GROWTH ANALYSIS OF SOME CHICKPEA (*Cicer arietinum* L.) LINES UNDER SALT STRESS

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ABSTRACT: A pot experiment was conducted to determine the growth analysis of some chickpeas (C*icer arietinum* L.) Lines under salt stress. The experiment was conducted in the wire house of the Old Botanical Garden, University of Agriculture, Faisalabad. Seeds of different chickpea lines (CH32/02, ch73/02, CH77/02, CM84/02, CH07/02, CM83/02, CH21/02, CM85/02 and CH44/04) were sown completely randomized design (CRD). Three concentrations of salinity 0, 25 and 50 m*M* were applied exogenously after the establishment of the seedlings. Each treatment was replicated thrice. Data for different growth and yield parameters was recorded during the course of study and was subjected to statistical analysis for the comparison of treatment means. Exposure of chickpea lines to salt stress severely affected the morphological and yield parameters. Plant heights (root and shoot length) and fresh and dry weights were significantly reduced as compared to plants grown under salt free environment. Salt stress also caused reduction in ion uptake and accumulation. Marked reduction in both leaf and shoot Na^+, K^+, and Ca^+ contents was observed under salt stress application, photosynthetic pigments i.e. chlorophyll *'a'* ,chlorophyll *'b'* and carotenoids adversely affect by salt stress . Maximum reduction in all parameters was observed at 50 m*M* concentration of salt. Similarly, salt stress also caused reduction in seed yield per pot and no of pods per plant. This study proved that salinity is highly toxic that suppressed growth, yield and inhibition of ion uptake and accumulation in chickpea and Salinity decreases the photosynthetic pigments at every salinity level.

Keywords: Chlorophyll pigments, Yield traits, Morphological traits.

INTRODOUTION

Soil salinity has adversely affected an area of about 100 mha of the arable land. Overall this area is expanding dramatically in world (Ghassemi *et al.,* 1995). There is about one third agricultural land is affected and their salt level is also increasing with time (Lazof and Bernstein, 1997). Of the total land area in Pakistan, 21.87 mha is affected by salinity (Government of Pakistan, 2008). Salinity is the result of different types of salts in soil or water. It may be chlorides, sulfates, carbonates and bicarbonates of Ca, Mg, Na and potassium that may disturb the growth of plants (Levy and Robaire, 1999). Salt stress greatly dismays the growth by reducing the work of nitrogen fixing bacteria in Leguminose.

Salinity is one of the environmental limitations on agriculture in a large number of areas of the world (Boyer, 1982; Serrono and Gaxiola, 1994). When ion concentration exceeds the threshold level then it becomes toxic that severely affected growth of plants. It reduces plant growth by extensively reducing the water potential or interfering with the nutrients uptake (Hameed and Asharf, 2008). Salinity disturbs plant metabolism in the response of high amount of salt concentration in soil solution that may results in reduced growth (Marschner 1995; Ashraf *et al.,* 2006). Salinity affects plant growth by weakening the plants ability to absorb water from the soil. The large amount of salts found in soil makes it harder for plant to absorb all the nutrients necessary to be healthy. As a result, most of the plants become weaker, and in some cases, end up dying.

Chickpea (*Cicer arietinum* L.) is a major food Legume and an important source of protein in many countries. It is also used widely as fodder and green manure. Its seed contain 20.6% protein, 2.2% fat and 61.2% carbohydrates (Gupta, 1987). *Cicer arietinum* L. is native to arid areas; it also has an extent to adapt different environmental stresses. However it is highly sensitive to salinity, like many other leguminous crops (Ashraf and Waheed, 1993). The average yield of chickpea in the major growing regions is around 0.5-0.7 t/ha. Generally the crop produces excessive vegetative growth under high input conditions but is unable to convert the biomass into high seed yield. The major abiotic constraints to production include drought, heat, cold and salinity while biotic constraints are *Fusarium* wilt, *Ascochyta* blight, *Rhizoctonia* dry root rot, *Botrytis* gray mold (BGM), chickpea stunt and *Helicoverpa* pod borer (HPB). The present study will focus on the impact of abiotic stress (salinity) on *C. arietinum* L.

OBJECTIVES

- To examine the growth of (*Cicer arietinum* L.) under the salt stress.
- To evaluate growth analysis of chickpea lines under salt stress.
- To correlate growth of (*Cicer arietinum* L.) under normal and saline conditions.

MATERIALS AND METHODS

The experiment was carried out in wire house of the Old Botanical Garden, University of Agriculture, Faisalabad to evaluate the growth of chickpea (*Cicer arietinum* L.) under salt stress. Three salinity levels were maintained (0, 50 and 100 m*M* NaCl). The experiment was laid down in Completely Randomized Design (CRD) with three replications. All treatments were applied 20 days after germination. Data for different growth and yield parameters was recorded during the course of study and was subjected to statistical analysis for comparison of treatment means. Following parameters was evaluated during the course of study:

Morphological traits

Shoot length (cm)**,**Root length (cm)**,**
Shoot fresh weight (g)**,**Root fresh weight (g),
Shoot dry weight (g) and Root dry weight (g)

Ions contents

Na^{+} contents**,**Ca^{2+} contents and K^{+} contents

Chlorophyll pigments

Chlorophyll *a* (mg/g), Chlorophyll *b* (mg/g) and Carotenoid (mg/g)

Yield traits

Amount of pods per plant and No of grams per pot.

STATISTICAL ANALYSIS

A two way analysis of variance of data for all parameter was computed under (CRD). The data collected was analyzed using the analysis of variance (ANOVA) technique and the treatment means were compared by least significant differences (LSD) at 5% probability level (Steel and Torrie, 1984)

RESULTS AND DISSCUSION

It is evidence that land clearing and subsequent irrigation resulting in rising water table are the main causal factors of salinity in agricultural soil

(Munns *et al.*,2002) with use of low quality irrigation water, water logging, and excessive leaching being exacerbating factors (Szabolcs, 1994). While rain water generally contains up to 500 mgL^{-1}. Since crops require from 6,000 to 10,000 m^3 of water per hectare each year, one hectare of land may receive3 to 5 tons of salt (Ghassemi *et a*l., 1995).

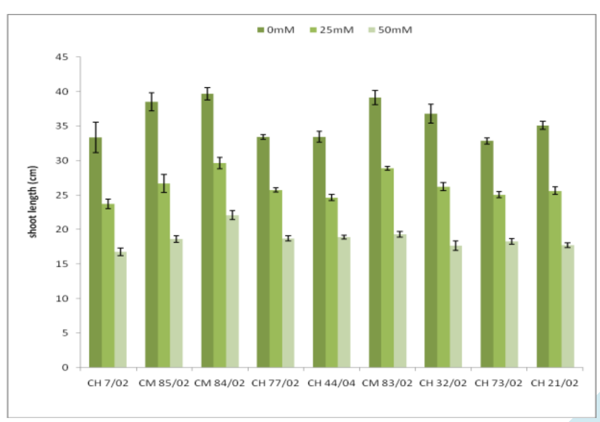
In the view of results obtain from this experiment; it is evident that salt stress causes a reduction in growth and yield of chick peas cultivars. However, this adverse effect of salt stress was predominant on photosynthesizing leaves, plant dry biomass, number of pods and total seed weight. (Ashrif , 2005).NaCl application through rooting medium exacerbated the adverse effect on the vegetative growth of chickpeas cultivar. Salt stress caused reduction in plant fresh and dry biomass and also reduced its yield and photosynthetic pigment (Mass and Grieve, 1987; Mass and Grieve 1990).

Results about the reduction in plant bio mass and yield due to salt stress are in the favor of (Ashraf, 1994, 2004; Zhu, 2002; Tester and Devenport, 2003).They reported that soil salinity causes reduction in plant productivity because plant under salt stress may fsce foure types of stresses i.e. osmotacily induced water stress, specific ion toxicity, ion imbalance and oxidative stress. So in view of above reports salt stress caused a reduction in in cell water status of chickpeas which might be responsible for reduction in plant bio mass and yield.

. Application of salt to a medium (soil) caused a significant reduction in shoot length, root length, plant dry and fresh weight of all chickpea cviltvars. However, all varieties different concentrations of salinity showed similar behavior. Overall, maximum reduction was observed in all verities when 50mM concentration of salinity was applied. A significant varietal difference in shoot length, root length, dry and fresh weight of chickpea genotypes was also observed. However, maximum increase in shoot length was observed in CM 84/02 when no salinity was applied whereas maximum reduction was observed in CH 73/02 when 50mM salinity level was applied.

SOV	SS	D.F.	MS	F-VALUE	P-VALUE
Varieties (V)	262.0161	8	32.7520	16.6159	0.0000 ***
Salinity (S)	3978.9873	2	1989.4936	1009.3240	0.0000 ***
Interaction V x S	62.5260	16	3.9078	1.9825	0.0318 *
Error	106.4402	54	1.9711		
Total	4409.9697	80			

Analysis of variance (ANOVA) for shoot length of different chickpeas varieties under varying levels of NaCl.

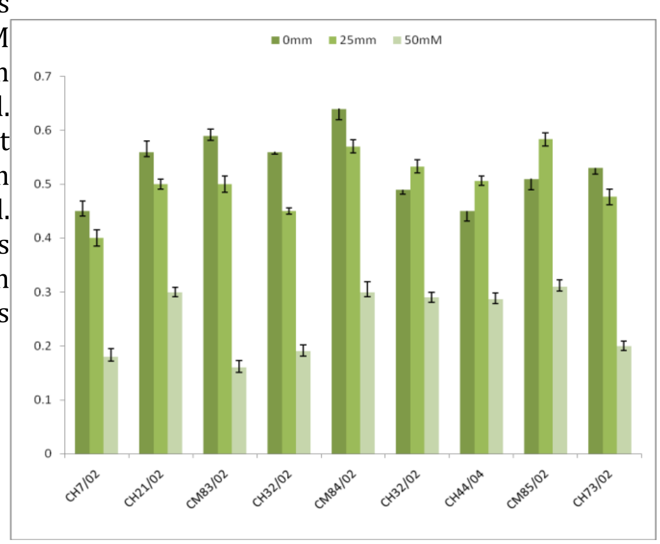


Salinity cause three potential effects on plant growth (i) Lowering in water potential, (ii) Direct toxicity of Na^+ and Cl^- absorbed, (iii) Interference with essential nutrients (Flower and Flowers, 2005).

Present study shows that the addition of salinity to the medium (soil) caused a significant increase in the Na contents of both the leaf as well as the shoot of all chickpea genotypes. All the treatments and genotypes also showed highly significant effects on this attribute. Treatment x variety interaction was highly significant statistically. It was observed that CM 85/02 and CH 73/02 showed minimum increase in leaf Na^+ contents control Maximum reduction in leaf Na^+ contents was observed in CM 83/02 and CM 85/02 when 50 m*M* concentration was applied. Overall maximum reduction was observed at 50mM salinity level. And in the case of Ca^+ It was observed that CM 85/02 showed maximum increase in shoot Ca^{2+} contents under control. Maximum reduction in shoot Ca^{2+} contents was observed in CM 85/02 when 50mM concentration was applied. Overall maximum reduction was observed at 50 m*M* salinity level. Likewise K^+ ion concentration was observed that CM 84/02 and CH 83/02 showed maximum increase in leaf K^+ contents under control. Maximum reduction in leaf K^+ contents was observed in CH 44/04 when 50mM concentration was applied. Overall maximum reduction was observed at 50mM salinity level.

NaCl salinity reduced the amount of carbohydrates that are needed for cell growth in the most of cultivated plants, which are sensitive to salt stress. It also lowers photosynthetic rates in plants hence the carbohydrate supply is reduced causes the limitation in the availability of water and imbalance in the uptake of nutrients by plants (Parida and Das, 2005; Arzani, 2008).

It is generally known that photosynthetic efficiency depend upon photosynthetic pigments such as chlorophyll '*a*' chlorophyll '*b*' which play an important role in photochemical reaction of photosynthesis (Taiz and Zieger, 2002). In present study chlorophyll '*a*' and chlorophyll '*b*' were increases at low salinity level (20m*M*/L) but decreases at high salinity level (50 m*M*/L). Such effects of NaCl application on photosynthetic pigments can be explain in view of some earlier studies in which it was found that increase or decrease in photosynthetic pigments with NaCl application depends on type of species or cultivars.. It was observed that CM 84/02 showed maximum increase in seeds per pot under control. Maximum reduction in chlorophyll '*a*' was observed in CH 44/04 when 50 m*M* concentration was applied. Overall maximum decrease was observed at 50mM salinity level. However in the case of chlorophyll '*b*' It was observed that CM 84/02 showed maximum increase in seeds per pot under control. Maximum reduction in chlorophyll '*b*' was observed in CH 32/02 when 50 m*M* concentration was applied. Overall maximum decrease was observed at 50 m*M* salinity level.



From the above discussion, it can de concluded that salt induced reduction in seed production can be increased with increase in salt levels, although the growth of chick peas (*cicer arantium* L.) plants was reduced less salt concentration. Salt –induced reduction in vegetative growth of (*cicer arantium* L.) cultivars was found to be associated with reduced rate of photosynthesis and increased water stress. Thus, further studies are required to elucidate the mechanism of salt-induced decreases in growth, photosynthesis coupled with a decrease in vegetative growth of (*cicer arantium* L.).

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