VEGETATIVE PARAMETERS AND MINERAL COMPONENTS OF SALT-SENSITIVE STRAWBERRY EXPOSED TO COMBINED SALT STRESS AND CADMIUM CONTAMINATION

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Introduction

Strawberry is one of the most cultivated crops in irrigated horticulture where hydro/land resources during last decades are becoming limiting factors of production due to excessive salinization and/or contamination (by metals/nutrients/persistent organics). Salinity induces different physiological disorders in crops known as salt stress, whereas consummation of crops cultivated on metal contaminated land resources represents one of the most dominant transmission routs of many potentially toxic metals in the human food chain (Ondrasek and Rengel, 2012 and references therein). Also, an interaction of salinity (salt stress) and metal (Cd) contamination might further compromise nutritional status and crop yield (e.g. Ondrasek, 2013 and references therein) as was examined in this study.

Methods

A greenhouse pot trail was carried out to investigate the response of strawberry (*Fragaria ananassa* Duch., cv *Elsanta*) exposed to increasing NaCl salinity and Cd contamination in the rhizosphere. The effect of a factorial combination of four NaCl (0-60 m*M*) and three Cd application rates (0.3-10 mg kg^{-1}) on mineral accumulation and distribution in plant as well as vegetative parameters was assessed.

Results

After 68 days of growth, NaCl salt stress decreased total fresh fruit yield (up to 60%), total number of fruits (up to 45%), fruit size, number of runners (up to 90%) and the length of the longest runner (1.3-2.6 times), and was accompanied by accelerated leaf senescence and plant mortality (at >40 m*M* NaCl) (Fig. 1).

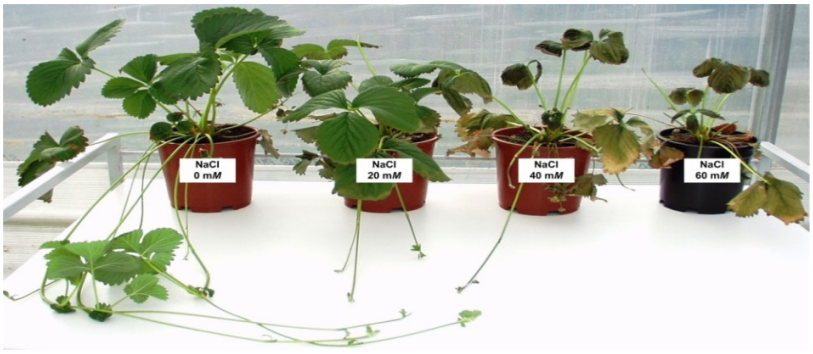

Figure 1. Strawberry plants 68 days after commencement of NaCl treatment (0-60 m*M*)

NaCl application increased uptake and accumulation of Na, Cl, Cd, Zn and Cu (in leaves and fruits) but decreased these parameters for K (in leaves and fruits) and Ca and Mg (in leaves) (Table 1). The soil contamination by Cd progressively increased Cd and decreased Cu and Zn concentration in analyzed tissues, whereas Cd contamination had no effect on most other measured parameters (Table 1).

Table 1. Mineral composition in strawberry tissues

Tissue	Treatment	Cl	Na	Ca	Mg	Cd	Zn	Cu
		g kg^{-1}				mg kg^{-1}		
Leaves	$NaCl_0$	3.0a	0.12a	13.6a	4.4a	0.70a	30.4a	4.20a
	$NaCl_{20}$	23.2b	2.4b	12.8a	4.3a	1.02b	31.8a	4.60a
	$NaCl_{40}$	30.4c	4.7c	11.8b	4.2a	1.04b	36.1b	9.18b
	$NaCl_{60}$	39.3d	10.2d	11.7b	3.1b	1.05b	43.8c	13.70c
	Cd_0	23.1a	5.0a	13.8a	4.4a	0.2a	37.4a	10.3a
	Cd_5	22.7a	4.5a	11.5b	3.9b	1.2b	31.0b	8.70b
	Cd_{10}	22.0a	4.5a	12.1b	3.9b	1.7c	30.7b	4.70c
	NaClxCd	n.s.	n.s.	n.s.	n.s.	*	n.s.	n.s
Fruits	$NaCl_0$	3.3a	0.2a	1.5a	1.3a	0.59a	16.4a	3.13a
	$NaCl_{20}$	7.8b	2.0b	1.7a	1.4a	0.92b	20.9b	3.53a
	$NaCl_{40}$	12.1c	3.0b	1.7a	1.4a	0.95b	22.3b	4.10b
	$NaCl_{60}$	21.2d	7.0c	1.9a	1.5a	1.32c	26.6c	5.93c
	Cd_0	12.5a	3.3a	2.0a	1.5a	0.17a	23.8a	4.53a
	Cd_5	11.5a	2.8a	1.7a	1.4a	1.00b	20.5b	3.92b
	Cd_{10}	12.0a	3.1a	1.7a	1.4a	1.67c	20.4b	4.05b
	NaClxCd	n.s.	n.s.	n.s.	n.s.	*	n.s.	n.s.

*Means with the same letter in the columns are not significantly different, P≤0.05; *significant interaction of applied NaCl and Cd treatments, P≥0.05*

Conclusion

The results confirmed that strawberry is one of the most salt-sensitive horticultural species whose vegetative growth and mineral composition can be severely compromised even under moderate rhizosphere salinity (20 m*M* NaCl). Cd contamination significantly enhanced its accumulation and reduced Cu/Zn concentration in leaves/fruits, indicating strawberry as crop with relatively high potential to take up and transport Cd from roots to leaves/fruits, and/or to translocate Cd via phloem from leaves to fruits.

References

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