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Impacts of Biotic and Abiotic Factors on Evaluation of *Triticum aestivum* L. as a Crop

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Abstract

Wheat (*Triticum aestivum* L.) is a self-pollinating annual grass which is cultivated as staple crop widely cultivated in the world belong to the family poaceae. Wheat plays a vital role in human and animal nutrition because it is a major source of carbohydrates. Drought is a generally prolonged period of dryness which creates significant damage to crops and prevents their effective growth. It can also refer to a prolonged period of extremely low precipitation, especially one that has a negative impact on growing or living conditions. The nutritional and versatile value of wheat grain recognizes it so important that it can be refined into semolina, flour, and other products such as cookies, bread, pastries, noodles, pasta and couscous also stated that wheat is largely used to make chapatti, cakes and other food products. The germplasm was comprised of test varieties or test treatments and check varieties or control treatments. The field experiment was out by utilizing augmented block design. Parameters like germination %, tillers per plant, canopy temperature, normalized difference vegetation index (NDVI), days to 50% heading, flag leaf area (cm2), days to maturity, plant height (cm) were evaluated. Under drought condition yield/plant had positive and highly significant correlation with number of tillers, seed weight/spike and positive non-significant with NDVI, flag leaf area, days to maturity and thousand kernel weight under drought condition.

Keywords: Nutritional, versatile value, wheat grain, pastries, food products.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a self-pollinating annual grass which is cultivated as staple crop widely cultivated in the world. Wheat relates to the genus *Triticum* and family graminaeae (poaceae). It is ploughed in late summer or winter. It germinates and then begins to grow. It matures at the end of spring season and initiation of summer season. It has fibrous roots for anchoring and absorption. Leaves are present on nodes and each leaf compromises of leaf sheath and a lamina [1, 2]. Stem is erect and composes of nodes and internodes. Wheat plant has ability to produce tillers on lateral branches and number of tillers depends on the factors such as number of plants, date of sowing, nutritional value and plant growth regulators application. Wheat has grains which is dry indehiscent fruit present in spikelets. Wheat has a vital action in people and animal diet because it is a major source of carbohydrates [3, 4].

Wheat is a prominent resource of many nutrients and dietary fibers when consumed as whole grain. The nutritional and versatile value of wheat grain

recognizes it so important that it can be refined into semolina, flour, and other products such as cookies, bread, pastries, noodles, pasta and couscous also stated that wheat is largely used to make chapatti, cakes and other food products. Wheat is occupying seventeen percent of crop acreage worldwide, feeding more than forty percent of population. It is a major food crop for world population. China is the biggest producer of wheat. It may continue to attract massive research attentions to face the challenge of feeding human beings. To meet this demand yield increases are essential, as expanding wheat area is not feasible [4-6]. In Pakistan, wheat is leading grain crop and primary staple food. Productivity enhances because of extend in area of cultivation, healthy kernel formation and better crop yield. Increase in relative growth rate and higher honors for attractive output and supportive government policies [7, 8].

This research aiming for estimating the growth and yield traits of wheat germplasm under drought with biological and agricultural conditions. Wheat yield is affected by numerous biotic and abiotic factors such as disease, pests, drought and toxic deposition. Abiotic factors are measured as the dominant suppressions for yield and cause about 71 percent reduction in production of crops and it is estimated that theoretical yield loss due to drought is 17 percent. Decline in water reserves conflict for maintenance of food requirements of the world population. Water supply is going to decline progressively but nutrients requirements increasing due to increase in population [9, 10].

MATERIALS AND METHODS

Experimental Area

The experiment was done for the investigation of bread wheat (*Triticum aestivum* L.) germplasm for yield and yield components during water deficiency. A field trial was laid out at Wheat Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan during the cropping season 2020-21. The environmental conditions of the experimental area are mild, semiarid with a high summer temperature and a low winter temperature. Maximum temperature is 40 °C to 27 °C in June and minimum temperature is 4.1 °C to 19.4 °C in January. Annual rainfall is 346 mm or 13.6 inches.

Soil Preparation

The field was cultivated with the assistance of a tractor, using a deep ploughing and manual leveling. Soil was ploughed with modern agricultural tools and normally irrigated. During soil preparation fertilizers were applied (120-90-60 Kg ha^{-1} N, P, K). Data on corresponding parameters (growth, development and agronomic traits) was documented in the course of field study.

Germination %

When plants were totally germinated and tillering started, the germination percentage was observed.

Tillers per Plant

Number of tillers per plant was calculated by selecting three plants from each row. Tillers from plants were counted in numbers and their mean value was calculated.

Average tillers per plant = Sum of selected plant tillers / Number of selected plant

Canopy Temperature (℃)

Canopy temperature was measured by digital instrument "LT 300 sixth sense infrared thermometer" which had measuring range -60 to 760 °C with one percent accuracy by two readings were recorded and their mean values were computed for further evaluation [11].

Normalized Differences Vegetation Index (NDVI)

Vegetation index was calculated by digital instrument "Green Seeker handheld crop sensor" manufactured by Trimble. Instrument was kept at the height of 60-75 cm above the crop. The mean values were noted for further evaluation.

Days to 50 % Heading

The days of heading was noted when the 50% of the plants opened their heads out from flag leaf sheath along all the plots. Days were counted from the date of sowing till 50% heading.

Flag Leaf Area (cm^2)

Leaf area was recorded by selecting 5 flag leaf from each line. Length and width of flag leaf was measured by scale in centimeters (cm) when flag leaf had green color and fully matured. Area was computed by using formula given by Muller.

Flag leaf = maximum length × maximum width × K, K = 0.74 (for cereal), Where K is constant for flag leaf area for cereals and their mean had calculated.

Days to Maturity

The maturity days were noted from the date when fifty percent of the plants had yellow spike. Days to maturity were counted from sowing date.

Plant Height (Cm)

Plant height was recorded with the help of meter rod when plant was fully matured and no more growth was observed. From upper position of the spike excluding awns to the soil surface in centimeter were noted before harvesting.
Average plant height = Sum of selected plant height / Number of selected plant

Statistical Analysis: The obtained data were subordinated to analysis of variance (ANOVA) based on augmented block design.

RESULTS & DISCUSSION

Analysis of Variance

Analysis of variance was used to evaluate the genotypic differences among genotype for different traits. It is a statistical term that used and resulted.

Germination percentage (%)

Data from the table 1 revealed that blocking effect for germination percentage had non-significant under normal and drought conditions. The interactive effect for germination % had also non-significant during water availability and water stress.

Table 1: Analysis of variance for G% under normal and drought conditions

Source	Df	Conditions	SS	MS	F
Block	4	Normal	44.00	11.00	1.06^{NS}
		Drought	34.00	8.50	0.69^{NS}
Checks	4	Normal	44.00	11.00	1.06^{NS}
		Drought	84.00	21.00	1.71^{NS}
Error	16	Normal	166.00	10.37	
		Drought	196.00	12.25	
Total	24	Normal	254.00		
		Drought	314.00		

P≤ 0.05; NS= Non-significant

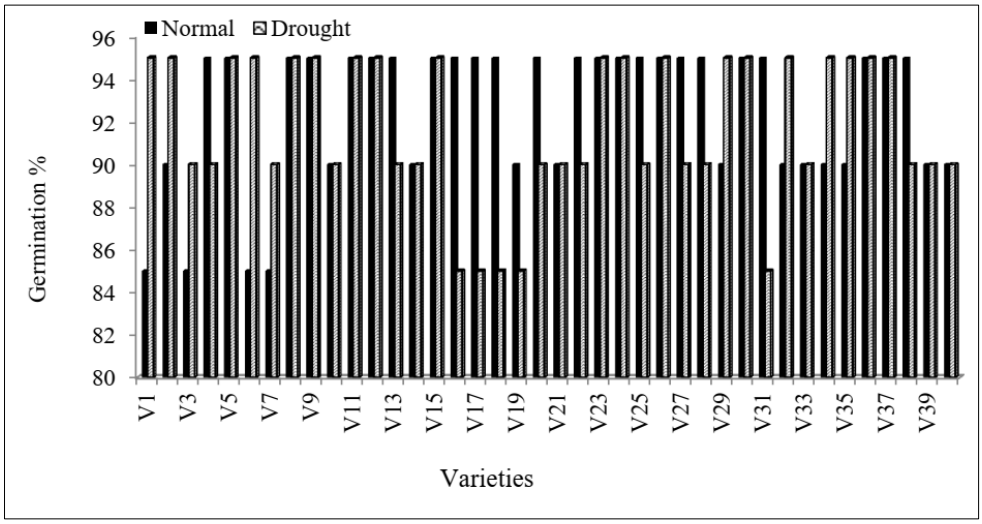

Fig. 1: Mean values of Germination percentage of 40 (1-40) germplasm of wheat under normal and drought conditions

Tillers per Plant

Data from the table 2 resulted that tillers per plant had non-significant blocking effect under normal and drought conditions. Checks had non-significant variations for tillers per plant under normal and drought conditions.

Table 2: Analysis of Variance for tillers per plant normal and drought condition

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	128.56	32.14	1.73^{NS}
		Drought	44.00	11.00	1.06^{NS}
Checks	4	Normal	205.05	51.26	2.76^{NS}
		Drought	44.00	11.00	0.06^{NS}
Error	16	Normal	297.57	18.60	
		Drought	166.00	10.37	
Total	24	Normal	631.18		
		Drought	254.00		

P≤ 0.05; NS= Non-significant

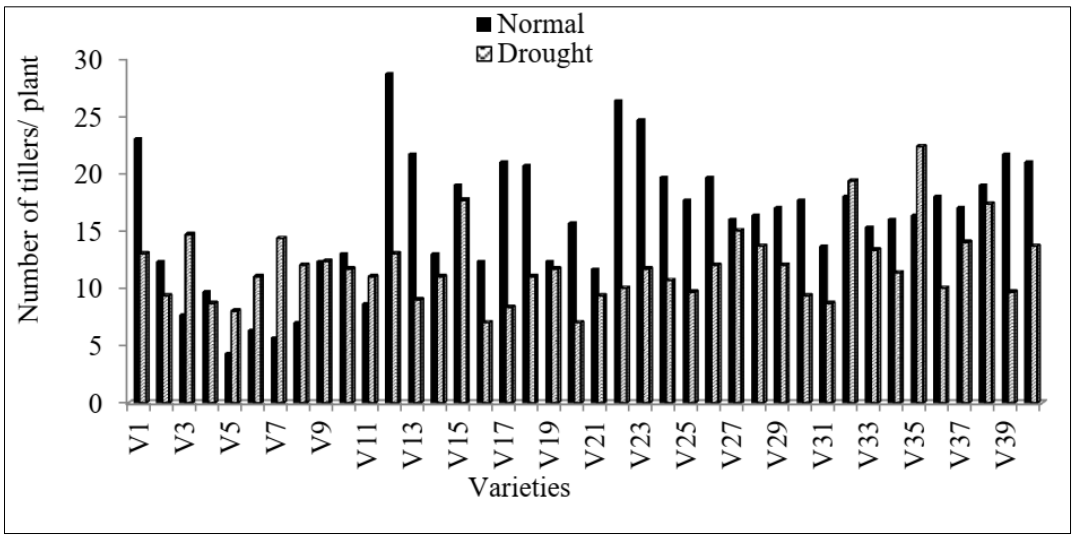

Fig. 2: Mean values for number of tillers per plant of 40 (1-40) wheat germplasms under normal and drought conditions

Canopy Temperature (°C)

Data from the table 3 conducted that unadjusted means for canopy temperature had significant blocking effect during water availability and highly significant during water stress. Data for canopy temperature had arranged and adjusted means were computed, used for graphing under normal and drought conditions. Checks had non-significant canopy temperature variation.

Table 3: Analysis of Variance for canopy temperature under normal conditions

Sources	Df	Condition	SS	MS	F
Block	4	Normal	27.349	6.837	3.29*
		Drought	59.980	14.995	7.50**
Checks	4	Normal	9.169	2.292	1.10^{NS}
		Drought	7.985	1.996	1.00^{NS}
Error	16	Normal	33.262	2.079	
		Drought	32.010	2.001	
Total	24	Normal	69.780		
		Drought	99.975		

***=Significant at P≤ 0.05; NS= Non-significant**

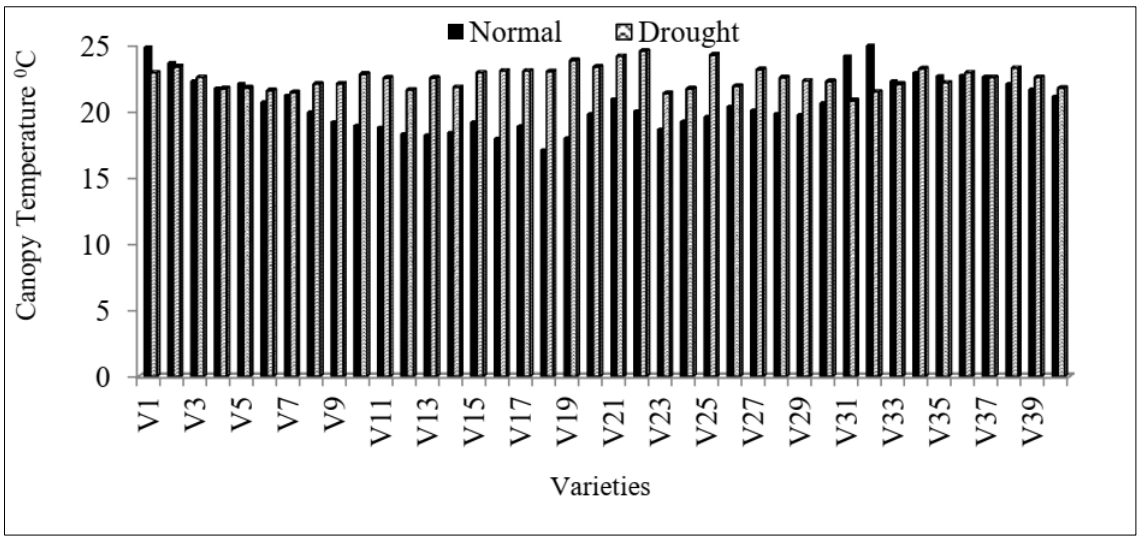

Fig. 3: Mean values for canopy temperature of 40 (1-40) wheat germplasm under normal and drought conditions

Normalized Difference Vegetation Index (NDVI)

Data from the table 4 revealed that ANOVA for NDVI had non-significant blocking effect during normal irrigation and rainfed conditions. Checks had significant variation during normal irrigation and rainfed conditions.

Table 4: Analysis of Variance for NDVI under normal and drought conditions

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	0.001584	0.000395	0.017^{NS}
		Drought	0.008440	0.002110	0.89^{NS}
Checks	4	Normal	0.028184	0.007046	3.04*
		Drought	0.045320	0.011330	4.79*
Error	16	Normal	0.037096	0.002318	
		Drought	0.037840	0.002365	
Total	24	Normal	0.066864		
		Drought	0.091600		

***=Significant at P≤ 0.05; NS= Non-significant**

Days to 50% Heading

Data from the table 5 conducted that days to 50% heading trait had non-significant blocking effect under normal and drought conditions. Checks had non-significant variation during normal irrigation and rainfed conditions.

Table 5: Analysis of variance for days to 50% heading under normal and drought conditions

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	59.60	14.90	0.61^{NS}
		Drought	29.84	7.46	0.60^{NS}
Checks	4	Normal	134.00	33.50	1.37^{NS}
		Drought	140.24	35.06	2.81^{NS}
Error	16	Normal	392.40	24.53	
		Drought	199.36	12.46	
Total	24	Normal	586.00		
		Drought	369.44		

***=Significant at P≤ 0.05; NS= Non-significant**

Flag Leaf Area (Cm^2)

Data from the table 6 resulted that flag leaf area had non-significant blocking effect under normal and drought conditions. Checks had highly significant differences during normal irrigation and rainfed conditions.

Table 6: Analysis of variance for leaf area of flag leaf area under normal and drought conditions

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	744.0	186.0	0.81^{NS}
		Drought	196.21	49.05	0.59^{NS}
Checks	4	Normal	10879.8	2719.9	11.90**
		Drought	2573.13	643.28	7.79**
Error	16	Normal	3658.1	228.6	
		Drought	1321.18	82.57	
Total	24	Normal	15281		
		Drought	4090.51		

****= Highly Significant at P≤ 0.01; NS= Non-significant**

Days to Maturity

Data from the table 7 revealed that days to maturity had significant blocking effect for unadjusted maturity days under normal condition and days to maturity were adjusted for graphing. Under drought condition days to maturity had non-significant blocking effect for unadjusted values. Checks had non-significant difference during normal irrigation and rainfed condition.

Table 7: Analysis of variance for days to maturity under normal and drought conditions

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	24.240	6.060	4.08*
		Drought	8.240	2.060	0.65^{NS}
Checks	4	Normal	4.240	0.060	0.71^{NS}
		Drought	67.840	16.960	5.32^{NS}
Error	16	Normal	23.760	10485	
		Drought	50.960	3.185	
Total	24	Normal	52.240		
		Drought	127.040		

***=Significant at P≤ 0.05; NS= Non-significant**

Plant Height (Cm)

Data from the table 8 resulted that plant height had non-significant blocking effect under normal and drought conditions. Checks had significant variation during water availability and non-significant variation during water deficiency.

Table 8: Analysis of Variance for plant height under normal and drought conditions

Sources	Df	Conditions	SS	MS	F
Block	4	Normal	16.24	4.06	0.21^{NS}
		Drought	40.64	10.16	0.33^{NS}
Checks	4	Normal	261.44	65.36	3.40*
		Drought	185.84	46.46	1.52^{NS}
Error	16	Normal	307.76	19.23	
		Drought	490.56	30.66	
Total	24	Normal	585.44		
		Drought	717.04		

***=Significant at P≤ 0.05; NS= Non-significant**

Results for analysis of variance conducted that growth and yield attributes like germination percentage, tillers per plant, NDVI, days to heading, flag leaf area, plant height, spike length, number of spikelets per spike, peduncle length, grain weight per spike and thousand kernel weight had non-significant and canopy temperature, maturity days and yield per plant had significant blocking effect under normal irrigation. Likewise, germination percentage, tillers per plant, NDVI, heading days, flag leaf area, maturity days, plant height, spike length, number of spikelets per spike and seed yield per plant had non-significant and canopy temperature and thousand kernel weight had significant blocking effect under water stress. Significant treatment effects were analyzed in NDVI, maturity days, plant height, spike length, peduncle length and highly significant in flag leaf area and grain weight per spike under normal irrigation [10, 11]. Likewise, NDVI, flag leaf area and spike length had significant treatment effect and grain weight per spike had highly significant treatment effect and germination percentage, tillers per plant, canopy temperature, heading days, maturity days, plant height, number of spikelets per plant and grain yield per plant had non- significant effect [12, 13].

Minimum canopy temperature had been recorded in V18, V-17262 (17.08 ^{0}C) and V16, V-15306 (17.93 ^{0}C) genotypes under normal conditions and V44, AZRI-TW-1581 (20.49 ^{0}C) and V57, 172190 (20.94^{0}C) under drought conditions. Fakhar-E-Bakhar (V76) had 24.54 ^{0}C least significant increase (LSI) and observed mean combine value for canopy temperature among checks under normal condition and test genotype V10 (Gold-16) had more value for canopy temperature than V76 (Fakhar-E-Bakhar). All others test entries had less canopy temperature than checks under normal condition. Under drought condition all test entries had less canopy temperature than check entries for bread wheat plant germplasm. Bayhan *et al.,* (2020) also found the germlines which had temperature less than LSI of checks. Less canopy mean that test germplasm had more transpiration rate and more adaptive to drought stress [14-16].

CONCLUSION

Wheat (*Triticum aestivum* L.) is a self-pollinating annual grass which is a staple crop widely cultivated in the world. Wheat plays a vital role in human and animal nutrition because it is a main source of carbohydrates. Drought is a generally prolonged period of dryness which creates significant damage to crops and prevents their effective growth. It can also refer to a prolonged period of extremely low precipitation, especially one that has a negative impact on growing or living conditions. During unavailability of water peduncle length had positive and non-significant correlation with germination percentage, NDVI, days to heading, flag leaf area, plant height. Seed weight/spike had highly significant correlation flag leaf area,

yield/plant and positive significant correlation with thousand kernel weight.

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