SALINE STRESS IN AMARANTHACEOUS PLANTS AND pH STRESS ON LETTUCE

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Abstract: Two experiments were carried to test stress reactions on plants. First, salinity experiments were performed in hydroponical cultures of spinach and beets. While the results were statistically untenable, a negative correlation between salinity and nitrate reductases was found. Second, pH stress experiments were conducted on lettuce. The optimal range for lettuce growth is near neutrality. The present work is the presentation of the first (mostly negative) results of a series of ecophysiological experiments carried since 2011.

"El estrés es el conjunto de respuestas bioquímicas o fisiológicas que definen un estado particular del organismo diferente al observado bajo un rango de condiciones óptimas."
(Basurto Sotelo et al., 2008)

Introduction

For the first experiment, the response of two species of the same botanical family to salt stress was compared: one that performs osmotic adjustment, *Beta* vulgaris L. "beet" (*Betoideae*: *Amaranthaceae*: *Caryophyllales*); and one which does not, *Spinacia oleracea* L. "spinach" (*Chenopodioideae*: *Amaranthaceae*: *Caryophyllales*). For this purpose the experimental subjects underwent different salinities for the time necessary to observe the effects. Each treatment had three repetitions on each species: one control group and two experimental groups were considered. At the end of experiment, the size of the plants, its fresh and dry weight, the presence of chlorophylls (A and B) and the concentration of nitrate reductases in each individual was quantitatively analyzed. These species where chosen due to the lack of knowledge of important and widely effective osmotic adjustment in *S. oleracea*, found in many recent scientific publications (Hoyos Rodriguez, Hernandez and Cardenas-Balaguera-Lopez; 2009); and reputation backed by scientific studies of *B. vulgaris* tolerance to drought and their ability to perform osmotic adjustment (Katerji, van Hoorn, Hamdy, Mastrorilli, and Mou Karzel; 1997). The salinity measurement was made by measuring the electrical conductivity, expressed in decisiemens per meter.

For the second experiment, the reaction to induced pH stress on lettuce was observed. Lettuce, *Lactuca sativa* L. (*Cichorioideae*: *Asteraceae*: *Asterales*), is used in various physiological experiments due to its rapid growth, availability and its great adaptability to different mechanisms and growing media (Lallana and Lallana, 2001; Mora, 2008). Also it clearly manifests symptoms, depending on the syndromes to which it has been conditioned according to the experimental needs.

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In this test, it intended to observe the response of two varieties of lettuce to four experimental treatments and control. Ten individuals, five for each cultivar (Lunix and Americana), two per treatment were used in total.

In previous studies, the response of plants to stress pH is due to the inability of the acid solutions to retain dissolved oxygen in them, so the acidity, which is produced under natural conditions by excess cations Al^{+3} causes decreased cell growth and division of cells by asphyxiation (Llorente, 2002. Bazán *et al.*, 2009). That stress causes "apical growth inhibition, increased root growth and changes in the life cycle" (Fuentes *et al.* 2005), which contrasts with the findings of the first authors are also known.

Finally, the nutrients themselves are not fully available in extreme pH for most crop plants, most mesophilic them. This adds an additional risk factor (Berrios et al., 2007)

Results and discussions

For the saline stress experiments; precise and verifiable effects of salt stress on chlorophyll are unknown. However, it has been possible to observe certain (not representative) trends that have been shown in other studies.

A negative correlation between the level of stress (expressed in salinity) and the amount of nitrate reductase is observed, consistent with the expected response. Thus, in the control treatment, the level of nitrate reductase is increased, while the concentration of this enzyme falls due to higher levels of salinity stress.

Chlorophyll test: Non-significant increases in the chlorophyll of both species were observed, with a non-significant decrease in the ratio of chlorophyll a and b.

Nitrate reductase test in *B. vulgaris*: a negative correlation is observed in the presence of nitrate reductase treatment under stress is greater. This is fully consistent with the expected values as a mechanism of resistance to salt stress is the accumulation of nitrogen compounds derived from tissues ion and the decrease in nitrate reductase levels because the plants assimilate nitrogen by secondary roads in these cases of stress (Márquez, Betti, Garcia-Calderon, Credali Diaz and Monza, 2007).

For the pH experiment, it was determined that the ideal pH range for the growth of lettuce plants is between 6.5 and 7.5.

It was also observed that acidic pH, root length and height of the head are significantly lower than the mean values. In addition, the appearance of the head is withered, discolored and necrotic, hence unpleasant as a commercial product.

Finally, we observed that in a highly alkaline pH, few leaves grew, very loose and high; without forming head. Furthermore, although the appearance of the plant is

wilted and the colors are intense, the taste is too bitter for the latex, which disqualifies it as a commercial product.

We can conclude that the alkaline stress is better supported by lettuce, showing brighter coloring and less necrotic root tissue, but anyway it is not desirable for commercial purposes.

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