Kareem *et al.*, 2018; Sharif *et al.*, 2019). Plants cannot maintain moisture contents of leaf without constant availability of water and during water unavailability, leaf moisture contents dwindle. Consequently, thrash of turgor pressure (Lonbani and Arzani, 2011). During water shortage wheat cultivars produce deeper roots (Siddig *et al.,* 2013) and those plant which have capability to grow longer and deeper roots can survive well. Therefore, the performance of genotypes which indicated longer root length also performed fine in water deficit conditions. Shoot acts as best source of sink for plant therefore it is very critical attribute for plant during water deficit stress. Shoot length is most drought affected parameter and decrease significantly with increasing water shortage (Ahmad *et al.,* 2013). In order to maintain the root shoot ratio during water deficit conditions, it is also very important for the plant to maintain the shoot length (Taiz and Zeiger, 2014) because during water shortage, plant use all of its reserve food for the root growth to elongate the roots because with deeper roots plant can extract water from the depth of the soil. In this process shoot indicates stunted growth. Those genotypes which indicated longer shoot length under water shortage environment should be considered as water deficit tolerant because they are least effected by water shortage conditions. In wheat genotypes which show maximum resistant to change in root shoot ratio proved to be maximum tolerant against drought (Rauf *et al.,* 2006). In morphological trait, root shoot ratio genotypes 26-4IBSN, 230-4SIBW, 1135EWYT, Manthar 2003, 9864, 9860, 9846, 9787, Chakwal 86 and Aas 2011indicated maximum resistant against change in root shoot ratio. Limited water supply reduces biomass of plants especially at seedling stage (Mujtaba *et al.,* 2016). Khakwani*et al.* (2011) also documented decline in shoot fresh weight of wheat seedling due to water shortage. Water shortage is decline of available water, in response plant concentrated available solutes e.g. carbohydrates and proline to take water and maintain water potential through osmotic regulation (Martin *et al.,* 1993). Osmotic regulation helps plant in growth and development in water dearth milieu (Pessarkli, 1999). Decrease of RWC% resulted in closing of stomata which ultimately decrease in rate of photosynthesis (Cornic, 2000). High percentage of relative water contents increase chances of survival for plant in water deficit environment (Schonfeld, *et al.,* 1988). Moderate to rigorous water deficit conditions effect plant's morphological and physiological traits. Bilal *et al.* (2015) confirmed relative water contents as excellent criteria for selection against drought stress. The ability of plant to survive in stern water deficit conditions depends on its relative water contents (Larabi and Mekliche, 2004). Relative water contents proposed as most important indicator of plant water status as compared to any other (Almeselmani *et al.,* 2011). Wheat cultivars retained maximum relative water contents are most tolerant against drought stress (Arjenaki *et al.,* 2012). In this sense RWC% are the reliable and widely used source to check the sensitivity and tolerance of plant against drought (Liu *et al.,* 2013). Final investigation indicated that 9522 UAF, Chakwal 86, AS-2002, 9860, 9787, 9864, Aas 2011, 9846, PB 85 and Manthar 2003 were in leading wheat genotypes for relative water contents.

***Conclusion*:** The wheat genotypes Aas 2011, Chakwal 86, 9787UAF, 9846UAF, 9860UAF, 9864UAF and Manthar 2003 among 200 genotypes maintained root-shoot ratio and RWC% and performed consistently in water deficit milieu. These genotypes should include in developing new elite drought tolerant commercial varieties. These commercial varieties can be directly recommended for arid and semi-arid regions.

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