Proceedings of the 6th World Congress on Civil, Structural, and Environmental Engineering (CSEE'21)
~~Lisbon, Portugal~~ Virtual Conference – June 21 – 23, 2021
Paper No. ICEPTP 101
DOI: 10.11159/iceptp21.lx.101

Combined Heat and Drought Tolerance of Tomato Plants when Treated with different Arbuscular Mycorrhizal Fungi

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Extended Abstract

As sessile organisms, plants are frequently confronted with abiotic and biotic stress factors acting simultaneously or in combination. Among abiotic stresses, extreme temperature and drought conditions are two of the most frequent environmental threats to crop growth and productivity that weakens global food security worldwide [1]. Given the current and growing effects of climate change and increases in the occurrence and severity of both stress factors, it is essential to develop a biotechnological method to handle the drought and heat stresses. Even though there are still gaps in our knowledge on the mechanism of influences of arbuscular mycorrhizal fungi (AMF) on host plants subjected to the combined heat and drought stresses, AMF can increase the plant resistance against stresses by enhanced antioxidant enzyme activities (peroxidase, catalase, and superoxide dismutase), moreover, decrease the oxidative damage in the cell [2]. The symbiotic interactions between AMF and plants increase water uptake, leaf water potential, stomatal conductance, improved gas exchange, transpiration, and photosynthesis in mycorrhizal plants. Meanwhile, fungal colonization often increases the root transcript abundance of some of the major intrinsic proteins (aquaporin) and increases cell hydraulic conductivity in plant roots [3,4].

This study aims to explore and compare the effect of three different AMF strains on tomato plants (*Solanum lycopersicum* L.) when exposed to heat and drought stresses. This research focuses on the alleviation of the adverse impacts and the improvement of plant tolerance.

In order to confirm our hypothesis that some strains of AMF can increase the tolerance of tomato plants on unfavorable heat and drought conditions, a pot experiment (12 replicates) was performed under controlled conditions in a growth chamber at 26/20°C with 16/8 h photoperiod. After six weeks of growth, AM and non-AM plants were put in normal conditions above and drought conditions (40% of field capacity) for two weeks. Half of the plants were subjected to high-temperature conditions (45ºC for 6h) at the end of the drought period. Peroxidase, catalase, and glutathione S-transferase enzyme activities are going to measure using U-2900 UV-VIS spectrophotometer. Now we are reporting our results regarding catalase enzyme measuring.

All data were evaluated by one-way analysis of variance (ANOVA). Means were compared by Duncan’s post hoc test at $P \leq 0.05$.

Results and Discussion

We did not found any substantial difference among treatments was observed under both no stress condition and droughtb+ heat, as compared with the corresponding non-AM plants. Moreover, *R. irregularis* and *F. coronatum* have ability to promote leaf CAT activity by 42 % and 57 %, respectively under drought + heat shock, in plants as compared with that of uncolonized plants (Figure 1A).

A significantly higher activity of root CAT was observed in plants exposed to both stresses, compared with that of plants under no stress conditions. Under drought + heat stress, no significant differences in root CAT activity were observed between treatments (Figure 1B), while a higher root CAT activity (increased by 30 %) was observed in plants inoculated with *F. mosseae* under drought + heat shock, while plants inoculated with *R. irregularis* and *F. coronatum* increased root CAT activity by 4 and 11 %, respectively, as compared with non-AM plants. There were significant impacts of AMF inoculation and stress imposed ($P < 0.0001$) and their interaction on leaf CAT activity as well as on root CAT activity. The change in the catalase activity in leaves as well as in roots, and exposed to both stress reflecting the different behaviour of

AMF strains in alleviating stress imposed. Moreover, these changes also, can be related to the global metabolic alteration (physiological, and biochemical) in the host plant (tomato) due to the mycorrhization and AM benefits.

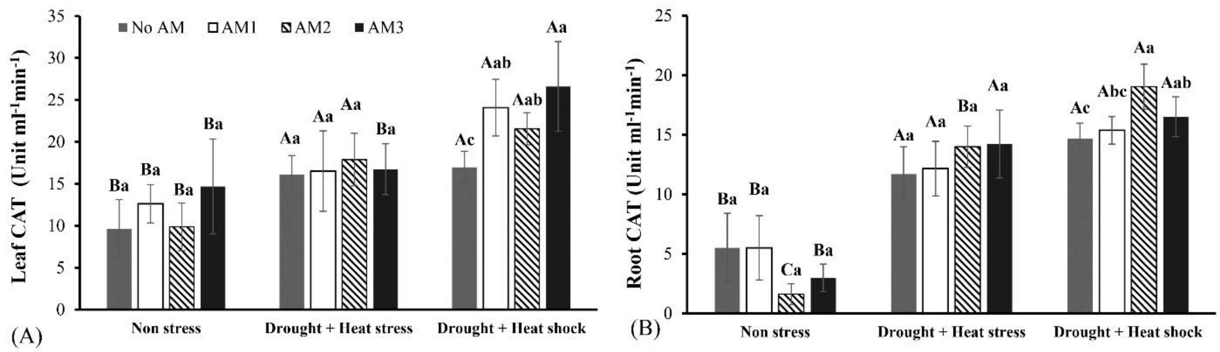

Figure 1. The activity of catalase (CAT) in leaves (A) and roots (B) of non-inoculated plants (No AM) and plants inoculated by *R. irregularis* (AM1), *F. mosseae* (AM2), or *F. coronatum* (AM3) subjected to non-stress (NoS), drought + heat stress (D + H), and drought+ heat shock (D + HS). Each bar represents the mean and standard deviation (n = 4). Different minuscules indicate significant differences among treatments under the same conditions (no stress, drought + heat stress, or drought + heat shock) by Duncan's post hoc test at $P \leq 0.05$. Different capital letters indicate significant differences of the same treatments (No AM, *R. irregularis, F. mosseae*, or *F. coronatum*) under different conditions (no stress, drought + heat stress, and drought + heat shock) by Duncan's post hoc test at $P \leq 0.05$.

Acknowledgement

This work was supported by Stipendium Hungaricum scholarship and Szent István University (Hungary): NKFIH-1159-6/2019.

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