Differences in morphology, physiology and biomass between African baobabs from Malian provenances under salt stress

Universiteit Antwerpen

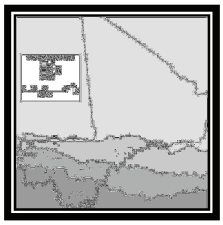
Shadi Jafari, Roeland Samson

INTRODUCTION

The African baobab (*Adansonia digitata L.*) is a widely used multipurpose tree species, growing in the dry regions of tropical Africa. Any part of the tree provides many benefits to people. Salt is one of the most important problems for good crops and productivity in dry countries. This is made even worse by inappropriate use of saline irrigation water, especially in dry areas. For this study Baobab seedlings were investigated on growth, physiological behavior on baobab seedlings from 3 provenances under varying levels of salt stress. This was done in 2 phases.

Fig. 1. Baobab tree

Fig. 2. Map of Mali



OBJECTIVES

- To consider the issue of salinity on growth and examine the development of African baobab seedlings in order to classify the *A. Digitata. L* them in terms of salt tolerance.
- To investigate the link between morphology response to photosynthesis for the provenance which has shown high tolerance to salt stress during the 1st phase.
- Determine the extent to which the various mechanisms are important for the adaptation of baobab seedlings to their saline habits.

Fig. 3. Baobab 4 months old seedlings at the greenhouse

Fig. 5. One of the highest baobab seedling from control treatment

MATERIALS AND METHODS

Study site

- Baobab seedlings were sampled from three contrasting Malian provenances seedlings (western, southern and northern) have been studied during 1st phase and 1 study site was selected for 2nd phase related to difference of IWC.IWC-O of the soil characteristics from those provenances.
- Seeds of similar weight were grown in pots with river sand in the greenhouse of Antwerp (Belgium/51° 00' N, 3° 50' E) at a temperature ranging from (22 ◦C at night to 35 ◦C day, maintaining the air humidity at 40% to 60%). Thousand seedlings during 1st phase, 120 seedlings during 2nd phase.
- Salt- treated seedlings were watered until 2 months old with 20 and 40 mM NaCl supplemented by the nutrient solution for ten weeks, seedlings under the control condition were irrigated with tap water and nutrient solution only.
- Some physiology measurements have been done during 2nd phase such as gas exchange, leaf hyperspectral reflectance and chlorophyll fluorescence.

RESULTS

- Morphological responses of baobab seedlings of western Mali indicated a significantly higher resistance to salt stress compared to other Malian provenances.
- The dynamic change in leaf reflectance showed salt caused increasing the leaf spectral reflectance in (700-1300 nm and, 1300-2500 nm). Plants treated with salinity exhibited 59% drop in Pn and 79% stomatal conductance compared to control.
- Chlorophyll fluorescence responses were shown to be reduced by salinity

Fig. 5. Biomass allocation of 3 provenances at 40 mM NaCl

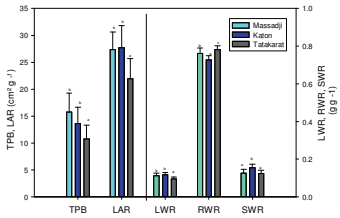
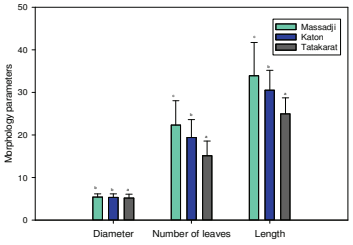


Fig. 6. Morphological parameters of 3 provenances at 40 mM NaCl



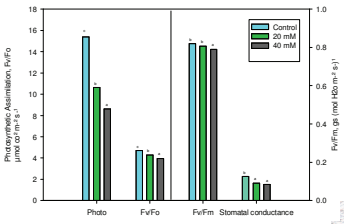


Fig. 7. Photosynthetic parameters in baobab seedlings under salt stress

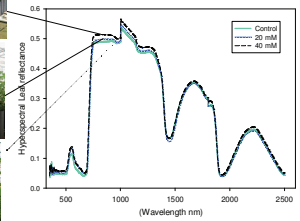


Fig. 8. Leaf hyperspectral reflectance of baobab seedlings under salinity

DISCUSSIONS

- Relative stress had a strong impact on growth, physiological characteristics and biomass allocation.
- Changes in growth by salinity affected spectral reflectance in range 400-2500nm and chlorophyll loss caused an increase of reflectance in visible range. Reduced gas exchange could also be linked to degradation of chlorophyll.
- Visible symptoms of leaf damage were linked to salt stress, the most affected were Tatakarat seedlings at a high salt level.

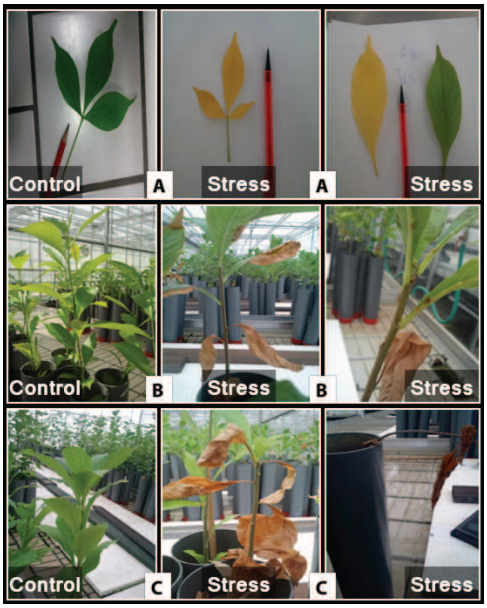


Fig. 10. (A) Leaf presented salinity-induced necrosis at 20 mM NaCl treatment. (B) Seedlings at 40 mM NaCl presented leaf and branch necrosis. (C) Seedlings at 40 mM NaCl showing leaf drop and necrosis after 30 days.

CONCLUSIONS

- The baobab can be considered a moderately salt sensitive species. It is capable of adapting to low levels of salt stress, however higher levels of salt stress significantly reduce growth, physiology and biomass characteristics.
- In order to maintain or further improve the cultivation of the baobab, measures have to taken in order to prevent further salinization of soil from damaging young seedlings.

Departement Bio-ingenieurswetenschappen, University Antwerpen, Groenenborgerlaan 171, 2020 Antwerpen

Contact roeland.samson@uantwerpen.be | shadi.jafari@student.ua.ac.be | shadi@baobab-science.com