Physiology of Salinity Stress in Almond

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INTRODUCTION

Salinity is a serious concern in all almond-producing regions of California and will become a greater problem as availability and quality of irrigation water is reduced.

Objectives of the project:

- Study the salinity tolerance of important rootstocks and cultivars by monitoring growth, toxicity symptoms and tissue salt levels
- Elucidate the physiological mecahnisms of salinity tolerance in almond
- Understand the relative importance of specific ion toxicities
- Evalute the effectiveness of in-season recovery treatments for salinity management
- Understand the effects of non-uniform salinity on water and mineral uptake of almond

First-season results demonstrated the presence of a wide variation in salinity tolerance among rootstocks and cultivars and provided important physiological clues.

Selected second-season results are shown below.

EXPERIMENTS

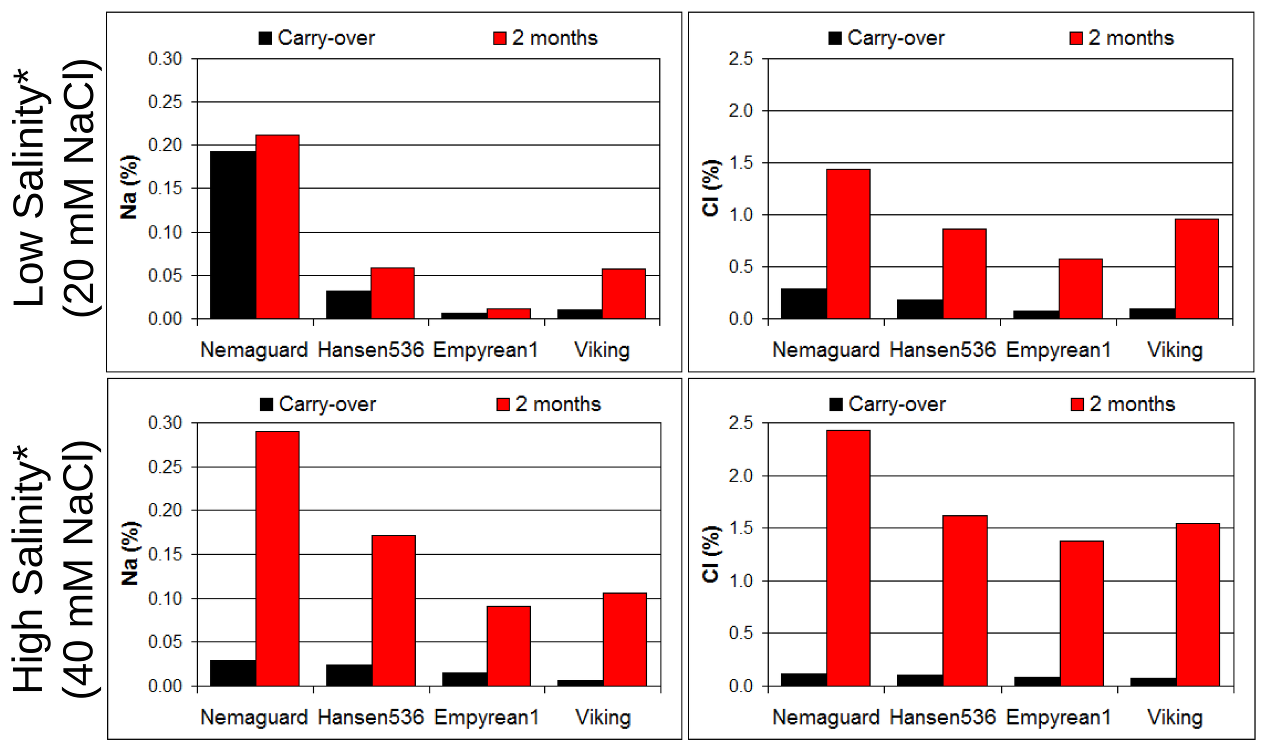
Main experiments (2014 & 2015) on grafted trees grown outdoors in 7-gal pots: rootstock exp., cultivar exp., double-grafting exp.

Recovery experiment (2015) on grafted trees grown outdoors in 2.5–gal pots

Split-root experiment (2015) on non-grafted rootstocks grown hydroponically in greenhouse

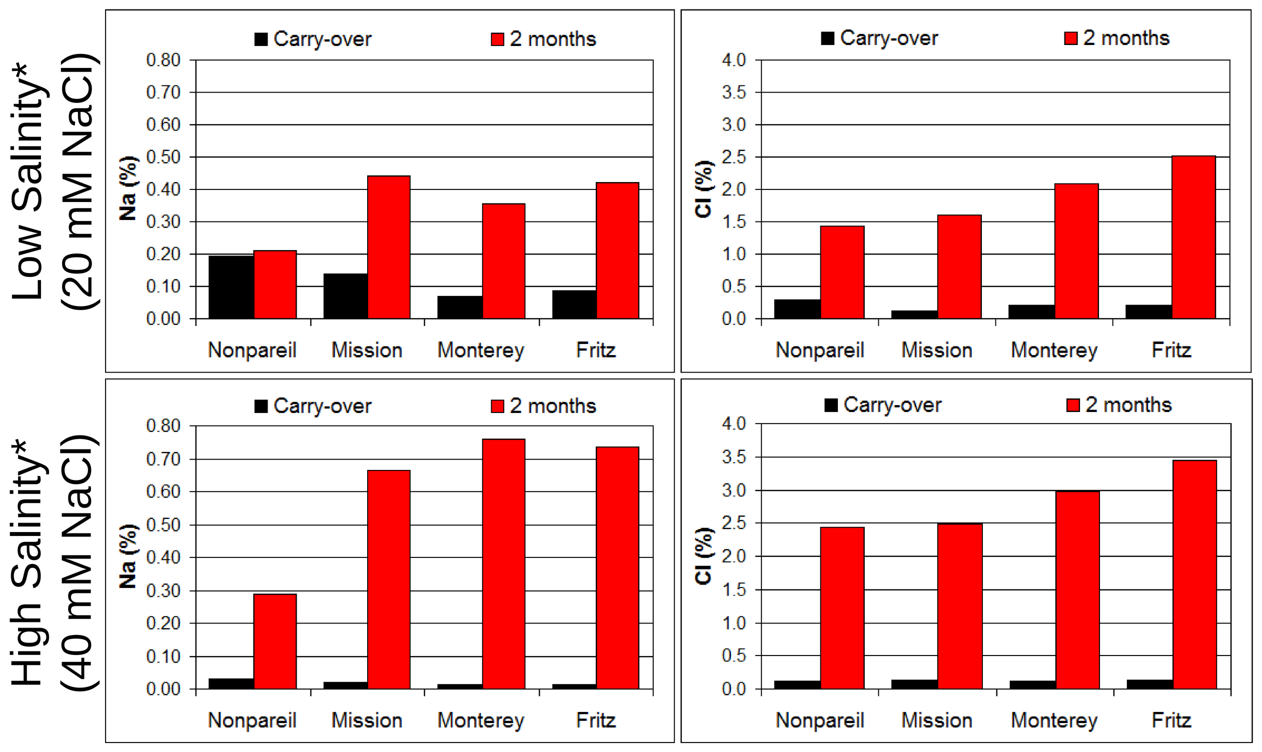
RESULTS

Rootstock effect on the leaf Na and Cl concentrations of Nonpareil in the 2nd season:



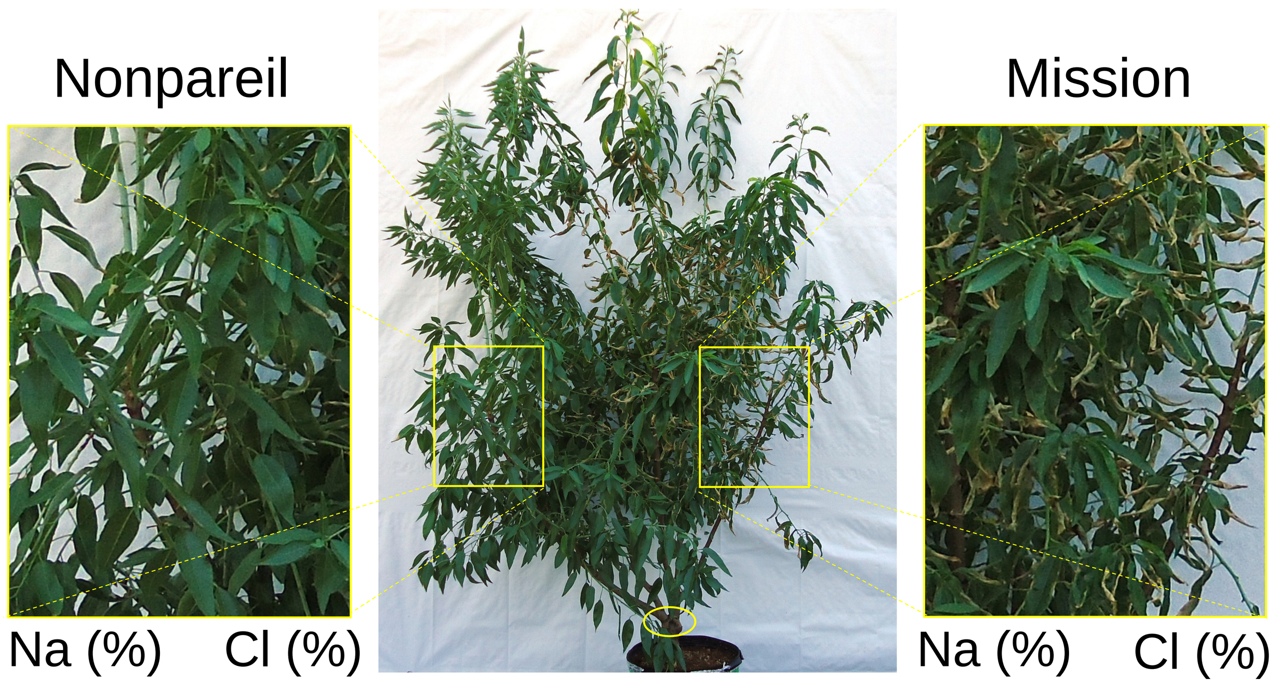
* High-salinity trees received a recovery treatment at the end of the 1st season while low-salinity trees did not.

Leaf Na and Cl concentrations of different cultivars grafted on Nemaguard in the 2nd season:



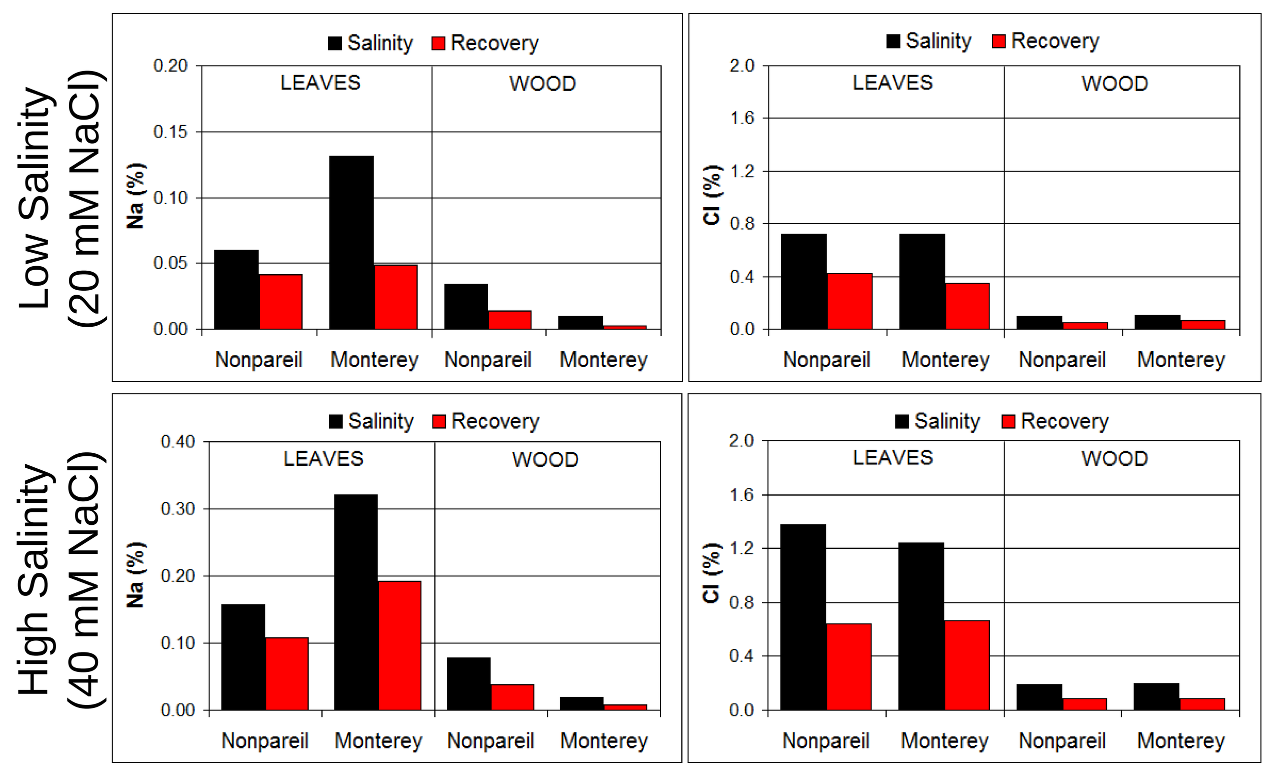
* High-salinity trees received a recovery treatment at the end of the 1st season while low-salinity trees did not.

Ion toxicity (leaf-burn) symptoms and leaf Na and Cl levels of Nonpareil and Mission scions double-grafted on Nemaguard:

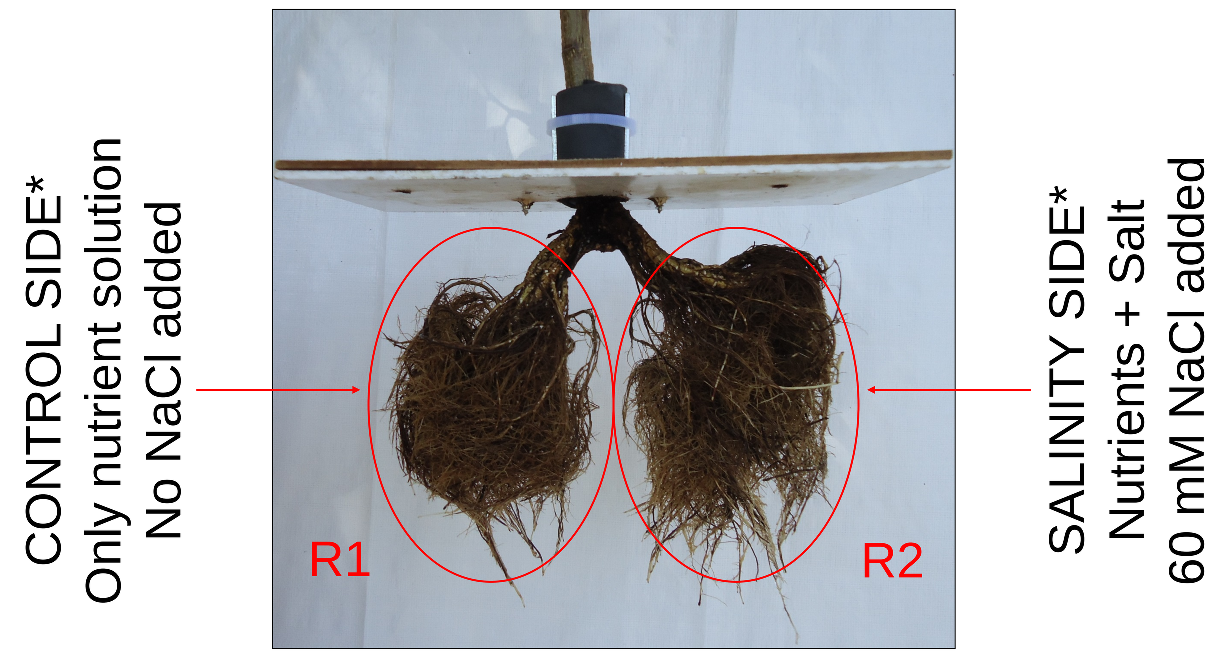


Nonpareil Na (%)	Nonpareil Cl (%)		Mission Na (%)	Mission Cl (%)
0.72	3.01	----------Leaves----------	1.70	3.92
0.25	0.47	----------Bark----------	0.02	0.41
0.10	0.04	----------Xylem----------	0.02	0.04

Recovery treatment with high-quality water significantly reduces leaf and wood Na and Cl levels of Nonpareil and Monterey cultivars on Nemaguard.

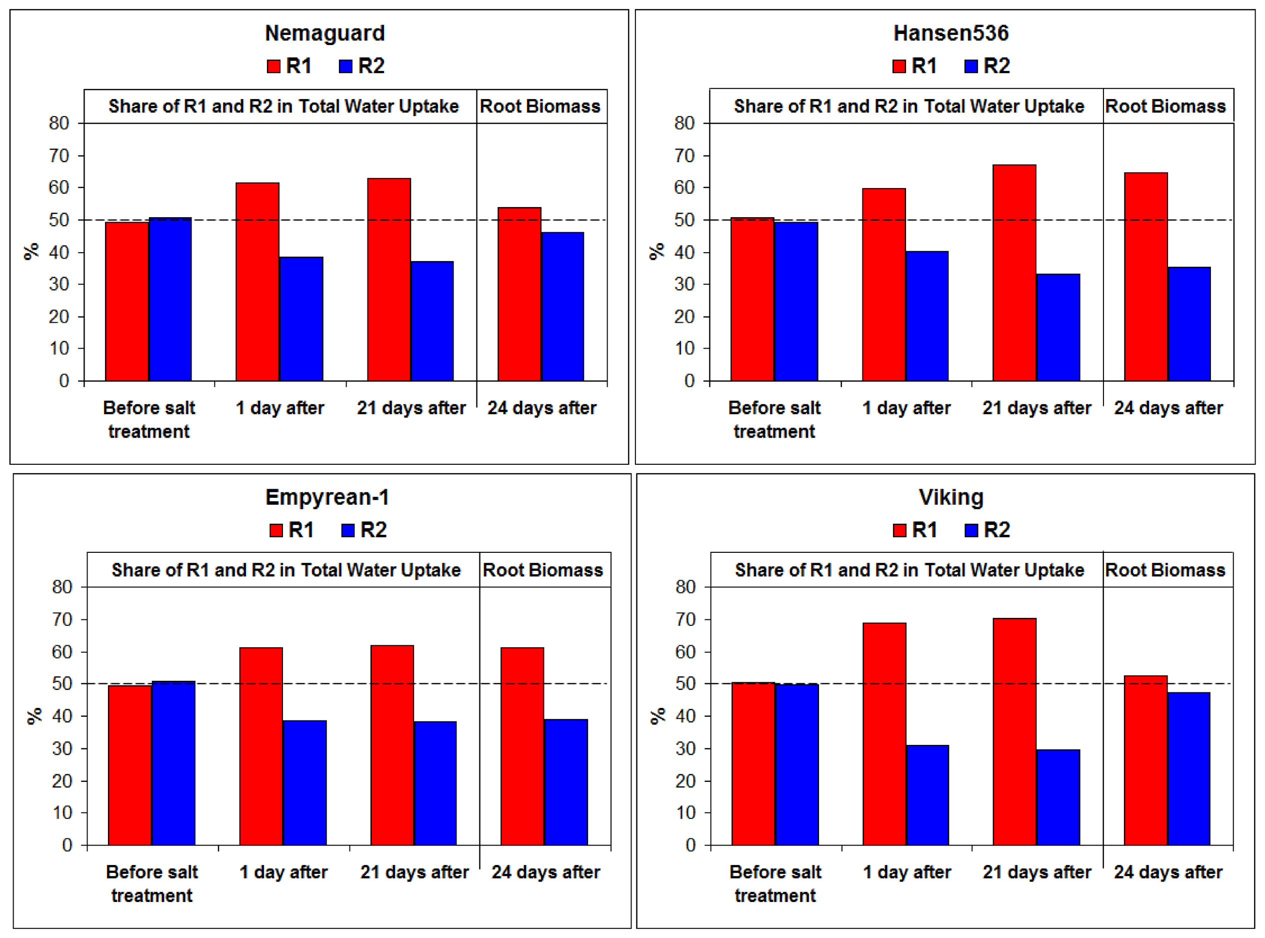


In the split-root experiment, rooted rootstock cuttings (non-grafted) were grown hydroponically under control conditions, uniform salinity and non-uniform salinity.



* Non-uniform salinity treatment. Photo was taken before starting the treatment.

Water consumption and final dry biomass percentages of the two root halves (R1 and R2) under non-uniform salinity:



CONCLUSION

- Rootstocks in order of decreasing leaf Na and Cl concentrations: Nemaguard> Hansen536 > Empyrean-1≈ Viking
- Nonpareil is the best one in excluding Na from leaves.
- Na allocation to woody tissues plays a critical role in Na exclusion from leaves.
- Nonpareil and Mission are the best cultivars with respect to leaf Cl accumulation.
- In-season recovery treatment effectively reduces leaf and wood Na and Cl concentrations.
- Under non-uniform salinity, all rootstocks preferentially absorb water from the less-saline side.