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Salicylic acid and abiotic stress: nature of interaction

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Motivation and Aim: A plant hormone salicylic acid (SA) has attracted attention of plant physiologist as a modulator of plant immunity under biotic stress conditions [1]. However, over the past decades, a large amount of data has accumulated describing the SA role in plant growth under various abiotic stresses [2]. Despite SA application in agriculture as plant growth regulator has great potential, the requirements, which would provide an optimal growth-defense balance, are poorly understood. The aim of the current study is to compile a general map of characteristic changes in root morphology after SA treatment under stress conditions such as chilling, salinity, drought and heavy metals, and retrieve the conditions, which facilitate protective effects of SA.
Methods and Algorithms: In the study, we analyzed more than 30 publications devoted to the simultaneous stress and SA effects on the root system architecture in 17 plant species. Systematization of information in tables and separation of data by process (seed germination, root length, root biomass), abiotic stress types, plant species and SA treatment conditions were used for comparative data analysis.
Results: SA treatment alleviates the abiotic stress effects on the root system. SA can restore root length and biomass suppressed by salt, drought, cold, nickel, cadmium, arsenium, zinc, lead, chromium and aluminium stresses [3]. The effective SA concentration depends on the plant species and the stress type. For example, for some species, low SA concentrations promote seed germination under salinity, while higher SA concentrations lead to an increase of stress effects.
The SA protective effect may rely on a decrease in the toxicity of a stress factor but mainly it is related to SA stimulation of plant growth and development, which are inhibited by stress conditions. This recovery is especially promoted by SA protection of cell divisions. The restoration of root growth under stresses needs treatment with those SA concentrations, which under normal conditions enhance growth or at least do not inhibit it [4–6]. Such treatment provides the optimal level of endogenous SA through the regulation of SA metabolism [3]. Further SA mitigation of abiotic stress effects occurs in crosstalk with other plant hormones (in particular, IAA, ethylene, ABA).
Conclusion: SA treatment completely eliminates the effect of weak and moderate stress and partially restores root growth under severe ones. To ensure optimal plant growth under abiotic stress plants have developed various mechanisms to control balance between growth and defense, in which SA plays an important role.
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