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1 Arbuscular mycorrhizal fungi mitigate negative effects of combined drought and heat stress on 2 tomato plants

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7 **Abstract**

8 Arbuscular mycorrhizal (AM) symbiosis can alleviate drought and temperature stresses in plants, but it
9 is unknown whether the benefits can be maintained when the plants are exposed to combined drought
10 and heat stress. In this study, the impacts of AM fungi, *Septoglomus deserticola* and *Septoglomus*
11 *constrictum* on tomato plant tolerance to combined drought and heat stress were investigated. No
12 substantial differences in physiological parameters were found in all plants under non-stress conditions,
13 except a higher expression of *SILOXD* and *SIP2.7* in plants+*S. constrictum*. Under drought, heat and
14 drought+heat stress, both fungal symbionts could moderate oxidative stress by decreasing the lipid
15 peroxidation, hydrogen peroxide level and improving leaf and root antioxidant enzyme activities,
16 however better performance in plants+*S. constrictum*. Under drought and the combined stress,
17 inoculation with *S. constrictum* enhanced stomatal conductance, leaf water potential and relative water
18 content, elevated F_v/F_m and biomass production of the hosts as compared to non-inoculated plants
19 whilst these improvements in plants+*S. deserticola* were not obvious. Under the combined stress
20 inoculation of *S. constrictum* did not change the expression of *SINCE1* and *SIP2.7* in roots as under
21 heat stress. Expression of *SILOXD* in root were upregulated in plants+*S. constrictum* under drought+heat
22 stress as in mycorrhizal roots under drought stress. Altogether, our results indicated that AM
23 inoculation, particularly with *S. constrictum* had a positive influence on the tomato plant tolerance to
24 drought+heat stress. Further studies are essential to add some light on molecular mechanisms of
25 mycorrhizal plant tolerance to this combined stress.

26 **Keyword:** Arbuscular mycorrhizal fungi, combined drought and heat stress, heat stress, stress
27 tolerance, tomato plant, water deficit.

28 **Abbreviation**

29 ABA, abscisic acid; AM, arbuscular mycorrhizal; CAT, catalase; JA, Jasmonate; MDA,
30 malondialdehyde; POD, peroxidase; PSII, photosystem II; ROS, reactive oxygen species; RWC,
31 Relative water content; *SILOXD*, lipoxxygenase D gene; *SINCE1*, 9-*cis*-epoxycarotenoid dioxygenase
32 gene; *SIP2.7*, plasma membrane intrinsic protein 2.7 gene; SOD, superoxide dismutase.
33

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