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# The effect of water stress and genotype on some characteristics of common bean (*Phaseolus vulgaris* L.)

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**ABSTRACT:** The common bean (*Phaseolus vulgaris* L.) species is not very tolerant to severe water stress. About 60% of the yield loss is reported from drought, making it second only to disease as a grain yield reducer. Some management practices, like irrigation, can contribute to the increase of grain yield under water stress conditions, thus the development of tolerant cultivars becomes an efficient and economical production strategy. Water plays an important role in plant life. In many localities, it is the limiting factor for agricultural crops and hence increasing yield. Therefore for judicial use of water, attempts should be made to obtain maximum yield with minimum water supply. Under conditions of drought the free energy of water available to the plant is reduced well below that of pure free water. The osmotic adjustment as accumulation of solutes within the cell helps in maintaining turgor at decreasing water potentials. Plant water status controls the physiological processes and conditions which determine the quality and quantity of growth. The experiment was conducted at the research zahak (In Iran) which is situated between 25° North latitude and 37° East longitude and at an altitude of 85m above mean Sea Level.The field experiment was laid out in randomized complete block design with split plot design with three replications. Analysis of variance showed that the effect of water stress and genotypr on all characteristics was significant.

***Keywords*:** Plant height, number of branch, number of pods.

## INTRODUCTION

The common bean (*Phaseolus vulgaris* L.) species is not very tolerant to severe water stress. About 60% of the yield loss is reported from drought, making it second only to disease as a grain yield reducer. Some management practices, like irrigation, can contribute to the increase of grain yield under water stress conditions, thus the development of tolerant cultivars becomes an efficient and economical production strategy (White . 1994; Singh, 1995). Hall (1993) defines drought as the relative yield of a genotype compared to other genotypes submitted to the same water stress. Susceptibility to drought is frequently measured by reduction in grain yield, but the values are frequently confused with the potential genotype yields (Blum, 1988). The crop also has ability to maintain soil fertility through its excellent capacity to fix atmospheric nitrogen, and thus does not require very fertile land for growth (Lobato ., 2006). Phaseolus forms an integral part of sustainable agriculture and land use (Ogbonnaya ., 2003). Improvements in water economy probably will help water-stressed Phaseolus plants in maintaining their physiological and biochemical processes. To the best of our knowledge there has been no previous report regarding the effects of foliar application of chitosan on Phaseolus plant growth and yield. Therefore, the purpose of this study was to determine the ability of chitosan to alleviate the deleterious effects of water stress on common bean (Phaseolus vulgaris L.) plants grown in the Kingdom of Saudi Arabia. Worldwide, the aggressive exploitation of natural resources has endangered water resources, biodiversity and soil quality. More than 1.2 billion people in over 110 countries are already affected by the social and environmental effects of the land degradation in dry lands (Schuster, 2003), which leads to declining biological and economic productivity. Water plays an important role in plant life. In many localities, it is the limiting factor for agricultural crops and hence increasing yield. Therefore for judicial use of water, attempts should be made to obtain maximum yield with minimum water supply. Under conditions of drought the free energy of water available to the plant is reduced well below that of pure free water. The osmotic adjustment as accumulation of solutes within the cell helps in maintaining turgor at decreasing water potentials. Plant water status controls the physiological processes and conditions which determine the quality and quantity of growth (KRAMER, 1969). Plants under water stress can avoid the harmful of drought throw several ways among them stomatal closure, leaf rolling, osmotic adjustments, reductions and consequently decreases in cellular expansion, and alterations of various essential physiological and biochemical processes that can affect growth, productivity and yield quality (Hefny, 2011; Farouk and Amany, 2012). In this respect, Bittelli . (2001) reported that occasional or episodic drought events can be counteracted through the use of anti-transpirants, compounds applied to foliage to limit the water loss. These compounds are able to increase leaf resistance to water vapor loss, thus improving plant water use and increasing biomass or yield (Tambussi and Bort, 2007). The yield response to water deficit of different crops is of major importance in production planning. Water deficit in crops and resulting water stress on plants affect crop evapotranspiration (ET) and crop yield. When water supply does not meet crop water requirements, actual evapotranspiration (ETa) will fall below maximum evapotranspiration (ETm). Under such conditions, water stress will develop in plants, which adversely affects crop growth and ultimately crop yield. However, for a full evaluation of the effect of limited water supply on yield and production, consideration must be given to the effect of the limited water supply during individual growth stages of the crops. The response of yield to water supply is quantified through the yield response factor (ky) which relates relative yield decrease to relative ET deficit (Doorenbos and Kassam, 1979). Studies to evaluate common bean performance under water stress conditions have been carried out, by assessing the morphological, physiological and biochemical characteristics associated with tolerance (Acosta-Gallegos, 1988). Blum (1997) Seed yield and viability can be reduced by environmental stress. It is reported that drought stress during seed production of soybean usually reduced seed yield. The major portion of this reduction is related to fewer number of seeds being produced (Dornbos ., 1989 and Heatherly, 1993) but some yield loss is also associated with a reduction in weight per seed (Heatherly, 1993). Drought tolerance implies the ability to sustain reasonable yields under moderate water stress, and not the ability to survive over prolonged and severe water stress periods (Mariot, 1989). recommended the use of parameters correlated with crop grain yield which are easy to measure, instead of assessments such as proline, glycinebetain and deidrine accumulation, which are hard to measure. Water stress reduces the expression of many characteristics, except days to flowering and moisture retention in the leaf (Ramirez -Vallejo and Kelly, 1998). Singh (1995) observed a decrease in grain yield and mean weight of a hundred seeds along with accelerated maturity among these characteristics.

## MATERIALS AND METHODS

### *Location of experiment*

The experiment was conducted at the research zahak (In Iran) which is situated between 25° North latitude and 37° East longitude and at an altitude of 85m above mean Sea Level.

### *Field experiment*

The field experiment was laid out in randomized complete block design with split plot design with three replications.

### *Treatments*

Treatments included the water stress as main plot (I1: 5days, I2: 10days and I3: 15 days) and genotype in four levels as sub plot.

### *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

### *Plant height*

Analysis of variance showed that the effect of water stress on Plant height was significant (Table 1). The maximum of Plant height (27.67 cm) of treatments Full irrigation (5 days) was obtained. The minimum of Plant height (22.63 cm) of treatments 15 days of irrigation (5 days) was obtained. Analysis of variance showed that the effect of genotype on Plant height was significant (Table 1). Plants under water stress can avoid the harmful of drought throw several ways among them stomatal closure, leaf rolling, osmotic adjustments, reductions and consequently decreases in cellular expansion, and alterations of various essential physiological and biochemical processes that can affect growth, productivity and yield quality (Hefny, 2011; Farouk and Amany, 2012). In this respect, Bittelli . (2001) reported that occasional or episodic drought events can be counteracted through the use of anti-transpirants, compounds applied to foliage to limit the water loss. These compounds are able to increase leaf resistance to water vapor loss, thus improving plant water use and increasing biomass or yield (Tambussi and Bort, 2007).

### *Number of branch*

Analysis of variance showed that the effect of water stress on number of branch was significant (Table 1). The maximum of number of branch (16.37) of treatments Full irrigation (5 days) was obtained. The minimum of number of branch (11) of treatments 15 days of irrigation (5 days) was obtained. Analysis of variance showed that the effect of genotype on number of branch was significant (Table 1). Studies to evaluate common bean performance under water stress conditions have been carried out, by assessing the morphological, physiological and biochemical characteristics associated with tolerance (Acosta-Gallegos, 1988).

Table 1. Anova analysis of the common bean affected by water stress and genotype

| S.O.V | df | Plant height | Number of branch | Number of pods |
|---|---|---|---|---|
| R | 2 | 1.082$^{ns}$ | 0.465$^{ns}$ | $^{ns}$*802.0* |
| water stress | 2 | 76.271$^{**}$ | 68.882** | *681$^{**}$.6* |
| Error | 4 | 0.635 | *403.0* | *171.0* |
| genotype | 3 | 38.192$^{**}$ | *155$^{**}$.33* | $^{ns}$*910.0* |
| water stress * genotype | 6 | 15.178$^{*}$ | *030$^{**}$.14* | *844$^{**}$.1* |
| Total error | 18 | 1.544 | *627.1* | *304.0* |
| C.V | - | 4.95 | *12.9* | *47.14* |

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

Blum (1997) Seed yield and viability can be reduced by environmental stress. It is reported that drought stress during seed production of soybean usually reduced seed yield. The major portion of this reduction is related to fewer number of seeds being produced (Dornbos ., 1989 and Heatherly, 1993) but some yield loss is also associated with a reduction in weight per seed (Heatherly, 1993). Drought tolerance implies the ability to sustain reasonable yields under moderate water stress, and not the ability to survive over prolonged and severe water stress periods (Mariot, 1989).

### *Number of pods*

Analysis of variance showed that the effect of water stress on number of pods was significant (Table 1). The maximum of number of pods (4.5) of treatments Full irrigation (5 days) was obtained. The minimum of number of pods (2) of treatments 15 days of irrigation (5 days) was obtained. Analysis of variance showed that the effect of genotype on number of pods was significant (Table 1). Blum (1997) Seed yield and viability can be reduced by environmental stress. It is reported that drought stress during seed production of soybean usually reduced seed yield. The major portion of this reduction is related to fewer number of seeds being produced (Dornbos ., 1989 and Heatherly, 1993) but some yield loss is also associated with a reduction in weight per seed (Heatherly, 1993). Drought tolerance implies the ability to sustain reasonable yields under moderate water stress, and not the ability to survive over prolonged and severe water stress periods (Mariot, 1989). recommended the use of parameters correlated with crop grain yield which are easy to measure, instead of assessments such as proline, glycinebetain and deidrine accumulation, which are hard to measure. Water stress reduces the expression of many characteristics, except days to flowering and moisture retention in the leaf (Ramirez -Vallejo and Kelly, 1998). Singh (1995) observed a decrease in grain yield and mean weight of a hundred seeds along with accelerated maturity among these characteristics.

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