International Journal of Water Resources and Environmental Sciences 1(3): 94-97, 2012
ISSN 2311-2492

DOI: 10.5829/idosi.ijwres.2012.1.3.1114

Morphological, Physiological and Biochemical Attributes as Indicators for NaCl Tolerance in Lady Finger (*Abelmoschus esculantus* L.)

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Abstract: Salt stress is the major problem that effects the growth and productivity of the *Abelmoschus esculantus*. This effect is high in the low concentration of water. To study the effect of NaCl on *A. esculantus* an experiment was conducted in the research lab University Of Gujrat in 2013. The experimental design was Complete Randomized Design (CRD) having four replicates with four different treatments. We observed the NaCl affect the leaf length, root fresh weight, root dry weight, root length and chlorophyll a concentration. Therefore, the low concentration of water and high concentration of salt retard the different growth and physiological and biochemical attributes of *A. esculantus.*

Key words: Morphology · Physiology · NaCl · Lady finger

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is an annual, often cross pollinated important vegetable of the tropical and subtropical areas. It was originated in India but now grown in many parts of world including the Middle East, Africa, Brazil, Turkey and southern states of [1, 2]. Almost all parts of okra plant are consumed, like fresh okra fruits are used as vegetable, roots and stem are used for clearing the cane juice [3] and leaves and stems are used for making fiber and ropes [1]. Okra seeds containing good quality edible oil and high protein are used to complement other protein sources [4]. The okra pods contain mucilage, which is comprised of a mixture of pectin and carbohydrates, which is used as a thickener in food industries [5]. Okra flour is an effective food additive in wheat flour for baking bread with good technological and sensory characteristics [2].Salinity, drought and high temperature are the predominant environmental stresses to crop production in tropical and subtropical areas but in arid and semi-arid environments the effect of salinity are more devastating [6-8]. About 7% of the lands surface and 5% of cultivated land in the world is already inundated by excess salinity [9], primarily caused by insufficient drainage and low quality irrigation water [10]. In addition, there is greater pressure on arable lands to produce more to feed growing populations, especially in developing countries and consequently marginal lands are being brought under cultivation which was not cropped due to their high degree of natural salinity or other toxicities [11]. Pakistan is situated within the subtropical region and has semi-arid to arid climate. According to a survey conducted by WAPDA the total irrigated area in Pakistan is 16.795 million ha, which is categorized as non-saline (73%) slightly saline (10%), moderately saline (4%), strongly saline (7%) and miscellaneous land type area (6%) [12]. The soils contain mixture of different salts [13] but in Pakistan more than 60% soils are sodic and salinity stress is mostly due to Na+ salts [14]. Characteristics of a salt-tolerant variety include Na+ 'exclusion', K+/Na+ discrimination, retention of ions in the leaf sheath, tissue tolerance, ion partitioning into different-aged leaves, osmotic adjustment, transpiration efficiency, early vigor and early flowering leading to a shorter growing season and the increased water use efficiency [15].

The objective of this study to evaluate of adverse effect NaCl on the morphological and physiological parameter of growth on ladyfinger.

MATERIAL AND METHODS

Adverse effect of NaCl on ladyfinger examine during April –June 2013. Seed of the ladyfinger were sow in pots

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at 23 March. Four replicate were form and at 27 march seeds were germinate. After 14 days implementation of treatment were start.

Following treatments were applied:

T_0 : Control (Distilled Water)
T_1 : 50 ppm NaCl
T_2 : 50ppm Na_2So_4
T_3 : 50 ppm NaCl+ 50 ppm Na_2SO_4

After the 10 days water treatment were applied and then the plants uprooted from the pots. Fresh weights of the whole plant are taking by electric balance and then the fresh weight of the roots and shoot measure. The length of leaves, shoot and root also measured with scale. For the dry weight shoot and root put in to the oven for four days at 65°C. Then the weighted dry shoot and root. The chlorophyll and Carotenoids tests were taken on spectrophotometer model UV 300, Company O.R.I., Reinbeker Weg. 75 Hamburg, Germany. The readings of samples were taken on different wavelengths i.e. 480, 510, 645, 663. Following formula was applied on the spectrophotometer reading.

Chl.a (mg g^{-1}f.wt) = [12.7 (O.D 663) - 2.69 (O.D 645)] x V/1000 x W
Chl.b (mg g^{-1}f.wt) = [22.9 (O.D 645) - 4.68 (O.D 663)] x V/1000 x W
Carotenoids (mg g^{-1}f.wt) = [7.6 (O.D 480) - 1.69 (O.D 510)] x V/1000 x W

W = Weight of the fresh leaf (g)
V = Volume of the extract (ml)

RESULT AND DISCUSSION

This experiment was show the adverse effect of salt on ladyfinger applied at seedling stage. In Fig. 1i. root length shows that the root length decrease in t_1 as compare to the t_0 because t_1 was treated with NaCl while t_0 with water. Therefore, it represent that NaCl reduced the leaf growth. In the leaf area (Fig. 1 e.) shoot length (Fig. 1. f.) and root length (Fig. 1.i.) the t_0 was minimum but little decrease the other treatments.Salinity affects plant growth during all developmental stages therefore the crop responses to salinity may vary during the ontogeny [16-19]. For the selection of salt tolerant breeding material, information about the degrees of salt tolerance at all plant growth stages in a crop species is important. Response to salinity is thought to be controlled by a number of genes that may be stage specific [20].

In this case of leaves as shown in (Fig. 1. g.) t_3 was minimum while minimum at $t_o$due to salt stress also shown in Table 1. A reduction in the plant height was reported in lady finger [21] and in canola [22] with increased salinity in growth medium. The number of branches plays animportant role in yield increase by bearing more number of pods and the similar reduction in number of tillers in wheat was reported by Bhatti, *et al*. [23]. Under saline conditions, the number of branches per plant was also decreased but more in salt sensitive genotypes and less in salt tolerant genotypesRoot dry weight increase at t_1 and decrease at t_o and t_3 shows that NaCl was appropriate for the root dry weight. Shoot, fresh weight (Fig. 1. b) was reducing at t_0 due to salt stress (50ppmNaCl). Ashraf *et al*. [24] reported that percent fresh and dry weights of roots and shoots and mean shoot length and leaf area were significantly higher in Sabz Bhindi than

Table 1: Means of analysis of variance for shoot fresh weight, root fresh weight, shoot dry weight, root dry weight shoot length, leaf length and leaf area

S.0.V	df	M.S of shoot fresh weight(g)	M.S of root fresh weight(g)	M.S of shoot dry weight(g)	M.S of root dry weight(g)	M.S of shoot length(cm)	M.S of leaf length(cm)	M.S of leaf area(cm^2)
Adverse effect of NaCl	3	0.0360	1.244	0.537	0.003	1.244	0.069	4.220
Error	12	0.0250	1.695	0.202	0.003	1.695	0.260	4.518
Total	15							

Table 2: Means of analysis of variance for Chl. a, Chl. bCarotenoids, SLW, LAR and RGR.

S.0.V	df	M.S of root length(cm)	M.S of chl. a	M.S of chl. b	M.S of Carotenoids	M.S of SLW	M.S of LAR	M.S of RGR
Adverse effect of NaCl	3	0.193	0.268	0.155	0.097	0.073	265.513	0.002
Error	12	0.868	0.114	0.804	0.050	0.124	238.414	0.001
Total	15							

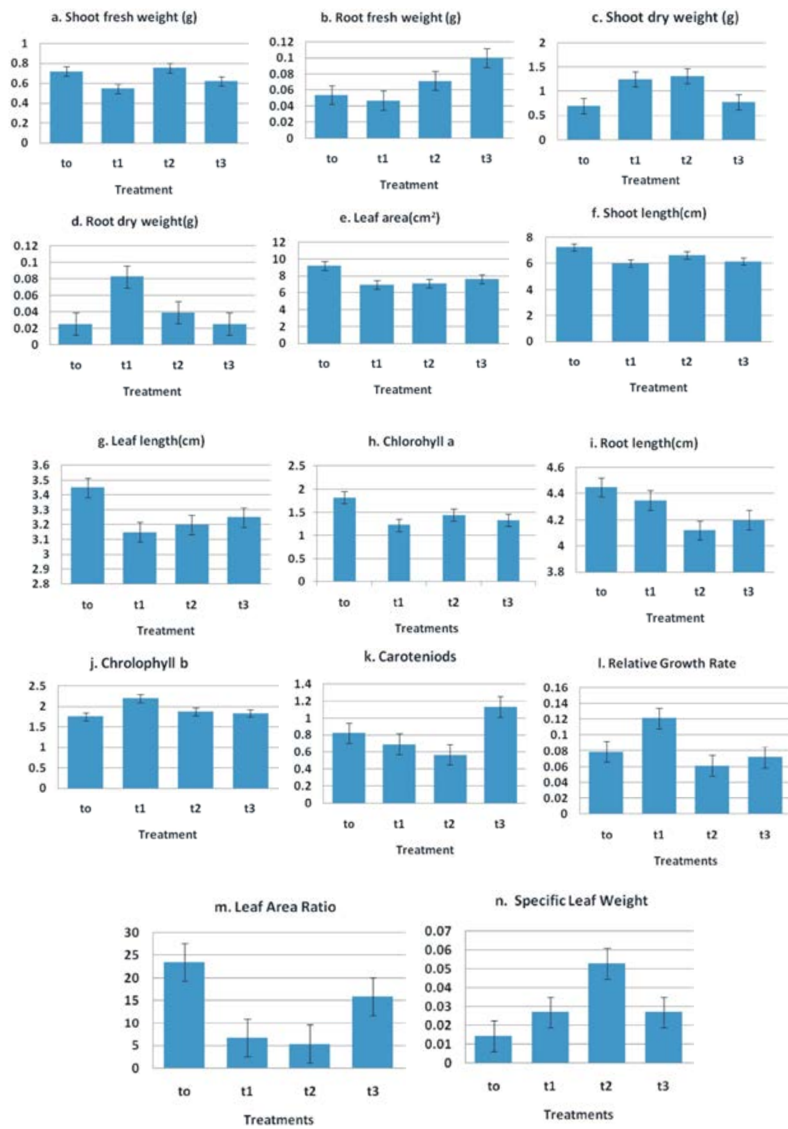

Fig. 1: Shows effect of NaCl on lady's finger on shoot fresh weight (a), root fresh weight (b), shoot dry weight (c), root dry weight (d), leaf area (e), shoot length (f), leaf length (g), Chl. a (h), root length (i), Chl. b (j), Carotenoids (k), relative growth ratio (l), leaf area ratio (m) and specific leaf weight (n).

those of Pusa Sawani under saline conditions. Chlorophyll a, chlorophyll b and carotenoids are the photosynthetic pigments. In the case ladyfinger chlorophyll a (Fig. 1. h) concentration was decrease due to the salt stress and the photosynthetic rate decrease. Chlorophyll b was not much effect (Fig. 1.j) but the carotenoids (Fig. 1. k) value was decreases, which reduce the photosynthetic rate. Therefore, the excess of salt resulted the stunted growth of ladyfinger and the environmental factor such as humidity influenced it. Excess salt in the soil have the similar effect with the stress due to lack of water. High concentration of salt has osmotic effect which shows that amount of water is reduce from soil. Toxicity symptoms appeared and the yield decreases. Excess salt in soil may also reduce the nitrogen and potassium. Therefore, these elements add by fertilizers.

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