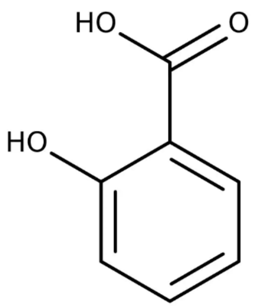




Salicylic acid and abiotic stress: nature of interaction



Cd

NaCl

$ZnSO_4$

Chilling

Drought

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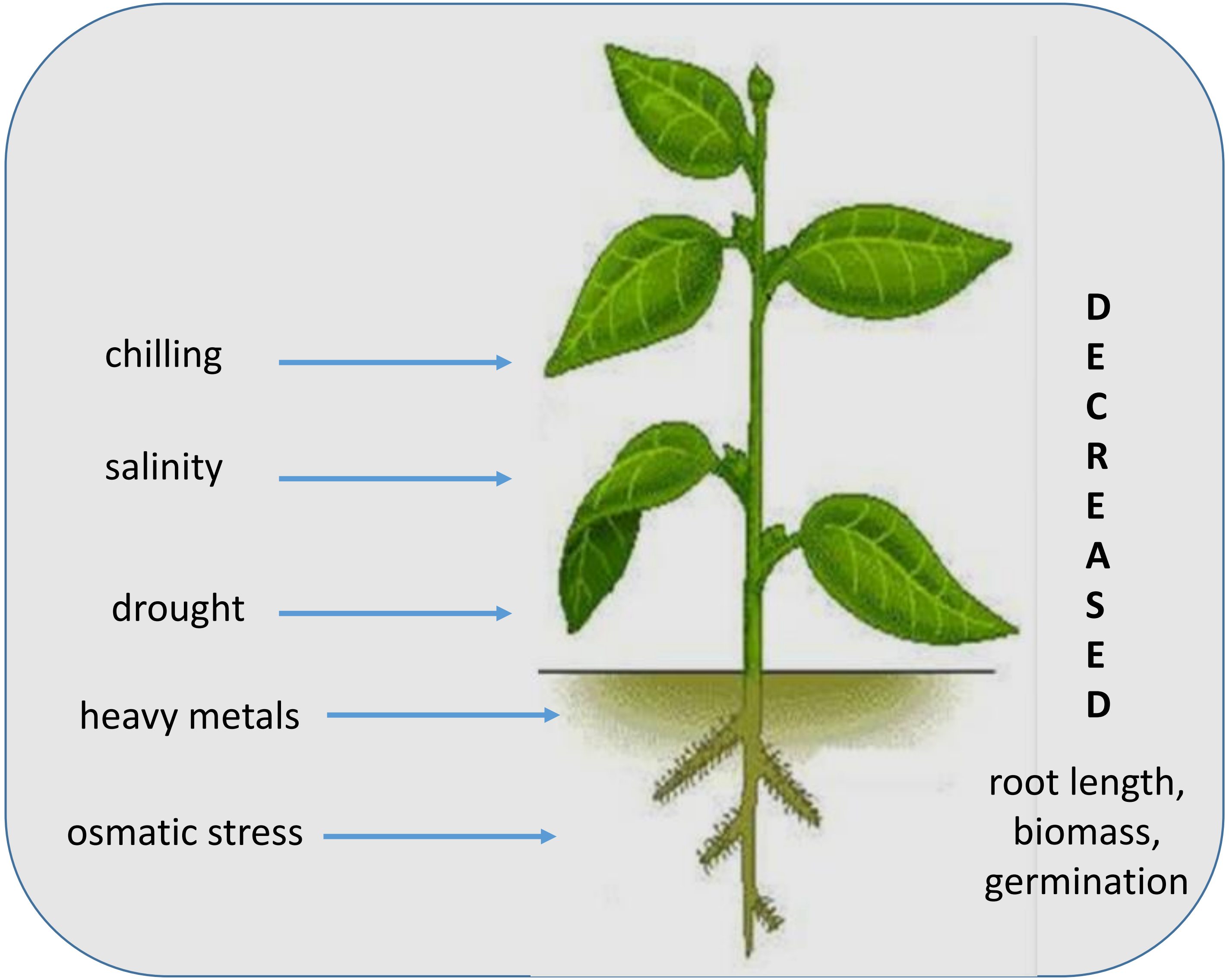
Motivation and Aim

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 (chilling, salinity, drought, heavy metals), and retrieve the conditions, which facilitate protective effects of SA.

Methods and Algorithms:

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

Three key results

I. SA can restore root length and biomass suppressed by salt, drought, cold, nickel, cadmium, arsenium, zinc, lead, chromium and aluminium stresses

Abiotic stress

D E C R E A S E D

root length, biomass, germination

SA treatment

R E C O V E R E D

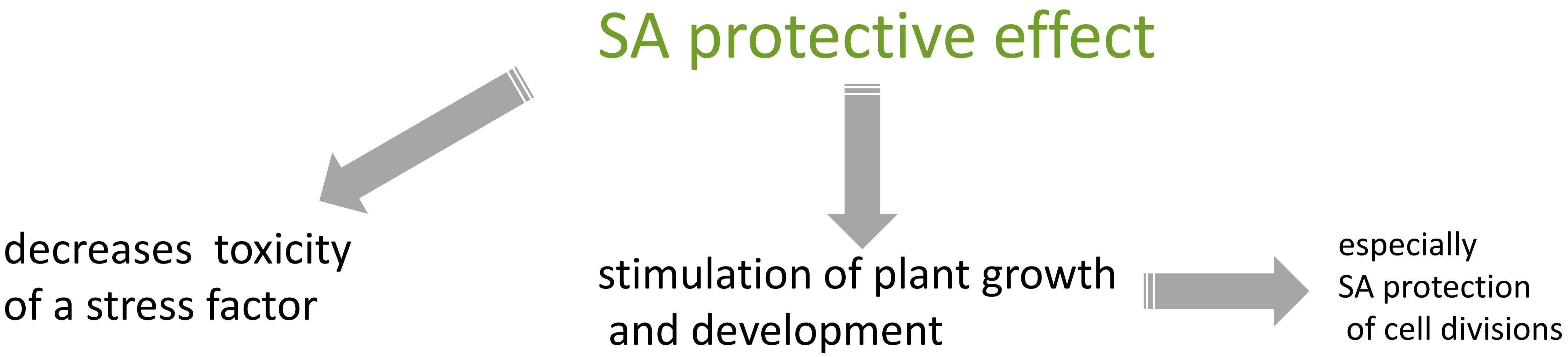
root length, biomass, germination

excerpt from the table in publication [3]

	Abiotic stress			Abiotic stress & SA treatment		
Species	Abiotic stress factor	Germination	PR lenght	SA treatment parameters	Germination	PR lenght
Triticum aestivum L.	NaCl 50 240 h	decreased	decreased	10 µM 6 h	recovered	recovered
Nigella sativa L.	3 bar Osmotic stress (PEG 6000)	decreased	decreased	200 µM 12h	increased	increased
Nigella sativa L.	3 bar Osmotic stress (PEG 6000)	decreased	decreased	500 µM 12h	recovered	recovered
Nigella sativa L.	6 bar Osmotic stress (PEG 6000)	decreased	decreased	200 - 500 µM 12h	partly recovered	partly recovered
Brassica napus L.	40-100 mM NaCl for 56 days in perlite		decreased	1 mM 56 d		partly recovered
Silybum marianum L.	40 mM NaCl for 14 days		decreased	500 µM 6h		recovered
Silybum marianum L.	80 mM NaCl for 14 days		decreased	500 µM 6h		partly recovered
Cassia tora L.	10 µM Al 24h			5 µM 24h		partly recovered
Zea mays L.	NACl 1-2% 14 days	decreased		1 - 2 mM		recovered

II. The effective SA concentration depends on the plant species and the stress type.

III. 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, 5, 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.

References

1. Zhang Y. et al. Salicylic acid: Biosynthesis, perception, and contributions to plant immunity. *Curr. Opin. Plant Biol.* 2019;50:29–36.
2. Rivas-San Vicente M. et al. Salicylic acid beyond defence: Its role in plant growth and development. *J. Exp. Bot.* 2011;62:3321–3338.
3. Bagautdinova Z. et al. Salicylic Acid in Root Growth and Development. *Int. J. Mol. Sci.* 2022;23(4):2228.
4. Zadehbagheri M. Salicylic acid priming in corn (Zea mays L. var. Sc. 704) Reinforces NaCl tolerance at germination and the seedling growth stage. *Int J Biosci.* 2014;4:187-197.
5. Alyemeni M. et al. Effect of salicylic acid on the growth, photosynthetic efficiency and enzyme activities of leguminous plant under cadmium stress. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca.* 2014;42(2):440-445.
6. Espanany A. & Fallah S. Seed germination of dill (Anethum graveolens L.) in response to salicylic acid and halopriming under cadmium stress. *Iranian Journal of Plant Physiology*.2016;6(3):1701-1713.

Thank you for your attention