Deciphering salinity resistance in *Amaranthus cruentus* in relation to its nutritional value: a bright future for an old plant.

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1. INTRODUCTION

Soil salinity is a concerning issue, especially in (semi-)arid areas. Major crops are usually unable to tolerate salt stress. In a context of an increasing food demand, it is urgent to find plants able to produce appreciable yields on salt-contaminated soils.

Several **amaranths** (*Amaranthus* spp.) are cultivated for leaves or grain production, mainly in tropical regions and/or highlands. Both organs are highly nutritive. Moreover, their good tolerance to several biotic and abiotic stresses is recognized.

2. OBJECTIVES

- ❑ Comparing the **salt tolerance** of several *A. cruentus* cultivars.
- ❑ Deciphering the **physiological mechanisms** involved in the salt tolerance of *A. cruentus*.
- ❑ Assessing the impacts of a salt stress on the **nutritional quality** of leaves and seeds.
- ❑ Prospecting the possibility of **using a single cultivar for both leaves and grain production**.

3. MATERIALS & METHODS

- ❑ **Four cultivars** of *A. cruentus*
- ❑ Salt stress : **75 mM NaCl** (irrigation).
- ❑ In tropical greenhouses.
- ❑ **Growth**, **phenology** & **yield** monitoring.
- ❑ **Physiology**: gas exchange, chlorophyll fluorescence, hydric/osmotic potential.
- ❑ Content in various **metabolites**: stress markers, antioxidants, nutrients in leaves and seeds.

4a. RESULTS – Yield and metabolism

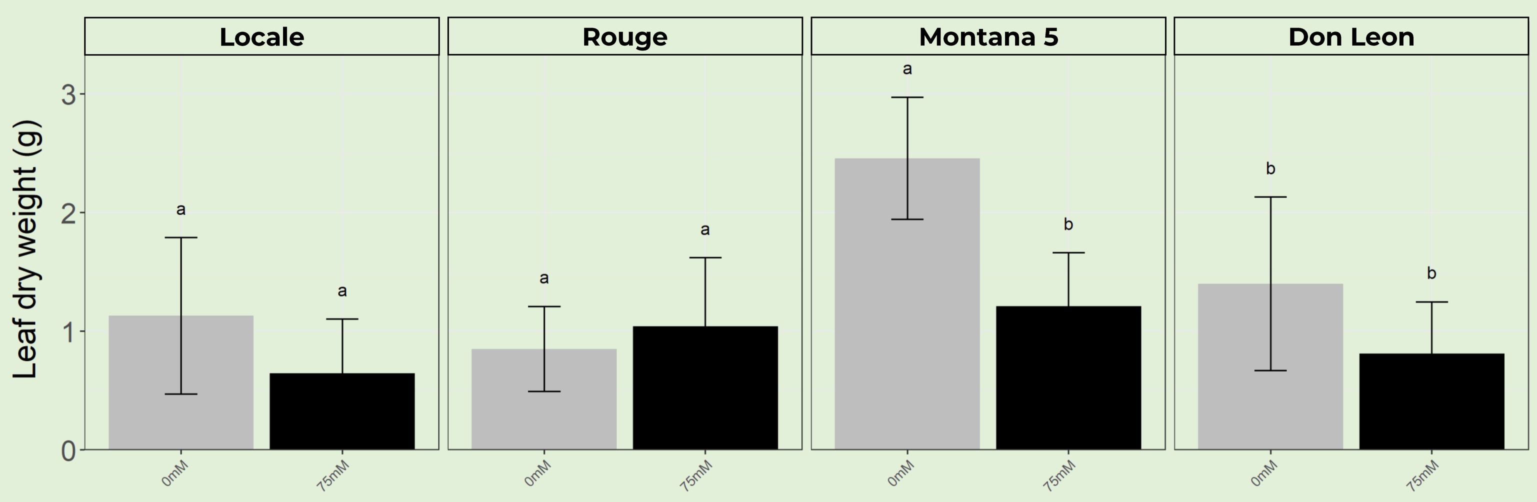

Figure 1. **Leaf biomass** after 50 days of growth. Values with different letters are significantly different (LSD[1], α < 0.05).

[1]Least significant difference test

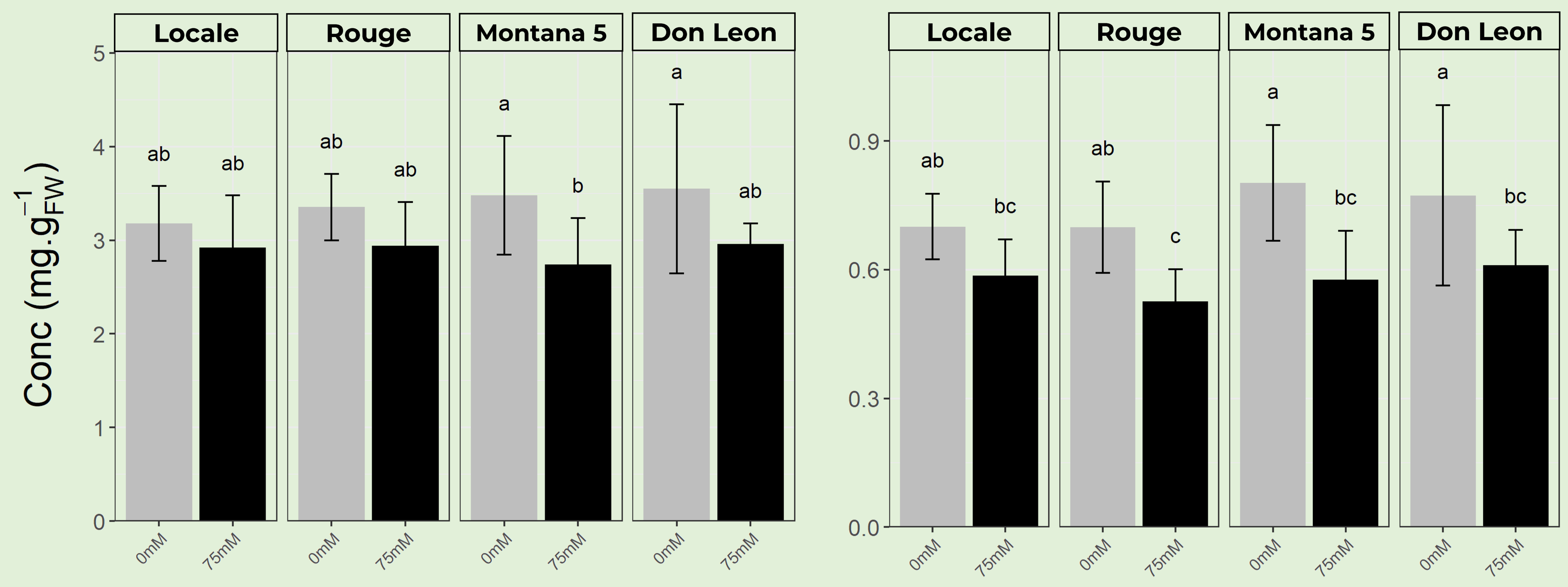

Figure 2. **Total soluble carbohydrates** (a) and **total polyphenols** (b) content in leaves harvested after 50 days of growth. Values with different letters are significantly different (least significant difference test, α = 0.05).

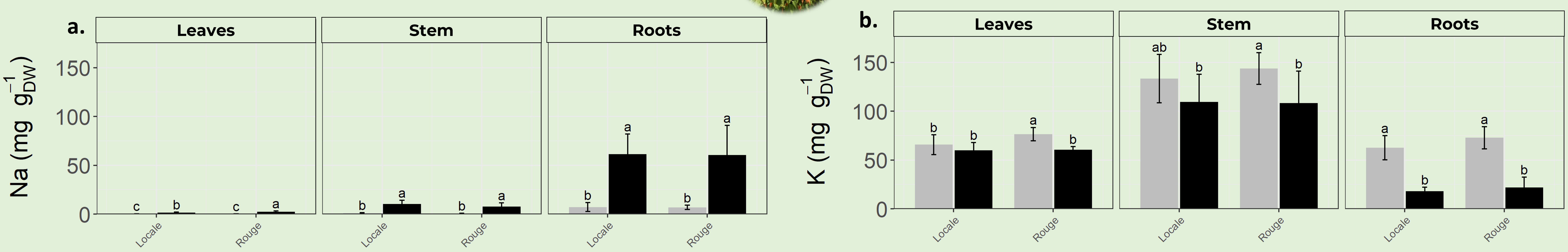

Figure 3. Content in **sodium** (a) and **potassium** (b) in leaves, stems and roots of *A. cruentus* plants harvested after 50 days. Values with different letters are significantly different (LSD α < 0.05).

Leaf production at the vegetative stage was hardly affected by the salt stress, whereas seed yield strongly decreased. Salt caused a delay of flowering, especially in cultivar *Rouge*. Sodium accumulates mainly in roots, whereas its concentration is much lower in stems and nearly absent from leaves. Potassium content negatively correlates with Na content in all organs.

Phenolics and carbohydrates were not significantly affected by salt stress, except in Montana 5 (decrease in total polyphenols and soluble carbohydrates), the most sensitive cultivar and Rouge for total polyphenols.

4b. RESULTS – Photosynthesis

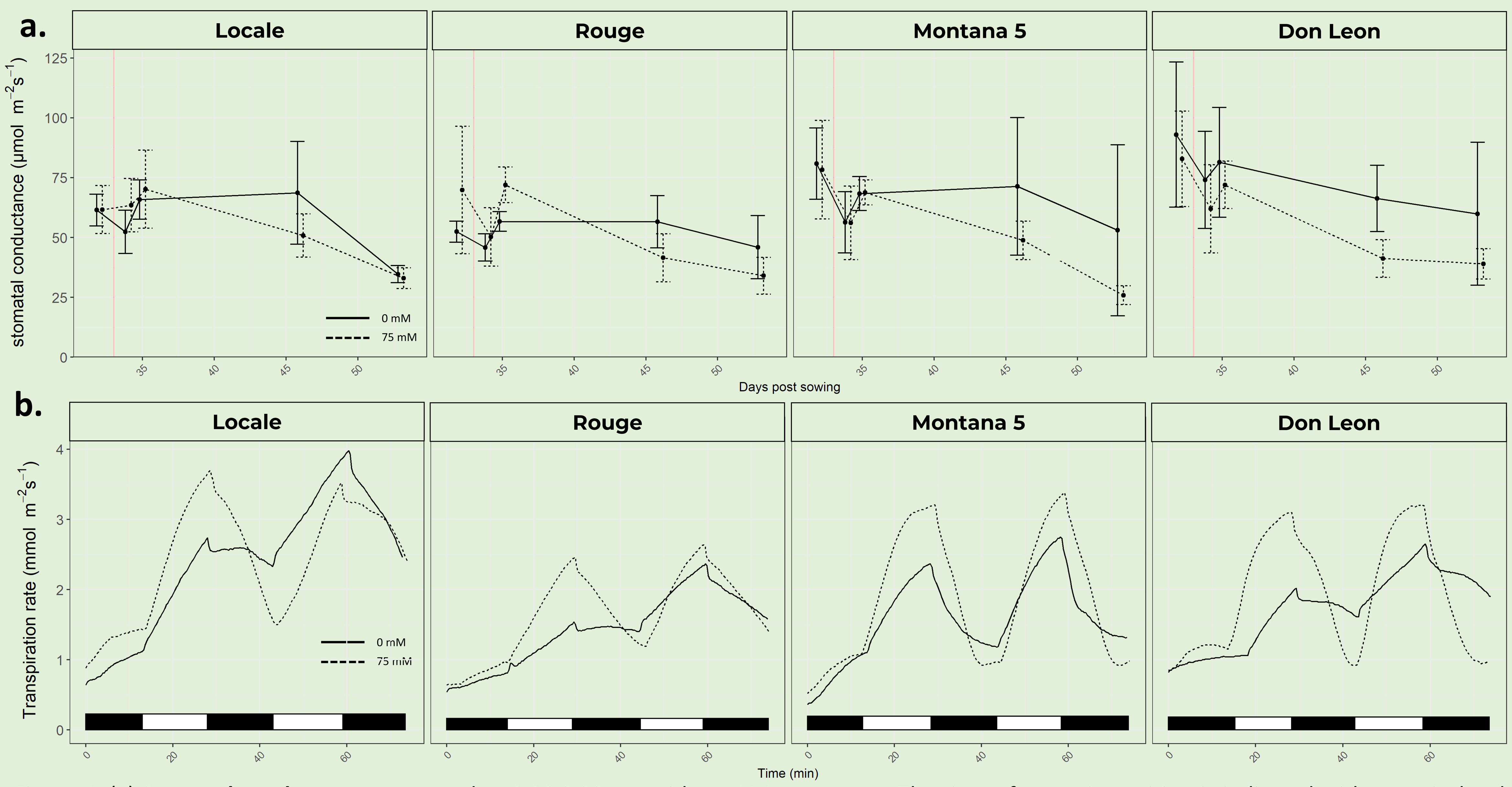

Figure 4. (a) **Stomatal conductance** measured at 8.30-9.30 am with an AP4 porometer. The time of stress imposition is indicated with a vertical red line. (b) Evolution of the **transpiration rate** with varying light intensities, alternating between 15' periods of 100 (black) and 1000 (white) µmol m^{-2}s^{-1}.

Stomatal conductance decreases with the salt, but stomatas close faster and stronger in response to low light intensity in conditions of salt stress compared to controls. These results highlight a mechanism of transpiration regulation –and therefore of water saving – in response to the stress.

4. DISCUSSION & CONCLUSION

- ❑ These results reveal that *Amaranthus cruentus* is a **promising crop for leaf production** on moderately saline soils, but grain production is compromised.
- ❑ An **efficient compartimentalization** of Na in roots and, to a lesser extent in stems, therefore exclusion from leaves could be a tolerance strategy for protecting the photosynthetic machinery.
- ❑ Nutritional quality of leaves slightly decreased. → Other **nutrients** should be investigated in both leaves and seeds : amino acid profile, lipids, etc.
- ❑ **Proteomics** and **metabolomics** analyses will be conducted to understand how the four cultivars are affected at the metabolic level.
- ❑ **Field trials** will be carried out in Benin.

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