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**Research Article**

# Influence of gibberellin and drought stress on biological and grain yield of wheat

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**Abstract** Plant growth regulators have plentiful applications in agriculture such as delaying or accelerating maturity, stimulation, flowering, abscission, controlling weeds and so on. Gibberellins induce flowering in long-day plants which require chilling. Heading was delayed by addition of gibberellic acid (GA3) to the root zone. 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. 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 biological and grain yield was significant.

**Keywords** Drought, Yield, Wheat

## Introduction

Nowadays, phytohormones have been found to play an important role in plants development. Plant growth regulators have plentiful applications in agriculture such as delaying or accelerating maturity, stimulation, flowering, abscission, controlling weeds and so on. Gibberellins induce flowering in long-day plants which require chilling [1]. Heading was delayed by addition of gibberellic acid (GA3) to the root zone in super-dwarf rice [2]. Gibberellins are probably one of the growth regulators that have a significant effect on flowering [3]. The rice-wheat cropping system is practiced on 26 million ha in South and East Asia [4]. 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 [5]. 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 [6-8]. 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 [6]. Water deficit effects have been extensively studied on several crops such as maize, sorghum, sugar beet and hot pepper [9] etc. 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 [10]. Water is essential at every stage of plant growth and agricultural productivity is solely dependent upon water especially, from seed germination to plant maturation [11]. Drought stress is one of the most important abiotic stress factors which are generally accompanied by heat stress in dry season [12]. 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 [14]. However, it has been found that both quantity and distribution of water has a significant impact on seed yield and seed quality in sunflower [15-16]. 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 [16]. Iqbal *et al.* (2005) reported a trend in yield decline and reduce of yield components due to water stress treatments [15]. 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 [17]. Decreasing water supply either temporarily or permanently affects morphological and physiological and even biochemical processes in plants adversely. 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 [18]. On the other hand, some evidences have indicated that water stress deficit causes considerable decrease in the yield and oil content of sunflower [19]. Although a lot of literature is available about water stress effects on sunflower [20-22], information regarding the effect of normally irrigated and water deficit environment on seed yield, yield component, seed oil and protein content is. Once again researched in our laboratory to ascertain the present scenario.

## Material 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. 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

### Biological Yield

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

| S.O.V | df | Biological yield | Grain yield |
|---|---|---|---|
| Replication (R) | 2 | 2756375.6 $^{n.s}$ | 41073.7 $^{n.s}$ |
| a | 2 | 18823929.8* | 195501.3 * |
| Error a | 4 | 1115334 | 40660 |
| b | 3 | 7702102.5* | 485381.7 ** |
| a*b | 6 | 9628903.9** | 396375.1 ** |
| Error b | 35 | 2178153.5 | 50579.2 |
| C.V | - | 15.9 | 8.5 |

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

Analysis of variance showed that the effect of water stress on biological yield was significant (Table 1). The maximum of biological yield of A1B4 treatments were obtained (Table 2). The minimum of biological yield was obtained on 'A3B1treatment (Table 2). Analysis of variance showed that the effect of gibberellic acid on biological yield was significant (Table 1). The maximum of biological yield of treatments was obtained on A1B4treatment (Table 2). The minimum of biological yield obtained on A3B1 (Table 2). However, it has been found that both quantity and distribution of water has a significant impact on biological yield and seed quality in sunflower [14-15]. 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 [16].

**Grain yield**

Analysis of variance showed that the effect of water stress on grain yield was significant (Table 1). The maximum of grain yield of A1B4 treatments were obtained (Table 2). The minimum of grain yield was obtained on 'A3B1 treatment (Table 2). Analysis of variance showed that the effect of gibberellic acid on grain yield was significant (Table 1). The maximum of grain yield of treatments was obtained on A1B4 treatment (Table 2).

**Table 2:** Means of variance the wheat affected by water stress and gibberellic acid

| Treatment | Biological yield (kg.ha$^{-1}$) | Grain yield |
|---|---|---|
| A1B1 | 8800 cdef | 2440.6 efgh |
| A1B2 | 8820 abc | 2857.3 abc |
| A1B3 | 9360 cde | 3205 a |
| A1B4 | 12926.6 a | 3205.3 a |
| A2B1 | 9606.6 cd | 2602.3 bcd |
| A2B2 | 7723.3 efg | 2440.6 defg |
| A2B3 | 11390 ab | 2367.6 fghi |
| A2B4 | 11083.3 ab | 2564 def |
| A3B1 | 7200 ijk | 2149.33 ghijk |
| A3B2 | 7353.3 hij | 2215.3 fghij |
| A3B3 | 7665 fgh | 2583.3ghi |
| A3B4 | 7462.3 ghi | 3010.6 hi |

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

The minimum of grain yield obtained on A3B1 (Table 2).Decreasing water supply either temporarily or permanently affects morphological and physiological and even biochemical processes in plants adversely. Drought stress is one of the most important abiotic stress factors which are generally accompanied by heat stress in dry season [12]. 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 [13].

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