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Evaluation of yield and yield components of 10 wheat genotypes under water deficit

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ABSTRACT

This study was performed to evaluation of yield components of 20 wheat genotypes under water deficit. Experiment was conducted with a split plot design. The main factor included normal and deficit irrigation (drought: 40% of field capacity) and sub-plots included 10 wheat genotypes Chamran, Marvdasht (Iran's cultivars), N14 and N49 (Iran Landrace related to the eastern regions of Central and South Western), C15 and 168 (Babax), 169 (Seri), C4, C6 and C14 (lines of Babax /seri) also booting stage was applied for drought stress. Some of traits were investigated that included: Biological yield, Seed yield, Harvest index, seed number, 1000seed weight. According to analysis of variance, it was founded that all studied traits affected by drought stress, also there were significant differences between cultivars in responses to stress. Means comparisons showed that highest seed yield was obtained by 169, 168, C6, C15, Chamran, Marvdasht and C16 at normal condition and in drought condition Marvdasht cultivars had lowest seed yield. Highest and lowest yield reductions were obtained by 169 and N49, respectively. In relation to biological yield and at normal condition, 169 and 168 showed highest means and at stress condition highest value observed by 168. The highest harvest index under normal irrigation belonged to C14, C6, Marvdasht, 169, 168 and C15. N49 harvest index was higher in drought conditions in compare to normal condition. Under drought deficit, most grain number was obtained by Chamran, 168, N14, C6 and C15 genotypes. Also, the highest 1000 seed weight were observed by C4, C14 and C6 under normal irrigation, however all genotypes showed significant reduction and N49, 169, C14, C4 and Marvdasht had the highest 1000seed weight under drought stress.

Introduction

Effect of Drought is among the environmental constraints that affect crop growth and crop production worldwide (Farooq et al., 2009). It has been estimated that up to 45% of the world agricultural lands are subjected to drought (Bot et al., 2000). Amongst the crop plants, wheat cultivation inadvertently faces drought conditions under arid and semi-arid regions. It is widely consumed by humans in producer countries and other countries where wheat cannot be grown. Moisture stress on wheat depends on different developmental stage and it could significantly affect yield and other physiological traits (Azimi et al., 2013). In arid and semiarid regions climate, wheat crops usually encounter drought, which reduces grain yield, dramatically (Sanjari Pireivatlou and Yazdansepas, 2010). Denčić et al (2000) reported The number of kernels per spike, 1000 kernel weight and especially yield were more sensitive to drought stress in the cultivars than plant height and number of spikelets per spike (Denčić et al., 2000). Guinta et al. (1993), Zhong-hu, and Rajaram (1994) revealed that kernels/spike and the number of spikes/m^2 were the most sensitive yield components to drought stress under water limitation treatments, while kernel weight remained relatively stable (Giunta et al., 1993, Zhong-hu and Rajaram, 1993). It has also been reported by Simanae et al. (1993) that the number of spikes/ m^2 and also the number of grain/spike were the effective factors to determine the drought stress(Simane et al., 1993).

Hence decreasing the amounts of these traits under water deficit conditions will indicate a negative effect on grain yield (Moayedi et al., 2010). This study was performed to evaluation of yield components of 20 wheat genotypes under water deficit.

Material and methods

Experiment was conducted as split plot design in a randomized complete block design and four replications. The main factor included normal and deficit irrigation (drought: 40% of field capacity) and sub-plots included 10 wheat genotypes Chamran, Marvdasht (Iran's cultivars), N14 and N49 (Iran Landrace related to the eastern regions of Central and South Western), C15 and 168 (Babax), 169 (Seri), C4, C6 and C14 (lines of Babax /seri) also booting stage was applied for drought stress. Some of traits were investigated that included: Biological yield, Seed yield, Harvest index, seed number, 1000seed weight.

Results and discussion

According to analysis of variance, it was founded that all studied traits affected by drought stress, also there were significant differences between cultivars in responses to stress. Means comparisons showed that highest seed yield was obtained by 169, 168, C6, C15, Chamran, Marvdasht and C16 at normal condition and in drought condition Marvdasht cultivars had lowest seed yield. Highest and lowest yield reductions were obtained by 169 and N49, respectively.

Table 1. Comparison of studied traits in responses to drought stress and genotypes.

Genotypes	Biological yield		Seed yield		Harvest index		Seed number		1000seed weight	
	Normal	Drought stress	Normal	Drought stress	Normal	Drought stress	Normal	Drought stress	Normal	Drought stress
C_{14}	1.9288 d	1.27 abc	0.8996 abc	0.461915a	46.6488a	36.3049 a	20.75 cd	16.1667b-e	43.3547 ab	29.09 ab
N_{14}	2.0953bcd	1.4387 ab	0.779667bc	0.461497 a	37.2492	32.1866ab	24.75 bc	20 ab	31.5613de	23.05bcd
Chamran	2.3808abc	1.4717 ab	0.954585ab	0.398585ab	39.2737bc	27.0093bc	27.4167 b	23.4167 a	35.2265cde	17.09 d
168	2.4422 ab	1.5508 a	1.079247 a	0.43675 ab	43.7124	27.8796bc	30.1667ab	20.3333ab	35.4788cde	21.34 cd
C_4	1.8928 d	1.1543 bc	0.724835 c	0.346583ab	38.3103 c	30.2631ab	16.3333de	13def	44.3363 a	26.81abc
C_{15}	2.3596abc	1.4378 ab	1.007252 a	0.416165ab	42.6213	b 289298b	33.5833 a	18.6667a-d	30.1061 a	22.46 cd
Marvdasht	2.0738bcd	1.0316 c	0.941583ab	0.23208 b	45.4234ab	22.372 c	26.75 b	9f	35.2947cde	25.78abc
C_6	2.2562 ad	1.2575abc	1.037748 a	0.403668ab	46.0388 a	32.0765ab	25.75 bc	18.8334abc	40.301 abc	21.44 cd
N_{49}	2.0624 cd	1.3098 abc	D0.503165d	0.350585	24.8054 d	26.6999bc	13.6667 e	11.75 ef	37.8304bcd	29.76 a
169	2.4885 a	1.3603 abc	1.116583 a	0.405917ab	44.8138ab	29.9001ab	30.0833ab	13.19167c-f	37.0828cd	29.37 a

Destro et al., (2001) reported that irrigation increased the total grain yield of the wheat crop in environments under water stress and less water availability decreased the main stem and tiller heights and the number of days to maturity in wheat(Destro et al., 2001). In relation to biological yield and at normal condition, 169 and 168 showed highest means and at stress condition highest value observed by 168, the detailed data are shown in Table 1. Moustafa et al. (1996) and Villareal et al. (1998) showed that certain cultivars react better under water stress(Moustafa et al., 1996, Villareal et al., 1998). The highest harvest index under normal irrigation belonged to C14, C6, Marvdasht, 169, 168 and C15. N49 harvest index was higher in drought conditions in compare to normal condition. It is obvious that N49 is a tall cultivar that had been selected for rainfed cropping and under irrigation, the lodging were observed which it could cause problems. Variation in water regimes causes different responses in the genotype harvest index(Villareal et al., 1998). Under drought deficit, most grain number were obtained by Chamran, 168, N14, C6 and C15 genotypes. Responses to drought stress are extremely different according to the genetic background(Rampino et al., 2006). In fact, inter- and intra-species variations in drought resistance are known. Early domestication of crop plants and plant breeding has dramatically eroded the allelic variations of crop species. This led to an increasing susceptibility of crop plants to environmental stresses, diseases and pests (Reif et al., 2005). It is well known that wild plants rarely die in their environment as a consequence of water supply fluctuation. On the contrary in many crop species that have been selected for yield potential and other quality characteristics, the potential for drought tolerance appears to be compromised. Hence, improving of drought resistance in cultivated wheat might be achieved using the allelic repertoire offered by wheat wild relatives. For this reason the existing variability currently available in gene pools must be properly characterized and understood at physiological, morphological and genetic levels(Nevo et al., 2013). According to table 1 and means comparison, the highest 1000 seed weight were observed by C4, C14 and C6 under normal irrigation, however all genotypes showed significant reduction and N49, 169, C14, C4 and Marvdasht had the highest 1000seed weight under drought stress. The highest and lowest percentage of decline observed by Chamran and 169, respectively.

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