International Journal of Water Resources and Environmental Sciences 1(3): 76-81, 2012
ISSN 2311-2492

DOI: 10.5829/idosi.ijwres.2012.1.3.1112

Effect of Na_2So_4 Salinity on Brinjal (*Solanum melongena*)

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Abstract: Soluble salts are present in all soils and irrigation water, which are essential and required for normal plant development and growth. The design used for the experiment is CRD with three replicates with three different treatments of Na_2So_4, was conducted to check the effect of salinity on plant growth. After 14 days interval it was observed that different replicates showed different morphological growth parameters due to application of Na_2So_4. Results showed that replicates with maximum salt concentration i.e. that is 60 ppm Na_2So_4 gave best growth which showed that maximum salt stress for brinjal was good enough for growth and stress showed positive response on the plants with 60 ppm Na_2So_4 normally salinity stress in excess is harmful for plant growth but our experimental observations showed that our brinjal specie was salt tolerant. Plants bore the salt stress upto 60 ppm Na_2So_4. It was examined that this tolerance limit was not harmful and not acted as stress on brinjal spp. Infact it favored the plant growth. Discrepancies and inconsistences can also exist there in some of information due to difference in environments, cultivars and experimental conditions.

Key words: Na_2So_4 · *Solanum melongena* · Salinity Egg Plant

INTRODUCTION

Many soils especially the semi-arid irrigated areas that contain excess amount of these salts that could become hazardous and harm full for plant growth. Water salinity has its negative influence on growth of many crops. Normally, Salinity occurs due to the excess presence of salts like sodium chloride, magnesium and calcium sulfate and bicarbonates. Recently, very high temperature and rainfall absence are major salinity factors. High temperature results in excess evaporation and so annual precipitation less than annual evaporation. Moreover salinity also results in the fertilizers we apply to our crops; salinity may also due to the ions toxicity and imbalance uptake of nutrients. Crop damage in Pakistan is due to salinity, is estimated of about Rs880 million ($28.5 million) this year. Saboora *et al*. [1] alarmed that there was a hazardous increase in saline areas 10 % per year throughout the world. In Pakistan Aslam [2] and Khan *et al*., [3] told that 5.3 million hectors in Pakistan is covered by saline soils. In agriculture land 6.67 million hectors are affected by salinity out of 20 million hectors and this damage is going to be increase in next twenty years. Brinjalsor egg plant (*Solanum melongena)* is salt tolerance but due to the increase in salinity absorption of nutrients i.e. NPK, Ca and Mg by brinjal fruit, root and plant body is decreased. While the Na value increases with increase in salinity. The quality of brinjal plant is also costly affected by increased salinity. Different morphological parameters in brinjals like plant growth and leaf size affected by salinity. Grafting method of rootstock has been found to be most effective for increasing salt tolerance in different vegetables like tomato and brinjals. Grafting can raise the salt tolerance of tomato and brinjal by limiting transport of sodium and chloride to the shoot [4, 5]. All types of soils are suitable for brinjal, but the most suited for brinjal growth and cultivation is clay loam and silt loam soils. 5.5-6.0 is the best optimum soil pH range for brinjals. The general effect of salinity is to reduce the growth rate resulting in smaller leaves, shorter stature and sometimes fewer leaves. The initial and primary effect of salinity, especially at low to moderate concentrations, is due to its osmotic effects [6, 7].

MATERIALS AND METHODS

General Procedures: 42 days pot experiment was examined and supervised in the Botany department, at University of Gujrat, 2013. There were 9 pots (15cm diameter 27 cm depth) and each pot was filled

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with 6 kg loamy soil taken from university of Gujrat. About one month old equal and uniformed size seedlings of brinjal were collected from Kisaan beej store, Lalamusa. In each pot 2 seedlings were grown during May, 2013. Watered these pots for 14 days. After that out of 9 pots, 3 pots were kept as controlled pots with no treatment, 3 pots were given a treatment of 30 ppm Na2So4 and remaining 3 received the treatment of 60 ppm Na_2SO_4.

Initial Stage Readings: After 14 days of treatment with Na_2So_4 we started taking initial stage readings of different parameters, we took readings of (1) Leaf area (2) Root length (3) Shoot length (4) Leaf length (5) Root fresh weight (6) Shoot fresh weight (7) Leaf area ratio (8) Specific leaf weight (9) Root dry weight (10) Shoot dry weight (11) Relative growth rate (12) Leaf area per plant.

Chlorophyll Test: Chlorophyll test was done of all the replicates of all 3 treatments with the help of spectrophotometer.

Final Stage Readings: After initial stage readings by the gap of 14 days we took final stage readings by removing 2^{nd} seedlings from the pots and all above described parameters were taken again for the final readings.

Instruments: During performing experiments, different instruments were used like spectrophotometer and weight balance etc. in spectrophotometer 2 cuvettes were available and one cuvette filled with acetone and fixed in the spectrophotometer while another cuvette filled with the chlorophyll and placed right next to the acetone cuvette in sample compartment of spectrophotometer after closing that compartment desired wavelength was set and then readings obtained of each replicate in this way one by one for chl a, chl b and caroteniods respectively. Another instrument that utilized was Analytical Balance which was use for fresh shoot and root weights and dry shoot and root weights a central pan is present to put root and shoot etc, otherwise level screw is also present to balance this instrument for proper use.

Results: Following are the initial stage readings:

Initial Readings

Table 1: Showing M.S of Leaf Area, M.S of Root Fresh Weight and M.S of Shoot Fresh Weight

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Leaf Area	M.S of Root Fresh Weight	M.S of Shoot Fresh Weight
Salinity	2	74.768 ns	0.123 ns	0.032 ns
Error	6	62.247	0.081	0.153
Total	8			

Table 2: Showing M.S of Shoot Length, M.S of Root Length and M.S of Leaf Length

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Leaf Area	M.S of Root Fresh Weight	M.S of Shoot Fresh Weight
Salinity	2	13.23 ns	0.223 ns	1.701 ns
Error	6	11.40	4.868	1.477
Total	8			

Table 3: Showing M.S of Leaf Area Per Plant, M.S of Specific Leaf weight and M.S of LAR

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Leaf Area Per Plant	M.S of Specific Leaf Weight	M.S of Leaf Area Ratio (LAR)
Salinity	2	2296.921 ns	0.388 ns	1230.011 ns
Error	6	1453.358	1.962	7202.057
Total	8			

Table 4: Showing M.S of Chlorophyll 'a', Chlorophyll 'b' and Carotenoids

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Chlorophyll "a"	M.S of Chlorophyll"b"	M.S of Carotenoids
Salinity	2	0.068 ns	0.009 ns	4.623 ns
Error	6	0.143	0.004	0.002
Total	8			

Table 5: Showing M.S of Root Dry Weight, M.S of Shoot Dry Weight and M.S of RGR

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Root Dry Weight	M.S of Shoot Dry Weight	M.S of Relative Growth Rate (RGR)
Salinity	2	0.110 ns	0.088 ns	0.020 ns
Error	6	0.039	0.020	0.079
Total	8			

Final Readings

Following are the Final Stage Readings

Table 6: Showing M.S of Leaf Area, M.S of Root Fresh Weight, M.S of Shoot Fresh Weight

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Leaf Area	M.S of Root Fresh Weight	M.S of Shoot Fresh Weight
Salinity	2	136.942 ns	0.147 ns	0.112 ns
Error	6	73.644	0.180	1.947
Total	8			

Table 7: Showing M.S of Shoot Length, M.S of Root Length, M.S of Leaf Length

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Shoot Length	M.S of Root Length	M.S of Leaf Length
Salinity	2	89.954 ns	16.734 ns	5.151 ns
Error	6	17.51	9.986	2.214
Total	8			

Table 8: Showing M.S of Leaf Area Per Plant, M.S of Specific Leaf Weight, M.S of LAR

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Leaf Area Per Plant	M.S of Specific Leaf Weight	M.S of Leaf Area Ratio (LAR)
Salinity	2	1174.339 ns	448.829 ns	18811.831 ns
Error	6	1786.634	393.533	12153.080
Total	8			

Table 9: Showing M.S of Chlorophyll 'a', M.S of Chlorophyll 'b', M.S of Carotenoids

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Chlorophyll "a"	M.S of Chlorophyll "b"	M.S of Carotenoids
Salinity	2	0.0200 ns	0.240 *	0.292 ***
Error	6	0.020	0.02	0.010
Total	8			

Table 10: Showing M.S of Root Dry weight, M.S of Shoot Dry Weight

Source of variance (S.O.V)	Degree of freedom (df)	M.S of Root Dry Weight	M.S of Shoot Dry Weight
Salinity	2	0.224 ns	0.083 ns
Error	6	0.088	0.058
Total	8		

Graphs Showing Results: In both final and initial graphs deviation is present. In initial readings there is no any significant results are there. Graphs are showing extreme variations. But after 14 days in final stage readings results are significant in chlorophyll b and in careteniods (final stage reading). While reaming other parameters are not affected much.

RESULTS AND DISCUSSION

The general effect of salinity is to reduce the growth rate resulting in smaller leaves, shorter stature and sometimes fewer leaves. The initial and primary effect of salinity, especially at low to moderate concentrations, is due to its osmotic effects [6, 7].

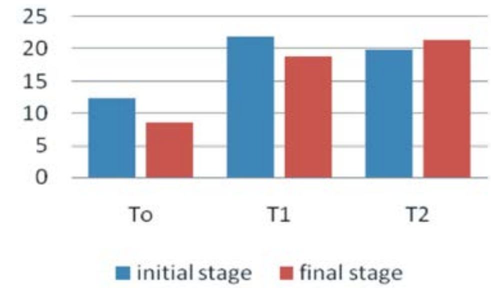

Fig. 1: leaf area (cm^2)

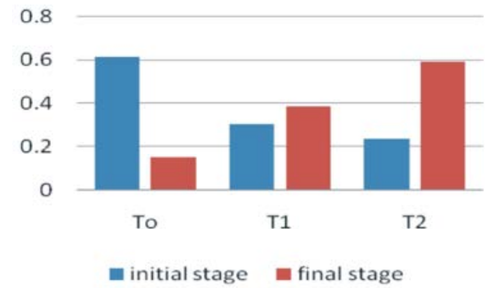

Fig. 2: Root Fresh Weight (g)

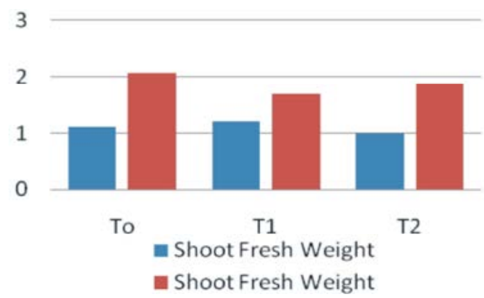

Fig. 3: Shoot Fresh Weight (g)

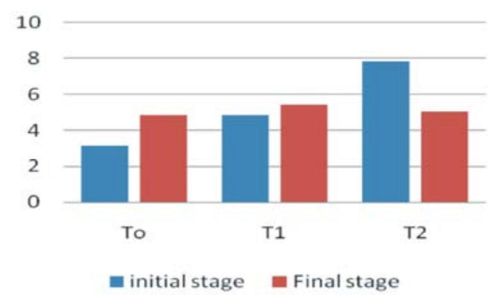

Fig. 4: Root Length (cm)

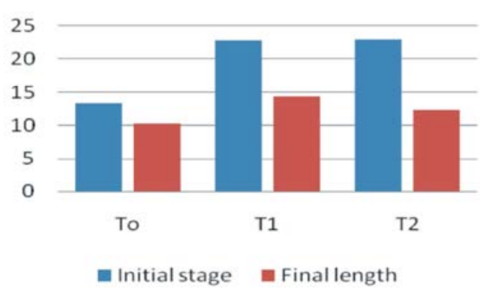

Fig. 5: Shoot Lenght (cm)

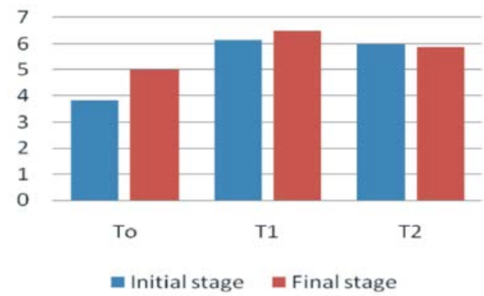

Fig. 6: Leaf Length (cm)

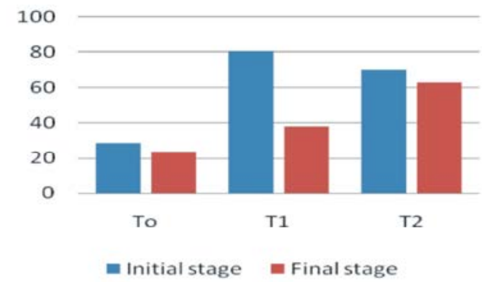

Fig. 7: Leaf Area Per Plant

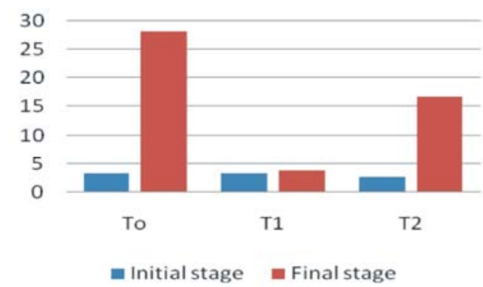

Fig. 8: Specific Leaf weight (mg/cm^2)

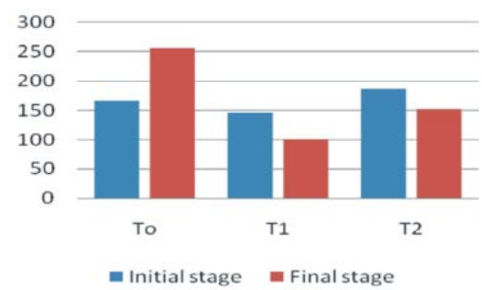

Fig. 9: Leaf area Ratio (cm^2)

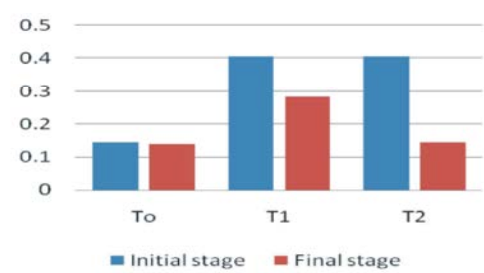

Fig. 10: Chlorophyll `a`

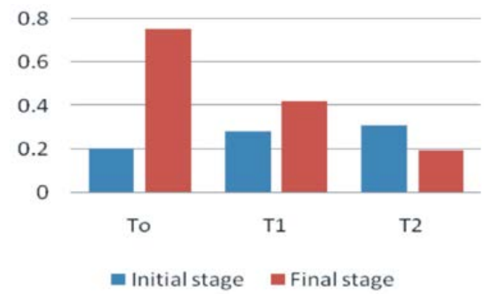

Fig. 11: Chlorophyll `b`

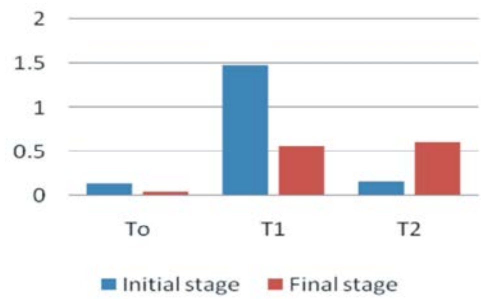

Fig. 12: Carotenoids

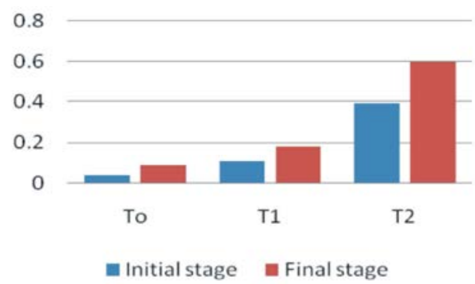

Fig. 13: Root Dry weight (g)

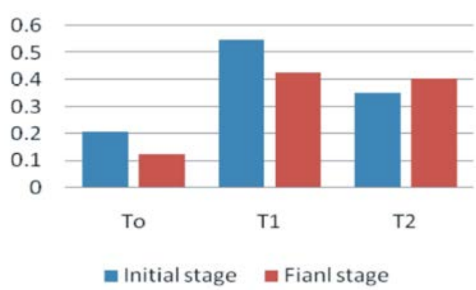

Fig. 14: Shoot Dry Weight (g)

The severity of salinity response is also mediated by environmental interactions such as relative humidity, temperature, radiation and air pollution [8]. All salinity effects may not be negative; salinity may have some favorable effects of yield, quality and disease resistance. Important environmental factors that show significant interaction with salinity include temperature, wind, humidity, light and air pollution. High temperatures and low humidity's may decrease crop salt tolerance by decreasing the effective values.

Depending upon the composition of the saline solution, ion toxicities or nutritional deficiencies may arise because of a predominance of a specific ion or competition effects among cations or anions [9]. All salinity effects may not be negative; salinity may have some favorable effects of yield, quality and disease resistance. In brinjal for example, yields may initially increase at low to moderate salinity [10]. The relative salt responses of various crops are often dependent upon soil type andother environmental factors [11].

Rana [12] has cited the complexity of soils and environmental interactions as major obstacles to successful breeding for salt tolerance. He noted that crops adapted to alkali soils are usually tolerant of non-alkaline saline soils, but the converse was not true.

Various institutes are working to manage the salinity which gives adverse effect on different plants and vegetables growth. As it is known that excess of everything is bad. In case of salinity there should be management tools from the government to safe land and crop. One of the best management is to grow plant species which are the salinity tolerant. Use of less saline water so the normal nutrient balance should be there for plant to use. More over careful irrigation design system should be applied on fields. In the above experiments initial readings does not show any significant readings the reason may be human error or may be instrumental error. Instrumental error in such senesce that the weight machine may not properly balanced. Salt tolerance ability varies from crop to crop well there is no any obvious and clear salinity affect was found on brinjal growth however some brinjal plant showed less growth as compared to others. While the final readings showed better growth and significant readings as compared to first one.

All the above experiment details revealed that salinity does not always affect in negative way but it promotes growth up to certain limits and conditions.

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