

## Abstract

Drought stress is the most common non-living environmental stress and the most important limiting factor for plant growth around the world. Species of genus *Trichoderma* are important factors in improving plant growth and play a key role in plant resistance to environmental stress. To investigate the effect of *Trichoderma* fungi on expression of *RAS* gene in three genotypes of two herbal medicines Lemon balm (*Melissa officinalis* L.) and Moldavian balm (*Dracocephalum moldavica* L.) under drought stress, a factorial experiment based on randomized completely design with three replications, was conducted in the completely randomized design with three replications in 2016 Zabol Agricultural Research Institute (Chah-Nimeh) and Agricultural Biotechnology Research Institute, University of Zabol (Biocenter). The experiment Treatments consisted of two levels *Trichoderma* fungi treatment of inoculation and non-inoculation (control), drought stress at three levels of irrigation (%50, %70 and %90 of Field capacity) and three genotypes (Isfahan, Shiraz and Mashhad). The features which can be evaluated are: plant height, leaf length, leaf width, stem diameter, root length, fresh weight of the plant, dry weight of the plant, root fresh weight, root dry weight, lateral branches, catalase enzymes, Guaiacol peroxidase, Ascorbate peroxidase, polyphenol oxidase, phenylalanine ammonia, chlorophyll a, chlorophyll b, total chlorophyll, flavonoids and proline. The results showed that the main effect of *Trichoderma* fungi, drought stress, genotype and their interactions on the most traits of the two plant in the probability level of one percent was significant. The results of drought stress and *Trichoderma* fungi on evaluating traits, showed that in all of the morphological traits, drought stress cause the Reduced of morphological traits, photosynthetic pigments, flavonoids also, increased antioxidant enzymes and proline. And *Trichoderma* also cause increasing all morphological traits, photosynthetic pigments, flavonoids, proline and some antioxidant enzymes. *RAS* gene expression was performed with actin reference gene, gene expression was performed using Real Time PCR and data analysis with  $\Delta\Delta C_t$  method, then the expression of the genes for all treatments was considered. The results of study on the effect of *Trichoderma* fungi on three genotypes under drought stress in two plants showed that the main effect of *Trichoderma* fungi treatments, drought stress, genotype and their interaction at ( $P \leq 0.01$ ) level was significant. The highest expression of *RAS* gene was observed in the two herbs of lemon balm and Moldavian balm respectively in Mashhad (2.20) and Shiraz (2.07) genotypes in the level drought %50 of Field capacity along with inoculation treatment of *Trichoderma* fungi. Final results were shown that, with increasing of drought stress, *RAS* gene expression increased, This indicates the effect of drought stress on the expression of this gene. also, Among the studied genotypes, Mashhad genotype in the lemon balm and Shiraz genotype in Moldavian balm are recommended as resistant genotype to drought Stress.

**Keywords:** *Trichoderma*, Drought stress, Gene expression, *Actin*, Rosmarinic acid, Real time PCR



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under drought stress in Lemon balm and Moldavian balm plants**

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