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Salt Stress Effects on Cowpea (*Vigna unguiculata* L. Walp) Varieties at Different Growing Stages

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Introduction

In Cuba approximately 228,000 ha of agricultural soils are affected by salt. This amounts nearly 23 % of the total Cuban area. Diverse methods have been used to reduce the salt affected soils and increase the quality of these soils, for example seraping (physical removal), flushing and leaching (Siyal *et al. 2002)* but these methods are characterized by their high costs. Therefore alternative measures are necessary. The legumes are very important both ecologically and agriculturally because of their ability to fix nitrogen in the root nodules in a symbiotic interaction with soil rhizobia. However, legumes are very sensitive to salt levels and soil drought status. The physiological consequences of environmental stress in legumes depend on the specific characteristics of these plants. Possible approaches to improve crop productivity under adverse environmental conditions require a better understanding of the mechanisms involved in the response to abiotic stress (Crespi and Galvez 2000).
Cowpea (*Vigna unguiculata* L. Walp.) is well adapted on different environmental conditions and could be used as an alternative crop for salt affected soils (Murillo *et al.* 2002). The objective of the study is to evaluate the salt tolerance of cowpea genotypes at different growth conditions.

Material and Methods

The first experiment was carry out under laboratory conditions to determine the response of twelve cowpea genotyes on different salts levels during germination. We tested the following genotypes: Cubanita – 666, Trópico Yarey, IT86 D-715, IT 86-D 792, IT 86 D-389, IT 82 E-9, IIT A-precoz, IT 86 D–386, IT 86 D-510, Viñales–144, Cancarro, IT 86 D-719. Seed water absorption, hypocotyls and roots length and seedlings weight were measured at seven days after sowing. We performed a correlation among the salt levels and water absorption, hypocotyl and roots length and seedlings weight, to calculate the salt level that cause 50% of reduction of the measured parameters and were clustered with the complete linkage hierarchical cluster based on Euclidean distance analysis.
We set up a second trial under greenhouse condition to evaluate the salt effects on plant physiological and morphological parameters. We tested the following genotypes: IT 86 D-715, Trópico Yarey y Cubanita-666, with two salt levels control (0.02 $dS.m^{-1}$ and 5 $dS.m^{-1}$). The length

and width of stem, number of leaves, shoot dry weight, and dehydrogenase (DHA) activity in soil were measured.

The inhibition index (I.I) for salt stress in length and width of stem, number of leaves and shoot dry weight were calculated using the following equations according to (González *et al*., 1996):

I.I.= 100*(TC-TS)/TC.

Where TC and TS represent the treatments without and with salinity respectively

Under field conditions, cowpea genotypes were cultivated to determine the effect of one non affected soil (1.3 dS m^{-1}) and one affected soil (9.8 dS m^{-1}) on cowpea yield parameters. The most tolerant cowpea genotypes tested in the first trial under laboratory conditions were evaluated under field conditions. Pods per plant, grains per plant, weight of 100 grains (g) and the yield ($t.ha^{-1}$) were measured for these conditions. The salt tolerance index was calculated like described for the greenhouse experiment. The *Vigna* genotypes were clustered with the complete linkage hierarchical cluster based on Euclidean distance analysis.

Results and Discussion

Differences in varieties response to saline levels were found during the germination. Through a cluster analysis based on Euclidian distances, four groups were formed to characterize the tolerance. Among others, IT 86 D-715, Cancarro and Cubanita-666 were classified as tolerant. IT 86 D–386 and IITA-Precoz were found to be most susceptible (Figure 1).

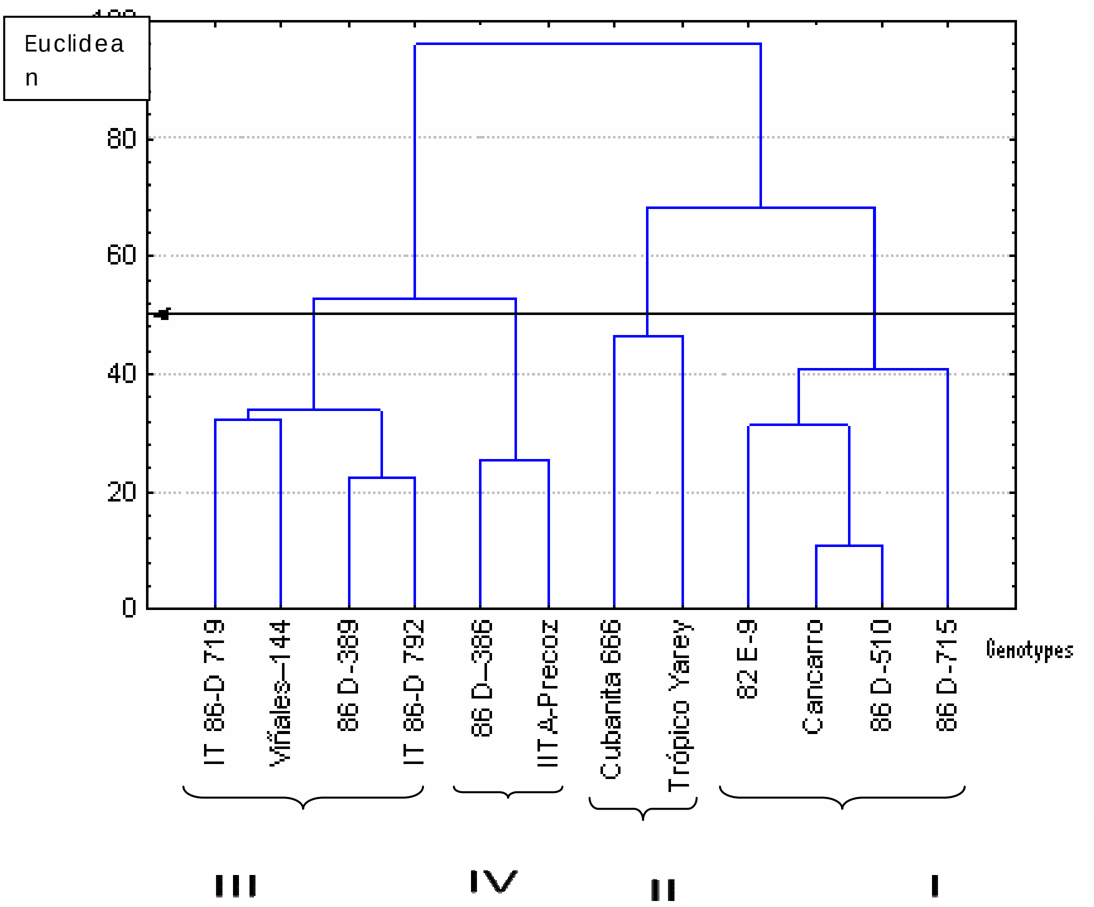

Figure 1: Cluster analysis of the genotypes according to the salt tolerance during the germination.

The largest reductions was found in the genotype Cubanita 666, while in IT 86 D 715 showed few affectations in the evaluation of inhibition index for salt stress (Figure 2). This behavior can be due to the response capacity of these genotypes under salt stress and wide genetic variability, which manifested a different response in similar conditions (González *et al.*, 2000).

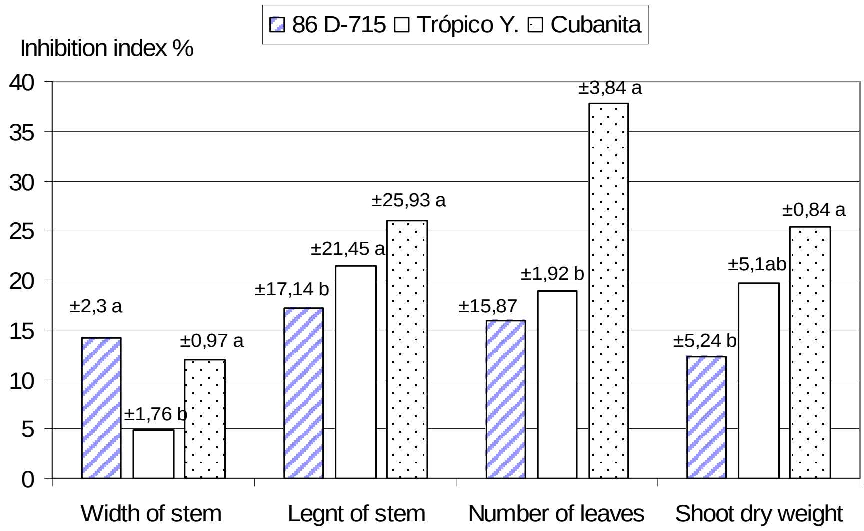

Figure 2: Salt stress inhibition index of different growth indicators in three *Vigna* genotypes.

The DHA activity differed in dependence of genotype (Figure 3). The DHA increased by salt stress conditions in IT 86 and 715 Cubanita-D-666 genotypes, while values declined in Yarey Tropics. This suggests that under osmotic stress, the enzyme activity may depend on the specific response of each genotype compared to salinity, influenced by the high genetic variability of these species. (Cerón *et al*., 2005).

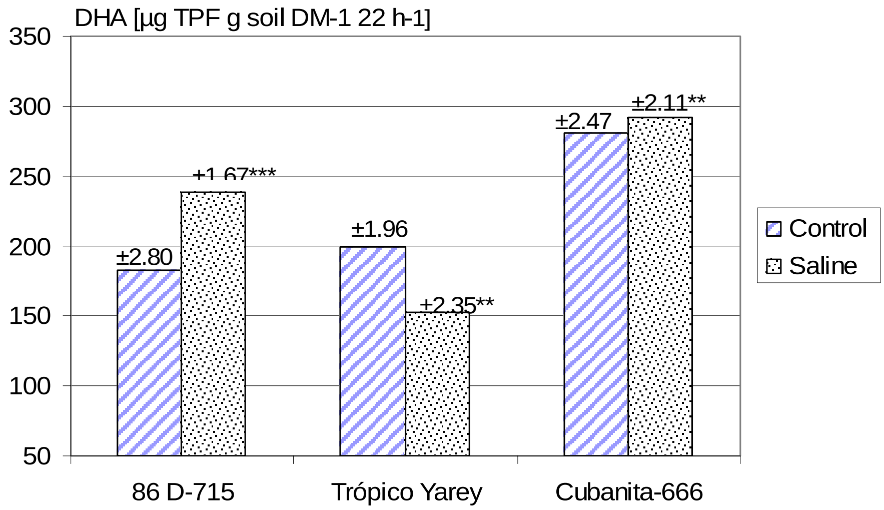

Figure 3: Influence of salt stress on dehydrogenase activity in three *Vigna* genotypes.

The complete linkage hierarchical cluster based on Euclidean distance analysis showed the presence of three groups from the behavior of the yield and components. The group I only included the IT 86 D-715 genotype with the highest average values. The group II formed by IT 86 D-150, IT 82 E-9, Cancarro and Trópico Yarey, can be considered moderately tolerant with intermediate values for all the parameters evaluated (Figure 4).

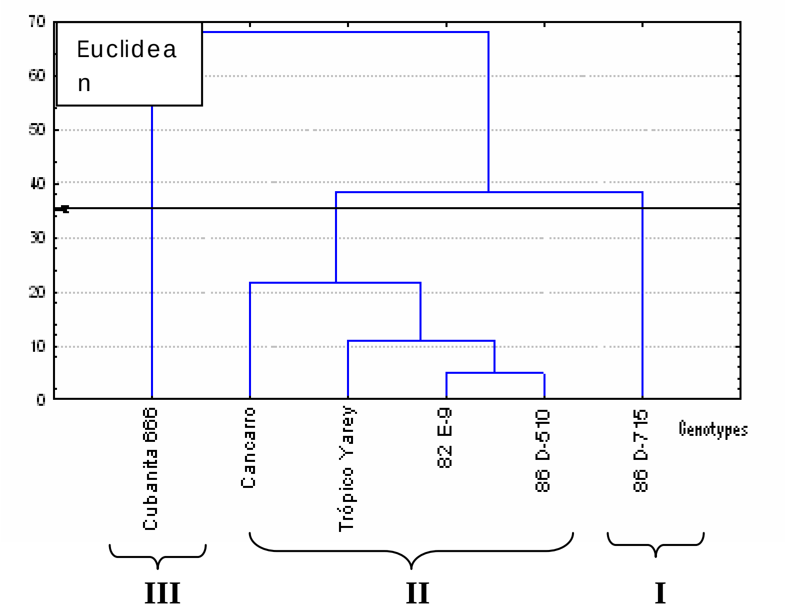

Figure 4. Cluster analysis of the genotypes according to the salt tolerance and yield in field conditions.

Conclusions

The *Vigna* genotypes showed significant differences in their tolerance to salinity. The results indicated that under all evaluated conditions IT 86 D-715 genotype was found to be most tolerant to salt stress among the genotypes. Generally, the results indicated that the selection of salt tolerant genotypes may have an important role to establish salt adapted cropping systems.

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