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Chapter

Review on the Role of Salicylic Acid in Plants

Ali S. Hassoon and Inas Abdulsattar Abduljabbar

Abstract

Salicylic acid and its derivatives as one of the plant hormones produced by the plant naturally belong to the group of phenolic acids and consist of a ring linked to the group of hydroxyl and carboxyl group, and the starting ingredient to form the cinnamic acid. It is mainly manufactured within the plant in cytoplasmic cell. This acid was first discovered in *Salix* spp., which contains the Salicin compound by 9.5–11% and is present in the plant in the form of free phenolic acids or associated with amino compounds. Symbolized by the symbol SA called chemical ortha hydroxyl benzoic acid chemical formula is $C_7H_6O_3$.

Keywords: salicylic acid, plants

1. Introduction

Salicylic acid and its derivatives as one of the plant hormones produced by the plant naturally belongs to the group of phenolic acids and consists of a ring linked to the group of hydroxyl and carboxyl group, and the starting ingredient to form is the cinnamic acid (**Figure 1**). It is mainly manufactured within the plant in cytoplasmic cell. This acid was first discovered in *Salix* spp., which contains the salicin compound by 9.5–11% and is present in the plant in the form of free phenolic acids or associated with amino compounds [1]. Symbolized by the symbol SA called chemical ortha hydroxyl benzoic acid chemical formula is $C_7H_6O_3$ [2].

Salicylic acid plays an important role in the growth and development of the plant for important physiological roles such as increasing the plant's response to stress conditions (biotic and abiotic) by increasing the resistance of the plant to System Acquired Resistance (SAR) by stimulating or changing the internal paper dissection endogenous signaling to withstand a large number of stresses. Salicylic acid acts as a stimulant or transmitter of the cell to withstand environmental stress conditions such as dryness, coldness, heat, stress of heavy elements, and conditions of ammonia tension and also increases the plant's ability to withstand salt stress salt particularly harmful sodium chloride compound NaCl [3].

It also has the ability to bind conjugate with some amino acids such as proline and arginine, which increase the plant's effectiveness in resisting environmental stresses and at the same time maintain systemic acquired resistance [4].

The most important effects of salicylic acid are to stimulate the production of antioxidants. Antioxidant against the effect of free radicals from the group Reactive Oxygen species (ROS) when exposed to heat stress and stress Drought stress and prevents the oxidation of algebraic and oxytin and cytokinein and also has a role at

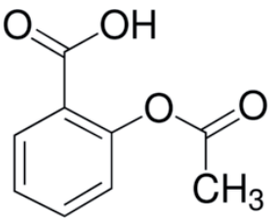

Figure 1.
Chemical structure of SA acid.

the genetic level. It stimulates the genes of antioxidant enzymes such as manganese superoxide dismutase (Masud) [5].

Salicylic acid increases the plant's response to tolerance and resistance to various diseases affecting plants as it is found that increasing its internal concentration activates the protective role of pathogenic pathogens [6]. The SA also has many important physiological roles, such as stimulating the flowering, ion absorption, nutrient transfer, increasing the representation of CO_2 gas, controlling the movement of stomata, photo materials, gas exchange, and protein synthesis. It also contributes to increasing the percentage of nucleic acids and amino acids and the accumulation of dry matter and speeds up the formation of various plant dyes and increasing their levels such as chlorophyll and carotene and prevents the representation of ethylene gas, and it is contrary to the work of ABA responsible for the fall of leaves. It also plays an important role in increasing metabolic rates, which contributes to the energy saving of the plant through alternative pathways accompanied by a change in the level of nucleic and amino acids within the plant [7].

2. Effect of salicylic acid in growth and yield

De Kock et al. [8] were the first to talk about the role of salicylic acid as a growth regulator during the past two decades, after which the interest in this compound has increased, and many studies have been conducted that showed a relationship between salicylic acid and the growth and development of plants. Among these studies is the finding of the cotton plant *Gossypium hirsutum* L., which belongs to the Malvaceae family in three levels of salicylic acid (50, 100, and 150) mg/l had it. The highest rate of the studied traits was the plant height (143.80) cm, the number of branches (34.28 branches), and the total cotton yield (3371.9) kg/Ha in relation to other concentrations used [9].

Najafian [10] concluded that *Rosmarinus officinalis* L. spraying with three levels of salicylic acid (450, 300, and 150) mg/l resulted in a significant increase in growth rates and photosynthesis compared to untreated plants. The increase was more pronounced when spraying plants with a concentration of 300 Mg.

Najafian [11] found that spraying SA acid at three levels (150, 300, and 450) mMol on *Thymus vulgaris* L. had a significant effect on the studied traits. Spraying at a concentration of 150 mM gave an increase in the dry weight of the vegetative total and photosynthesis and increased plant tolerance for salt stress conditions.

In a study on the response of the Indian mustard *Brassica juncea* L. to spraying with two levels of salicylic acid (35 and 70 mg), there was a significant superiority in all vegetative traits studied (plant height, number of branches, and leaf area). In addition, there was a significant increase in all the parameters of the crop (the weight of one mustard, the total yield of the seed, and the seed yield), when spraying the plants at a concentration of 70 mg/l in comparison with the concentration of 35 mg/l and spraying with distilled water only [12].

In a study conducted in Pakistan on the *Abelmoschus esculentus* L., which belongs to the marsh family, [13] found that salicylic acid spraying with concentrations of 50 and 75 mg/l had a significant effect on most studied traits. The effect of spraying was 50 mg/l is more pronounced in increasing vegetative growth rates and leaf content than chlorophyll.

Abbas and Ibrahim reported [14] that the growth regulator SA was sprayed on *Niggella sativa* L. at several levels (50, 100, and 200) mg/l with significant effect on the studied traits. And 200 mg/l. Spraying at a concentration of 50 mg/l was the best in increasing growth, yield, and oil ratio indices.

Al-Mohammadi and Al-Rawi also [15] observed a study on the effect of spraying on some of the growth catalysts on *Datura stramonium* L. The spraying with acetylsalicylic acid at 200 ppm gave the highest rate of all vegetative and studied traits (plant height, dry and vegetative content of the leaves, nitrogen and potassium, number of fruits, plant and the total yield kg/hectare) compared to non-treated plants.

3. Effect of salicylic acid in qualitative and medical qualities

The significant phylogenetic effects reflected by the salicylic acid act towards the growth and development of the plant and the improvement of its health made it a popular vehicle for those interested in agricultural production. This has already been shown to improve the qualities of many plants that occupy a high economic position. It also activates the roles of many enzymes and also has an important action towards syphilis and the bio-synthesis of ethylene gas (the maturation hormone and aging) and the movement of stomata and contributes to plant metabolism and transfer of ions [16, 17].

Through research and studies on the effect of salicylic acid treatment on the specific qualities of plants, Gharib [18] noted that the spray of the basil plants *Ocimum basilicum* L. and the *Majorana hortensi* L. were planted in a 40 cm pot with three concentrations of salicylic acid [10^{-3}, 10^{-4}, 10^{-5}] mole resulted in a significant increase in the ratio of the active ingredient of both plants compared to the comparison treatment. The spraying of two varieties of *Cymbopogon flexuous* L. with a concentration of 5–10 m of salicylic acid developing in the plants gave a significant increase in the specific qualities and active substances of plants and antioxidants compared to non-treated plants [19].

Khandaker et al. showed [20] that spray of red *Amaranthus tricolor* L. plants with three concentrations of salicylic acid (10^{-3}, 10^{-4}, and 10^{-5} mm) had the most significant effect on plant active compounds compared to untreated plants and significant increase in properties (total phenols, antioxidant, and plant pigments). Salicylic acid spraying with concentrations (25 and 50 mg/l) on the vegetative group of *Cumin cyminum L.* resulted in a significant increase in the percentage of plant pigments at a concentration of 50 mg/l compared to comparison plants [21].

The addition of salicylic acid with three concentrations (30, 60, and 90 mg/l) resulted in a significant increase in the production of some plant antioxidants from blackwheat leaves when treated with concentrations of 60 and 90 mg/l compared with non-treated plants [22].

Majoul showed [23] a significant increase in the percentage of nutrients P, N, and the leaf content of chlorophyll when spraying the okra plants were measured at two levels of salicylic acid (78 and 155 mg/l) and in two steps compared to the comparison treatment.

The medicinal seeds of the *Digitalis trojanaivanina* collected from the Turkish Aida mountains with three concentrations of salicylic acid resulted in significant superiority in the studied active substances (pigment content, total phenols, phenols, and flavonoids) compared to non-treated plants [24].

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