INTERNATIONAL ASSOCIATION OF BIOLOGICALS AND COMPUTATIONAL DIGEST
International & Peer-Reviewed Journal
E-ISSN: 2583-3995

GROWTH ANALYSIS OF EPIPREMNUM AUREUM (L.) ENGL. IN RESPONSE TO SALINITY STRESS

Sonara Aastha Himmatlal[1]*, Sandhya R. Verma[2], Hiteshkumar Solanki[3] and Archana U. Mankad[4]

[1*] M.Sc. Student, Department of Botany, Bioinformatics and Climate Change Impacts Management, School of Science, Gujarat University, Ahmedabad, Gujarat, India.
Email ID: aasthasonara@gmail.com
[2] Ph.D. Scholar, Department of Botany, Bioinformatics and Climate Change Impacts Management, School of Science, Gujarat University, Ahmedabad, Gujarat, India
[3]Professor, Department of Botany, Bioinformatics and Climate Change Impacts Management, School of Science, Gujarat University, Ahmedabad, Gujarat, India
[4]Professor and Head, Department of Botany, Bioinformatics and Climate Change Impacts Management, School of Science, Gujarat University, Ahmedabad, Gujarat, India

ABSTRACT

Potted plants of Epipremnum aureum (L.) Engl. were submitted to salinity stress (0, 100 ppm and 500 ppm NaCl irrigation) for 28 days in order to assess the effect on growth parameters viz. Relative Growth Rate (RGR), Net Assimilation Rate (NAR) and Leaf Weight Ratio (LWR). The salt stress caused reduction in LWR, NAR and RGR. It was observed that the effect of salinity was more pronounced on growth parameters at higher concentration than that at lower concentration.

Keywords: Epipremnum aureum (L.) Engl., growth analysis, NaCl, net assimilation rate, relative growth rate, leaf weight ratio.

1. INTRODUCTION

Epipremnum aureum (L.) Engl., also called Money Plant, belongs to the family Araceae. It is a perennial climber with three to four inches long heart-shaped leaves. The plant is native to Southeastern Asia. It is mainly grown indoors as it filters the air and increases oxygen inflow. (Meshram and Srivastava, 2015).

Money plant requires very little care and sunlight making it a popular indoor plant. It is a good air cleansing plant (Meshram and Srivastava 2015; Yang and Liu, 2011; Douglass, 2011). The characteristic activities of Epipremnum aureum (L.) Engl. include: Phytoremediation (Kamel et al., 2007), Antitermites activity (Srivastava et al., 2011), cleaning air pollution (Yang and Liu, 2011) and as antimicrobial agent (Srivastava et al., 2011; Meshram and Srivastava, 2014).

Crop growth and its production are affected seriously due to salt stress. Plant growth can be inhibited by two factors, first by osmotic or water deficit effect by salts present in soil, which causes reduction in water absorption capacity, and other is salt- specific or ion-excess effect resulting into injury to the cells of transpiring leaves due to presence of excessive amounts of salt in the transportation stream (Greenway and Munns, 1980; Parihar et al., 2015).

The plant growth under salinity stress has been expressed as relative growth rate (RGR) which divides absolute growth rate by initial weight of the plant. This provides relative basis to compare growth rates of plants (Cramer et al., 1990). Only a few studies have used plant growth analysis to determine the effects of salinity on growth (Ruiz et al., 1997, Curtis and Lauchli 1986, Schachtman et al., 1989, Cramer et al., 1990, Wickens and Cheeseman 1988). There was no information about the growth analysis of Money plant. Therefore, the aim of current study was to investigate the effect of salinity on the growth parameters of Money plant through relative growth rate (RGR), leaf weight ratio (LWR) and Net Assimilation Rate (NAR). In addition to that, other parameters such as number of leaves, stem length and fresh weight have also been taken into consideration.

2. MATERIALS AND METHODS

Plant material

This study was a laboratory experiment carried out at the Department of Botany, Bioinformatics and Climate Change, School of Sciences, Gujarat University, Gujarat, India. Plant Saplings of Epipremnum aureum (L.) Engl. were obtained from a local nursery used as the experimental material.

Experimental Design

The experiment was carried out for 28 days (January to February). Total 45 plants were used for current study and were placed in a greenhouse with sufficient sunlight. The Mean temperature throughout the growing period was 28℃ and the humidity was 28%. Plants were divided into three groups– Control, Treatment1 and Treatment 2, with each section comprising 15 plants. Two different concentrations of Sodium Chloride used for salinity stress was of 100ppm (T1) and 500ppm (T2). Distilled water was used in control plants. The pots were irrigated with their respective solutions every third day and Plants were harvested every 7th day and data was collected for following Growth Measurements.

- Number of plant leaves
- Fresh weight of plants
- Dry weights of plants.

Number of leaves were counted and their fresh weights were taken through analytical balance. Fresh weight of all the plants were calculated with the help of Digital balance. Every seventh day, three plants were taken to the laboratory from each group. Soil was thoroughly removed from plants and then were placed in the Hot Air Oven at 100˚C. Dry weight of the plants and leaves were recorded with the help of Digital balance. Following formulas were used to calculate the growth parameters:

$$LWR = \frac{(L1-L0)(LogW1-LogW0)}{(W1-W0)(LogL1-LogL0)}$$

$$NAR = \frac{(W1-W0)(LogL1-LogL0)}{T\times(L1-L0)}$$

$$RGR = LWR \times NAR$$

where W is total dry weight, T is time, L is total dry weight of leaves, and 1 and 0 are the beginning and the end of the period, respectively. RGR is Relative Growth Rate, LWR is Leaf Weight Ratio and NAR is Net Assimilation Rate.

3. RESULTS AND DISCUSSION

Several parameters have been studied to determine the effect of NaCl on plant growth on Money plant which are as follows:

Leaf Weight Ratio

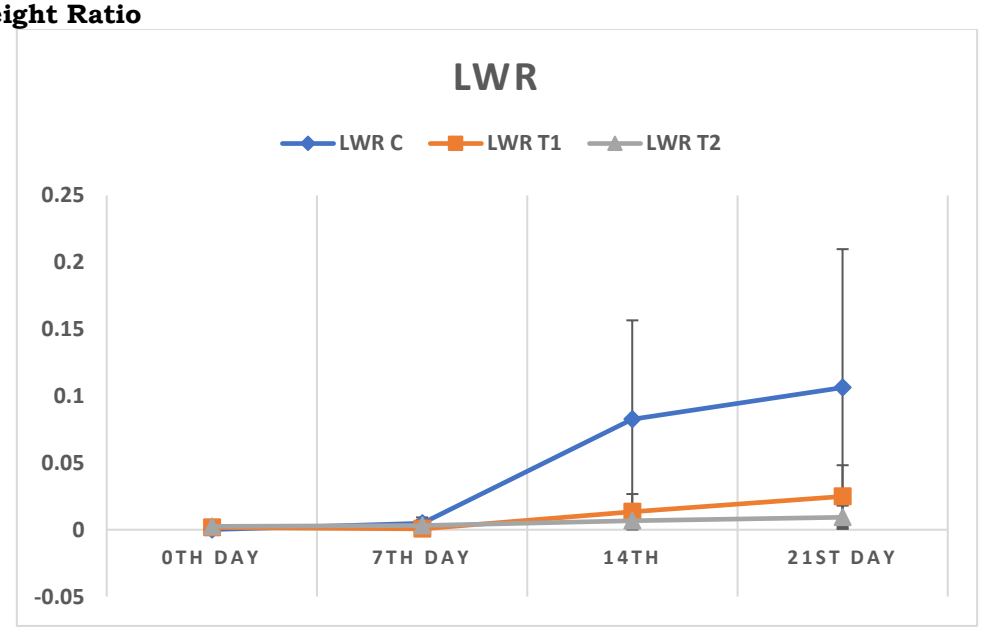

Fig 1: Effect of Salinity on LWR (g g^{-1}) of Money Plant over the time

The Leaf Weight Ratio (LWR) increased in both control and treated plants. The LWR remained almost the same for both the categories till 7th day with values ranging from 0.00013 g g^{-1} to 0.0048 g g^{-1}. LWR in control plants increased from 0.00013 g g^{-1} on 0th day to 0.1063 g g^{-1} on

21st day, in T1 plants it increased from 0.0017 g g^{-1} to 0.0249 g g^{-1} and in T2 plants it increased from 0.0025 g g^{-1} to 0.0093 g g^{-1} as shown in Fig 1. At the end of the experiment, LWR of control plants was higher than in treated ones. During the experiment, highest value of LWR was found in Control on 21st day (0.1063 g g^{-1}) and lowest in control on 0th day (0.00013 g g^{-1}).

Similar results were found in the experiment conducted on Astericus maritimus which revealed that there was an increase in LWR. This increase was related to the sensitivity observed in stem dry weight to salt stress during their experiment. In addition to that, it carries an important ornamental value as in spite of the total biomass reduction, plants can maintain leafy characteristics and good blooming (Rodriguez et al., 2005). In another experiment carried out in four citrus rootstocks (sour orange, Cleopatra mandarin, Carrizo citrange and Citrus macrophylla) with NaCl concentrations up to 80 mM, changes in LWR also suggest increase in or maintenance of biomass of leaves under saline conditions (Ruiz et al., 1997).

Net Assimilation Rate

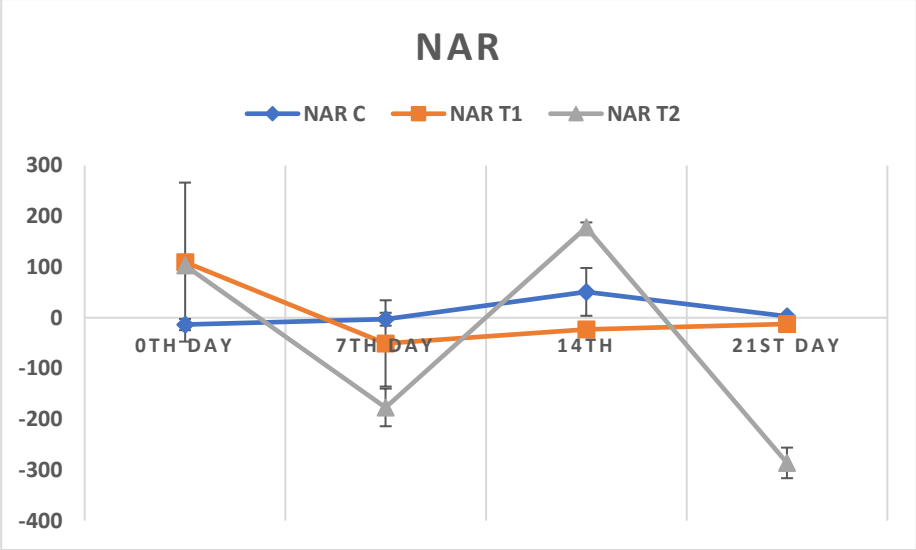

Fig 2: Effect of Salinity on NAR (g g^{-1} Day^{-1}) of Money Plant over the time

Fig. 2 shows that on 0th day, the highest NAR was observed in T1 (109.7103 g g^{-1} Day^{-1}) and lowest in control. On 21st day, lowest NAR was in T2 and highest in control (2.9911 g g^{-1} Day^{-1}). NAR increased only in control and decreased in T1 and T2. Notable reduction in NAR was observed in T2. Overall, the highest value of NAR was observed in T2 on 14th day and lowest in T2 on 21st day.

Similar results were found by Ruiz et al., (1997), on four citrus rootstocks (sour orange, Cleopatra mandarin, Carrizo citrange and Citrus macrophylla), showing decrease in NAR in treated plants is associated with reduction in photosynthetic or respiration rate or increase in non-photosynthetic tissue participating in respiration (Poorter, 1989). Increase in respiration may be a reason for decrease in NAR as it induces higher carbohydrate requirement (Richardson and McCree 1985; Schwarz and Gale, 1981). It can provide more energy for rebuilding of organelles and compounds harmed as a result of salinity.

Relative Growth Rate

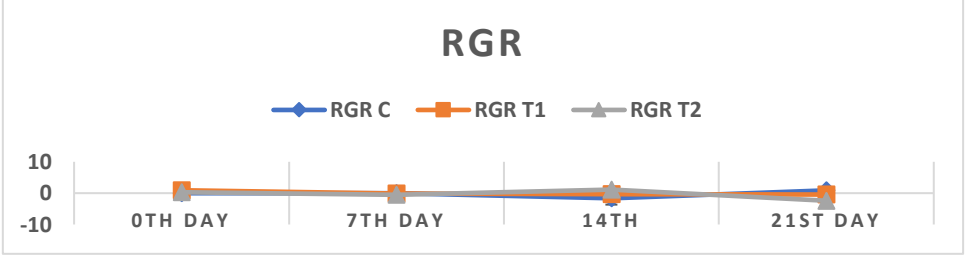

Fig 3: Effect of Salinity on RGR (Dry weight Day^{-1}) of Money Plant over the time

The results indicate decrease in RGR in control till 14th day and then it started increasing and highest RGR in control plants was observed on 21st day. In T2, RGR started decreasing on 7th day then showed an increase in RGR till 14th day and then there was a sudden drop from 14th day to 21st day shown in Fig 3. Highest reduction in RGR was observed in T2. Similar kinds of results were obtained in the experiment on Astericus maritimus when treated with NaCl, shows reduction in RGR. This might be due to direct effect of stress on photosynthetic apparatus and/or stomatal closure indicating photosynthesis as a growth-limiting factor. (Cramer et al., 1990; Sánchez-Blanco et al., 2002; Rodriguez et al., 2005).

Table 1: Effects of salinity on growth parameters of Money plants

Time	Treatment	Shoot length (cm)	Dry weight of plants (gm)	Dry weight of leaves (gm)	Number of leaves
0th day	Control	14.766	3.376	0.091	5
	Treatment 1	15.566	1.960	0.053	5
	Treatment 2	15.5	2.047	0.075	5
7th day	Control	15.733	3.005	0.083	6
	Treatment 1	16.633	3.570	0.098	6
	Treatment 2	16.6	2.223	0.115	6
14th day	Control	17.25	2.914	0.039	7
	Treatment1	18.291	2.96	0.082	7
	Treatment 2	18.041	1.333	0.068	7
21st day	Control	18.611	2.548	0.430	8
	Treatment1	21.333	2.25	0.122	8
	Treatment 2	18	2.048	0.084	7
28th day	Control	21	2.967	0.054	9
	Treatment 1	23.166	1.98	0.069	9
	Treatment 2	18.833	2.711	0.031	7

Shoot Length

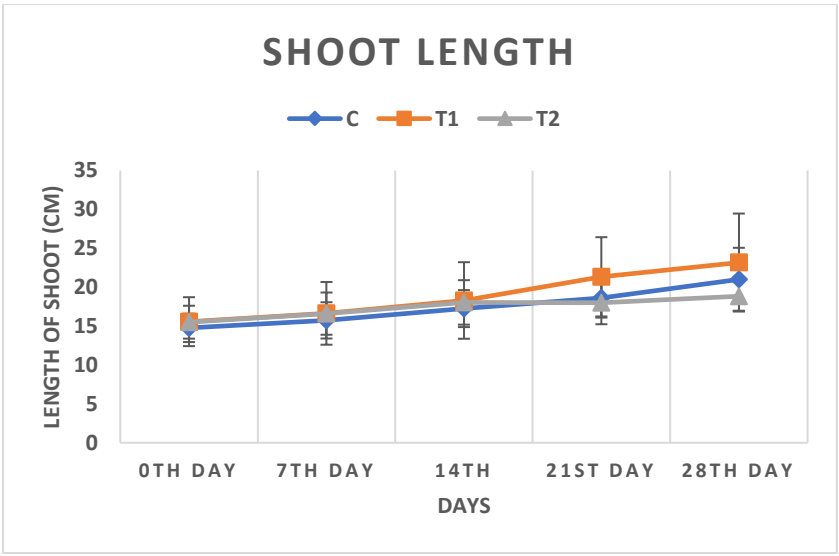

Fig 4: Effect of Salinity on Shoot Length(cm) of Money Plant over the time

Fig. 4 shows that the Shoot length increased in control and T1. However, in T2 plants, the length remained constant after 14th day. At the end of the experiment, the shoot length of control plants increased by 6.234 cm, in T1 plants it increased by 7.6 cm and length in T2 increased by 3.333 cm as shown in the Table 1.

In the salinity experiment conducted in Vicia faba L. by Qados (2011), effect of salt on plant height was observed. When plants were treated with low and medium concentrations of NaCl, there was an increase in plant height. This may be due to improvement of growth as a result of induction of osmotic adjustment activity in the plants treated with low concentrations (Mazher et al., 2007).

Number of leaves

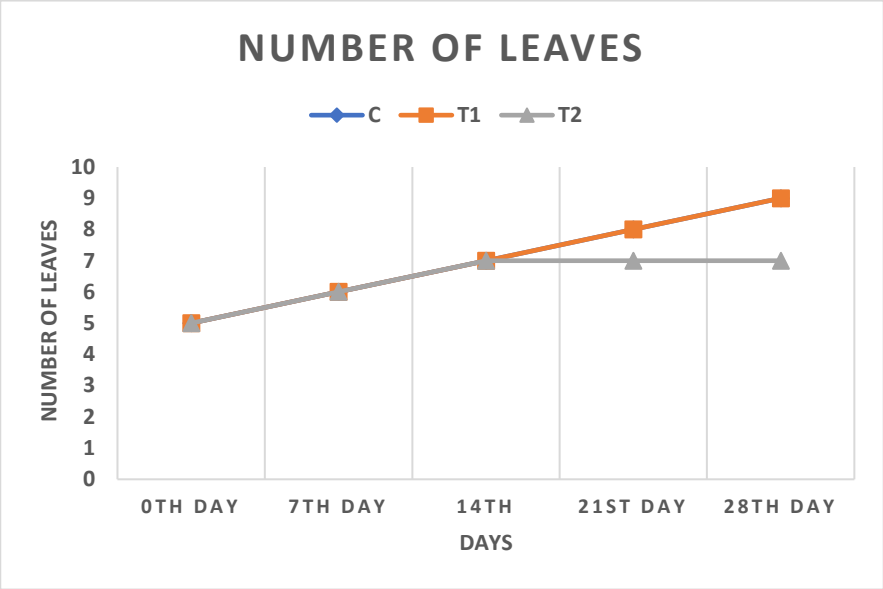

Fig 5: Effect of Salinity on No. of Leaves of Money Plant over the time

Fig 5 shows that the number of leaves increased in control and T1 plants. In these plants, number of leaves increased by 1 every 7th day. However, in T2 plants the number remained constant after 14th day. Maximum no. of leaves (9) was observed in Control and T1 (Table 1) as compared to T2 (7).

In the experiment conducted on Vicia faba L. by Qados (2011), there was no effect of salt stress on number of leaves under low concentrations. However, in plants treated with high concentrations, there was a significant reduction in number of leaves and height of the plants (Qados, 2011). Accumulation of NaCl in the cell walls and cytoplasm of older leaves may be a reason for reduction in the number of leaves. Simultaneously, inability of vacuole sap to accumulate enough salt results in quick death and cut down as the concentration of salt inside the cells decreases (Munns, 2002).

4. CONCLUSION

The study was carried out to observe the influence of salinity on growth of money plant. The plants revealed notable difference in growth of money plant. The Relative growth rate (RGR) and Net assimilation rate (NAR) decreased with increasing salinity. Maximum reduction in RGR, NAR, shoot length and number of leaves was observed under 100ppm as compared to 500 ppm. The length of the shoot and number of leaves remained constant after 14th day and no further increase was observed. In general, it could be concluded that Money plant could tolerate low salinity stress but higher salinity cause reduction in growth parameters.

5. REFERENCES

1) Cramer, G. R., Epstein, E., & Läuchli, A. (1990). Effects of sodium, potassium and calcium on salt stressed barley. I. Growth analysis. Physiologia Plantarum, 80(1), 83-88.
2) Curtis, P. S., & Lauchli, A. (1986). The role of leaf area development and photosynthetic capacity in determining growth of kenaf under moderate salt stress. Australian Journal of Plant Physiology 13(4), 553-565.

3) Douglass, F. (2011). Indoor air quality-planting healthier indoor air. News forum. Environ Health Perspect, 119, A426-A427.
4) Greenway, H., & Munns, R. (1980). Mechanisms of salt tolerance in nonhalophytes. Annual review of plant physiology, 31(1), 149-190.
5) Kamel, H. A., Eskander, S. B., & Aly, M. A. S. (2007). Physiological response of Epipremnum aureum for cobalt-60 and cesium-137 translocation and rhizofiltration. International Journal of Phytoremediation, 9(5), 403-417.
6) Mazher, A. A., El-Quesni, E. F., & Farahat, M. M. (2007). Responses of ornamental and woody trees to salinity. World J. Agric. Sci, 3(3), 386-395.
7) Meshram, A., & Srivastava, N. (2015). Epipremnum aureum (Jade pothos): a multipurpose plant with its medicinal and pharmacological properties. Journal of Critical Reviews, 2(2), 21-5.
8) Meshram, A., & Srivastava, N. (2014). Molecular and physiological role of Epipremnum aureum. International Journal of Green Pharmacy (IJGP), 8(2).
9) Munns, R. (2002). Comparative physiology of salt and water stress. Plant, cell & environment, 25(2), 239-250.
10) Parihar, P., Singh, S., Singh, R., Singh, V. P., & Prasad, S. M. (2015). Effect of salinity stress on plants and its tolerance strategies: a review. Environmental science and pollution research, 22, 4056-4075.
11) Poorter, H. (1989). Interspecific variation in relative growth rate: on ecological causes and physiological consequences. Causes and consequences of variation in growth rate and productivity of higher plants, 24, 45-68.
12) Qados, A. M. A. (2011). Effect of salt stress on plant growth and metabolism of bean plant Vicia faba (L.). Journal of the Saudi Society of Agricultural Sciences, 10(1), 7-15.
13) Richardson, S. G., & McCree, K. J. (1985). Carbon balance and water relations of sorghum exposed to salt and water stress. Plant physiology, 79(4), 1015-1020.
14) Rodrıguez, P., Torrecillas, A., Morales, M. A., Ortuno, M. F., & Sánchez-Blanco, M. J. (2005). Effects of NaCl salinity and water stress on growth and leaf water relations of Asteriscus maritimus plants. Environmental and Experimental Botany, 53(2), 113-123.
15) Ruiz, D., Martínez, V., & Cerdá, A. (1997). Citrus response to salinity: growth and nutrient uptake. Tree physiology, 17(3), 141-150.
16) Sánchez-Blanco, M. J., Rodrıguez, P., Morales, M. A., Ortuño, M. F., & Torrecillas, A. (2002). Comparative growth and water relations of Cistus albidus and Cistus monspeliensis plants during water deficit conditions and recovery. Plant Science, 162(1), 107-113.
17) Schachtman, D. P., Bloom, A. J., & Dvořák, J. (1989). Salt tolerant Triticum× Lophopyrum derivatives limit the accumulation of sodium and chloride ions under saline stress. Plant, Cell & Environment, 12(1), 47-55.
18) Schwarz, M., & Gale, J. (1981). Maintenance respiration and carbon balance of plants at low levels of sodium chloride salinity. Journal of Experimental Botany, 933-941.
19) Srivastava, N., Shwarupa, S., & Bhagyawant, S. S. (2011). Comparative study on the anti-termite, antimicrobial and antioxidant activity of leaf and root extracts of Pothos aurea (Epipremnum aureum L.). J Pharm Res Clin Pract, 1, 1-11.
20) Wickens, L. K., & Cheeseman, J. M. (1988). Application of growth analysis to physiological studies involving environmental discontinuities. Physiologia Plantarum, 73(2), 271-277.
21) Yang, H., & Liu, Y. (2011). The impact of air pollution on health, economy, environment and agricultural sources. Mohamed Khallaf, editor. Phytoremediation on air pollution, 281-94.