

## EFFECT OF CHLORIDE AND SULPHATE DOMINATED SALINITY ON MINERALS CONSTITUENTS OF SENNA (*CASSIA ANGUSTIFOLIA* VAHL.)

Suman Bala\*, U.K. Varshney and Anita Kumari

Department of Botany and Plant Physiology, CCS HAU, Hisar

Email: [sumanmalika14@gmail.com](mailto:sumanmalika14@gmail.com)

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**Abstract:** The present experiment was conducted to study the effect of chloride and sulphate dominated salinity on mineral constituents in leaves of Senna at pod maturity stage, a pot factorial experiment based on randomized complete design with three replicates was conducted in screen house. Four varying EC levels viz. control (without salt), 4, 8 and 12 dSm<sup>-1</sup> of each salinity types along with nutrients supplemented in sand filled polythene bags. The study revealed that accumulation of sodium in leaves was recorded with the increase of salinity and it was more under sulphate dominated salinity treatment. Potassium on the hand declined with the increment of salinity and the decline was relatively higher under sulphate dominated salinity. Chloride and sulphate in leaves accumulation was found in chloride dominated salinity and sulphate dominated salinity respectively with the increase of salinity levels. The minerals estimated in leaves at the pod maturity stage an increase of their salts in the growing medium. Potassium on the other hand declined due to exchange with sodium.

**Keywords:** Chloride, Sulphate, Minerals, Senna

### INTRODUCTION

Salt stress changes the morphological, physiological and biochemical response of plant. Plants exposed to stresses undergo changes in their metabolism in order to changes in the environment. Seed germination, water deficit, ion balance of the cellular ions (cause ion imbalance of the cellular ions resulting in ion toxicity) and osmotic stress is effected by salinity (Khan *et al.*, 2002; Khan & Panda, 2008; Bala *et al.*, 2016). Munns (2002) reported that salinity reduces the ability of plants to utilize water and causes a reduction in growth rate, as well as changes in plant metabolic processes. Excess of salt in many plants causes decreasing amount of Ca<sup>2+</sup>, K<sup>+</sup> and Mg<sup>2+</sup> while increases amount of Na<sup>+</sup> and Cl<sup>-</sup> (Yilmaz *et al.*, 2011). It is also reported that the salt stress increases Na<sup>+</sup>, Ca<sup>2+</sup>, Mn<sup>2+</sup>, Cu<sup>2+</sup> and Fe<sup>2+</sup> but it causes to decrease K<sup>+</sup> and P<sup>3-</sup> (Erdal *et al.*, 2000).

Cultivation of agricultural crops in soil is limited by salt stress, which arises from the excessive uptake of salt by plants and it is an unavoidable consequence of high salt concentrations. The world population is continuing to increase and the amount of the arable land to decrease. Greater emphasis must therefore be placed on bringing marginal productive and presently non-arable land under cultivation. With the diversification of agriculture, medicinal and aromatic plants are gaining importance in the national scenario. So, there is growing global demand for medicinal plants. *Cassia angustifolia* is an important medicinal plant species belonging to the family caesalpiniaceae. It is a native to Sudan and Arabia and cultivated mainly in India and Pakistan. It is now also grown on a small scale in Andhra Pradesh, Karantaka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Haryana. The total export of senna leaves from India is of about Rs. 20

million. The leaves and pods of *Cassia angustifolia* are cathartic, contains sennosides A, B, C, D, rhein and aloe-emodin. It is useful in loss of appetite, hepatomegaly, splenomegaly, indigestion, malaria, skin diseases, jaundice and anaemia. So, marginal and salt lands could be exploited for the cultivation of medicinal plants such as Senna. The present experiment was planned to study mineral constituents in leaves of Senna in response to salt stress.

### MATERIAL AND METHOD

The experimental site was in the screen house, Department of Botany and plant physiology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. Seeds of Senna var. sona for these experiments were obtained from the Institute of Herbal Heritage (A unit of Asian Medicinal plants and Health care trust) Sonamukhi Nagar, Sangaria Fanta, Salawas Road, Jodhpur-342005 (Rajasthan), INDIA.

**Culture conditions:** The plants were raised in polythene bags (18" X 15"), each containing 12 kg of dune sand. The sand filled polythene bags were saturated with the solution of respective salinity treatment along with the nutrient (Hogland and Arnon, 1950) before sowing. Two types of salinity i.e. chloride (Cl<sup>-</sup>:SO<sub>4</sub><sup>2-</sup>(7:3); Na<sup>+</sup>:Ca<sup>2+</sup>+Mg<sup>2+</sup> (1:1); Ca<sup>2+</sup>:Mg<sup>2+</sup> (1:3)) and sulphate (SO<sub>4</sub><sup>2-</sup>:Cl<sup>-</sup> (7:3); Na<sup>+</sup>:Ca<sup>2+</sup>+Mg<sup>2+</sup> (1:1); Ca<sup>2+</sup>:Mg<sup>2+</sup> (1:3)) dominated salinity with three replication was given at 4 different salinity level such as 0 (control), 4, 8 and 12 dSm<sup>-1</sup>. 15 seeds of Senna were sown on variously treated sand beds in polythene bags. The moisture in the bags was maintained at field capacity by adding water as and when required. After establishment of

\*Corresponding Author

seedlings thinning was done to maintain 3 plants of uniform size in each bag.

**Plant material:** For mineral studies the leaves of each treatment were dried in an oven at 60°C for 48h. The dried mass was ground to fine powder and used for analysis.

**Digestion:-** 500 mg of oven dried and well ground material was taken in 50 ml conical flasks to which 5 ml of HNO<sub>3</sub> : HClO<sub>4</sub> (4:1) diacid mixture was added. The flasks were heated gently on a hot plate till the formation of dense white fumes. When fumes reduced and subsided at this stage and samples become transparent. The digest thus obtained was cooled and 25 ml of distilled water was added. Then it was filtered by using Whatman filter paper and used for analysis.

**Sodium:** The diluted and filtered acid digest was then used to analyses. Sodium with a flame photometer (Elico) using standard NaCl. The values measured were then expressed as mg g<sup>-1</sup> tissue dry weight. **Potassium:** Estimated in the similar way as sodium above.

**Chloride :** 5 ml of the acid digest was further diluted to 50 ml. 1 ml of 5 M NaNO<sub>3</sub> was then added and the solution was analysed by ion analyser for chloride against standard NaCl. The values were expressed as mg g<sup>-1</sup> tissue dry weight.

**Sulphate:** The sulphate was estimated by Turbidimetric method as suggested by Chesin and Yien (1950).

**Reagents: i. Gum acacia solution:** Dissolve 250 mg of gum acacia in distilled water and diluted to 100 ml.

**ii. Barium chloride:** Grind BaCl<sub>2</sub>.2H<sub>2</sub>O crystals in a mortar, until they pass through a 20-30 mesh sieve, but retained on 60 mesh sieve.

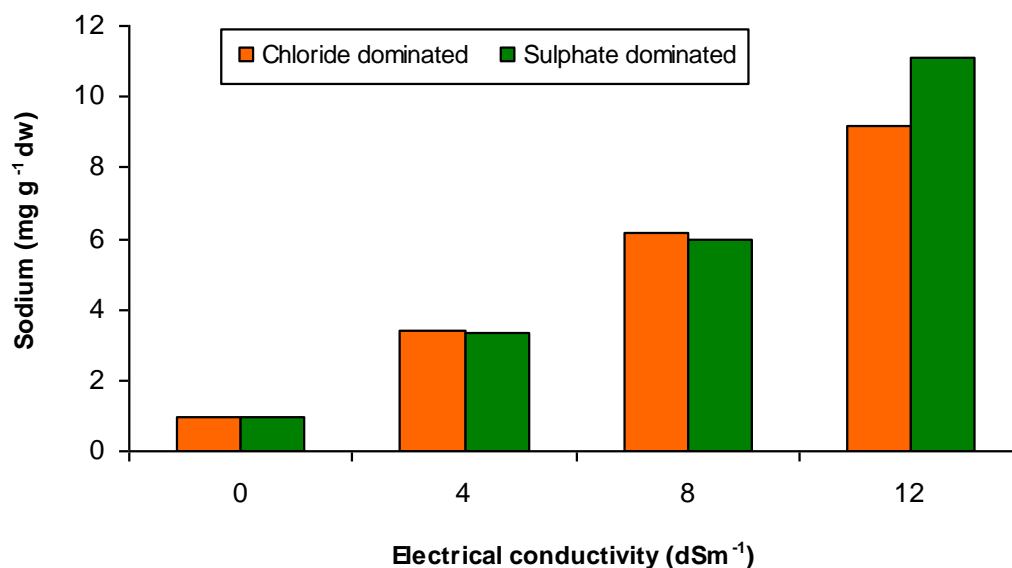
**iii. Standard SO<sub>4</sub><sup>2-</sup> solution:** Dissolve 0.1815g of reagent grade K<sub>2</sub>SO<sub>4</sub> in 1litre distilled water. This is 100 mg/l stock solution of SO<sub>4</sub><sup>2-</sup>. Transfer 1.25, 2.50,

5.0, 7.5, 10.0, 12.5, 15.0 ml. of the 100 mg/l SO<sub>4</sub><sup>2-</sup> stock solution in a series of 25 ml. volumetric flasks to obtain 5, 10, 20, 30, 40, 50, 60 mg/l SO<sub>4</sub><sup>2-</sup> respectively. Prepare a standard curve by plotting % transmittance (T) on Y- axis and concentration on X-axis on a semi-log graph paper. There should be straight line relationship between C and T.

**Procedure:** Transfer of a 5ml aliquot of digest to a 25ml volumetric flasks, add 1ml of gum acacia solution make the volume up to the mark and shake for 1 min. Further add 1g of a sieved BaCl<sub>2</sub> crystals and shake for 1 min Measure the turbidity in 25-30 min, after adding BaCl<sub>2</sub> crystals, on Spectrophotometer using a blue filter at a wavelength of 420 nm. Simultaneously carry out a blank (without sample). Data were expressed as mg g<sup>-1</sup> tissue dry weight.

## RESULT AND DISCUSSION

Sodium content of leaves significantly increased with the progressive increase of EC level in the growing medium (Fig. 1). Increased salinity level, in general, have been reported to enhance the accumulation of sodium in different crops (Georgive and Spasenovski, 1977; Cerda *et al.*, 1979; Kara and Kesar, 2001; Surajkala, 2010). The differential effect of salinity type on sodium content was significant. More pronounced accumulation of sodium in leaves was noticed under sulphate dominated salinity. Kanta Rani (2000) in isabgol seedlings have also reported more accumulation of sodium under sulphate salt treatment than chloride salt treatment at comparable EC levels. Although the effect of salinity types was not distinct up to 8 dSm<sup>-1</sup> EC level. But higher accumulation of sodium was observed under sulphate dominated salinity at 12 dSm<sup>-1</sup> EC level.



**Fig 1:** Sodium (mg g<sup>-1</sup> dry weight) content of leaves of Senna at pod maturity stage under varying salinity

CD at 5%,

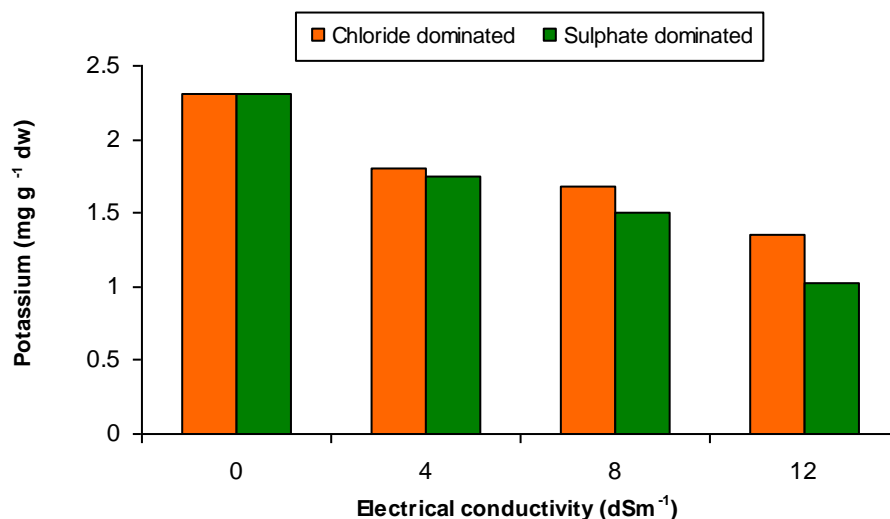
ST = 0.149

EC = 0.210

ST×EC = 0.297

A significant decline in potassium content of leaves was noticed with the progressive increase of salinity right from 4 dSm<sup>-1</sup> EC level (Fig. 2). Jaleel *et al.*, (2008) in *catharanthus roseus* also found similar results Potassium content was relatively lower under sulphate dominated salinity than chloride dominated salinity. This accumulation of sodium and concomitant decline of potassium under salt stress is ascribed to fact that high external sodium content is known to have an antagonistic effect of potassium

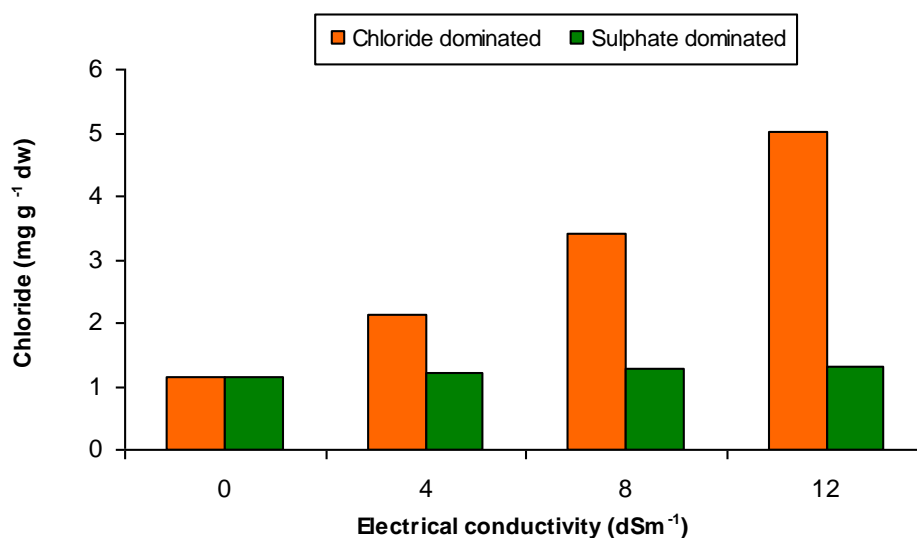
uptake in plants. Sodium competes with potassium uptake through common transport system because of its high concentration in saline environment. A number of workers have reported that sodium increased and potassium decreased under salt stress in guar (Francois *et al.*, 1990), isabgol (Kanta Rani, 2000 and Nehru, 2003), chickpea (Kukreja *et al.*, 2005), ajwain (Ashraf and Orooj, 2006), tomato (Tantawy *et al.*, 2009), canola (Bybordi, 2010) and *Mentha pulegium* (Queslati *et al.*, 2010).



**Fig 2:** Potassium (mg g<sup>-1</sup> dry weight) content of leaves of Senna at pod maturity stage under varying salinity  
 CD at 5%, ST = 0.113 EC = 0.160 ST×EC = N.S.

More accumulation of chloride in leaves was observed under chloride dominated salinity than sulphate dominated salinity (Fig. 3). In chloride dominated salinity, the increase of leaf chloride content with increase of salinity was significant right from 4 dSm<sup>-1</sup> of EC level, whereas in sulphate dominated salinity no significant change was seen. A significant increase in chloride content of leaves of Senna under chloride dominated salinity was due to

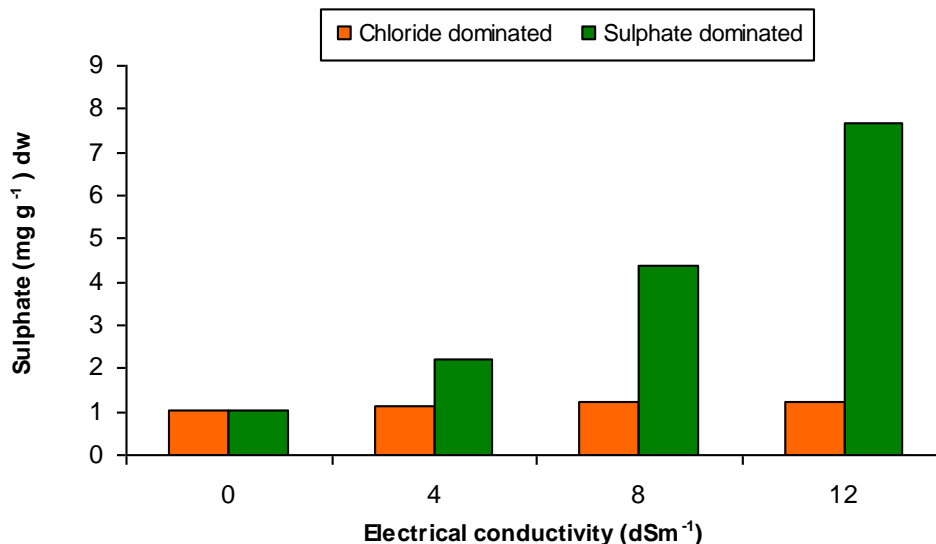
enhanced uptake of chloride by plant tissue. The uptake of chloride was concomitant with increasing EC levels. An increase in chloride content in different parts of pea plants with increase in soil salinity was also observed by Siddique (1980). Similar results were reported by Sharma and Kumar (1972), Kanta Rani (2000), Nehru (2003) in isabgol, Ashraf and Orooj (2006) in ajwain and Hussain *et al* (2009) in chasku.



**Fig 3:** Chloride (mg g<sup>-1</sup> dry weight) content of leaves of Senna at pod maturity stage under varying salinity  
 CD at 5%, ST = 0.105 EC = 0.149 ST×EC = 0.210

Sulphate content of leaves significantly increased with increasing EC level right from 4 dSm<sup>-1</sup> EC level (Fig. 4). The differential effect of salinity type on leaf sulphate content was also highly significant. Under sulphate dominated salinity, significantly

higher sulphate content was recorded than chloride dominated salinity. Sulphate uptake under Na<sub>2</sub>SO<sub>4</sub> salinity have been reported in bean plants by Meiri *et al.* (1971), in wheat by Datta *et al.* (1995), and in isabgol by Kanta Rani (2000) and Nehru (2003).



**Fig 4:** Sulphate (mg g<sup>-1</sup> dry weight) content of leaves of Senna at pod maturity stage under varying salinity  
 CD at 5%, ST = 0.064 EC = 0.090 ST×EC = 0.128

## CONCLUSION

Among the minerals estimated in leaves at the pod maturity stage an increase of their salts in the growing medium. Potassium on the other hand declined due to exchange with sodium.

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