

## Abstract

Nodayse, antioxidants and plant growth regulators has been proposed to reduce the negative effects of stress. To reduce the damages caused by drought stress in plants, using biological fertilizers, such as growth promoting phosphate fertilize<sup>2</sup>, Jasmonic acid, and also the improvement of physiological parameters and raising the level of plant yield in arid and semiarid regions are the necessary management to reduce drought stress in plants, including the calendula officinalis plant. So, the current study was performed to triplicate the form of factorials based on a randomized complete design with three levels of drought stress, 80% of field capacity as a control, 60% of field capacity and 40% of the field capacity, phosphate fertilize<sup>2</sup> (inoculated and non-inoculated) and Jasmonic acid (zero as a control and 100 mM). The results of variance analysis showed that the different levels of drought, Jasmonic acid, phosphate fertilize<sup>2</sup>, and their interactions on the growth of calendula officinalis were effective. Drought stress reduced some measured traits, while it increased the activities rate of antioxidant enzymes (catalase, peroxidase, polyphenol oxidase). Jasmonic acid alone increased traits such as, pigments, antioxidants, carbohydrates, proline and flavonoids and also reduced the oxidative damage. Antioxidants have no significant effect on phosphate fertilize<sup>2</sup>. Phosphate fertilizer<sup>2</sup> and jasmonic acid effects on all traits, except carotenoids, carbohydrates, and antioxidant enzyme-were significant. Carotenoid Isomerase gene expression study was carried out by QReal time PCR method. The results showed that the effects treatment on gene expression were significant at 5% level. The findings of the current study indicated that the use of phosphate fertilizer 2 and jasmonic acid is an appropriate way to increase plants' resistance to water stress.

Keywords: calendula officinalis, Drought stress, Antioxidan enzymes, jasmonic acid, Carotenoid, gene expression.



**University of Zabol  
Graduate school  
Faculty of Agriculture  
Department of Horticulture and Landscape  
The Thesis Submitted for the Degree of Master of Science  
(in the field of modification of garden plants Science)**

**The effects of drought stress, phosphate  
fertilize<sup>2</sup> and Jasmonic acid on gene expression  
pattern of carotenoi isomerase in plant  
*calendula officinalis***

**Supervisor**

**B.Fakheri**

**Advisors**

**N. Mahdinejad**

**By**

**Amin Basherafat**

**June 2015**