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# Effect of application elements, water stress and variety on nutrients of grain wheat in Zahak region, Iran

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**Abstract**

Wheat (*Triticum aestivum* L.) is one of the main cereal crops in the world together with maize and rice. Drought stress is the most important limiting factor of field crops in Iran. Most parts of Iran's cultivation land is placed in arid and semiarid regions and because of water deficiency, plant stress appears and wheat performance reduces severely in these regions. The experiment was carried out as Completely Randomized Block under spilt - spilt plot design with three replicates, on loomy fine sand soil during 2001-2002 and 2002- 2003 growth season at the Research Center Institute of Zabol, Zahak. Analysis of variance showed that the effect of cut irrigation, nutrient application and variety on all characteristics was significant. The maximum grain nitrogen of treatments w2 (2.528) was obtained. The minimum grain nitrogen of treatments w1 (2.391) was obtained. Analysis of variance showed that the effect of variety on grain nitrogen was significant. The maximum grain potassium of treatments w2 (0.983) was obtained (Table 2). The minimum grain potassium of treatments w1 (0.879) was obtained.

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**Introduction**

Wheat (*Triticum aestivum* L.) is one of the main cereal crops in the world together with maize and rice (Wanag *et al.*, 2009). It can be cultivated in a wide range of agricultural environments (Royo *et al.*, 2005). However, drought and salinity are the most serious threats to agriculture and are far more important globally (Altman, 2003), water stress is major harmful factor in arid and semi-arid regions worldwide (Ranjana *et al.*, 2006) that limits the area under cultivation and yield of crops. Drought is observed in irrigated areas due to insufficient supply of water and canal closure (Hafeez *et al.*, 2003). Water deficit/drought affects every aspect of plant growth and the yield modifying the anatomy, morphology, physiology, biochemistry and finally the productivity of crop (Jones *et al.*, 2003; Hafiz *et al.*, 2004). Plants under natural and agricultural conditions are exposed to stress constantly. Drought limits plant growth and field crops production more than any other environmental stresses (zhu, 2002). Although breeders are continuing to improve the yield potential of wheat, however progress in increasing wheat yields in drought environments has been more difficult to achieve. In general, breeding for drought tolerance involves combining good yield potential in the absence of the stress and the selection of high heritable traits that provide drought stress tolerance (Blum, 1988; Jones, 2007). In defining a strategy for wheat breeding under drought tolerance, Rajaram *et al.* (1996) suggested that simultaneous evaluation of germplasm should be carried-out both under near optimum condition (to utilize high heritability and identify genotypes with high yield potential) and under stress conditions (to preserve alleles for drought tolerance). Almost 32 percent of wheat culture face up to various types of drought stress during the growth season in developing Countries (Morris *et al*, 1991). Drought stress is the most important limiting factor of field crops in Iran. Most parts of Iran's cultivation land is placed in arid and semiarid regions and because of water deficiency, plant stress appears and wheat performance reduces severely in these regions. Drought stress is a decrease of soil water potential so plants reduce their osmotic potential for water absorption by congestion of soluble carbohydrates and proline and in other words osmotic regulation is performed (Martin *et al*, 1993). It is also well known fact that any increase or decrease in agronomic traits is caused by variable response of wheat genotypes via physiological changes. Thus, the development of cultivars for water limited environments would involve selection and incorporation of both physiological and morphological mechanisms of drought resistance through traditional breeding programmes. Considerable progress for rapid screening methods in both directions has been already made since then (Rauf *et al.*, 2007). For optimal growth and development, 17 essential elements are required by crop plants. These minerals, when required in relatively high amounts, are called macronutrients or, in trace amounts, micronutrients. While micronutrients are required in relatively smaller quantities for plant growth, they are as important as macronutrients. If any element is lacking in the soil or not adequately balanced with other nutrients, growth suppression or even complete inhibition may result (Mengel *et al.*, 2001). Intensive farming practices, that warrant high yield and quality, require extensive use of chemical fertilizers, which are costly and create environmental problems. Therefore, more recently there has been a resurgence of interest in environmental friendly, sustainable and organic agricultural practices (Esitken *et al.*, 2005). Given the fertilizer significant effect of improving wheat yield, how to apply the nitrogen fertilizer reasonably to improve both yield and quality has become a hot research topic today. There have been some researches about effect of fertilizer mode on wheat yield (Yan *et al.*, 1999, 2001; Rashid *et al.*, 2008) and researches on the effect of nitrogen fertilizer on wheat yield and grain protein components (Wang *et al.*, 2003; Abad *et al.*, 2004; Liu *et al.*, 2007). Evidence of greater nutritional value in crops is currently a subject of intense debate (Murphy *et al.*, 2008). Micronutrients are as important as macronutrients for adequate plant nutrition and a deficiency of just one nutrient can greatly reduce yield. Adequate plant nutrition with micronutrients depends on many factors. These factors include the ability of soil to supply these nutrients, rate of absorption of nutrients to functional sites and nutrients mobility within the plants. Interaction occurs between the micronutrient and some macronutrients. Micronutrients play a vital role in growth and development of plant and occupy an important portion by virtue of their essentiality in increasing crop yields. In fact, their essential role in plant nutrition and increasing soil productivity makes their importance ever greater. In view of intensive cropping with high yielding varieties and application of high analysis major and secondary nutrient fertilizers, incidence of micronutrient deficiencies have been more pronounced (Dewal and Pareek, 2004). Micronutrient deficiency has become a major yield limiting factor that may either be primary, due to their low total contents or secondary, caused by soil factors that reduce their availability to plants (Sharma & Chaudhary, 2007). The use of micronutrients is also important because of increasing economic and environmental concerns (Siddiqui *et al.*, 2009). Khan *et al.*, (2006) reported that Cu, Fe, Mn and Zn contents of leaf, straw and grain of wheat increased with the application of mineral fertilizers. More to the point, application methods for the use of micronutrients also affects the crop growth and yield. The aim of this study is effect of application elements, water stress and variety on nutrients of grain wheat in zahak region (iran).

## Materials and methods

*Location of experiment*

To determine the effects of water deficiency in different final growth stages of two wheat cultivars (Chamran and Kavir) accompany with application of various elements such as potassium (K), zinc (Zn) and copper (Cu) on yield production, harvest index (HI), concentration of nitrogen (N) and other elements in grain were investigated under weather condition of Sistan.

*Field experiment*

The experiment was carried out as Completely Randomized Block under spilt - spilt plot design with three replicates, on loomy fine sand soil during 2001-2002 and 2002- 2003 growth season at the Research Center Institute of Zabol, Zahak. In this experiment, there were 3 type of irrigation, complete irrigation (w1), cut irrigetion after pollination (10.5-1, Fix scale) (w2), and cut irrigetion after milky stage of grain (10.5-5, Fix scale) (w3) as sub–plots , and fertilizer treatments included; non-fertilizer (e1), copper sulphate ($CuSo_4$) (e2), zinc sulphate ($ZnSo_4$) (e3) and potassium sulphate ($K_2SO_4$) (e4) 0, 30, 40, 150kg/ha, respectively which is applied at sowing time as sub-sub plot.

*Characters of plot*

Each plot consisted of 6 rows planting a length of 6 meters and the distance between rows was 20 cm. Wheat planting density of 450 plants per square meter was intended.

*Amount of phosphorus fertilizer*

The amount of phosphorus fertilizer 150 kg/ha the source of triple superphosphate and the amount of 350 kg urea per hectare to supply nitrogen to the plant before planting was added to the soil.

*Methods of measurement concentration of elements*

Grain nitrogen concentration in the first experiment, the method Kejeldal obtained. Also seed samples obtained in the first experiment, the concentration of potassium, zinc, and copper film devices atomic absorption, respectively.

*Data collect*

Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

**Results and discussion**

*Grain nitrogen*

Analysis of variance showed that the effect of cut irrigation on grain nitrogen was significant (Table 1). The maximum grain nitrogen of treatments w2 (2.528) was obtained (Table 2). The minimum grain nitrogen of treatments w1 (2.391) was obtained (Table 2). Analysis of variance showed that the effect of variety on grain nitrogen was significant (Table 1). Analysis of variance showed that the effect of application of elements on grain nitrogen was significant (Table 1). The maximum grain nitrogen of treatments e3 (2.501) was obtained (Table 2). The minimum grain nitrogen of treatments e0 (2.365) was obtained (Table 2).

**Table 1.** Anova analysis of elements of grain affected by cut irrigation and Variety.

| Ms | | | | | |
|---|---|---|---|---|---|
| S.O.V | df | N | k | Zn | Cu |
| R | 2 | $0.011^{ns}$ | $0.002^{ns}$ | $6.402^{**}$ | $7.563^{ns}$ |
| Cut Irrigation | 2 | $0.113^{*}$ | $0.078^{**}$ | $15.181^{**}$ | $741.087^{**}$ |
| Error a | 4 | 0.014 | 0.002 | 3.052 | 0.316 |
| Variety | 1 | $0.616^{**}$ | $0.159^{**}$ | $353.337^{**}$ | $53.277^{**}$ |
| Cut Irrigation* Variety | 2 | $0.001^{ns}$ | $0.009^{*}$ | $0.901^{ns}$ | $2.206^{ns}$ |
| Error b | 6 | 0.008 | 0.001 | 3.839 | 0.668 |
| Application of elements | 3 | $0.071^{**}$ | $0.001^{ns}$ | $50.312^{**}$ | $19.715^{**}$ |
| Application of elements* Cut Irrigation | 6 | $0.006^{ns}$ | $0.013^{**}$ | $18.608^{*}$ | $6.302^{**}$ |
| Application of elements* Variety | 3 | $0.005^{ns}$ | $0.005^{*}$ | $21.418^{*}$ | $9.424^{**}$ |
| Application of elements* Variety* Cut Irrigation | 6 | $0.020^{**}$ | $0.006^{**}$ | $4.549^{ns}$ | $9.546^{**}$ |
| Error c | 36 | 0.003 | 0.002 | 3.683 | 1.675 |
| C.V | - | 2.18 | 4.25 | 5.05 | 13.92 |

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

R: Repeat, Ms: Means of square, CV: Coefficient variation, N: Nitrogen, K: Potassium, Zn: zinc, Cu: copper.

*Grain potassium*

Analysis of variance showed that the effect of cut irrigation on grain potassium was significant (Table 1). The maximum grain potassium of treatments w2 (0.983) was obtained (Table 2). The minimum grain potassium of treatments w1 (0.879) was obtained (Table 2). Analysis of variance showed that the effect of variety on grain potassium was significant (Table 1). Analysis of variance showed that the effect of application of elements on grain potassium was not significant (Table 1).

**Table 2.** Comparison of different traits affected by cut irrigation.

| Cut Irrigation | N | k | Zn | Cu |
|---|---|---|---|---|
| W1 | 2.391b | 0.879b | 35.963b | 8.450c |
| W2 | 2.528a | 0.983a | 38.796a | 9.409b |
| W3 | 2.448ab | 0.971a | 39.179a | 10.029a |

Any two means not sharing a common letter differ significantly from each other at 5% probability

W1: complete irrigation, W2: cut irrigetion after pollination.

*Grain zinc*

Analysis of variance showed that the effect of cut irrigation on grain zinc was significant (Table 1). The maximum grain zinc of treatments w3 (39.179) was obtained (Table 2). The minimum grain zinc of treatments w1 (35.963) was obtained (Table 2). Analysis of variance showed that the effect of variety on grain zinc was significant (Table 1). Analysis of variance showed that the effect of application of elements on grain zinc was significant (Table 1). The maximum grain zinc of treatments e2 (40.289) was obtained (Table 2). The minimum grain zinc of treatments e3 (36.578) was obtained (Table 2).

**Table 3.** Comparison of different traits affected by nutrients.

| Nutrient application | N | Zn | Cu |
|---|---|---|---|
| e0 | 2.365b | 38.106b | 8.426b |
| e1 | 2.494a | 36.944bc | 8.408b |
| e2 | 2.463a | 40.289a | 9.861a |
| e3 | 2.501a | 36.578c | 10.489a |

Any two means not sharing a common letter differ significantly from each other at 5% probability.
N: Nitrogen, K: Potassium, Zn: zinc, Cu: copper.

*Grain copper*

Analysis of variance showed that the effect of cut irrigation on grain copper was significant (Table 1). The maximum grain copper of treatments w3 (10.029) was obtained (Table 2). The minimum grain copper of treatments w1 (8.450) was obtained (Table 2). Analysis of variance showed that the effect of variety on grain copper was significant (Table 1). Analysis of variance showed that the effect of application of elements on grain copper was significant (Table 1). The maximum grain copper of treatments e3 (10.489) was obtained (Table 2). The minimum grain copper of treatments e1 (8.408) was obtained (Table 2).

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