



The Role of Arginin and Uric Acid on Portulaca Grandiflora Growth under Saline Conditions.

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Abstract

Seeds of *Portulaca grandiflora* were soaked in distilled water, NaCl or NaCl with uric acid or arginine or in one of the amino acids. Treatment of seeds of *Portulaca grandiflora* with arginine and uric acid under saline conditions increased the percent of seed germination from 55% to 80%. Incorporation of these amino acids in the nutrient medium also significantly enhanced the dry weights as well as the contents of chlorophyll and ascorbic acid in the seedlings. Levels of both total amino acids and proline were higher in salinized than in non-salinized plants. The results strongly suggest that incorporation of exogenous amino acids in seeds and seedlings of *P.grandiflora* helps to alleviate salt stress in the species.

Keywords: *Portulaca grandiflora*, salinity alginine, uric acid, ascorbic acid and stress tolerate.

1. Introduction

Salinity stress in plants retards all major growth processes that have been examined. Such processes as cell division and enlargement, production of proteins and nucleic acids, energy metabolism and increase in plant mass are adversely affected [1, 2, 3, 4, 5, 6]. Since non - halophytes have no means of salt tolerance regulation, ion build up takes place in their leaves if salinized. Consequently, growth of such plants is curtailed and death ensues [7, 8]. The authors in [9] pointed out that more tolerant non – halophytes avoid ion excess , but may consequently be deficient in solute for osmotic regulation. Water deficits may exert their effects directly on cell extension and division [10].

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However, different plants respond differently; for instance exposure of cotton (*Gossypium hirsutum*) and bean (*Phaseolus vulgaris*) plants to various levels of salinity stress reduced leaf area and caused decrease in total respiration [11]. Likewise, the authors in [12] observed inhibition of sorghum (*Sorghum bicolor*) leaf expansion under salt stress.

The authors in [13] Found out that decrease in growth of rice (*Oryza sativa*) caused by NaCl was concomitant with decreases in the contents of nucleic acids and protein. Chlorophyll contents were also reduced under salinity conditions in rice [14] and wheat plants. The authors in [15] Concluded that the majority of crop plants, including leafy vegetables, are susceptible to salinity. They apparently either do not survive high salinity conditions or, at best, do so with decreased yield.

Attempts to alleviate the adverse effects of salt stress in non-halophytes are meager. Presoaking of wheat (*Triticum aestivum*) seeds in plant hormones before subjection to salinity increased nutrient uptake and yield [16]. The authors in [15] Has also found out that certain vitamins reduced the deleterious effects of sodium chloride on wheat growth. The present work is an attempt to seeking means of improving the survival of *Portulaca grandiflora* under experimental saline conditions.

2. Materials and methods

Seeds of garden rocket (*Portulaca grandiflora*) were surface sterilized with 2% sodium hypochlorite for 3minutes. They were then thoroughly washed with distilled water and left to dry overnight. Subsequently, seeds were soaked for 6hrs in one of the following: Distilled water, 100 mM NaCl, 100 mM NaCl + 10 mM uric acid, 100 mM NaCl + 10 mM arginine, 10 mM uric acid and 10 mM arginine.

After that, they were sun dried for 8hrs. Soaking and sun drying was repeated twice. Batches of seeds were germinated in Petri dishes containing ash less filter paper moistened with a solution identical to that they had originally been soaked in. The percent of germination was recorded after 5days. Seedlings were selected on homogeneity of height and developmental stage, and Transferred to plastic pots (5 seedlings/pot) containing vermiculite moistened with the same soaking solution but containing quarter strength of Hoagland's solution. Seedlings were then raised in a greenhouse under natural light.

Temperatures were 25-28 C day, 19-23^o C nights with a relative humidity of 45- 70% sampling commenced fifteen days after transplanting. Five samples of ten shoots from each treatment were taken at intervals of five days. Samples were oven dried (at 60 C) to a constant weight and finely ground for bioassay. Chlorophyll was extracted with 80% acetone, and absorbed spectrophoto-metrically at 645 and 633 nm. Total amino acids and proline were determined as described by Moore and Stein methods. Dry weights were expressed as g/ plant. All other parameters were determined as mg/g dry weight. Fresh samples were used for ascorbic acid determination (as mg/100 g fresh weight) which was made on the basis of the colorimetric method using 2,6, dichloroindophenol [17].

3. Results and discussion

The results of the experiments showed that, the Salt treatment of *Portulaca grandiflora* seeds reduced their rate of germination from about, 62% (Fig.1). But when salinized seeds were presoaked in either arginine or uric acid, the percent of seed germination increased to 80%. On the other hand, treatment of non-salinized seeds with either of the amino acids invoked no significant change in their rates of germination ($P > 0.05$). Hence, it is assumed that exogenous amino acids improve seed Tolerance to salinity significantly.

The total dry weights of salinized young plants were consistently significantly lower than those of non-salinized plants of the same sampling period ($p < 0.05$) (Fig. 2). For example, at the end of the experiment the dry weights of solely salinized plants were less than half those of the control plants, it may be attributed to deterioration in photosynthetic efficacy. Acid-treated salinized plants produced dry weights nearly similar to the control ones. Yet, acid treatment of non-salinized plants significantly increased their dry weights.

As gauged by the dry weights, uric acid slightly surpassed arginine in improving growth of all plants.

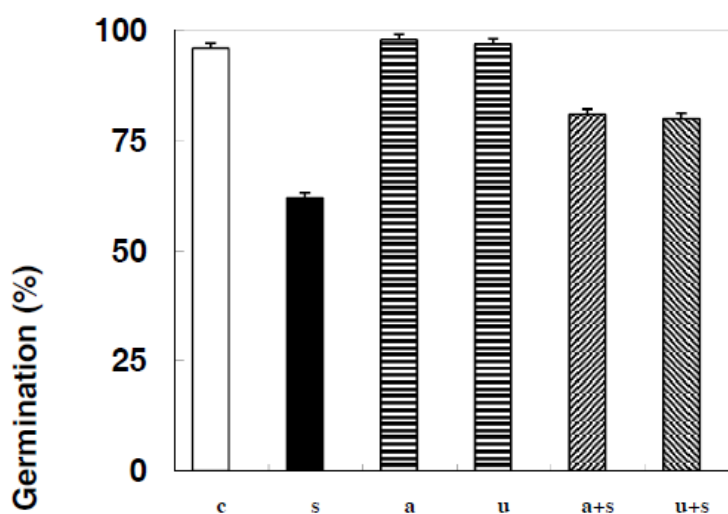


Fig. (1): Germination (%) *Portulaca grandiflora* Seeds Treated with Amino Acids under Saline and Non-saline Conditions (c, control; s, NaCl; a, Arginine; u, Uric Acid).

In all treatments, chlorophyll contents of *P.grandiflora* shoots increased over the duration of the experiment (Fig. 3). Depending on the treatment, they reached from about 1.5-fold (in solely salinized plants) to over 4-fold (in arginine and uric acid-treated non- salinized plants) the initial level. It is clear from the results that the use of exogenous acids counteracted the injurious effects of salinity and improved chlorophyll contents to levels considerably higher than those recorded in control plants. It is thus likely that these exogenous acids conferred an appreciable degree of salt tolerance and, hence, sustenance of chlorophyll synthesis systems in the plants.

[14] Found that the decrease in chlorophyll level in rice shoots was consistent with sodium ion increase. [15] Also reported that the use of certain vitamins had reduced the harmful effects of salinity on chlorophyll content of wheat plants.

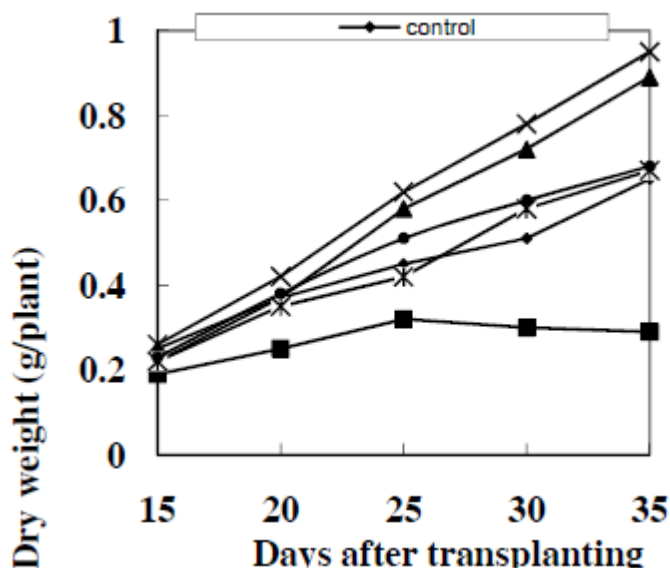


Fig. (2): Changes in Dry Weigh (g/plant) in *Portulaca grandiflora* Shoots Treated with Amino Acids under Saline and Non-saline Condition.

The level of ascorbic acid in plants that received salt treatment only was consistently much lower than those of all other plants (Fig. 4). It showed little increase until day 25 when it decreased again to near its initial level. In all other treatments, it increased gradually with time to about 2–2.5-fold the initial level.

The application of exogenous acids with NaCl stimulated increase of ascorbic acid to levels even greater than those of control plants, particularly from the middle of the experiment. Treatment with arginine or uric acid only had the greatest effect.

Total amino acids (Fig. 5) as well as the amino acid proline (Fig. 6) increased gradually over the experimental period in all treatments. The contents of total amino acids were higher in solely salinized plants than in plants that received both exogenous amino acids and NaCl simultaneously. Similarly their levels were significantly higher in salinized than non-salinized plants ($P < 0.05$), possibly due to protein degradation in response to Na^+ build-up. But the levels of proline were consistently highest in plants that had received the combined treatment of exogenous amino acids plus NaCl. Throughout the experimental period their levels were also significantly higher in salinized plants than in either amino acid- treated or control plants ($P < 0.5$). The results strongly suggest that these organic solutes promote salt tolerance in *G. grandiflora*. Accumulation of amino acids as well as proline was ascertained in different halophytes and non-halophytes under salinity conditions [18].

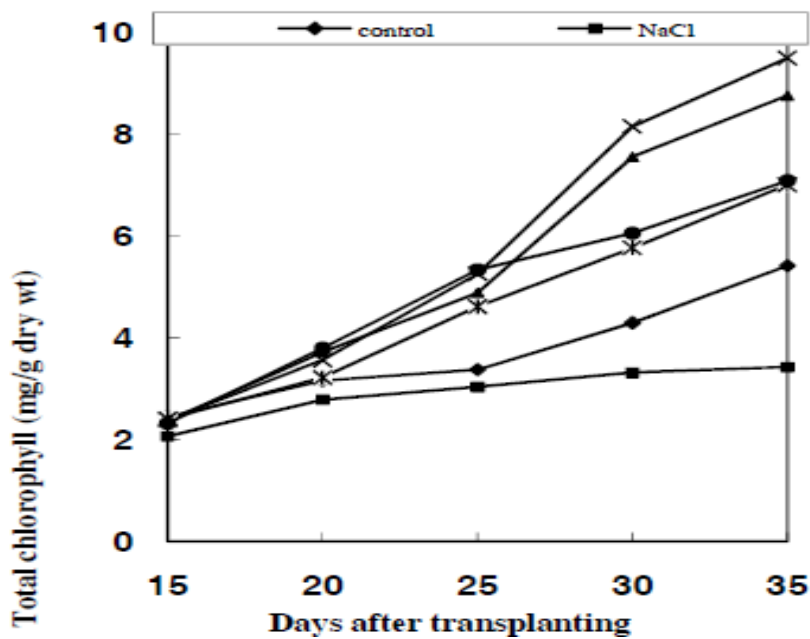


Fig. (3): Changes in Chlorophyll Content (mg/g dry weight) in *Portulaca grandiflora* Shoots Treated with Amino Acids under Saline and Non-saline Conditions

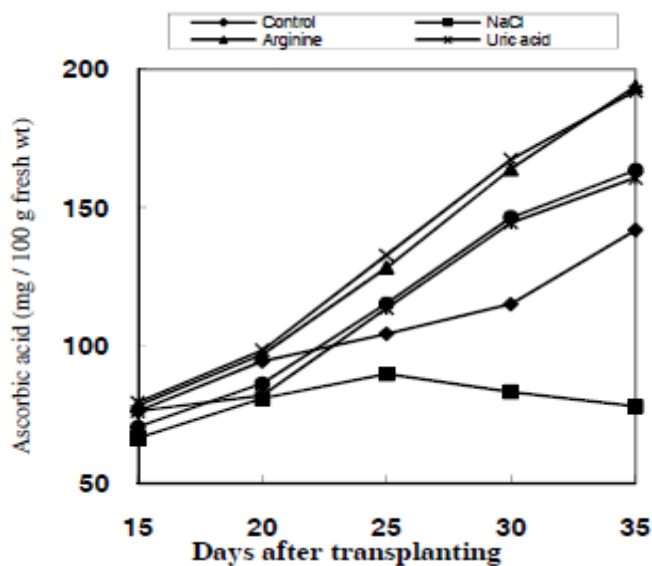


Fig. (4): Changes in Ascorbic Acid Content (mg/ 100 g Fresh Weight) in *Portulaca grandiflora* Shoots Treated with Amino Acids under Saline and Non-saline Conditions

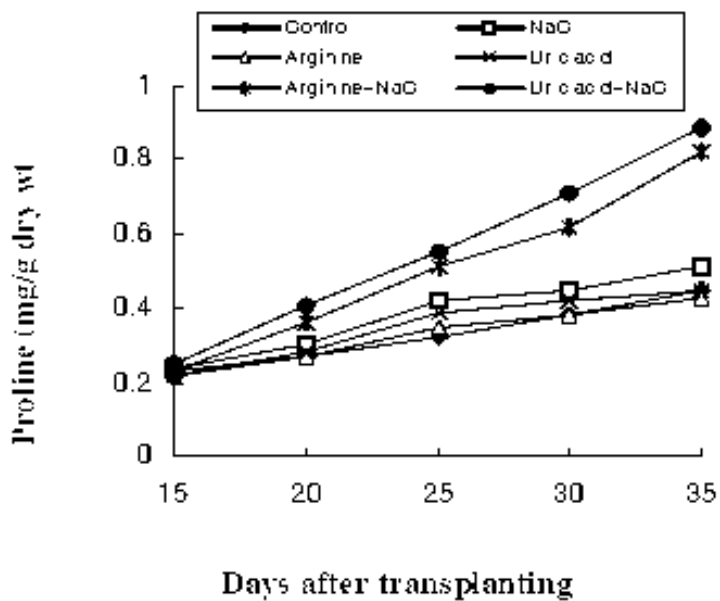


Fig. (5): Changes in Total Amino Acids (mg/g dryweight) in *Portulaca grandiflora* Shoots Treated with Amino Acids under Saline and Non-saline Conditions

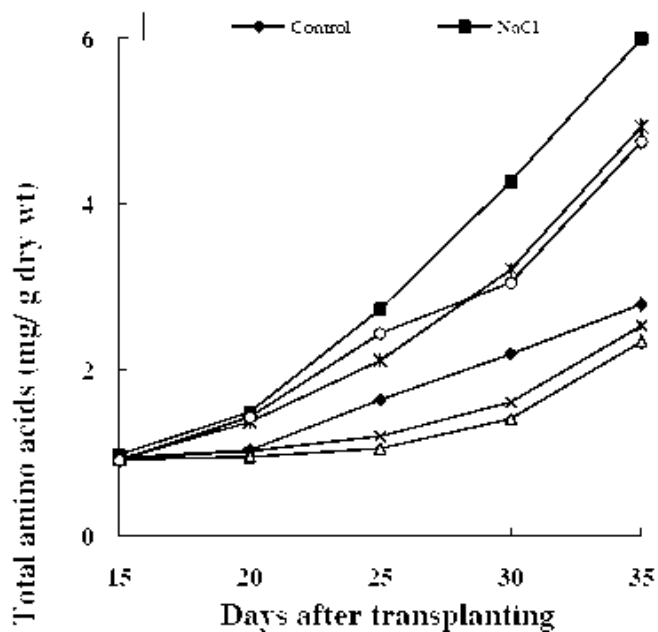


Fig. (6): Changes in Proline Content (mg/g Dry weight) in *Portulaca grandiflora* Shoots Treated with Amino Acids under Saline and Non-saline Conditions

4. Conclusion

The results of our experiments indicate that treatment of *P. grandiflora* seeds and seedlings with either exogenous amino acids helps to improve their survival under salinity conditions. Since arginine and uric acid are precursors for polyamines, it is presumed that these acids might have helped in the synthesis of polyamines, which are associated with the adaptation to stressful environments [19].

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