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# PHYSIOLOGICAL BEHAVIOR OF THE TOMATO (*Lycopersicon esculentum* Mill.) ROOT SYSTEM CULTIVATED IN SANDY SOIL AMENDED WITH BENTONITE AT JUVENILE STAGE

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## Introduction

Since the beginning of the XX$^{th}$ century, the cultivated areas affected by salinity, particularly by the excessive content of mineral salts (NaCl), have increased substantially. Today, approximately 25 % of the irrigated lands in the arid and semi-arid regions in the tropical and Mediterranean areas (Levigneron *et al*., 1995) are affected by this constraint.

The saline elements accumulated in the soil, can limit or stop the growth of the plant. This inhibiting action is related primarily to the augmentation of the osmotic pressure of the soil's solution and with the increasing salt concentration.

Indeed, the presence of salts in the soil and their effects on the plant physiological mechanisms, is a major restrictive factor of the agricultural productivity. These soils are charged with high and abnormal soluble salt concentrations (Poljakoff-Mayber and Gale, 1975) and impose permanent stress on the plants (Gupta and Abrol, 1990), lower agricultural yield, limit the crop distribution and even threaten of extinction certain species (Chamard, 1993).

## Materials and Methods

The vegetable material used in this study included two varieties of processing tomato, Rio Grande and Imperial. Tomato seeds were sown in pots filled with two different types of substrates: sand and sand mixed with bentonite up to 1-cm depth. The sand was washed and rinsed with hydrochloric acid and distilled water before the experiment started.

The sand-bentonite mixture was made of 90 % sand and 10 % bentonite. The weight of pot was 1,000g, having in consequence 900g of sand and 100g of bentonite. Bendella (1994) describes the bentonite characteristics. This type of material is rich in total calcium, has very high water holding capacity and CEC but is poor in organic matter content and the pH is alkaline.

Our study was undertaken in natural climatic conditions with daily temperatures varying from 20-24°C and an oscillating relative humidity of 70-75 %. After germination, irrigation was started using nutritious solutions as described by Hoagland (1938). At 5 leaves stage, the irrigation with saline solution of $NaCl+CaCl_2$( 0, 100, 200 and 300 $meq.l^{-1}$ )

began. The Control pot is irrigated only with the nutritious solution. Two weeks after, samples are taken and analysed.

A quantification of the growth and hydric parameters was carried out on morphological description and hydric potential of roots (relative water content and the total water content).

## Results and Discussions

### Root morphology

The figures show that for the two varieties, the rooting system expres an important density significantly in the control pot, whereas differences appear under the other treatment conditions.

Indeed, photographs A and B announce that for the variety Rio Grande, cultivated on sandy substrate, the root density decreases with the increase of $NaCl+CaCl_2$ concentration. It should be noted that in this case, the plants treated with 100 $meq.l^{-1}$ of $NaCl+CaCl_2$ have a well localised rooting system in the first ten centimetres. The root's length does not seem to be affected by salinity for treatments 100 and 200 $meq.l^{-1}$.

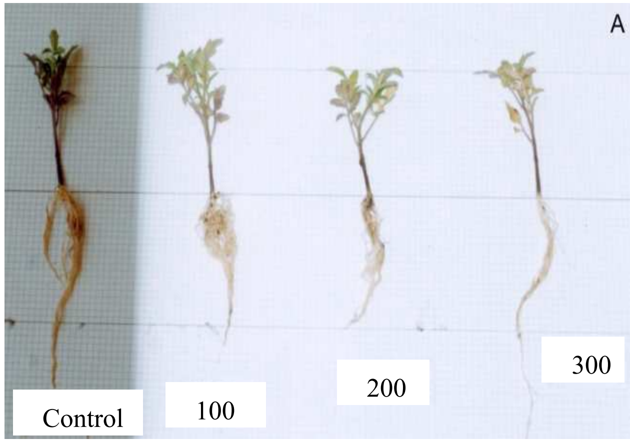
Photo B reveals that plants that are sensitive to salinity express this by very low root density evolving to an elongation of the root itself. For the Imperial variety, it should be noticed that the root density evolves when salinity increases concentration on sandy substrate (Photo C). In the mixture substrates, roots tends to increase their length, rather the root density.

### Hydric parameters: Relative Water Content

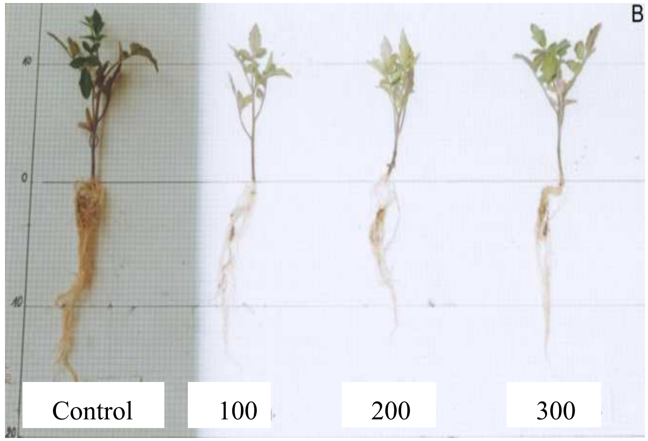
The figure 1, illustrates that the relative water content of tomato roots for both varieties increase appreciably when in the two substrates the salt amount increases with values between 200 and 300 $Meq.l^{-1}$.

Moreover, the plants in the mixture (sand/bentonite) present relative lower water content compared to those cultivated on sand (58, 61, 64 and 65 %) against (66, 71, 76 and 77 %) in Rio Grande variety and (61, 66, 72 and 73 %) against (53, 55, 59 and 59%) in Imperial variety.

In addition, the Rio Grande variety shows more significant rate of relative water content compared to those of the Imperial variety. Figure 1, illustrates that the roots relative water content in both varieties increases appreciably when the salt amount increases with a stability between 200 and 300 $Meq.l^{-1}$, in the two substrates.

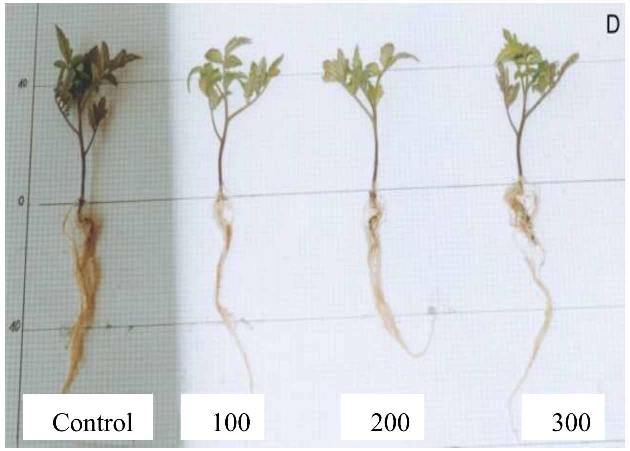



**A**: Rio Grande variety on the sand
at 5 leaves stage.




**B**: Rio Grande variety on the sand-
bentonite at 5 leaves stage


**C**: Imperial variety on the sand
at 5 leaves stage




**D**: Imperial variety on the sand-
bentonite at 5 leaves stage

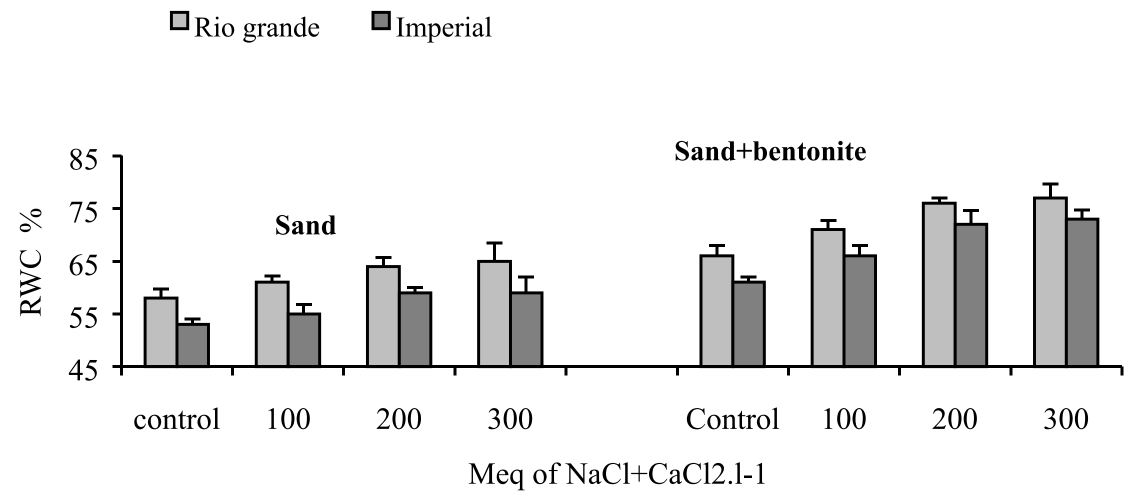



Fig.1. Roots relative water content of two hybrids processing tomato stressed with NaCl+CaCl2 at 5 leaves stage.

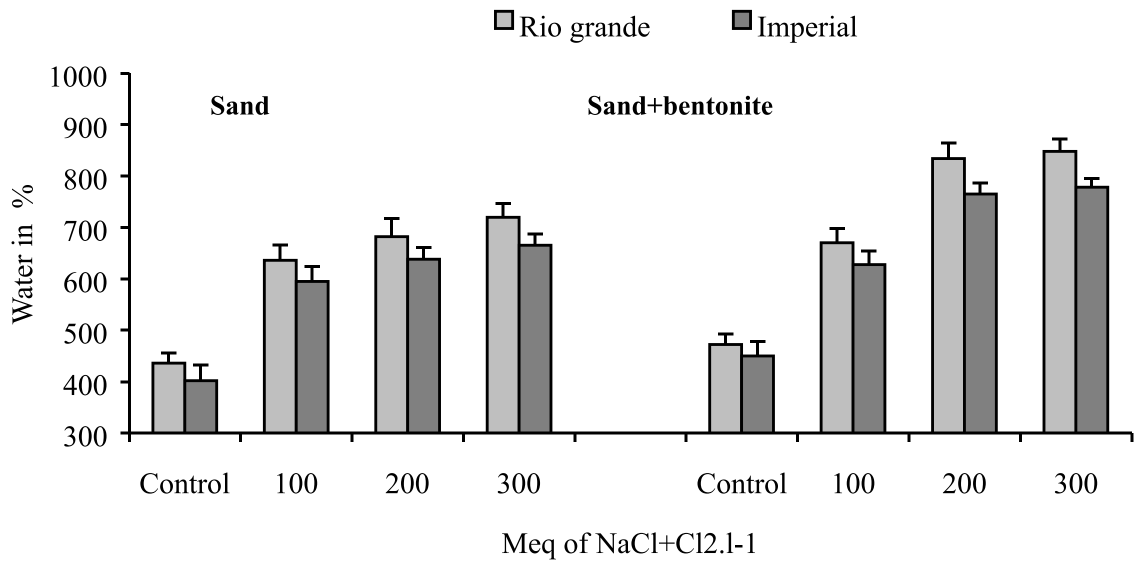



Fig.2. Roots total water content of two hybrids processing tomato stressed with NaCl+CaCl2 at 5 leaves stage

### Total water content

Figure 2 indicates that total water content of the roots of two varieties cultivated in all substrates progresses with the increase of saline concentration. In sand pots, both varieties present in water content an increase of 68, 64 and 60% in comparison to the control pots respectively to 100, 200 and 300meq.$l^{-1}$ in the case of Rio Grande hybrid and 67, 63 and 60.45% in the case of Imperial hybrid.

In the mixture pots, the same parameter recorded 70, 56, and 55% increase in comparison to the control respectively to 100, 200 and 300meq.$l^{-1}$ in the case of Rio Grande variety and 71, 59 and 58% in the case of Imperial hybrid. It should be noticed that the Rio Grande variety in both substrates gave significant increase in total water content compared to the Imperial variety.

## Conclusions

The results of this study showed that salinity affects the rooting system according to the nature of the substrate and the hybrid. In sandy pots treated with 100 meq.$l^{-1}$ of NaCl+CaCl2, the rooting density was higher for the Rio Grande hybrid. On the other hand, the roots of the same hybrid tend to lengthen in the sand-bentonite substrate whatever the concentration of salts will be.

The response of the Imperial hybrid indicates that the rooting density drops with the increase of salt concentration under sandy substrate. In the mixture conditions under all rates of salt concentrations, the effects are in favour of growth length.

Hasegawa *et. al.,* (1986) reported that the reduction of the growth is due to a reduction in division and cellular growth rate. However Singh *et al.,* (1989) affirm that the reduction of the growth is rather the result of the deceleration of the extensibility of the cells rather than the limitation of their division.

The physiological responses of tomato to salinity, shows that it is possible to improve salinity resistance. The varieties studied, which are regarded as moderately sensitive to salinity, have a positive hydric behaviour in their roots, in particular the Rio Grande variety reveals an interesting index of tolerance.

The results obtained for the various studied parameters, namely the morphology and hydric characteristics are modified by salinity. These modifications differ from a variety to another according to genetic potentialities of the plant and the substrate (sand and sand-bentonite).

The bentonite mixed with sand made it possible to obtain a substrate, which decreased the effect of salt. The tomatoes cultivated on this mixture react differently compared to those cultivated on sand. The hydric characteristics were better and morphology underwent less damage.

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