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## Research Article

# Effect of drought stress and gibberellin on some characteristics of wheat

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**Abstract** Gibberellins play an important role in inducing anthesis during the vegetative growth stage in many species, including leafy vegetables such as lettuce. This phenomenon known as bolting, affects severely the yield and quality of lettuce due to stem elongation and is stimulated by both high temperatures and endogenous metabolism of gibberellic acid (GA). The field experiment was conducted in Zahak located at the sistan and balouchestan provinces of Iran. Treatments included water stress are control (a1), 10 days once (a2), 20 days once (a3) and gibberellic acid including 0 ppm (b1), 50 ppm (b2), 100ppm (b3) and 150ppm (b4). Analysis of variance showed that the effect of water stress and gibberellin on Plant height and 1000 grain weight was significant. Analysis of variance showed that the effect of water stress on harvest index was significant. The maximum of harvest index of a1 treatments were obtained and minimum of harvest index was obtained on a3 treatment.

**Keywords** Harvest Index, Spike length, stress

## Introduction

Gibberellins play an important role in inducing anthesis during the vegetative growth stage in many species, including leafy vegetables such as lettuce. This phenomenon known as bolting, affects severely the yield and quality of lettuce due to stem elongation and is stimulated by both high temperatures and endogenous metabolism of gibberellic acid (GA) [1-2]. Harrington et al. (1960)[3] reported that spraying lettuce plants at the stage of 4 and 8 leaves with 3 to 10 mg $L^{-1}$ resulted in earliness for harvesting date for 14 days, whereas plant growth and development were extremely uniform. In a similar study, Lovato et al. (2000) [4] reported that foliage spraying with 20 ppm GA3 before bolting induced a slight earliness in seed maturity and increased seed yield. It is well known that GA3 promotes plant growth and its secondary metabolite production [5]. Exogenously applied GA3 (0.5 mg $L^{-1}$) enhanced growth and promoted the accumulation of coumarin content in hairy root cultures of Cichorium intybus L. cv. Lucknow Local [6]. However, some conflicting reports showed that GA3 was ineffective or had slight effects on plant growth. By common literature consensus, the effects of spraying with GA3 might depend on the particular species and surrounding factors [7]. Due to water deficits, the physiology of crop is disturbed which causes a large number of changes in the morphology and anatomy of plants. Drought stress is a major limiting factor for plant growth and development worldwide and, in Iran, too. Sunflower is a well-adapted drought crop, essentially because of the powerful water uptake due to its efficient root system [8]. Reduced precipitation together with the higher evapo-transpiration is expected to subject natural and agricultural vegetation to a greater risk of drought in those areas [9]. Water is essential at every stage of plant growth and agricultural productivity is solely dependent upon water especially, from seed germination to plant maturation [10]. Drought stress is one of the most important abiotic stress factors which are generally accompanied by heat stress in dry season [11]. However, it has been found that both quantity and distribution of water has a significant impact on seed yield and seed quality in sunflower [12-13]. Intensity of yield reduction by drought stress depends on the growth stage of a crop, the severity of the drought and tolerance of genotype. Petcu *et al.* (2001) showed that grain yield of sunflower hybrids were affected by drought stress with the low status treatment yielding 10-13% less than the control treatment [14]. Iqbal *et al.* (2005) reported a trend in yield decline and reduce of yield components due to water stress treatments [13]. Razi and Asad, (1998) indicated that drought stress at flowering stage was observed to be a limiting factor for seed filling, so significant reduction of unfilled seeds were observed as a result of no irrigation [15]. D'Andria *et al.* (1995) reported that, the ability of sunflower to extract water from deeper soil layers as "when water stress during the early vegetative phase causes stimulation of deeper root system" and a tolerance of short periods of water deficit, are useful traits of sunflower for producing acceptable yields in dry land farming [16]. On the other hand, some evidences have indicated that water stress deficit causes considerable decrease in the yield and oil content of sunflower [17]. Drought problems for Mung beans are worsening with the rapid expansion of water stressed areas of the world with a foresee of three billion people at 2030 [18]. Adequate rainfall is required from flowering to late pod filling in order to ensure good yield. Crop yield of Mung bean is more dependent on an adequate supply of water than on any other single environmental factor [19]. Among the favorable characters of growing Mung bean in short-term growth nitrogen fixation capability, soil reinforcement and prevention of soil erosion are at the great heights. Mung bean is popular as an intercrop, or as mixed crop with cash crops. The rice-wheat cropping system is practiced on 26 million ha in South and East Asia [20]. Water shortage and the increasing competition for water resources between agriculture and other sectors compel the adoption of irrigation strategies in semi-arid Mediterranean regions, which may allow saving irrigation water and still maintain satisfactory levels of production [21]. The growth, development and spatial distribution of plants are severely restricted by a variety of environmental stresses. Among different problems faced by crop plants, water stress is considered to be the most critical one [22-24]. Shortage of water, the most important component of life, limits plant growth and crop productivity, particularly in arid regions more than any other abiotic environmental factor [22]. Water deficit effects have been extensively studied on several crops such as sugar beet and hot pepper [25] etc.

## Materials and Methods

The field experiment was conducted in Zahak located at the sistan and balouchestan provinces of Iran. Zahak region which is situated between 30° North and 61° East. Seeds of hamun wheat cultivar were purchased from the Zahak. Soil (depth of 0–30) samples were taken in order to determine the physical and chemical properties. Soil properties of field were: pH 7.5, 1.15% Organic Matter (OM), 0.059% total N, , 0.836 mg kg-1 Zn and 59.2 mg kg-1 Fe and clay-loam texture (28% sand, 42% clay and 30% silt). The field experiment was laid out in split plot with randomized complete block design with three replications. Treatments included water stress are control (a1), 10 days once (a2), 20 days once (a3) and gibberellic acid including 0 ppm (b1), 50 ppm (b2), 100ppm (b3) and 150ppm (b4). Irrigation was proceeded according to the propose design throughout the growing season. Irrigation was proceeded according to the propose design throughout the growing season. A uniform basal dose of 30 kg N ha-1 as urea (46 % N) was applied and mixed with the soil during seedbed preparation to all plots. Phosphorus in the form of single super phosphate (18 % $P_2O_5$) was applied at the time of sowing. All other agronomic practices were carried out equally during the growing season. Weeds were manually eradicated whenever they were observed in the field. The data collected in this study were subjected to analysis of variance (ANOVA) using the general linear model procedure in the Statistical Analysis System and the means comparison was done through an LSD test using a SAS statistical package.

## Results and Discussion

### Harvest Index

Analysis of variance showed that the effect of water stress on harvest index was significant (Table 1).

**Table 1:** Anova analysis of the wheat affected by water stress and gibberellic acid

| S.O.V | df | Spike length | Harvest Index |
|---|---|---|---|
| Replication (R) | 2 | $2.54^{ns}$ | $1.39^{ns}$ |
| a | 2 | $0.5^{ns}$ | 76.5** |
| Error a | 4 | 0.05 | 4.2 |
| b | 3 | $2.35^{ns}$ | 21.8* |
| a*b | 6 | $0.9^{ns}$ | 282.8** |
| Error b | 35 | 0.41 | 6.69 |
| C.V | - | 6.6 | 8.4 |

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

The maximum of harvest index of a1 treatments were obtained (Fig 1). The minimum of harvest index was obtained on a3 treatment (Fig 1). Analysis of variance showed that the effect of gibberellic acid on harvest index was significant (Table 1). The maximum of harvest index of treatments was obtained on b4 treatment (Fig 2). The minimum of harvest index obtained on b1 (Fig 2). However, it has been found that both quantity and distribution of water has a significant impact on Plant height and seed quality in sunflower [12-13]. Intensity of yield reduction by drought stress depends on the growth stage of the crop, the severity of the drought and tolerance of genotype. Petcu et al, (2001) showed that grain yield of sunflower hybrids was affected by drought stress with the low status treatment yielding 10-13% less than the control treatment [14].

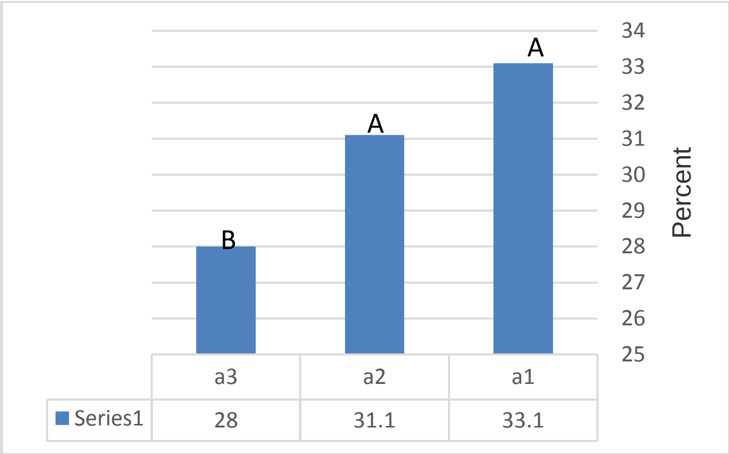


*Figure 1: Means of variance the Harvest Index affected by drought stress*

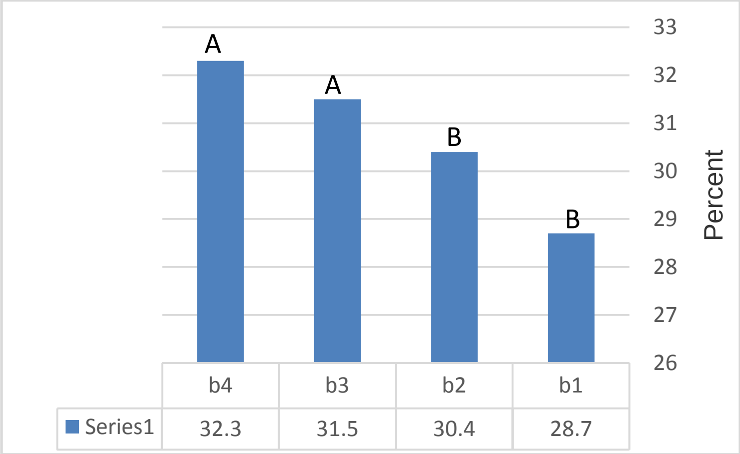


*Figure 2: Means of variance the Harvest Index affected by gibberellic acid*

**Spike length**

Analysis of variance showed that the effect of water stress on Spike length was not significant (Table 1). Analysis of variance showed that the effect of gibberellic acid on Spike length was not significant (Table 1). Drought stress is one of the most important abiotic stress factors which are generally accompanied by heat stress in dry season [11]. Due to water deficits, the physiology of crop is disturbed which causes large number of changes in the morphology and anatomy of the plant. Drought stress is a major limiting factor for plant growth and development in Iran and in other countries too. Sunflower is a well-adapted drought crop, essentially because of the powerful water uptake due to its efficient root system [8].

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