Effect of salicylic acid on growth and yield under abiotic stress: An overview

Rajan Saini and Anaytullah Siddique

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Abstract

Biotic and abiotic stresses are the major constraint to limit the production of crops in agriculture. Biotic stress includes attack of insect, pest, bacteria, virus and fungus while extreme and low temperature, drought, flood, salinity and heavy metal stress are the major cause of abiotic stress. The reduction in the performance of plant growth was started from the negative effect of chlorophyll synthesis or degradation under wide range of environmental stress. The generation of harmful free radicals or reactive oxygen species (ROS) like O₂, H₂O₂ and OH. Salicylic acid (SA) improves plant growth and development by improving rate of photosynthesis by protecting the damage of chloroplast, protein and DNA against the wide range of environmental stress including both biotic and abiotic stress. Application of SA also accelerate the production of osmolyte like proline and antioxidant enzymes like CAT, POD, SOD that help to scavenge free radicals safely from the cell.

Keywords: Catalase, heat stress, peroxidase, SOD, salicylic acid, salinity, water stress

Introduction

Biotic and abiotic stresses are very dangerous constraints to limit the production of crops around the word. Biotic stress caused by the attack of insect, pest, fungus, bacteria and virus on the plant while the cause of abiotic stress is heat, cold, drought, salt, flood and heavy metals etc. To avoid such a drastic situation from the field of cultivated land, it is an urgent need to develop either stress tolerance genotypes for specific type of environmental stress or manage / manipulate the adverse situation to cope up with availing situation (Khan et al., 2013b; 2014; Nazar et al., 2015; Fayed and Bazaid, 2014 and Jini and Joseph, 2017) [11, 10, 16, 6, 9]. Hence the production of harmful radicles dissipates safely during the growth and development of plants. There are many chemical compounds, enzymes and hormones are endogenous present inside the plant that may help to ameliorate the adverse situation like Proline, mannitol, sorbitol, salicylic acid, catalase (CAT), peroxidase (POD), and superoxide dismutase (SOD) (Khan et al., 2012 b and Farooq et al., 2009) [12, 5]. Salicylic acid (SA) is a member of phenolic group compound produce automatically inside of the plant that helps to modify physiological, biochemical and molecular events like Photosynthesis, chlorophyll, nitrogen, protein, proline content, SOD, CAT and POD in favour of plants under diverse stress condition both biotic and abiotic situation (Miura and Tada, 2014 and Khan et al., 2013b) [11]. The exogenous application of salicylic acid as seed priming or foliar application is also very effective in same mode of action at each and every stage of plant life from seed germination to the harvesting of crop. Even though the concentration of SA is also having both positive and negative roles against the environmental conditions (Csiszár et al., 2014; Saruhan et al., 2012 and Awate and Gaikwad, 2014) [4, 19, 2].

Role of SA on seed germination, seedling growth and yield under stress condition

Seed germination is one the dynamics phase of plant life and on it’s the performance of crop depends. Whereas during this period the morphological, physiological and biochemical changes occurs frequently due to diverse environmental situation. However, the roles of different growth regulator are well known for seed germination like gibberellic acid (GA3), Auxin, ABA, cytokinin and Ethylene (Vishal and Kumar, 2018) [23]. The salicylic acid is one of the members of phenolic group compound having the ability to accelerate or maintain pace of seed germination under adverse environmental stress like salinity and drought stress
Effect of SA on rate of photosynthesis

As a signaling molecule, salicylic acid (SA) plays a fruitful role on the rate of photosynthesis. It is reported in many crop like wheat and mustard that SA have positive effect on increasing the concentration of total chlorophyll and the ratio of chlorophyll a and b results accelerated rate of photosynthesis. Furthermore, the activity of important enzymes PEPC and Rubisco responsible for the photosynthetic process elevated by the exogenous application of salicylic acid including the the photosynthetic apparatus including PSI, PSII and D1 protein (Qui et al., 2011 and Krantev et al. 2008) [13].

ROS and production site: Free radicles like 1O2, H2O2, and *OH are the member of reactive oxygen species (ROS) that produced in both the conditions stress and unstressed condition at various sites like chloroplast, mitochondria, cell wall, peroxisome and ER. Within the chloroplast and mitochondria the major site of ROS production is PSI and PSII and ETC. The defense system of a cell needs at least equilibrium regarding the generation and scavenging of reactive oxygen species for normal cellular function. Enhanced concentrations of ROS lead to degrade lipid, protein and Deoxyribonucleic acid results production of free radicles while the antioxidative enzymes help to break these free radicles in to safe molecules like H2O2 in to water and oxygen by catalase enzyme (Krieger-Liszkay, 2005; Starkov, 2008 and Lobo et al., 2010) [14, 22, 15].

Conclusion

Salicylic acid is considered a member of phenolic group compound and act as a anti biotic and abiotic stress growth hormone. It is effective in both the form seed priming and foliar application while the concentration of its use is a crucial to obtain desirable results. It also helps to protect the plant by using the network of antioxidant enzymes like catalase, peroxidase, ascorbate and SOD results better performance of plant under wide range of environmental stress.

References

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