

HUMIC ACID RESTORES ROOT GROWTH IN AN ABA-DEFICIENT TOMATO (SITIENS)

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Humic acids (HA) have been recognized as hormone-like substances. Previously we have shown that root growth is enhanced by HA and this enhancement is associated with up-regulation of the plasma membrane (PM) H⁺-pump. Abscisic acid (ABA) is a common signal for mediating responses to many environmental stresses, and ABA has also been shown to be necessary to maintain normal root growth. The ABA-deficient tomato mutant (*sitiens*) and wild-type (WT) were grown for 3 weeks in hydroponics and treated for 1 additional week with HA 40 mg L⁻¹. The *sitiens* plants had short, thicker roots, reduced root biomass and 6 times higher H⁺-ATPase activity compared to WT. When the *sitiens* were treated with HA, the fresh weight increased 2-fold and normal root morphology was restored. Interestingly, the HA treatment reduced the overactivation of the PM H⁺-ATPase of *sitiens* plants by 2-fold, down-regulating the activity to reach values very close to that presented by WT treated with HA, which in turn had 2 times greater ATPase activity than non-treated WT ones. It appears that the HA allow a fine-tuning of the PM H⁺-ATPase activity and related physiological and morphological responses, allowing root cells to adapt metabolism and root growth in ABA deficient plants.