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Full Length Research Paper

Manufacture of wheat seeds with humic fertilizer after anthesis famine condition

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Wheat is the most important crop in the world and drought is a worldwide challenge. Irrigated wheat production encounters water deficiency after anthesis stage in Ardabil Region. As a biologic fertilizer with natural origin, humic fertilizers have a balancing effect on plants encountering biotic and abiotic stresses. This experiment was conducted in split plot form based on completely randomized blocks in Ardabil. The main factor was combination of irrigation levels with humic fertilizer, whereas the sub factor was genotypes. Results indicated that there is a significant difference between study genotypes in terms of traits such as number of grain per spike, 1000 grains weight and seed yield. In addition, no significant difference was observed in any of the traits in terms of genotype × irrigation levels and humic fertilizer interaction. Humic fertilizer increased the seed yield from 3.05 to 3.53 ton/ha under drought condition. It is recommendable to apply humic fertilizer for organic seed production of wheat especially in cases of drought stress condition after anthesis.

Key words: Wheat, seed, humic fertilizer, drought stress.

INTRODUCTION

Water deficit is one of the important problems in arid and semi arid regions (Ramroudi and Sharifzadeh, 2008), also is one of the most important stress factors which can cause serious reduction in wheat production depending on an appropriate season (Molnal et al., 2004). Of course, the best alternative to produce more crops is through improving the productivity and efficiency and to stabilize it under such condition as soil humidity deficiency and to develop all types of crops which are tolerant against drought (Siddique et al., 2000). Seed must possess sufficient stored nutrients to support the growing seedling because the seedling is dependent on nutrients stored in seed as long as it is not self-sufficient (Gharineh et al., 2004). 1000 grain weight is one of the qualitatively important criteria for seed. The mentioned quality is dependent on the size of embryo, amount of materials stored for germination and vegetation. High 1000 grain weight leads to increased germination and vegetation percentage and more tiller numbers along with spike are maintained by the time of harvest which eventually is effective on yield. However, according to Nurmohammadi et al. (1995), 1000 grain weight of seed is highly effective on germination, seed vigor, seedling establishment and crop production.

Humic substances (HS) are the result of organic decomposition and the natural organic compounds comprising 50 to 90% of the organic matter of peat, lignites, sapropels, as well as of the no- living organic matter of soil and water ecosystems. There are different scientific reports about application of HS in horticultural and crop plants. Application of humic acids in agriculture as soil fertilizer and soil conditioner has been extensively discussed in the literatures. To date, numerous researches have demonstrated conclusively that HS have significant impacts on the soil structure and plant growth. Nevertheless, humic acid in proper concentrations can enhance plant and root growth. Humic preparations are the reliable protection for plants and crops against harmful admixtures from our environment (soil, subsoil waters, rain-water, and the atmosphere), which is more polluted each day. They also protect crops from unfavorable environmental factors (drought, ionizing radiation, etc) (Shahryari and Mollasadeghi, 2011a). Shahryari and Mollasadeghi (2011b) concluded that

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Table 1. Analysis of variance for the studied traits.

Source of variations	df	Mean of squares					
		Seed length	Seed diameter	Seed weight/spike	Seed number/spike	1000 grain weight	Seed yield
Replication	2	0.551**	0.09	0.000*	26.40	140.19	2.195
Irrigation levels × Humic fertilizer levels	3	0.461**	0.068**	0.000	92.98**	65.77*	5.51**
Error a	6	0.201	0.074	0.000	5.8	36.87	0.291
Genotypes	11	0.135	0.023	0.000	7.358**	555.44**	1.48**
Irrigation levels × Humic fertilizer levels × Genotype	33	0.083	0.017	0.000	12.5	14.34	0.307
Error b	88	0.107	0.015	0.00003	12.7	17.07	0.248
CV (%)		5.25	4.76	11.70	12.38	7.35	13.93

* and ** Significantly at $p < 0.05$ and < 0.01, respectively.

humic fertilizer improved economic yield in terminal drought condition. Therefore, it appears that application of this natural bio-fertilizer could be promising in production of wheat by reduction of chemical fertilizer application in terminal drought conditions of Ardabil region. Shahryari et al. (2011) in another research resulted that their applied humic fertilizer reduced average grain yield differences between stressed and non-stressed conditions from 1.0 to 0.1 ton/ha.

This study was aimed at determining the effect of a liquid humic fertilizer on the characteristics of wheat seed produced under the condition of terminal drought stress in Ardabil Region.

MATERIALS AND METHODS

In order to select genotype/genotypes tolerant for terminal drought of Ardabil region in autumn planting at the presence of a liquid humic fertilizer (containing 33.23 g/L of humic acid and 9.02 g/L of Fulvic acid), 9 genotypes were prepared from Agriculture and Natural Resources Research Center of Ardabil Province, and three other genotypes from Azerbaijan Republic. Seeds from each genotype were planted based on 450 grain per every square meter in Research Station of Ardabil branch, Islamic Azad University, Iran during 2008 and 2009 farming year. Experimental design was split plot based on completely randomized blocks which replicated three times. The main factor was the combination of "irrigation levels × humic fertilizer" and sub factor was genotypes. The combination of the factor included: normal irrigation, normal irrigation + spraying humic fertilizer, drought stress, drought stress + spraying humic fertilizer. In order to apply drought after flowering, irrigation were eliminated two times. Peat derived liquid humic fertilizer, was used as recommended by its producing company. Thus, 220 ml per 10 L of water was prepared for 1 ton of seeds and used for pretreatment of wheat seeds before planting. In order to do spraying in different growth stages, humic fertilizer was applied based on 400 ml per 50 L of water for a single hectare of wheat plantation. The spraying was done on above-ground parts of the bushes at the stages of tillering, stem elongation and grain filling. No kind of chemical fertilizers or poisonous materials was used during the experiment. Traits such as grain number per spike, 1000 grain weight, seed length, seed diameter, seed weight, seed yield were measured. Mean comparisons were done using Duncan's multiple range test at 5% probability level.

Minitab-11, SPSS-11 and MSTAT-C computer programming software's were used for statistic computations.

RESULTS AND DISCUSSION

Results from simple variance analysis of split plot for study traits given in Table 1, showed that there is a significant difference between study genotypes in terms of traits such as seed number, 1000 grain weight and seed yield at 1% probability level. This suggests that there is high genetic variation among genotypes in selection for these traits. In addition, no significant difference was observed between evaluated genotypes in terms of traits such as seed length, seed diameter and seed weight. It should be acknowledged that there was a significant difference in terms of all traits but seed weight, at 1 and 5% probability levels for examining the difference between the combination of irrigation levels and humic fertilizer (Table 1).

The investigations showed that the interaction of genotype in humic fertilizer and irrigation levels was of no significant difference for all traits (Table 1). This indicates that the response of genotypes in evaluated traits has been same in different conditions. It is obvious that those genotypes which are less affected by conditions and are of desirable values for above mentioned traits, they will be more desirable for selection. In other words, the difference between genotypes is due to genetic variations among them and this ensures a successful selection for drought stress tolerant genotypes with high yield at the presence of humic fertilizer. Comparison of measured traits for the wheat genotypes is presented in Table 3.

With respect to seed number per spike genotypes Toos and MV17/zrn with 34.45 and 33.3 numbers respectively, had significant difference with others and genotype Sardari with 15.67 seed number per spike had the lowest amount. However, with respect to 1000 grain weight, Sardari with 75.20 g and Toos with 50.89 g had the highest and lowest values among genotypes, respectively.

Table 2. Comparison of measured traits for the wheat genotypes studied.

Genotypes	Characters		
	Seed number/spike	1000 grain yield	Seed yield
Gascogne	29.6833^{bc}	61.6742^{b}	3.5875^{bcd}
Sabalan	29.9^{bc}	53.7383^{cde}	3.5333^{cd}
4057	31.8^{ab}	53.7650^{cde}	3.9292^{abc}
Ruzi-84	27.6^{c}	54.9683^{cd}	3.4642^{d}
Gobustan	23.7333^{d}	61.65^{b}	3.29^{de}
Saratovskaya-29	22.9333^{d}	57.0933^{c}	2.9633^{e}
MV17/Zrn	33.3^{a}	51.6250^{de}	3.6167^{bcd}
Sardari	15.6667^{e}	74.2017^{a}	3.5042^{cd}
4061	31.8917^{ab}	51.7758^{de}	3.4275^{d}
4041	31.3167^{ab}	51.3083^{de}	3.99^{ab}
Sissons	32.7667^{ab}	51.8967^{de}	3.3367^{de}
Toos	34.450^{a}	50.8925^{e}	4.285^{a}
Mean	28.75	56.22	3.58

Differences between averages of each column which have common characters are not significant at probability level of 5%.

Table 3. Comparison of traits for the combined interaction of irrigation levels × humic fertilizer levels .

Irrigation levels × Humic fertilizer levels	Characters				
	Seed length	Seed diameter	Seed number	1000 grain weight	Seed yield
Normal irrigation	6.1445^{b}	2.5004^{b}	28.8694^{b}	55.6689^{b}	3.7858^{a}
Normal irrigation + humic fertilizer	6.1992^{b}	2.6001^{a}	31.0444^{a}	55.1989^{b}	3.9450^{a}
Drought	6.1664^{b}	2.5652^{a}	27.7556^{b}	55.7883^{b}	3.05^{c}
Drought + humic fertilizer	6.3917^{a}	2.5829^{a}	27.3444^{b}	58.2069^{a}	3.5283^{b}
Mean	6.23	2.56	28.75	56.22	3.58

Differences between averages of each column which have common characters are not significant at probability level of 5%.

In addition, with respect to grain yield Toos with 4.280 ton/ha and Saratovskaya-29 with 2.96 ton/ha had the highest and lowest values, respectively. Comparison of means for the combination of "irrigation levels × humic fertilizer levels" was presented in Table 2. With respect to seed length the combination of "drought + humic fertilizer" had the highest value among the combinations with an average of 6.392 cm and the three other combinations were of no difference with each other. However, diameter of seeds produced from three combinations of "normal irrigation + humic fertilizer", drought and "drought + humic fertilizer" measuring 2.600, 2.565 and 2.583 mm on average respectively, had the highest values, whereas the seeds produced from normal irrigation averaging 2.500 mm had the lowest diameter. Results showed that with respect to seed number the combination of "irrigation + humic fertilizer" with 31.044 seed on average had the highest value, but the three other combinations showed no difference from each other. In addition, 1000 grain weight for the combination of "drought + humic fertilizer" measuring 58.21 g on average was the highest value. Investigations showed that seed yield from the two combinations of normal irrigation and "normal irrigation + humic fertilizer" averaging 3.79 and 3.95 ton/ha respectively, were the highest values for this trait, whereas drought stress condition with an average of 3.05 ton/ha had the lowest value.

Conclusion

It could be recommendable application of humic fertilizer for organic seed production of wheat especially in facing with drought stress problem. But some of genotypes have more genetic potential for response to a humic fertilizer. Because this pre application research program is need to reach this subject for under cultivation wheat varieties.

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