Journal of Applied Sciences Research, 9(1): 393-401, 2013
ISSN 1819-544X
This is a refereed journal and all articles are professionally screened and reviewed

## ORIGINAL ARTICLES

# Amelioration of salinity stress in mungbean (*Vigna radiate* L). plant by soaking in arginine

**[1]Hozayn M., [2,3]Abd El-Monem A.A., [2]Ebtihal M. Abd El-hamid E.M. and [4]Amira M.S. Abdul Qados**

*[1]Agronomy Dept.,[2]Botany Dept., Agric. & Biol. Div., National Research Centre, El-Behouth St., Dokki, Cairo, Egypt,*
*[3]B Biology Dept., Tabuk University, Tayma Branch, Tayma, Tabuk, Saudi Arabia,*
*[4]Botany Dept., Princess Nora Bint Abdul Rahman University, K.S.A*

**ABSTRACT**

Among the abiotic stresses, salinity is one of the most destructive factors which limits the crop production considerably. Suitable improves or stress alleviant is one of the tasks of plant biologists. Arginine (precursor of polyamine, i.e., spermidine, spermine, putrescine) is considered one of exogenous protectant which may alleviate the harmful effects of salinity stress. To achieve the aforementioned objective, two pot experiments were performed at the screen greenhouse of Agronomy Department, National Research Centre, Cairo, Egypt to study the effect of pre-soaking of mung bean seeds in different concentrations of arginine (0.0, 0.3, 0.6 and 1.2 mM) on growth, yield and chemical composition of yielded seeds of mung bean plants grown under different salinity levels (1500, 3000. 4500 and 6000 ppm) in 2008 and 2009 summer seasons. All growth parameters (plant height and dry weight) were significantly reduced at the highest salinity levels (3000, 4500 and 6000 ppm), while 1500 ppm induced slight increase. Salinity induced significant increases in Na and significantly decreased N, P, and K contents in green leaves of mung bean, as well as, yield components (plant height, pods number and weight, seeds number/pod, seeds weight/plant and biological yield/plant) and nutritional value (soluble carbohydrate, polysaccharides, total carbohydrate, proline, total amino acids and total protein) of seeds were reduced. Pre-treating mung bean seeds with arginine with different concentration 0.3 and 0.6 and 1.2 mM exhibited significant increments in mung bean growth, yield and yield components and nutritional value of yielded seeds compared to the untreated plants. The magnitude of increments was much more pronounced in response to 0.3 mM of arginine. From this study it could be concluded that, pre-soaking seeds of mung bean with arginine could alleviate the harmful effect of salinity especially at the lower levels of salinity of at all the studied parameters.

***Key words:*** *Mung bean, Salinity, Arginine, Growth, Yield, Mineral composition, N*utritional value.

## Introduction

World agriculture is facing a lot of challenges like producing 70% more food for an additional 2.3 billion people by 2050 while at the same time fighting with poverty and hunger, consuming scarce natural resources more efficiently and adapting to climate change (FAO 2009). However, the productivity of crops is not increasing in parallel with the food demand. The lower productivity in most of the cases is attributed to various abiotic stresses. Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity caused by high concentrations of salts in the soil. A considerable amount of land in the world is affected by salinity which is increasing day by day. More than 45 million hectares (M ha) of irrigated land which account to 20% of total land have been damaged by salt worldwide and 1.5 M ha are taken out of production each year due to high salinity levels in the soil (Munns and Tester 2008).

In most of the cases, the negative effects of salinity have been attributed to increase in $Na^+$ and $Cl^−$ ions in different plants hence these ions produce the critical conditions for plant survival by intercepting different plant mechanisms. Although both $Na^+$ and $Cl^−$ are the major ions which produce many physiological disorders in plants, $Cl^−$ is the most dangerous (Tavakkoli *et al*. 2010 ). Salinity at higher levels causes both hyperionic and hyperosmotic stress and can lead to plant damage.

Soil or water salinity is detrimental to plant growth and productivity as it causes nutritional imbalances by altering the uptake of nitrogen, phosphorus, potassium, and calcium, and interferes with the cellular metabolism

**Corresponding Author:** Hozayn M., Agronomy Dept., Agric. & Biol. Div., National Research Centre, El- Behouth St., Dokki,cairo, Egypt,
E-mail: m_hozien4@yahoo.com

by causing ion toxicity and osmotic perturbations. Under salinity the predominant cause of ion toxicity is the replacement of $K^+$ with $Na^+$ and non-covalent interactions of $Na^+$ and $Cl^-$ ions with amino acids of proteins and enzymes (Hasanuzzaman *et al*., 2012). The effect of this ionic imbalance manifests at the cellular as well as at the whole-plant level. Massive changes in ionic and water balance cause molecular damage and arrest growth (Jaleel *et al*. 2008). The deleterious effects of salinity on plant growth are associated with low osmotic potential of soil solution, nutritional imbalance, specific ion effect, hormonal imbalance and induction of oxidative stress, or a combination of these factors (Parida and Das 2005, Rahnama *et al*., 2011).

As indicated by Munns (1993), the effect of salinity on plant growth occurs in two-phase model. The first phase of the growth reduction is due to the osmotic stress of the salt outside the roots, the second phase being due to toxic effects that is to the accumulation of salt inside the plant to toxic levels. Potassium uptake is particularly important due to the chemical similarities between $Na^+$ and $K^+$, which makes difficult the discrimination between the two ions by transport proteins (Yamaguchi and Blumwald 2003). Thus, high levels of $Na^+$, or high $Na^+$:$K^+$ ratios can disrupt various enzymatic processes in the cytoplasm. Therefore, one of the key elements in salinity tolerance is the ability to maintain a high cytosolic $K^+/Na^+$ selectivity.

Plant biomass production depends on the accumulation of carbon products through photosynthesis, but elevated salinity can adversely affect photosynthesis (Ashraf and Harris 2004). Salinity reduces the ability of plants to take up water, causing a reduction in growth along with a suite of metabolic changes (Munns 2002). A metabolic response to salt stress is the synthesis of compatible osmolytes. These mediate osmotic adjustment and therefore protect sub-cellular structures and reduce oxidative damage caused by free radicals, produced in response to high salinity (Ashraf and Foolad 2007).

The osmotic stress has a greater effect on growth rates than the ionic stress. Ionic stress impacts on growth much later and with less effect than the osmotic stress, especially at low to moderate salinity levels (Munns and Tester 2008). High salt concentration in root affects the growth and yield of many important crops (Taffouo *et al*., 2004). Salinity may reduce crop yield by upsetting water and nutritional balance of plant (Khan *et al*., 2007, Taffouo, 2009 and Abdul Qados, 2009).

Mung bean (*Vigna radiate* L.) is a summer crop with short duration (70 – 90 days) and high nutritive value. The seeds contain 22-28 % protein, 60 – 65 % carbohydrates, 1 – 1.5 % fat, 3.5 – 4.5 fibers and 4.5 – 5.5 % ash. It has many effective uses, green pods in cooking as peas, sprout rich in vitamins and amino acids (Lawn and Ahn, 1985). This crop can be used for both seeds and forage since it can produce a large amount of biomass and then recover after grazing to yield abundant seeds (El– Karamany *et al*., 2003, Hozayn *et al*., 2007) and can be used in broilers diets as a non – traditional feed stuff (El-Khimsawy *et al*., 1998).

Arginine is one of the essential amino acids, considered the main precursor of polyamines which produced by decarboxylation of arginine via arginine decarboxylase to form putrescine (Bocherueu, 1999). Polyamines and their precursor arginine have been implicated as vital modulators in a variety of growth, physiological and developmental processes in higher plants (Glastone and Kaur-sawhny, 1990). Polyamines are involved in the control of cell cycle, cell division, morphogenesis in phytochrome and plant hormone mediated process and the control of plant senescence, as well as in plant response to various stress factors (Abdel Monem, 2007). The application of arginine significantly promoted the growth and increased the fresh and dry weights, certain endogenous plant growth regulators, chlorophylls a and b and carotenoids in bean (Nassar *et al*., 2003); in wheat (Abd El Monem, 2007 and El-Bassiouny *et al*., 2008). Moreover Hassanein *et al*., (2008) and Khalil *et al*., (2009) recorded the positive role of arginine in alleviating the inhibition occurs as the result of exposing plants to stress.

The objective of the present study was to evaluate the response of mung bean grown under saline irrigation and to investigate the role of arginine in alleviating the harmful effects of salinity stress.

## Materials and Methods

Two pot experiments were performed at the screen greenhouse of Agronomy Department, National Research Centre, Dokki, Giza, Egypt to study the effect of pre-soaking of mung bean seeds in different concentrations of arginine (0.0, 0.3, 0.6 and 1.2 mM) on growth, yield and chemical composition of yielded seeds of mung bean plants grown under different salinity levels (1500, 3000. 4500 and 6000 ppm) at 2008 and 2009 summer seasons. Mung bean seeds cultivar Kawmay-1 was soaked in different arginine concentrations for 6 hrs before sowing. The treatments were arranged in split plot in CRD design where salinity levels and arginine concentrations were allocated in main and sub plot, respectively. The mung bean soaked seeds were sown in pots (50 cm in diameter) containing equal amounts of sand and clay (1:1) soil. Every treatment consisted of 5 replicates. The pots were irrigated with equal volumes of the various salinity levels (Stroganov nutrient solutions (Stroganov, 1962)) after 21 days from sowing. Irrigation was run as follow 3 times with saline solutions and one with tap water. NPK Fertilization was done as the recommended rate. After 15 days from sowing thinning was carried out, so as five uniform seedlings were left in each pot for studying the effect of different treatments on the yield of mung bean cultivar.

*J. Appl. Sci. Res., 9(1): 393-401, 2013*

*Data recorded:*

After 60 days from sowing, three mung bean plants were taken from each pot to determine plant height and dry weight of plant as well as the nutrient elements N, P, K and Na were determined in green leaves according to the method described by Cottenie *et al*., (1982). At harvest, data on yield and yield contributing characters were recorded from each pot i.e., plant height (cm), Number of pods plant, Number of seeds pod, 100-seed weight (g), seed, straw and biological yield per plant and harvest index (%). In dried seeds, a total soluble carbohydrate was determined using modifications of the procedures of Yemm and Willis, (1954) and Handel (1968). Total carbohydrate content was determined calorimetrically according to Dubois *et al*. (1956). Polysaccharides were calculated by the difference between total carbohydrates and total soluble carbohydrates. Total free amino acids and proline contents were determined calorimetrically according to Hassanein, (1977) for extraction (Muting & Kaiser, 1963) and Bates *et al*. (1973). Total N and protein contents were determined by the Kjeldahl method of Pirie (1955).

*Statistical analysis:*

The values of all parameters were statistically analyzed to find out the level of significance using MSTAT-C package program (MSTAT, 1988). The means differences were compared by Least Significant Difference test (LSD) at 5% level of significance.

**Results and Discussion**

*Growth and nutrients content of mung bean plants:*

From the results obtained in Table (1), it could be concluded that plants irrigated with saline water showed great depression in plant height and dry weight/plant as compared with control. Such reduction may be due to the inadequacy of nutrients presented in the growing media (Sliman and Ghandoor, 1988). Or to the decrease in water entry rate into plant (Shreif, 2000) since under saline condition root pressure is reduced causing a decrease in water flow. That means less water is taken up by the roots and transported into shoots. Consequently, less water is available for normal growth and development (Satti and Lopez, 1996). In this concern, Greenway and Munns (1980) and Yeo and Flowers (1986) stated that the reduction in the previous parameters of growth could be attributed to the effect of salinity which caused a disturbance in plant uptake which lead to forming low molecular weight than higher molecular weight which consequently reflected on fresh and dry weight. They added that the growth of cells is primarily correlated with turgor potential, and decreased turgor in the major caused of inhibition of plant growth under saline conditions. Furthermore, El-Agrodi *et al*. (2005) stated that salinity levels above 0.2% had high significantly decrease on root dry weight.

The content of nutrients (N, P, K and Na) in mung bean leaves as affected by different salinity levels are presented in Table (1). It is clear from data that increasing salinity levels significantly reduced the percentage of N, P and K. These results are in agreement with those obtained by Azza *et al*. (2008) on *Toxodium, disticum*. In this connection, Hanafy Amed *et al*. (1996) pointed out that salinization impaired N accumulation and incorporation into protein and raised total free amino acid accumulation in saline plant.

Furthermore, the reduction in P concentration under saline conditions. Table (1), not only because of ionic strength effect that reduce the activity of phosphate but also because phosphate concentration in soil solution is tightly controlled by sorption processes and low solubility of Ca-P minerals. Therefore, it is understandable that phosphate concentration in field grown agronomic crops decreased as salinity increased (Mohamedin *et al*., 2006).

Concerning potassium concentration, Gemea *et al*. (1996) found an increase in Na concentration and a decrease in K concentration in leaves with high salinity, this result may be due to a possible antagonism between K and Na. This antagonism could be due to the direct competition between K and Na at the site of ion uptake at plasma lemma. Data in Table (1) indicated that there was a gradual increase in Na percentage in mung bean leaves with increasing salt concentration of irrigation water. Accordingly, the increase in Na concentration in plant with salinity may be a result of the ability of plants to use Na to maintain an adequate osmotic potential gradient between the plant tissues and the external solution (Glenn, 1987).

In this concern, Gray and Deluo (2004), stated that excess salt increases the osmotic pressure of soil water and produce conditions that keep the roots from absorbing water and nutrients and resulted in low nutrients in plant tissues. Generally, the reduction in vegetative growth and nutrients concentration due to high salinity effect is in harmony with those obtained by Taffauo *et al*. (2004), El-Agrodi *et al*. (2005) and Tauffauo *et al*. (2009) on some legumes plants.

**Table 1:** Effect of different concentrations of arginine on some macro elements in leaves of mungbean grown under salinity stress at 60 days after sowing (avarage of both seasons).

| Character Treatment | | Plant height (cm) | Dry weight (g/plant) | Macro elements (%) | | | |
|---|---|---|---|---|---|---|---|
| Salinity (ppm) | Arginine (mM) | | | N | P | K | Na |
| Zero | Zero | 30.67 | 2.05 | 0.96 | 0.09 | 0.99 | 0.017 |
| | 0.30 | 56.00 | 5.74 | 1.85 | 0.26 | 2.39 | 0.135 |
| | 0.60 | 52.00 | 5.62 | 1.54 | 0.23 | 2.13 | 0.057 |
| | 1.20 | 45.33 | 5.29 | 1.34 | 0.21 | 1.96 | 0.021 |
| 1500 | Zero | 42.67 | 3.17 | 1.12 | 0.11 | 1.39 | 0.025 |
| | 0.30 | 51.67 | 4.49 | 1.69 | 0.19 | 2.17 | 0.102 |
| | 0.60 | 45.33 | 4.09 | 1.43 | 0.17 | 1.78 | 0.071 |
| | 1.20 | 43.00 | 3.31 | 1.31 | 0.15 | 1.58 | 0.046 |
| 3000 | Zero | 33.67 | 2.31 | 1.16 | 0.11 | 1.37 | 0.020 |
| | 0.30 | 48.67 | 4.68 | 1.54 | 0.23 | 2.33 | 0.105 |
| | 0.60 | 45.00 | 3.63 | 1.48 | 0.17 | 2.05 | 0.065 |
| | 1.20 | 40.67 | 3.38 | 1.29 | 0.15 | 1.79 | 0.038 |
| 4500 | Zero | 31.33 | 1.85 | 0.92 | 0.08 | 1.24 | 0.032 |
| | 0.30 | 44.33 | 4.23 | 1.47 | 0.18 | 2.27 | 0.121 |
| | 0.60 | 38.67 | 3.40 | 1.14 | 0.12 | 1.87 | 0.072 |
| | 1.20 | 35.00 | 2.61 | 1.09 | 0.09 | 1.45 | 0.069 |
| 6000 | Zero | 29.33 | 1.83 | 0.81 | 0.04 | 0.89 | 0.050 |
| | 0.30 | 39.00 | 2.34 | 1.22 | 0.15 | 1.89 | 0.164 |
| | 0.60 | 36.00 | 2.20 | 1.04 | 0.10 | 1.66 | 0.132 |
| | 1.20 | 32.00 | 1.94 | 0.87 | 0.06 | 1.17 | 0.071 |
| LSD at 5% | | 3.10 | 0.12 | 0.08 | 0.02 | 0.06 | 0.004 |
| Mean of main effects: | | | | | | | |
| Salinity (ppm) | Control | 46.00 | 4.68 | 1.42 | 0.20 | 1.87 | 0.057 |
| | 1500 | 45.67 | 3.76 | 1.39 | 0.16 | 1.73 | 0.061 |
| | 3000 | 42.00 | 3.50 | 1.37 | 0.17 | 1.89 | 0.057 |
| | 4500 | 37.33 | 3.02 | 1.16 | 0.12 | 1.71 | 0.074 |
| | 6000 | 34.08 | 2.07 | 0.99 | 0.09 | 1.40 | 0.104 |
| LSD at 5% | | 1.38 | 0.04 | 0.11 | 0.02 | 0.06 | 0.001 |
| Arginine (mM) | Zero | 33.53 | 2.24 | 0.99 | 0.09 | 1.18 | 0.029 |
| | 0.30 | 47.93 | 4.29 | 1.55 | 0.20 | 2.21 | 0.125 |
| | 0.60 | 43.40 | 3.79 | 1.33 | 0.16 | 1.90 | 0.079 |
| | 1.20 | 39.20 | 3.31 | 1.18 | 0.13 | 1.59 | 0.049 |
| LSD at 5% | | 1.27 | 0.05 | 0.21 | 0.03 | 0.11 | 0.002 |

Results in Table (1) showed that soaking mung bean seeds in different arginine concentrations (0.3, 0.6 and 1.2 mM) significantly increased plant height, dry weight/plant and the concentration of N, P, K and Na in leaves as compared with control treatment. These results are in good harmony with those obtained by Abd El-Moneim (2007) and El-Basiouny *et al*. (2008).

Data also show that the maximum increases in the previous parameter were obtained by using 0.3 mM arginine. In this connection, Xu *et al*. (2001), El-Bassiouny and Bekheta (2001) and Nassar *et al*. (2003), suggested that the main role of all arginine products (putrescine, spermidine and spermine) in salt treated plants on the long run is to maintain a cation-anion balance in plant tissue by stabilizing membrane at high external salinity. They added that exogenous application of polyamine (end product of arginine) to several plant species have been shown to promote cell division, cell differentiation and general growth promotion. They can also help at stabilize membrane and wall properties (Velikov *et al*., 2000) and protect plant against environmental stress (Mo and Pua, 2002). It can be suggested that amino acids can act as components of salt tolerance mechanism and build up a favorable osmotic potential inside the cell in order to combat the effects of which replaced nitrate in the vacuoles.

### *Mung bean yield and its Components:*

Data in Table (2) showed that at harvest, the plant height, pods number and weight/plant, seeds number/pod, seed and straw yield as well as the biological yield of mung bean plants significantly affected by salinity irrigation water. All the salinity levels (1500, 3000, 4500 and 6000 ppm) induced significantly decreases in all the previous parameters of yield and its components as compared with control treatment (irrigation with tap water). For instance, the reduction in plant height, pods number and weight/plant and seeds number of pod reached to 33.69%, 49.9%, 30.43% and 25.6%, respectively in plants irrigated with 6000 ppm saline water. The depressive effect of salinity water on mung bean yield may be attributed to the harmful effect of salt stress on growth, the disturbance in mineral uptake and/or enhancement, of plant respiration (Abd El-Haleem *et al*., 1995).

**Table 2:** Effect of different concentrations of arginie on yield and its components of mungbean grown under salinity stress (avarage of both seasons).

| Character Treatment | | Plant ht. at harvest (cm) | Pods no/ plant | Pods wt. (g/plant) | Seeds no/pod | Yields/plant (g) | | | HI (%) |
|---|---|---|---|---|---|---|---|---|---|
| Salinity (ppm) | Arginine (mM) | | | | | Seed | Straw | Bio. | |
| Zero | Zero | 42.67 | 4.45 | 2.08 | 10.00 | 1.79 | 3.51 | 5.30 | 33.74 |
| | 0.30 | 58.33 | 7.17 | 4.47 | 10.00 | 3.66 | 5.62 | 9.28 | 39.44 |
| | 0.60 | 46.00 | 6.25 | 2.65 | 10.00 | 2.08 | 4.11 | 6.19 | 33.60 |
| | 1.20 | 44.33 | 4.67 | 2.28 | 10.00 | 1.86 | 3.75 | 5.61 | 33.16 |
| 1500 | Zero | 46.67 | 4.83 | 1.61 | 10.00 | 1.37 | 2.67 | 4.04 | 33.89 |
| | 0.30 | 60.33 | 6.33 | 2.50 | 10.00 | 2.21 | 3.17 | 5.38 | 41.08 |
| | 0.60 | 53.67 | 5.92 | 1.90 | 10.00 | 1.52 | 3.09 | 4.61 | 32.97 |
| | 1.20 | 51.33 | 4.83 | 1.84 | 10.00 | 1.46 | 2.86 | 4.32 | 33.80 |
| 3000 | Zero | 34.00 | 3.58 | 1.79 | 9.56 | 1.28 | 3.25 | 4.53 | 28.26 |
| | 0.30 | 49.67 | 6.08 | 3.18 | 10.00 | 2.65 | 4.76 | 7.41 | 35.76 |
| | 0.60 | 45.33 | 5.00 | 2.34 | 10.00 | 1.74 | 3.94 | 5.68 | 30.63 |
| | 1.20 | 40.33 | 4.92 | 2.08 | 9.89 | 1.46 | 3.28 | 4.74 | 30.80 |
| 4500 | Zero | 29.33 | 3.29 | 1.59 | 8.67 | 1.03 | 2.25 | 3.28 | 31.40 |
| | 0.30 | 43.33 | 5.58 | 2.38 | 10.00 | 1.83 | 3.27 | 5.10 | 35.88 |
| | 0.60 | 43.00 | 4.32 | 1.81 | 9.78 | 1.38 | 2.86 | 4.24 | 32.55 |
| | 1.20 | 32.67 | 4.25 | 1.72 | 8.67 | 1.27 | 2.76 | 4.03 | 31.54 |
| 6000 | Zero | 22.00 | 2.15 | 0.98 | 7.24 | 0.75 | 1.89 | 2.64 | 28.33 |
| | 0.30 | 40.00 | 3.33 | 1.98 | 7.89 | 1.58 | 2.84 | 4.42 | 35.75 |
| | 0.60 | 26.00 | 2.68 | 1.28 | 7.44 | 1.11 | 2.34 | 3.45 | 32.23 |
| | 1.20 | 22.33 | 2.42 | 1.13 | 7.24 | 0.93 | 2.17 | 3.10 | 30.00 |
| LSD at 5% | | 4.31 | 0.66 | 0.23 | 0.41 | 0.08 | 0.38 | 0.37 | 2.32 |
| Mean of main effects: | | | | | | | | | |
| Salinity (ppm) | Control | 47.83 | 5.63 | 2.87 | 10.00 | 2.35 | 4.25 | 6.59 | 34.98 |
| | 1500 | 53.00 | 5.48 | 1.96 | 10.00 | 1.64 | 2.95 | 4.59 | 16.76 |
| | 3000 | 42.33 | 4.90 | 2.35 | 9.86 | 1.78 | 3.81 | 5.59 | 52.12 |
| | 4500 | 37.08 | 4.36 | 1.88 | 9.28 | 1.38 | 2.78 | 4.16 | 61.98 |
| | 6000 | 27.58 | 2.64 | 1.34 | 7.45 | 1.09 | 2.31 | 3.40 | 35.43 |
| LSD at 5% | | 1.54 | 0.26 | 0.06 | 0.22 | 0.03 | 0.08 | 0.09 | 0.77 |
| Arginine (mM) | Zero | 34.93 | 3.66 | 1.61 | 9.09 | 1.24 | 2.71 | 3.96 | 31.12 |
| | 0.30 | 38.20 | 4.22 | 1.81 | 9.16 | 1.40 | 2.96 | 4.36 | 31.86 |
| | 0.60 | 42.80 | 4.83 | 2.00 | 9.44 | 1.57 | 3.27 | 4.83 | 32.40 |
| | 1.20 | 50.33 | 5.70 | 2.90 | 9.58 | 2.39 | 3.93 | 6.32 | 37.58 |
| LSD at 5% | | 1.77 | 0.27 | 0.09 | 0.17 | 0.03 | 0.15 | 0.15 | 0.95 |

Moreover, Tester and Davenport (2003), and Tayffouo *et al*. (2009) reported that, the significant decrease of yield components observed under salt stress in cowpea would be partly related to a significant reduction of chlorophyll contents (more than 50%), and $K^+$ concentration in saline media. They added that metabolic toxicity of $Na^+$ is largely a result of its stability to compete with $K^+$ for binding sites essential for cellular function. More than 50 enzymes are activated by $K^+$ and $Na^+$ cannot substitute in its role. Thus, high levels of $Na^+$ or high $Na^+/K^+$ ratios can disrupt various enzymatic processes in the cytoplasm. Moreover, protein synthesis requires high concentration of K+, owing to the K+ requirement for binding of RNA to ribosomes.

The obtained results in this study agree with those obtained by Zadeh and Naeini (2007) and Hussein *et al*. (2008), who stated that yield parameters were reduced by increasing rate of salts applied to soil. The NaCl salt of higher levels gave significantly higher decrease in biological, straw and grain yields of wheat and canola plants as compared with control treatment.

Results in Table (2), show that, presoaking seeds of mung bean in different concentration of arginine (0.3, 0.6, 1.2 mM) under all salinity levels caused an increase in all parameters of yield components as compared to the corresponding salinity level.

Krishnamuthy (1991), reported that, when putrescince (arginine substance) was exogenously supplied on the salt stressed plant, the grain yield of rice increased. This increment could be due to antisenescence effect of putrescine. El-Bassiouny and Bekheta (2001) proved that putrescine is intimately involved in salt treated wheat plant thereby regulating growth, development and grain yield and Wada *et al*. (1994). Nassar *et al*. (2003) concluded that arginine inducer early flowering and fruiting of morning glory and bean plants respectively.

*Chemical constituents of mung bean seeds:*

The obtained results in Table (3) show that irrigation of mugn bean plants with different salinity levels (1500, 3000, 4500 and 6000 ppm) significantly decreased all the physiological constituents except proline % (Total soluble sugar, polysaccharides, total carbohydrates, total amino acids and protein content) as compared with control treatment. The magnitude of reductions increased with increasing the salinity levels. The reduction in total soluble sugar, polysaccharides and total carbohydrate in mung bean seeds could be attributed to the nutritional imbalance and specific toxic effect of salinity as reported by Nou *et al*. (1995), hyperosmotic stress and reduced photosynthesis (Abd El-Wahab, 2006).

Moreover, total amino acid content in mung bean seeds found to be adversely affected due to salinity effect. The same results was obtained by Sarwat and Sherif (2007) who stated that, amino acids appeared to be decreased with salinity depending on the concerned amino acids response by barley plants.

The reduction in protein percentage in seeds of mung bean seeds irrigated with different salinity levels may be attributed to the reduction in total nitrogen in green leaves (Table 1), consequently decreased N content in seeds as salinity increased. These results were in line with Abd El-Wahab (2006) on *Foeniculum vulgare*.

Results presented in Table (3) clear that proline content of mung bean seeds significantly increased gradually by increasing the salinity levels as compared with control treatment. These results demonstrated that, the physiological function of proline which accumulated in mung bean under salinity stress may not only just behave as an osmolytes and protectant but also have other roles related to stress. Proline content in mung bean seeds is in good agreement with those obtained by Mohamedin *et al*. (2006) on sunflower.

The levels of salinity led to a pronounced decrease in physiological constituents in mung bean. This reduction could be attributed to toxic of $Na^+$ and $Cl^-$ in the physiological active parts of tissues, and to inefficient compartmentation for these ions in vacuoles (Yeo and Flowers, 1986).

Generally, the responses to salinity vary not only among the different crops but also among different organs of plant. Depending on osmotic upset, some physiological changes occur in stomata conductance, transpiration, photosynthesis, chlorophyll content and root and leaf activity. Consequently, reduction of physiological constituents and yield might be observed. Came to the same conclusion (Kucukahmetler, 2003).

**Table 3:** Effect of different concentrations of arginine on chemical constituents in grains of mungbean grown under salinity stress at 2009 season.

| Character Treatment | | Chemical constituents in grains (mg/100 g grain weight) | | | | | Protein (%) |
|---|---|---|---|---|---|---|---|
| Salinity (ppm) | Arginine (mM) | Total soluble Sugar | Poly sacharides | Total carbohydrates | Total amino acids | Proline | |
| Zero | Zero | 23.16 | 36.67 | 59.83 | 46.83 | 14.93 | 24.35 |
| | 0.30 | 36.70 | 37.74 | 74.44 | 60.44 | 21.36 | 29.30 |
| | 0.60 | 26.18 | 44.06 | 70.24 | 51.99 | 17.77 | 25.29 |
| | 1.20 | 25.84 | 36.30 | 62.14 | 48.95 | 17.22 | 25.12 |
| 1500 | Zero | 21.36 | 36.21 | 57.57 | 56.50 | 14.18 | 20.00 |
| | 0.30 | 33.16 | 46.35 | 79.51 | 68.71 | 19.98 | 25.50 |
| | 0.60 | 25.22 | 44.99 | 70.21 | 61.77 | 16.60 | 22.90 |
| | 1.20 | 25.08 | 43.28 | 68.36 | 58.66 | 16.18 | 21.27 |
| 3000 | Zero | 19.43 | 26.34 | 45.77 | 40.50 | 16.18 | 21.16 |
| | 0.30 | 28.55 | 36.57 | 65.12 | 55.33 | 21.73 | 24.55 |
| | 0.60 | 23.16 | 37.32 | 60.48 | 48.34 | 20.35 | 23.09 |
| | 1.20 | 20.24 | 30.37 | 50.61 | 47.90 | 18.88 | 21.21 |
| 4500 | Zero | 16.22 | 26.31 | 42.53 | 40.05 | 17.64 | 18.67 |
| | 0.30 | 24.84 | 32.19 | 57.03 | 51.39 | 22.33 | 23.67 |
| | 0.60 | 20.22 | 32.00 | 52.22 | 46.39 | 21.78 | 20.83 |
| | 1.20 | 18.59 | 26.49 | 45.08 | 44.73 | 21.40 | 20.23 |
| 6000 | Zero | 11.28 | 20.37 | 31.65 | 36.07 | 20.35 | 17.30 |
| | 0.30 | 21.13 | 25.03 | 46.16 | 50.66 | 24.76 | 22.63 |
| | 0.60 | 16.78 | 21.76 | 38.54 | 44.19 | 23.51 | 18.33 |
| | 1.20 | 15.50 | 22.68 | 38.18 | 42.51 | 22.80 | 17.63 |
| LSD at 5% | | 1.01 | 2.96 | 3.64 | 3.64 | 0.56 | 0.38 |
| Mean of main effects: | | | | | | | |
| Salinity (ppm) | Control | 27.97 | 38.69 | 66.66 | 52.05 | 17.82 | 26.02 |
| | 1500 | 26.20 | 42.71 | 68.91 | 61.41 | 16.74 | 22.42 |
| | 3000 | 22.84 | 32.65 | 55.49 | 48.02 | 19.29 | 22.50 |
| | 4500 | 19.97 | 29.25 | 49.22 | 45.64 | 20.79 | 20.85 |
| | 6000 | 16.17 | 22.46 | 38.63 | 43.36 | 22.86 | 18.97 |
| LSD at 5% | | 0.63 | 1.65 | 1.88 | 1.10 | 0.18 | 0.17 |
| Arginine (mM) | Zero | 18.29 | 29.18 | 47.47 | 43.99 | 16.66 | 20.30 |
| | 0.30 | 21.05 | 31.83 | 52.87 | 48.55 | 19.30 | 21.09 |
| | 0.60 | 22.31 | 36.03 | 58.34 | 50.54 | 20.00 | 22.09 |
| | 1.20 | 28.88 | 35.58 | 64.45 | 57.31 | 22.03 | 25.13 |
| LSD at 5% | | 0.42 | 1.21 | 1.49 | 1.49 | 0.23 | 0.15 |

Data presented in Table (3) show the role of arginine to ameliorate the adverse effect of salinity on the physiological constituents of mung bean seeds (total soluble sugar, polysaccharides, total carbohydrates, total amino acids, praline content and protein content). The pretreatment of mung bean seeds with arginine significantly increased the physiological constituents of mung bean seeds under saline and non-saline irrigation water. The increment magnitude was much pronounced by using 0.3 mM arginine under all salinity levels. These results could be supported by the results obtained by Abd El-Moneim (2007), El-Bassiony *et al*. (2008) and Hassanein *et al*. (2008) who indicated that arginine was the most effective compound in increasing soluble sugars, polysaccharides, total carbohydrates, total amino acids, proline and protein contents of wheat plants and grains under normal or stressed condition.

### References

Abd El-Haleem, A.K., S.A. Kandil, M.A. Kortam, 1995. Growth and yield of six wheat cultivars as affected by different levels of chloride salinization. J. of Agic. Sci., Mans. Univ., 20: 117.

Abd El–Monem, A.A., 2007. Polyamines as modulators of wheat growth, metabolism and reproductive development under high temperature stress. Ph.D. Thesis, Ain Shamas Univ., Cairo, Egypt.

Abd El-Wahab, M.A., 2006. The efficiency of using saline and fresh water irrigation as alternating methods of irrigation on the productivity of foeniculum vulgare mill subsp. vulgare var. vulgare under North Sinai Conditions. Res. J. of Agric. and Biol. Sci., 2(6): 571-577.

Abdul Qados, A.M.S., 2009. Effect of arginine on growth, yield and chemical constituents of wheat grown under salinity condition. Academic J. of Plant Sci., 2(4): 267-278.

Ashraf, M., M.R., Foolad, 2007. Roles of glycinebetaine and proline in improving plant abiotic stress resistance. Environ. Exp. Bot., 59: 206-216.

Ashraf, M. and P.J.C., Harris, 2004. Potential biochemical indicators of salinity tolerance in plants. Plant Sci., 166: 3-16.

Azza, A.M., S., Mazher, M., Zaghloul and T., El Mesiry, 2008. Nitrogen forms effects on the growth and chemical constituents of *taxodium disticum* grown under salt conditions. Australian Journal of Basic and Applied Sciences, 2(3): 527-534.

Bates L.S., R.P., Waldren, and I.D., Tear, 1973. Rapid determination of free proline for water – stress studies. Plant and Soil, 39: 205-207.

Bouchereau, A., A. Aziz, F. Larher and J. Murting-T.anguy, 1999. Polyamines and development challenges recent development. Plant Sci., 140: 103-125.

Cottenie, A., L.L.,Verloa, G. Hiens, Velghe and R., Camarlynch, 1982. Chemical analysis of plant and soil. Lab. Of Analytical and Agrochemichemistry, State Univ., Ghent, Belgium.

Dubois, M., K.A., Gilles, J.K., Hamilton, P.A., Robers, 1956. Colourimetric method for determination of sugars and related substances. Anal. Chem., 28: 350-356.

El- Bassiouny, H.M.S., M.A., Bekheta, 2001. Role of putrescine on growth, regulation of stomatal aperture, ionic contents and yield by two wheat cultivars under salinity stress. Egyptian J. Physiol. Sci, 2-3: 235-258.

El-Agrodi, M.W., M. Labeeb, G., Abd El-Hadi, T.A.M., Abdon, 2005. Influence of soil salinity on C.E.C, growth and NPK content of wheat roots. J. Agric. Sci. Mansoura Univ., 30(9): 5675-5687.

El–Bassiouny, H.M.S., H.A., Mostafa, S.A., El–Khawas, R.A., Hassanein, S.I., Khalil, A.A., Abd El–Monem, 2008. Physiological responses of wheat plant to foliar treatments with arginine or putrescine. Austr. J. of Basic and Applied Sci., 2(4): 1390-1403.

El-Karamany, M.F., M.S., Zeidan, and M.E., Gobarh, 2003. A comparative study on productivity of some mung bean varieties grown in sandy soil. Egypt. J. Agron. 25: 59-67.

El-Khimsawy, K.A., T.M., Younis, F.A., Mohamed, and M.A., Al-Alfy, 1998. A study on mung bean as a non-traditional feed stuff for broilers. Al-Azhar J. Agric. Res., 28: 101-115.

FAO, 2009. High level expert forum – how to feed the world in 2050. Economic and Social Development Department, Food and Agricultural Organization of the United Nations, Rome.

Galston, A.W. and Kaur-Sahney, 1990. Polyamines in plant physiology. Plant Physiol., 94: 406.

Gemea, I., J. Navarro, R. Moral, M. Iborra, G. Palacios, J. Mataix, 1996. Salinity and nitrogen fertilization affecting the macronutrient content and yield of sweet pepper plants. J. of Plant Nutr., 19: 353-359.

Ghoulam, C., A. Foursy and K. Fares, 2002. Effect of salts tress on growth, inorganic ions and proline accumulation in relation to osmotic adjustment in fuie sugar beet cultivars. Environ.Exp. Bot., 47: 39-50.

Glean, E.P., 1987. Relationship between cation accumulation and water content of salt tolerant grasses and sledge Plant Cell Environ., 10: 205-212.

Greenway, H. and R., Munns, 1980. Mechanisms of salt tolerance in nonhalophytes. Annu Rev Plant Physiol., 31: 149-190.

Hanafy, A.H., 1996. Physiological studies on tiploun and nitrate accumulation in lettuce plants .J.of Agric. Sci., Mansoura Univ., 21: 3971-3994.

Handel, E.V., 1968. Direct microdetermination of sucrose. Anal. Biochem., 22: 280.

Hasanuzzaman, M., M.A., Hossain, J.A.T., Silva and M. Fujita, 2012. Plant responses and tolerance to abiotic oxidative stress: antioxidant defenses is a key factors. In: Bandi V, Shanker AK, Shanker C, Mandapaka M (eds) Crop stress and its management: perspectives and strategies. Springer, Berlin, pp: 261-316.

Hassanein, R.A., 1977. Effect of certain growth regulators on plant growth and development. Ph.D. Thesis, Ain Shamas Univ., Cairo, Egypt.

Hassanein, R.A., S.I. Khalil, H.M.S. El–Bassiouny, H.A.M., Mostafa, S.A. El–Khawas, A.A. Abd El–Monem, 2008. Protective role of exogenous arginine or putrescine treatments on heat shocked wheat plant. 1st. International Conference on Biological and Environmental Sciences, Hurghada, Egypt, pp: 13-16.

Hozayn, M., M.S. Zeidan, E.M. Abd El-Lateef and M.S. Abd El-Salam, 2007. Performance of some mungbean ( *Vignna radiate* L. Wilczek) genotypes under late sowing condition in Egypt. Res. J. of Agric. and Biol. Sci., 3(6): 972-978.

Hussein, K.A., A.F. Hassan and G.Y. El-Nagar, 2008. Influence of irrigation with saline water on yield and nutrients uptake of wheat plant grown in sandy and sandy loam soils. Alex. Sci. Exch., 29: 55-63.

Jaleel, C.A., R., Gopi, P., Manivannan, and R., Panneerselvam, 2008. Soil salinity alters the morphology in Catharanthus roseus and its effects on endogenous mineral constituents. EurAsia J Bio Sci, 2: 18-25.

Khalil, S.I., H.M.S. El Bassiouny, R.A. Hassanein, H.A.M. Mostafa, S.A. El–Khawas and A.A. Abd El–Monem, 2009. Antioxidant defense system in heat shocked wheat plants previously treated with arginine or putrescine. Austr. J. of Basic and Applied Sci., 1517-1526.

Khan, M.A., A., Qayym, and E. Noor, 2007. Assessment of wheat genotypes for salinity tolerance proceedings of 8th. African Crop Sci. Conf. Octo. 27-31., El Minia, Egypt, pp: 75-78.

Krishnamurthy, R., 1991. Amelioration of salinity effect in salt tolerance rice Oryza sativa L. by foliar application of putrescine., Plant Cell Physiol., 32: 699-703.

Lawn, R.J., and C.S. Ahn, 1985. Mungbean (*Vigna radiata* (L.)Wilczek/Vigna mungo (L.) Hepper). In:R.J. Summerfield and E.H. Roberts (eds.). GrainLegume Crops. Collins, London, England., pp: 584-623.

Mo H., and E.C., Pua, 2002. Up – regulation of arginine decarboxylase gene expression and accumulation of polyamines in mustard (*Brassica juncea*) in response to stress. Physiol. Planta., 114: 439-449.

Mohamedin, A.A.M., A.A. Abd El-Kader M.B. Nadia, 2006. Response of Sunflower (*Helianthus annuus* L.) to Plants Salt Stress under Different Water Table Depths Journal of Apllied Sciences Research, 2(12): 1175-1184.

MSTAT-C, 1988. MSTAT-C, a microcomputer program for the design, arrangement and analysis of agronomic research. Michigan State University, East Lansing.

Munns, R., 2002. Comparative physiology of salt and water stress. Plant Cell Environ. 25:239-250.

Munns, R. and M. Tester, 2008. Mechanisms of salinity tolerance. Annual Review of Plant Biology, 59: 651-681.

Munns, R., 1993. Physiological processes limiting plant growth in saline soils: some dogmas and hypotheses. *Plant, Cell and Env.,* 16: 15-24.

Muting, D. and E. Kaiser, 1963. Spectrophotometric method of determining of amino-N in biological materials by means of the ninhydrin reaction. Seyler's Zschr. Physiol. Chem., 332: 276.

Nassar, A.H., K.A. El–Tarabily and K. Sivasithamparam, 2003. Growth promotion of bean (*Phaseolus vulgaris* L.) by a polyamine – producing isolate of Streptomyces griseoluteus. Plant Growth Regul. Kluwer Academic Publishers, Dordrecht, Netherlands, 40(2): 97-106.

Nou, X., R.A. Bressan, P.M. Hasegawa and J.P., Pardo, 1995. Iron homeostasis in NaCl stress environments. Plant Physiol., 109: 735-742.

Parida, A.K. and A.B. Das, 2005. Salt tolerance and salinity effects on plants: A review. Ecotoxicology and Environmental Safety, 60: 324-349.

Pirie F.G., 1955. Proteins. In Modern Methods of Plant Analysis. edited by (Peach K. and Tracey, M. V.). IV: 23-68 Springer Verlag, Berlin.

Rahnama, A., K. Poustini, R. Munns and R.A. James, 2010. Stomatal conductance as a screen for osmotic stress tolerance in durum wheat growing in saline soil. Functional Plant Biology, 37: 255-263.

Sarwat, M.I., and M.H., El-Sherif, 2007. Inducing salt tolerance in some rice varieties (Oryza sativa L.) by using some growth regulators. J. Biochem. Environ. Sci., 2: 189-215.

Satti, S.M.E., and M. Lopez, 1994. Effect of increasing potassium levels for alliviating sodium-chloride stress on the growth and yield of tomato. Commun. Soil Sci. Plant Anal., 25: 2807-2823.

Sherif, F.K., M.M. Raslan and F.Z. El-Sammak, 2007. Effect of Gamma radiation on some morphological and biological characters of Tagetes erecta grown in saline soil. Alexandria Science Exchange Journal, 28(2): 54-66.

Sliman, Z.T., and M.O., Ghandoor, 1988. Effect of salinity levels on dry matter production of soybean plants. Annals Agric. Sci. Fac. Ain-Shams Univ., 33(1): 213-229.

Stroganov, B.P., 1962. Physiological basis of the salt tolerance of plants (under different types of soil salinization) Izd. Akad. Nauk. USSR. Moscow.

Taffouo, V.D., J.K. Kouamou, L.M.T. Ngalangue, B.A.N. Ndjeudji and A. Akoa, 2009. Effects of salinity stress on growth, ion partitioning and yield of some cowpea (*Vigna unguiculata* L. Walp.) cultivars. Inter. J. of Botany, 5(2): 135-143.

*J. Appl. Sci. Res., 9(1): 393-401, 2013*

Taffouo, V.D., M. Kenne, T R. Fokam, W.O.T. Fotsoe, V.Z. Fonkou and A. Amougou, 2004. Salt stress variation response in five leguminous plants. Agron. Afr., 16: 33-44.

Tavakkoli, E., P. Rengasamy and G.K. McDonald, 2010. High concentrations of $Na^+$ and $Cl^-$ ions in soil solution have simultaneous detrimental effects on growth of faba bean under salinity stress. J Exp Bot., 61: 4449–4459.

Tester, M. and R. Davenport, 2003. $Na^+$ tolerance and $Na^+$ transport in higher plants. Ann. Bot., 91: 503-27.

Velikova, V., I.A. Yordanov and Edreva, 2000. Oxidative stress and some antioxidant systems in acid rain-treated bean plants. Protective role of exogenous polyamines. Plant Sci., 5: 59-66.

Wada, N., M. Shinozaki and H. Iwamura, 1994. Flower induction by polyamines and related compounds in seedlings of morning glory (Pharbities nil cv. Kidachi). Plant Cell Physiol., 35: 469-472.

Xu, Y.C., J. Wang, L. Shan, X. Dong, and M.M. Li, 2001. Effect of exogenous polyamines on glycolate oxidase activity and active oxygen species accumulation in wheat seedlings under osmotic stress. Israel J. Plant Sci., 49:173-178.

Yamaguchi, T. and E. Blumwald, 2005. Developing salt-tolerant crop plants: challenges and opportunities. TRENDS in Plant Science, 10(12): 615-620.

Yemm, E.W. and A.J. Willis, 1954. The respiration of barley plants.IX. The metabolism of roots during assimilation of nitrogen. New Phytol, 55: 229-234.

Yeo, A.R and T.J. Flowers, 1986. Salinity resistance in rice (*Oryzn sativa* L.) and a pyramiding approach to breeding varieties for saline soils. Aust J Plant Physiol., 13: 161-173.

Zadeh, H.M. and M.B. Naeini, 2007. Effects of salinity stress on the morphology and yield of two cultivars of canola (*Brassica napus* L.). J. Agron., 6: 409-414.