

ARTICLE

Interaction between salicylic acid and polyamines and their possible roles in tomato hardening processes

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ABSTRACT Long-term pre-treatment of tomato plants with low concentration of salicylic acid can induce abiotic stress tolerance by activating enzymatic and non-enzymatic antioxidant defense system. Changes of antioxidant defense system and catabolism of polyamines in tomato (*Solanum lycopersicum*) plants were investigated. Our results suggest that by affecting the polyamine catabolism salicylic acid can contribute to plant abiotic stress tolerance.
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KEY WORDS

Solanum lycopersicum
proline
polyamines
salicylic acid

Salicylic acid (SA) is considered as a hormone-like substance that has important role in the regulation of growth and development. There were several efforts to apply SA as pre-treatment or chemical priming in order to improve abiotic stress tolerance of plants. SA can increase H_2O_2 contents in tissues which can induce the expression of antioxidant enzymes and increase plant tolerance to abiotic stressors. Our previous studies proved that long-term pre-treatment with salicylic acid (SA) at low concentrations (10^{-7} and 10^{-4} M SA) can induce the synthesis of polyamines in tomato plants (Szepesi et al. 2009). Polyamines (PAs) are small, organic polycations found in all eukaryotic cells. Putrescine (Put), spermidine (Spd) and spermine (Spm) are the major free PAs in plants and they are involved in various processes such as cell proliferation, growth, morphogenesis, differentiation and programmed cell death (Kumar et al. 1997). Polyamine oxidation is the main catabolic process of polyamines. The main catabolic enzymes are the diamine oxidase(s) (DAO, EC 1.4.3.6) and polyamine oxidases (PAO, EC 1.5.3.3). They can regulate the endogenous content of polyamines and generate H_2O_2 , which can act as a signaling molecule. H_2O_2 produced by polyamine catabolism participates in important metabolic pathways involved in stress responses (Papadakis and Roubelakis-Angelakis 2005). The levels of PAs and proline (Pro) could be interrelated because they share certain common intermediates in their biosynthetic and catabolic pathways (Aziz et al. 1998). Interactions between stress-induced Pro and polyamine accumulations may reflect the fact that they share ornithine as a common precursor (Mohapatra et al. 2009). In these experiments we investigated how SA can influence the polyamine catabolism and antioxidant defense system at the

end of the pre-treatment and we evaluated whether elevated polyamine levels were a result of stress-induced injury or a protective response to salicylic acid treatment.

Materials and Methods

Tomato (*Solanum lycopersicum* cvar Rio Fuego) plants were grown hydroponically in a greenhouse under $180 \mu\text{mol m}^{-2} \text{s}^{-1}$ light intensity and at 12/12 day/night photoperiod. The temperature was maintained at 25°C and the relative humidity was 55-60 %. Plants were treated for 3 weeks with 10^{-7} M and 10^{-4} M SA added to the nutrient solution. Samples were prepared from the second, fully expanded leaves and roots in 3 replicates. Experiments were repeated 3-5 times. Data of time-course analysis presented are means $\pm$ SE for 3 replicates. Free polyamines were determined as described by Flores and Galston (1982). Enzyme activities of diamine oxidase (DAO, EC 1.4.3.6) and polyamine oxidase (PAO, EC 1.5.3.3) were estimated by method of Federico et al. (1985) with some modifications (Moschou et al. 2008). Superoxide dismutase (SOD) activity was determined by measuring the ability of the enzyme to inhibit the photochemical reduction of nitroblue tetrazolium (NBT) in the presence of riboflavin in light (Dhindsa et al. 1981). Catalase (CAT) activity was determined by the decomposition of H_2O_2 and was measured spectrophotometrically by following the decrease in absorbance at 240 nm (Upadhyaya et al. 1985). APX, MDHAR, DHAR, GR activities were measured by spectrophotometer. Free proline contents were determined as described by Bates et al. (1973). Potassium ion contents were determined by AAS (Hitachi-Z8200).

Results and Discussion

In order to maintain the integrity of membranes, effective

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Changes induced by powdery mildew in the salicylic acid and polyamine contents and the antioxidant enzyme activities of wheat lines

M Pál, V Kovács, G Vida, G Szalai, T Janda - European Journal of Plant ..., 2012 - Springer

Abstract Investigations were made on four wheat (*Triticum aestivum* L.) lines under greenhouse conditions, in order to reveal the role of stress-protective materials, namely salicylic acid, polyamines and antioxidant enzymes in the level of tolerance to powdery ...

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HS Aldesuquy, MA Abbas, SA Abo-Hamed... - Journal of Stress ..., 2012 - jspb.ru

A pot experiment was conducted to evaluate the beneficial effect of foliar application of glycine betaine (10mM), grain presoaking in salicylic acid (0.05 M) and their interaction on drought tolerance of two wheat (*Triticum aestivum* L.) cultivars (sensitive, Sakha 94 and ...

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