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EVALUATION OF SALINITY STRESS ON GROWTH PERFORMANCE OF VEGETABLE COWPEA (*VIGNA UNGUICULATA*)

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ABSTRACT

A pot experiment was conducted to evaluate salt stress on some growth parameters of vegetable cowpea. Root length, plant height plant weight and number of branches were evaluated with different concentration of salt treatment. This experiment was laid out in a Completely Randomized Design (CRD) with four replicates. The treatments were; 0%, 0.5%, 1%, and 1.5% NaCl concentration. Salinity affected all the considered parameters. Thus, high NaCl concentrations caused a great reduction in growth parameters such as plant height, root length, number of branches per plant and fresh weight of plant. Highest root length, plant weight, plant height and number of branches per plant were observed in 0% NaCl (control).

KEY WORDS: ***Salinity, Plant height, Plant weight, Root length, Shoot length.***

INTRODUCTION

Cowpea is a predominately hot weather crop widely grown in Eastern Africa and south-east Asia primarily as leafy vegetable. Cowpea (Vignaunguiculata(L.)Walp) is one of a multifunctional crop, providing food for man and livestock and serving as a valuable and dependable revenue-generating commodity for farmers and grain traders (Muluemebt, 2003). It has high value of protein content (23-29 %, with potential for perhaps 35%); high ability to fix atmospheric nitrogen, which allows it to grow in and improve poor soils and it is also more drought tolerant than other leguminous plants (Eaglesham *et al.*, 1992).

Soil salinity is categorized by excessive levels of contaminated salts, especially sodium chloride (NaCl) as dominant salt. Salinity of arable land is an increasing problem of many irrigated, arid and semi-arid areas of the world where rainfall is insufficient to leach salts from the root zone, and it is a significant factor in reducing crop productivity (Francois and Maas, 1994).

Cowpea cultivars showing contrasting responses to salinity have been identified (Murillo-Amador *et al.*, 2006); more recently. Researchers have shown that among crop species, legumes are considered as the most salt sensitive (Maas and Hoffman, 1977) but little information is available about the effect of soil salinity on growth parameters in Cowpea. Therefore this study was initiated to investigate the effect of different NaCl concentrations on growth parameters of vegetable cowpea.

MATERIALS AND METHODS

A shade house experiment was conducted to examine the effect of salt stress on plant growth of vegetable cowpea. The experiment layout was the Completely Randomized design (CRD) with four replicates. The non-saline treatment (T1) contained 0g/L of sodium chloride; the 0.5% saline treatment (T2) contained 5g/L of sodium chloride; the 1% saline treatment (T3) contained 10g/L of sodium chloride, and 1.5% saline treatment (T4) contained 15g/L of sodium chloride. The conversion factor from dSm^{-1} to g/L is 1 dSm^{-1} = 0.7 g of sodium chloride per one liter of water was used (Handreck and Black, 2002). Sixteen plastic buckets were taken and filled with 6 kg of NaCl saturated soil.

Five seeds of Sene variety of cowpea were sown in each plastic buckets. The treatments were irrigated with respective salt solution after transferring the pots to a shade house when the seedlings had the primary leaves developed. Two weeks after sowing, seedlings were thinned to three plants per pot. Fertigation and other management practices were applied during the experiment period as per the standard agronomic practice guideline.

One month after planting following morphological parameters were evaluated; root length, plant height plant weight and number of branches. Root length was measured using ruler in centimeters. The height of the plant was recorded from the surface of the soil to the tallest part of the stem. Height of each plant was measured and average was calculated. Fresh weight of plant was measured by electronic balance in grams. Number of branches per plant was counted manually.

RESULTS AND DISCUSSION

i. Root Length of Plants

There was a significant decrease in root length was observed when exposed to salt stress (Figure 1). As salt concentration increased the mean root length of experimental plants was decreased up to 2.02 cm while plants treated with non-salt solution showed significant promotion in root lengths. The longest root length 4.47cm was obtained from the control treatment which was significantly different from those of the other treatments. But among those treatments no significant difference was observed. Growth decline due to salinity is mostly recognized to water scarcity due to lowered water potential in root medium, nutritional imbalance and specific ion toxicity arising from higher concentration of Na^+ and Cl^- (Eisa *et al.*, 2012). High salinity may also inhibit root and shoot elongation by slowing down the water uptake by the plant (Ghoulam *et al.*, 2002). Neumann (1995) indicated that salinity can rapidly inhibit root growth and hence capacity of water uptake and essential mineral nutrition from soil. Hence, we could conclude that it is obvious salinity reduces root growth of plant.

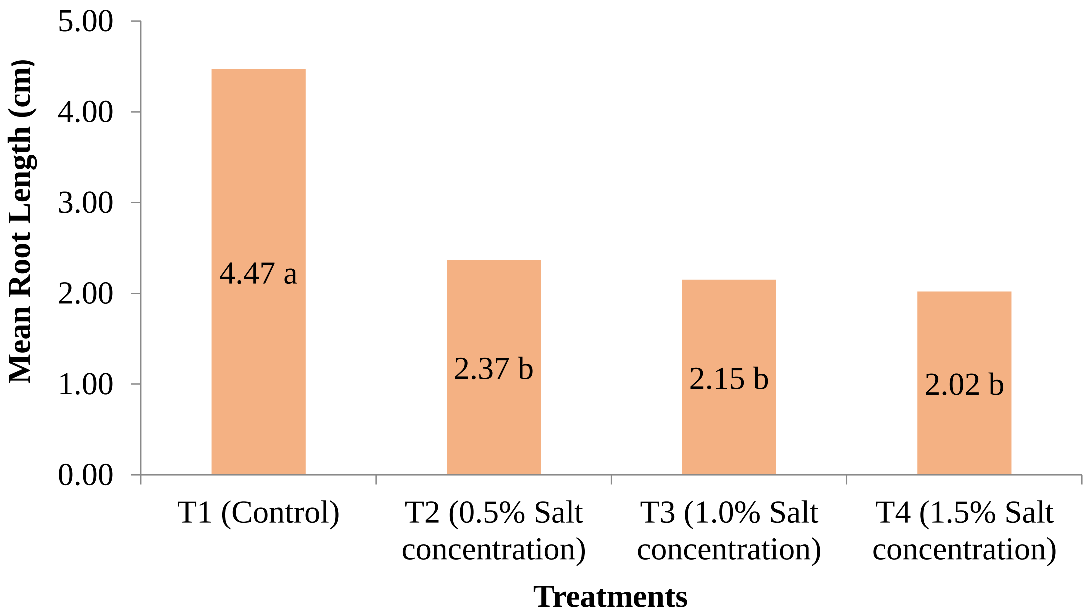

Figure 1: Effect of different salinity levels on root length of vegetable cowpea

ii. Fresh weight of plant

The greatest mean fresh weight of plant (4.12 g) was obtained from the control treatment which was significantly different from those of the other treatments (Figure 2). There was no significant change in fresh weight of plant among the treatments T2, T3 and T4. The reduction in biomass increased with the increase in salinity which is obvious because of disturbances in physiological and biochemical activities under saline conditions (Craine, 2005). Behzadifar *et al.* (2013) reported salinity-induced fresh weight reduction is a common phenomenon for most of the cultivated crop plants and trees, he found very high significant reduction of fresh weight of Catharanthusroseus at high salinity level. These results for fresh weight in this study, agree with the results presented by Andriolo *et al.* (2005) in their study on lettuce (Lactuca sativa L). Levitt (1980) found that increasing NaCl concentration in the rooting media significantly ($p<0.05$) reduced the roots, stems and leaves dry weights of cowpea cultivars.

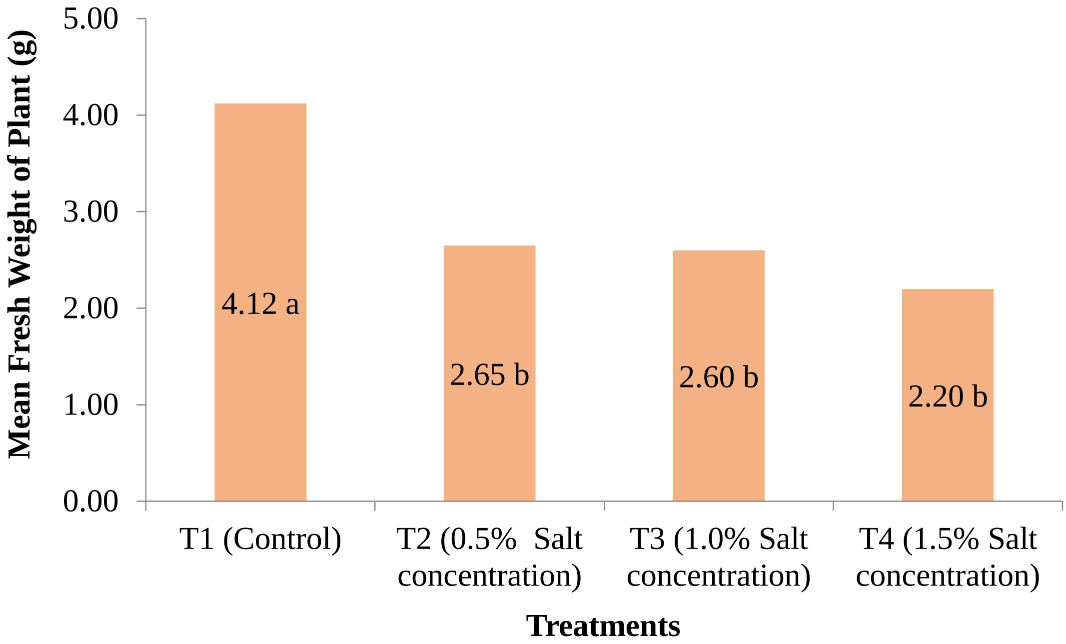

Figure 2: Effect of different salinity levels on Fresh Weight of vegetable cowpea

iii. Plant height

The result showed that the mean plant height was decreased with the increasing salinity levels and the degree of reduction was varied with the salinity levels (Figure 3). The highest plant height was observed for T1 which was 33.42cm. The lowest was observed for T4 which was 17.1cm. This result indicated that remarkable reduction in plant height was observed at higher levels of salt concentrations as compared to the control. Similar outcome were obtained earlier by Khadri *et al.* (2001). The elongation of the stem when treated with low concentrations of salts may induce osmotic adjustment activity in the plants which may improve growth. On the other hand, the noticed decrease in the length of the stem, also due to treatment with sodium chloride solution, could be due to the negative effect of this salt on the rate of photosynthesis, the changes in enzyme activity (that subsequently affects protein synthesis), and also the decrease in the level of carbohydrates and growth hormones, both of which can lead to inhibition of the growth (Mazher *et al.*, 2007).

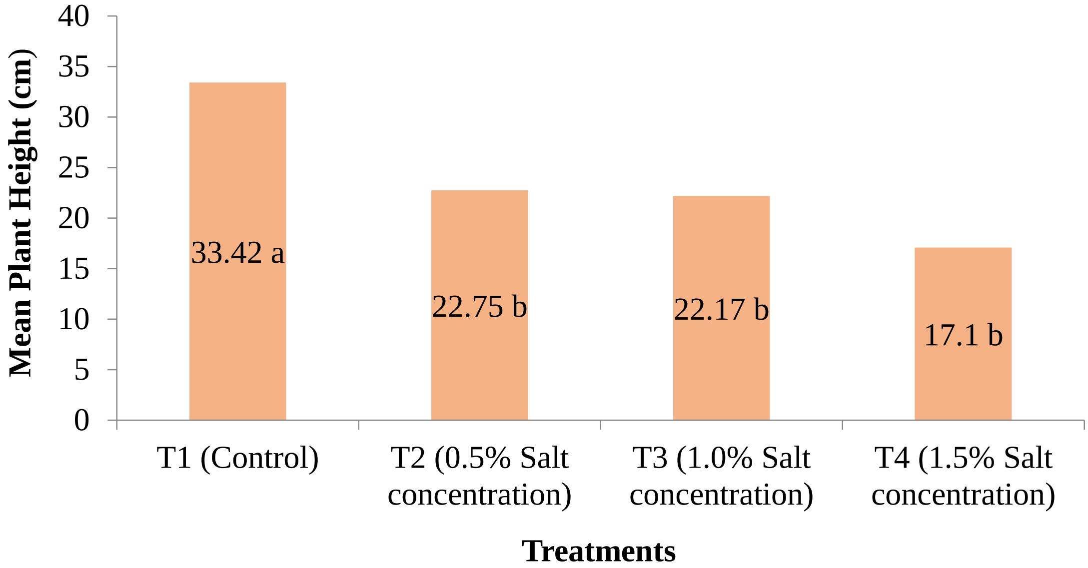

Figure 3: Effect of different salinity levels on plant height of vegetable cowpea

iv. Number of Branches

The highest numbers of branches were observed with control, while, the lowest number with T4. This might be due to salinity inhibits the formation of new branch and facilitating the aging of old branch at various degrees. The sprouting of the lateral buds was due to a breakdown of hormone induced apical dominance, a phenomenon implicated previously in salinity damage of plants (Waisel, 1972). At T4 (1.5%) salinity levels, all plants were botched to produce adequate number of branch at maturity level because of high salinity concentration which hampered the growth of branch on the individual plant and hindered photosynthetic activity of the plant as result the plant exposed to deficiency of important mineral and food to survive and the plant become die.

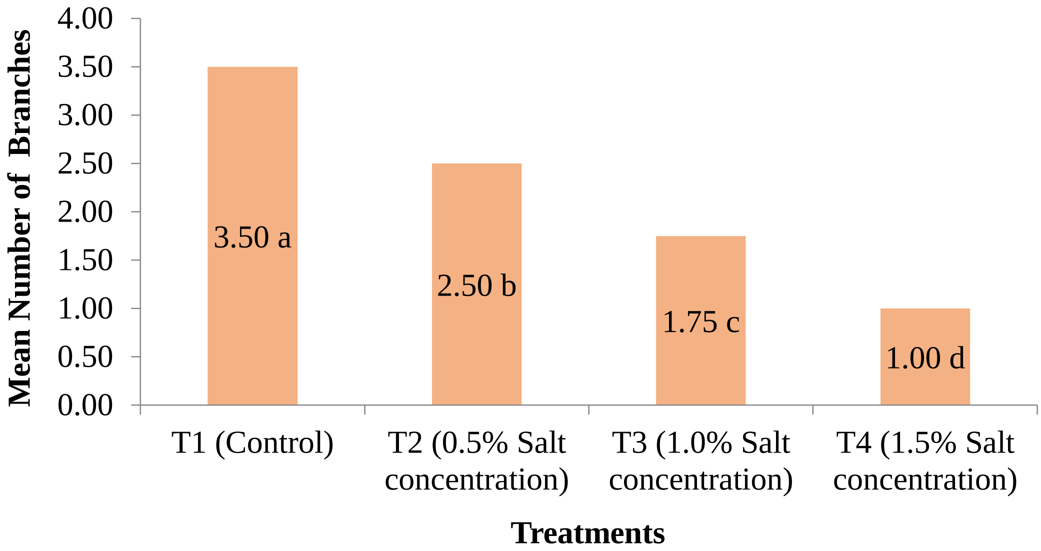

Figure4: Effect of different salinity levels on Branches of vegetable cowpea

Similar result was reported by Islam *et al.*, (2012) who found that decrement of branch number of lentil under salinity level. This might be due to salinity inhibits the formation of new branch and facilitating the aging of old branch at various degrees.

CONCLUSION

This work shows that salt stress has a depressive effect on all morphological parameters studied. The results suggest that cowpea plant is sensitive to NaCl at growth stage. The growth inhibitory effect of NaCl was more pronounced in 1.5% NaCl as compared to the control and 0.5% NaCl. Level of reduction was significant with control and no significant among the treatments T2, T3 and T4. Highest value for the above mentioned parameters were obtained from control (T1).

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