



## The Effects of Foliar Application of Methanol on Morphological Characteristics of Bean (*Phaseolus vulgaris L.*) under Drought Stress Condition

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### Introduction

Available water is an important factor for plant growth in arid environments. Results indicated that foliar application of methanol is believed to be more important than the drought tolerance in C<sub>3</sub> plant. Since bean is a C<sub>3</sub> plant, it performs light respiration under intense heat, light and water stress due to internal leaf CO<sub>2</sub> concentration reduction and oxygen concentration increase. Light respiration can cause up to 20% loss of carbon in plants and decrease the yield. Increasing concentration of carbon dioxide can neutralize the effect caused by drought stress. Thus, the use of substances that can cause an increase in the concentration of carbon dioxide in the plant, leads to improving the yield under the drought conditions. One of the ways of increasing the concentration of carbon dioxide in plants is by using compounds such as methanol, ethanol, propanol, butanol as well as use of the amino acids of glycine, glutamate and aspartate. Plants can easily absorb methanol sprayed on leaves and use it as a carbon source added to atmospheric carbon. Methanol is relatively smaller compared to the CO<sub>2</sub> molecules, so it can be easily absorbed and utilized by plants.

### Materials and Methods

In order to evaluate the effects of foliar application of methanol on some morphological characteristics of bean under drought stress, a factorial experiment was conducted based on completely randomized block design with three replications in 2014 at the Khatam Alanbia University of Behbahan. The treatment of spraying methanol was at 4 levels include control (without spraying), 10, 20 and 30% v/v methanol which added 2 g l<sup>-1</sup> glycine to each of solutions. Adding glycine to aqueous solution of methanol leads to prevention of damages caused by the toxicity of methanol. The drought factors including control (100% field of capacity), moderate drought stress (50% field of capacity) and severe drought stress (25% field of capacity) were considered. In this experiment, each experimental unit was a pot of 1 kg and 5 seeds were planted in each pot and after emergence decreased to 3 seedlings per pot. They were placed in a growth chamber with day and night temperatures as 25 °C and 15°C, respectively. Drought stress treatment based on soil moisture percentage was adjusted by measuring the weight percent of soil moisture and adding water consumed daily by each pot. Foliar application was done 3 times during the growing season and at intervals of 10 days. The first foliar application was performed during the seedling stage within 4 weeks after planting and other foliar application, respectively in early flowering and early podding. The foliar application was performed in such a way that solution droplets were present at all parts of the bean. Trait measurement was carried out 35 days after planting.

### Results and Discussion

Results showed that there was significant difference ( $P \leq 0.01$ ) between methanol and drought stress regarding the plant height, number of branches, leaf number per pod, root and shoot dry weight, tap root length, root area, root diameter, root volume, and number of pod ( $P \leq 0.05$ ). All of the morphological traits were mainly affected by severe drought stress. The results of the comparing mean data in the interactions of methanol and drought stress showed that 20% methanol level in non-drought stress significantly increased in plant height, number of branches, root dry weight, root diameter and number of pod compared with control. 20% methanol level in temperate drought stress condition significantly increased the number of pod compared with non-applied methanol foliar application. Severe drought conditions in other traits except plant height difference between the levels of methanol and the methanol was observed.

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## Conclusions

Present study showed that the use of methanol at 20% by volume of methanol without the stress could be effective but failed to reduce the negative effects of drought stress on bean (*Phaseolus vulgaris* L.cv. sadry) plants.

**Keywords:** Drought stress, Methanol foliar application, Morphological characteristics