Varietal Response of Wheat to Water Stress Condition of Baghlan Province, Afghanistan

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Abstract

A field experiment was conducted during winter season of 2017-18 on sandy loam soils of Poz-e-Ishan Research Farm of Agricultural Faculty of Baghlan University, to study the response of 11 different wheat varieties to water stress condition of Baghlan province. The experiment was laid out in Randomized Block design with three replications and eleven treatments. among all varieties SHARORA//INQALAB 91*2/TUKURU has taken more number of days to 70% heading (135 days), longer days for 70% anthesis (141.33) and longer period (165 days) to maturity compared to all other varieties. Similarly, SHARORA/INQALAB 91*2/TUKURU produced significantly taller plant height (111.33), more number of effective tillers (4.97/ plant) at maturity and longer spike length (10.50 cm), heavier test weight (40.24 g) with significantly highest grain yield (4080 kg/ha) and straw yield (6587 kg/ha) over all other treatments.

Keywords - Supplemental Irrigation, Wheat Varieties, Wheat Yield

I. INTRODUCTION

Drought is one of the major abiotic stresses that affect at least 60% of wheat production in high-income countries and about 32% of 99 million hectares in low-income least developed countries (Chen et al. 2012). Water is the major limitation for crop production in arid and semi arid regions. Wheat crop requires sufficient available water to produce optimum yield. Afghanistan is a mountainous country in a dry part of the world which experiences extremes of climate and weather. Winters are cold and snowy, and summers are hot and dry. Irrigation is critical for agricultural production in much of Afghanistan, as rainfall during the growing season is unreliable or insufficient in many areas. Snow runoff from the mountain ranges of central Afghanistan provides over 80 percent of the irrigation water used. The annual precipitation in is Afghanistan 327 mm. The rainfall in Afghanistan is below the average availability of irrigation particularly during winter wheat sowing period.

Wheat is the staple crop, accounting for about 83% of total cereal consumption in Afghanistan (Mail, 2010). A large part of the Afghan wheat crop is grown in the Northern provinces with the majority of the crop being dependent on seasonal precipitation. The 5-year average wheat grain yield production is 4.26 million tons. Harvested area is estimated at 2.55 million hectares. Yield is estimated at 1.96 tons per hectare which is much lower than neighbouring countries. Under situation of low rainfall supplemental irrigation or deficit irrigation has been extensively investigated as a valuable and sustainable production strategy for a wide range of crops in Afghanistan. By limiting water applications to drought-sensitive growth stages, this practice aims to maximize water productivity and to stabilize – rather than maximize – yields (Geerts and Raes 2009, FAO 2002). It involves the addition of limited amounts of irrigation water to essentially rainfed crops, in order to improve and stabilize yields during times when rainfall fails to provide sufficient moisture for normal plant growth. Unlike full irrigation, the timing and amount of supplemental irrigation cannot be determined in advance given the natural variability in season-to-season and within season rainfall levels (Oweis and Hachum 2012). The varieties good performance, its drought resistance and better responses to supplemental irrigation is one of the key factors which not only save the water but also produce higher yield. Therefore this investigation was taken to know the wheat varietal response to water stress condition and supplemental irrigation in Baghlan environmental condition.

II. Material and Method

The field experiment was carried out during winter season of 2017-18 on sandy loam soil with pH of 6.5 and organic matter 0.8% at Poz-e-Ishan Research Farm of Agricultural Faculty of Baghlan University, to study the response of 11 different wheat varieties to water stress condition of Baghlan province. The experiment was laid out in Randomized Block design with three replication and eleven treatments such as, T1.SONMEZ/EXCALIBUR, T2. SHARORA//INQALAB91*2/TUKURU,.T3.SUN VALE/PEHLIVAN,.T4.SAULESKU#44/TR81020 0//GRISET,.T5.ES14/SITTA//AGRI/NAC/3/ZAR GANA4,.T6.SONMEZ,.T7.ES14/SITTA//AGRI/N AC/3/PYN/BAU/4/CTY*3/TA2460,.T8.CSB5R/K ATIA1/3/NE87U119/CHAM6//1D13.1/MLT,.T9.A TAY/GALVEZ87/6/TAST/SPRW/4/ROMTASTB ON/3/DIBO//SU92/CI13645/5/FI30L1.12, T10. Improved Check (Kohdasht), T11. Local check (Safidcha).

The recommended dose of fertilizer (120:60 NP kg /ha) were used. Nitrogen through urea was applied in two splits (half dose at time of sowing and half dose after second irrigation). The crop was sown on 12/12/2017. All varieties were irrigated two times only. The first irrigation was applied on 28/03/2018. While the second irrigation was applied at milking stage on 09/05/2018. Weeds were controlled manually two times after first and second irrigation. All other operations were performed as per recommendation for the crop. The row spacing was 20 cm ×10 cm. The data on various growth, yield attributes was recorded in different treatments.

III. Results and Discussion

3.1 Effect on growth

Among all varieties treatment T2. SHARORA//INQALAB 91*2/TUKURU significantly produced taller plant height (111.33 cm) at harvest. Similarly, this treatment explored significant phenological characters over all other varieties and has taken maximum number of days to 70% heading (135 days), longer duration for anthesis (141.33 days), and more number of days to physiological maturity (165 days). Apart from T2, T3. SUNVALE/PEHLIVAN had indicated higher growth and physiological traits which was at par withT1.SONMEZ/EXCALIBUR.,T4.SAULESKU #44/TR810200//GRISET4,.T5.ES14/SITTA//AGRI /NAC/3/ZARGANA4,.T6.SONMEZ,.T7.ES14/SIT TA//AGRI/NAC/3/PYN/BAU/4/CTY*3/TA2460an dT8.CSB5R/KATIA1/3/NE87U119/CHAM6//1D1 3.1/MLT. The lowest plant height (87.33 cm) at maturity was produced by T11. Local check (Safidcha). Further this treatment also has taken the least number of days to 70% heading (121 days), 70% anthesis (126.67 days) and to physiological maturity (152.67 days).

Table 1: Growth and phenological response of wheat to supplemental irrigation

Treatments	Germination (%)	Days taken to 70% heading	Days taken to 70 % anthesis	Days taken to physiological maturity	Plant height (cm) at harvest
T1. SONMEZ/EXCALIBUR	92.67	131.67	135.33	161.33	103.67
T2. SHARORA//INQALAB 91*2/TUKURU	96.00	135.00	141.33	165.00	111.33
T3. SUNVALE/PEHLIVAN	94.00	130.67	136.67	162.00	104.33
T4. SAULESKU #44/TR810200//GRISET-4	92.67	129.33	135.00	161.33	103.67
T5. ES14/SITTA//AGRI/NAC/3/ZARGANA-4	92.67	129.33	134.00	161.00	102.33
T6. SONMEZ	92.00	128.67	133.67	161.00	99.33
T7.ES14/SITTA//AGRI/NAC/3/PYN/BAU/4/CTY *3/TA2460	91.67	128.67	133.33	160.67	98.00
T8.CSB5R/KATIA1/3/NE87U119/CHAM6//1D13 .1/MLT	91.00	128.67	133.33	160.00	96.00

T9.ATAY/GALVEZ87/6/TAST/SPRW/4/ROMT ASTBON/3/DIBO//SU92/CI13645/5/FI30L1.12	90.33	122.67	128.33	157.33	94.67
T10. Improved Check (Kohdasht)	91.33	122.67	128.67	155.67	88.33
T11. Local check (Safidcha)	87.67	121.00	126.67	152.67	87.33
SEm	1.82	1.06	0.43	0.51	2.09
CD at 5%.	NS	3.11	1.28	1.51	6.16

The higher growth and phenological traits associated with T2. SHARORA//INQALAB 91*2/TUKURU was due to its high genetic potential and its water drought tolerant traits. This signifies that limited water had a little effect on their protoplasmic structure as compared to sensitive varieties. Water deficit after 6 weeks of emergence of crop is more severe on water relations, nutrient uptake, growth, and yield than early imposed drought (after 3 weeks of seedling emergence) in most wheat varieties (Nawaz *et al*. 2014). The longer days taken to phenological traits of wheat with T2. SHARORA//INQALAB 91*2/TUKURU is due to better resistant of this variety to water stress condition, which prolonged the days to heading, anthesis and maturity and gave more time for crop to translocate more photosynthate from the vegetative part to reproductive parts of plant and to contribute to higher yield attribute and final yield.

Lower plant height and less number of days taken to heading, anthesis and maturity with T11, is associated to its sensitive potential of the variety to drought and water deficit condition. Water deficit significantly reduces chlorophyll content, membrane stability and relative water content of wheat cultivars at anthesis and at the result due to deficit water pressure takes lesser days to maturity (Moayedi *et al*. 2010).

3.2 Effect on yield

Yield attributes are the major factors determining the final crop yield. Among different treatments T2. SHARORA//INQALAB91*2/TUKURU significantly produced highest yield attributes of wheat namely number of effective tillers (4.97) at harvest, spike length (10.5 cm), test weight (40.24 g) with significantly highest grain yield (4080 kg/ha) and straw yield of (6587 kg/ha) than all other treatments. Apart from T2, the maximum yield attributes and yield of wheat was obtained from T3.SUNVALE/PEHLIVAN which was at par with T1. SONMEZ/EXCALIBUR,.T4.SAULESKU#44/ TR810200//GRISE,4,.T5.ES14/SITTA//AGRI/NA C/3/ZARGANA4andT6.SONMEZ.However,T7.ES 14/SITTA//AGRI/NAC/3/PYN/BAU/4/CTY*3/TA 2460,andT8.CSB5R/KATIA1/3/NE87U119/CHA M6//1D13.1/MLT produced at par effective tillers and test weight with T1, T3,T4,T5 and T6 but did not contributed to final yield, which might be due to shorter spike length and lesser number of grains per spike.

Table 2: Yield attributes and yield response of wheat to supplemental irrigation

Treatments	Number of effective tiller per plant at harvest	Spike length (cm)	Test weight (g)	Grain Yield (kg/ha)	Straw yield (kg/ha)
T1. SONMEZ/EXCALIBUR	3.83	9.50	37.77	2920	4470
T2. SHARORA//INQALAB 91*2/TUKURU	4.97	10.50	40.24	4080	6587
T3. SUNVALE/PEHLIVAN	3.93	9.80	38.34	2953	4843
T4. SAULESKU #44/TR810200//GRISET-4	3.77	9.43	37.50	2750	4337
T5. ES14/SITTA//AGRI/NAC/3/ZARGANA-4	3.77	9.27	37.60	2680	4240
T6. SONMEZ	3.40	9.23	37.17	2650	4207
T7.ES14/SITTA//AGRI/NAC/3/PYN/BAU/4/CT Y*3/TA2460	3.35	9.23	36.80	2450	4017

T8.CSB5R/KATIA1/3/NE87U119/CHAM6//1D13.1/MLT	3.24	9.13	37.07	2380	3867
T9.ATAY/GALVEZ87/6/TAST/SPRW/4/ROMTASTBON/3/DIBO//SU92/CI13645/5/FI30L1.12	2.83	8.67	35.83	1920	3247
T10. Improved Check (Kohdasht)	2.72	8.33	35.10	1690	2967
T11. Local check (Safidcha)	2.67	7.73	34.43	1230	1940
SEm	0.20	0.33	0.76	123.86	218.73
CD at 5%.	0.58	0.97	2.23	365.39	645.24

The higher yield attributes and yields of wheat with T2. SHARORA//INQALAB 91*2/TUKURU is due to genetic potential of this variety to resist water deficit condition. Similarly, this variety clearly indicated that there is good correlation among yield attributes, yield, growth and phenological traits of wheat due to its drought resistant traits.

IV. Conclusion

To achieve maximum yield of wheat in rainfed condition and drought areas of Baghlan province, the wheat variety of SHARORA//INQALAB 91*2/TUKURU is recommended for farmers of this region. This variety is a drought resistant variety, requires less irrigation and responds well to supplemental or life saving irrigation and further more it produces higher yield and increases the farmer's income in Baghlan Province of Afghanistan.

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