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Physiological response of ornamental tree species to induced salinity

JAGREETI GUPTA[1], R K DUBEY[2], NIRMALJIT KAUR[3] and O P CHOUDHARY[4]

Punjab Agricultural University, Ludhiana, Punjab 141 004

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Soil salinity is a global environmental challenge to sustainable agriculture which has been increasing over the time (Hossain *et al.* 2012). Salinity affects about one third of irrigated land, causing a significant reduction in crop productivity (Ravindran *et al.* 2007). Salt stress has been identified as one of the most serious environmental factors limiting the productivity of crop plants (Flowers *et al*. 2010). The total salinized land around the world was 323 million ha in 1980 (Brinkman 1980) and it is expected to cross 400 million ha by 2025. Importance of tree planting for the reclamation of salt-affected lands has been recognized by Morris and Thomson (1983) and Schofield (1990). However, the levels of salinity vary from site to site and the salt tolerance varies greatly among the plant species (Tinus 1984, Toth 1981, Tomar and Yadav 1980). Plantation of trees on such soils without considering their level of tolerance to salinity has resulted in heavy mortality (Singh *et al.* 1991, 1992). Therefore, the selection of tree species for plantation at different sites should be made in accordance with the salinity levels.

Some genera, such as *Prosopis, Tamarix*, and *Atriplex,* occur naturally on salt-affected soil and/or occur naturally within or near to coastal or inland sites where soils or ground water is saline. These genera contain species termed halophytes, which have evolved several salt-tolerating mechanisms. In addition, several species which may or may not be halophytes can grow well in saline soils. However, most plant species are non-halophytes and they do not grow well on highly salt-affected land. Non-halophytes rely on avoidance mechanisms that include restricting the entry of salt into the root and transport in the xylem, and retaining most of the salt that enters the shoot in old leaves (Yeo 1994).

There are many reports that depict that salt-tolerant species can be categorized using physiological criteria such as chlorophyll and carotenoid content (Percival and Fraser 2001).

The four ornamental tree species selected for the present investigation were *Acacia auriculiformis, Cassia fistula, Bauhinia purpurea* and *Milletia ovalifolia*. *Acacia auriculiformis* Benth. (Australian wattle) is a tree belonging to family Leguminosae and is native of arid zone of central Australia. It is planted in the garden for its attractive shape, foliage and shade. *Cassia fistula* L. commonly known as Indian Laburnum (*Amaltas*), belonging to family Leguminosae, originated in India. The tree remains leafless on commencement of flowering, and at the end of flowering season, the leaves start to appear. Flowering occurs during hot weather, i.e. during April-May. *Bauhinia purpurea* L. or *B. triandra* Roxb., originated in India, belongs to family Leguminosae, and is commonly known as purple bauhinia. It is good for roadside plantation and group planting. *Milletia ovalifolia* Roxb. a dwarf tree with small lilac coloured flowers, belongs to family leguminosae and it is African in origin. It is suitable for compounds of houses, parks and public places (Randhawa and Mukhopadhyay 1986). The objective of the present investigation was to study the relative tolerance of four ornamental trees, which has been compared on different levels of induced salinity. An understanding of growth and survival of plants under saline habitat conditions is needed for (i) screening the plant species for the afforestation of saline deserts and (ii) understanding the mechanisms that plants use in the avoidance and/or tolerance to salt stress.

Planting and treatments

Seeds of *Acacia auriculiformis* (Australian wattle), *Cassia fistula, Bauhinia purpurea* (Kachnar) and *Milletia ovalifolia* (Moulmein rosewood) were sown during first week of June 2014. Seedlings of all plants were transplanted in earthen pots of 10” size on first week of April 2015 by using Soil: FYM (2:1) as growing media. After 30 days of transplanting, i.e. in first week of May different concentrations of NaCl, i.e. 30 mM (1.75g/l of water/pot), 40 mM (2.34g/l of water/pot), 50 mM (2.92g/l of water/pot) and 60 mM (3.51g/l of water/pot), AR (Analytical reagent) grade were given with irrigation water and EC of media was maintained according to different concentrations of salt. The irrigation water volume was determined by adding the leaching amount to the water consumed by the plants. These conc. of NaCl were given till October and after that doses were increased as 30 mM (1.75g/l of water/pot), 60 mM (3.51g/l of water/pot), 90 mM (5.26g/l of water/pot) and

[1]e mail: jagriti20.gupta@gmail.com

120 mM (7.02g/l of water/pot), AR (Analytical reagent). The physiological parameters of trees were recorded during last week of May 2015-16 and August 2015-16.

Estimation of total chlorophyll and carotenoid

The freshly removed leaves collected during last week of May 2015-16 and August 2015-16 were finely chopped and 50 mg portion was dipped in a test tube containing 10 ml of DMSO (Dimethyl sulfoxide). The test tubes were then placed in an oven at 60^0C for two hours to facilitate the extraction of pigments. After the requisite period, the extract was allowed to reach room temperature and the absorbance was recorded at 645 and 665 nm on a spectrophotometer. The total chlorophyll contents were determined using the following equations:

Total chlorophyll = $20.2(A_{645}) + 8.02(A_{665}) \times V/1000 \times W$

where, A_{665} = Absorbance at 665nm, A_{645} = Absorbance at 645nm, V = Total volume of extract (ml), W = Weight of the sample (g).

Carotenoid = $A_{480} + 0.114\ A_{665} - 0.638\ A_{645} \times \left(\frac{V}{1000}\right) \times 100$

The value of total chlorophyll and carotenoid were expressed as mg/g fresh weight.

Estimation of Relative Leaf Water Content (RLWC)

The RLWC from the leaves of control and stressed plants was recorded during last week of May 2015-16 and August 2015-16. Ten leaf discs from each treatment were weighed immediately to obtain their fresh weight. The discs were submerged in distilled water in beakers till saturation. After 6 hr, the discs were removed from beakers. Surface water of the discs was blotted off without putting any pressure and then they were weighed to obtain saturated weight. After drying the discs at 70^0C for 72 hr their dry weight was determined. From these data RWC was calculated as follows and expressed as percentage.

$$\text{RLWC} = \left(\frac{\text{Freshweight-Dryweight}}{\text{Saturatedweight-Dryweight}}\right) \times 100$$

Estimation of electrolyte leakage

Leaf discs of uniform size (10 discs in 10ml water) taken in test tubes containing 10ml water in two sets. One set was kept at 40^0C for 30 minutes and the second set at 100^0C in boiling water bath for 15 minutes and their corresponding conductivities were measured by conductivity meter.

$$\text{EL (\%)} = \left(\frac{C1}{C2}\right) \times 100$$

where, C1 = EC at 40°C, C2 = EC at 100°C.

Statistical analysis

The experiment was arranged in a Completely Randomized Design (CRD) with 3 replications and 6 plants per replication. SAS software version 9.00 was used and the mean were compared using Duncan's New Multiple Range test (DMRT).

Total chlorophyll and carotenoid

The present findings clearly state that photosynthetic pigment fractions, i.e. chlorophyll and carotenoid were significantly reduced by NaCl stress in *Bauhinia purpurea* and *Milletia ovalifolia* (Table 1 and 2) during 2015-16 and maintained or slightly increased in *Acacia auriculiformis* and *Cassia fistula* (Table 1) during first year and when doses of salts were increased in November then pigment fraction decreases (Table 1). Similar results obtained by Kumari *et al.* (2012) in *Azadirachta indica*. The depressive effect of salt stress on chlorophyll biosynthesis may be due to the formation of proteolytic enzymes such as chlorophyllase, which is responsible for the chlorophyll degradation (Kaya *et al.* 2007) and /or damaging the photosynthetic apparatus (Singh and Jain 1981). A chlorophyllase enzyme is produced during salt stress in sensitive species. Many documents show that the performance of the chlorophyll pigment contents in the leaves of tolerant rice varieties were maintained better than in the sensitive varieties (Khan and Abdullah 2003, Cha-Um *et al*. 2009) . In the present study, the pigment content in both salt-tolerant and salt-sensitive species gradually reduced in the summer season and increased in the rainy season. Similar results have been reported by Chaum and Kirdmanee (2008) in Eucalyptus (*Eucalyptus camaldulensis* Dehnh.), rain tree (*Samanea saman* Merr.) and Thai neem (*Azadirachta siamensis* Val.). During summer season 2015, carotenoid content in *Acacia auriculiformia* and *Cassia fistula* increases by 68.18 and 29.41 % respectively and in *Bauhinia purpurea* and *Milletia ovalifolia* decreases by 16.86 and 36.61 % respectively at greatest concentration of salts, whereas during rainy season 2015, carotenoid content in *Acacia auriculiformia* and *Cassia fistula* increases by 92 and 32.07 % respectively and in *Bauhinia purpurea* decreases by 86.04 %, whereas in *Milletia ovalifolia* decreases by 3.2 times respectively at highest concentration of salts. During 2016 in summer month, carotenoid content decreases by 14.28, 10.86 and 36.23 % in *Acacia auriculiformis, Cassia fistula* and *Milletia ovalifolia* respectively at highest concentration of salts, whereas in rainy season the decrease in leakage were 4.08, 11.95 and 13.6 % in *Acacia auriculiformis, Cassia fistula* and *Milletia ovalifolia* respectively at highest concentration of salts. Plants of *Bauhinia purpurea* were died at greatest concentration of salts during second year.

Carotenoids are known to play an important role in plants as antioxidants. A new function for carotenoids has recently emerged, which relates to the response of plants to environmental stresses (Havaux 2014). Carotenoids are non–enzymatic constituents and provide a diversity of defense mechanisms against Reactive Oxygen Species. Reactive free electrons and photo activated chlorophyll can react with oxygen (O_2) resulting in the formation of reactive oxygen species (ROS) (Perl Treves and Perl 2002). ROS

Table 1 Effect of NaCl on physiological parameters of sub-tropical ornamental trees during summer and rainy season in 2015

Treatments	Chlorophyll (mg/g fresh weight)		Carotenoid (mg/g fresh weight)		Relative leaf water content (%)		Electrolyte leakage (%)	
	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy
Salt concentration								
T1	2.04 a	5.14 a	0.66 a	1.29 ab	71.49 a	77.72 a	46.19 d	42.42 c
T2	2.03 b	4.38 b	0.66 ab	1.28 b	71.50 a	77.72 a	46.50 c	42.52 c
T3	1.87 c	3.71 c	0.65 b	1.30 a	71.52 a	77.41 b	46.57 c	42.75 b
T4	1.77 d	3.31 d	0.64 c	1.19 c	71.20 b	77.07 c	46.76 b	43.17 a
T5	1.50 e	3.04 e	0.64 c	0.98 d	71.51 a	77.13 c	47.04 a	43.17 a
Ornamental trees								
V 1	1.43 d	1.68 d	0.27 d	0.71 d	75.13 a	80.96 a	45.18 b	39.50 c
V 2	2.31 a	6.01 a	0.58 c	1.17 c	74.09 b	75.70 d	52.17 a	48.55 a
V 3	2.09 b	4.80 b	0.85 b	1.66 a	73.09 c	76.91 b	44.22 d	41.54 b
V 4	1.53 c	3.17 c	0.90 a	1.28 b	63.47 d	76.07 c	44.88 c	41.58 b
Interaction								
T1 × V 1	1.43 ad	1.67 aa	0.22 a	0.50 abd	74.44 aa	80.06 aa	45.18 bd	39.51 cc
T2 × V1	1.43 bd	1.67 ab	0.24 aab	0.57 bd	74.42 aa	80.73 aa	45.18 bc	39.50 cc
T3 × V1	1.43 cd	1.68 ac	0.25 ab	0.72 ad	74.78 aa	80.61 ab	45.18 bc	39.50 bc
T4 × V1	1.44 dd	1.68 ad	0.29 ac	0.83 cd	74.93 aa	81.05 ac	45.17 bb	39.50 ac
T5 × V1	1.45 de	1.69 ae	0.37 ac	0.96 dd	77.08 ab	82.34 ac	45.17 ab	39.49 ac
T1 × V2	2.14 aa	5.54 ab	0.51 ab	1.06 abc	72.26 ab	75.10 ab	52.18 ad	48.56 ac
T2 × V2	2.19 ab	5.57 bb	0.54 abb	1.08 bc	72.84 ab	75.26 ab	52.18 ac	48.56 ac
T3 × V2	2.27 bc	5.73 bc	0.59 bb	1.13 ac	73.10 ab	75.43 bb	52.17 ac	48.55 ab
T4 × V2	2.45 bd	6.17 bd	0.63 bc	1.20 cc	73.41 ab	75.89 bc	52.17 ab	48.54 aa
T5 × V2	2.49 be	7.06 be	0.66 bd	1.40 cd	73.86 bb	76.84 bc	52.16 aa	48.54 aa
T1 × V3	2.71 ac	7.14 ac	0.97 ac	1.92 aab	75.11 ac	78.30 ac	43.19 dd	40.45 bc
T2 × V3	2.67 bc	5.16 bc	0.94 abc	1.87 ab	74.73 ac	77.85 ac	43.86 cd	40.86 bc
T3 × V3	2.11 cc	4.90 cc	0.90 bc	1.80 aa	74.30 ac	77.17 bc	44.07 cd	41.75 bb
T4 × V3	1.86 cd	3.11 cd	0.88 cc	1.70 ac	73.29 ac	76.13 cc	44.93 bd	42.20 ab
T5 × V3	1.11 ce	3.68 ce	0.83 cc	1.03 ad	73.05 bc	75.09 cc	45.05 ad	42.47 ab
T1 × V4	1.89 ad	6.21 ad	0.97 ad	1.70 abb	64.15 ad	77.41 ad	44.20 cd	41.16 bc
T2 × V4	1.83 bd	5.13 bd	0.93 abd	1.60 bb	64.03 ad	77.06 ad	44.79 cc	41.18 bc
T3 × V4	1.66 cd	2.53 cd	0.87 bd	1.55 ba	63.91 ad	76.41 bd	44.88 cc	41.22 bb
T4 × V4	1.32 dd	1.18 dd	0.76 cd	1.05 bc	63.20 ad	75.22 cd	44.77 bc	42.15 ab
T5 × V4	0.95 de	0.82 de	0.71 cd	0.53 bd	62.06 bd	74.25 cd	45.79 ac	42.18 ab

The different letters in each column are significantly different at $P \leq 0.05$ by Duncan's Multiple Range test (DMRT).

T_1 : Control (Tap water), **T_2 :** 30 mM NaCl, **T_3 :** 40 mM NaCl, **T_4 :** 50 mM NaCl, **T_5 :** 60 mM NaCl, V^1: *Acacia auriculiformis*, V^2: *Cassia fistua*, V^3: *Bouhinia purpurea*, V4: *Milletia ovalifolia*.

are physiologically damaging, highly reactive chemicals that plants must defend against for their survival.

Leaf Relative Water Content (LRWC)

Leaf relative water content is a criterion that is frequently used to define the water content of plants (Schonfeld *et al*. 1988). Significant results for leaf relative water content were seen. It is imperative that plants with high leaf relative water content have a more stable osmotic balance (Morgan 1984). LRWC increases in *Acacia auriculiformis* and *Cassia fistula* (Table 1) with increase in salinity stress during first year and in second year LRWC decreases slightly (Table 2). This indicates that these two species are more tolerant to salt as compared to *Bauhinia purpurea* and *Milletia ovalifolia*, in which RLWC decreases (Table 1 and 2) as salt conc. increases. The relative water content decreases under salinity stress conditions in most of the species but increases in salt tolerant species (Nader *et al*. 2003 and Kaya *et al*. 2003). Similar work has been done by Sohail *et al*. (2009). They observed that Salinity

Table 2 Effect of NaCl on physiological parameters of sub-tropical ornamental trees during summer and rainy season in 2016

Treatment	Chlorophyll (mg/g fresh weight)		Carotenoid (mg/g fresh weight)		Relative leaf water content (%)		Electrolyte leakage (%)	
	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy
Salt concentration								
T1	2.07 a	5.29 a	0.66 a	1.26 a	70.12 a	76.76 a	46.18 c	41.71 c
T2	1.80 b	4.93 b	0.63 b	1.22 b	68.37 b	75.64 b	46.95 b	41.78 b
T3	1.57 c	4.58 c	0.59 c	1.18 c	63.75 c	74.00 c	48.43 a	42.55 a
T4	1.18 d	2.92 d	0.37 d	0.74 d	43.95 d	53.71 d	36.77 e	32.24 e
T5	1.11 e	2.83 e	0.34 e	0.72 e	41.22 e	51.03 e	38.22 d	32.77 d
Ornamental trees								
V 1	1.40 c	1.63 d	0.23 d	0.50 d	70.70 a	76.83 a	45.01 c	37.39 c
V 2	2.01 a	5.34 b	0.48 c	0.97 c	65.09 b	70.14 c	52.82 a	48.45 a
V 3	1.18 d	3.86 c	0.54 b	1.06 b	51.86 c	45.25 d	28.60 d	25.33 d
V 4	1.59 b	5.60 a	0.82 a	1.56 a	42.27 d	72.68 b	46.81 b	41.67 b
Interaction								
T1 ×V 1	1.46 ac	1.71 ad	0.24 ad	0.51 ad	73.16 aa	79.17 aa	44.71 cc	37.17 cc
T2 × V1	1.45 bc	1.67 bd	0.23 bd	0.51 bd	73.05 ab	79.06 ab	44.70 bc	37.19 bc
T3 × V1	1.43 cc	1.65 cd	0.23 cd	0.51 cd	72.15 ac	78.14 ac	44.72 ac	37.35 ac
T4 × V1	1.38 dc	1.60 dd	0.22 dd	0.50 dd	69.82 ad	75.12 ad	44.76 ce	37.42 ce
T5 × V1	1.32 ce	1.55 de	0.21 de	0.49 de	65.32 ae	72.70 ae	46.15 cd	37.82 cd
T1 × V2	2.18 aa	5.71 ab	0.51 ac	1.03 ac	71.02 ab	74.15 ab	51.71 ac	47.81 ac
T2 × V2	2.14 ab	5.68 bb	0.49 bc	1.01 bc	70.14 bb	74.02 bb	51.73 ab	47.85 ab
T3 × V2	2.08 ac	5.61 bc	0.49 cc	0.98 cc	65.51 bc	72.15 bc	52.13 aa	48.61 aa
T4 × V2	1.88 ad	4.95 bd	0.47 cd	0.95 cd	60.92 bd	68.70 bd	52.84 ae	48.85 ae
T5 × V2	1.81 ae	4.78 be	0.46 ce	0.92 ce	57.85 be	61.72 be	55.72 ad	49.17 ad
T1 × V3	2.80 ad	7.24 ac	0.96 ab	1.85 ab	74.12 ac	77.31 ac	45.15 cd	41.71 dc
T2 × V3	1.94 bc	6.13 bc	0.88 bb	1.77 bb	71.10 bc	75.40 bc	47.19 bd	41.80 bd
T3 × V3	1.20 cc	5.94 cc	0.85 bc	1.67 bc	66.16 cc	73.57 cc	50.69 ad	43.16 ad
T4 × V3								
T5 × V3								
T1 × V4	1.86 ab	6.51 aa	0.94 aa	1.67 aa	62.18 ad	76.41 ad	43.18 bc	40.17 bc
T2 × V4	1.70 bd	6.24 ab	0.90 ab	1.62 ab	59.18 bd	74.11 bd	44.18 bb	40.27 bb
T3 × V4	1.59 bc	5.14 ac	0.81 ac	1.56 ac	51.18 cd	72.14 cd	46.19 ab	41.08 ab
T4 × V4	1.48 bd	5.13 ad	0.78 ad	1.51 ad	45.08 dd	71.02 dd	49.50 be	42.72 be
T5 × V4	1.34 be	5.02 ae	0.69 ae	1.47 ae	41.71 de	69.73 de	51.02 bd	44.11 bd

The different letters in each column are significantly different at $P \leq 0.05$ by Duncan's Multiple Range test (DMRT).

$\mathbf{T_1}$ **:** Control (Tap water)**,** $\mathbf{T_2}$ **:** 30 mM NaCl, $\mathbf{T_3}$ **:** 60 mM NaCl, $\mathbf{T_4}$ **:** 90 mM NaCl, $\mathbf{T_5}$ **:** 120 mM NaCl, $\mathbf{V_1}$: *Acacia auriculiformis,* $\mathbf{V_2}$: *Cassia fistula,* $\mathbf{V_3}$: *Bauhinia purpurea,* $\mathbf{V_4}$: *Milletia ovalifolia.*

levels of 40, 80 and 160 mM enhanced leaf water contents by 14, 16 and 17%, respectively in *Ziziphus spina-christi* (L.). Reduction in relative water content causes reduction in photosynthesis. Trivedi *et al*. (1992) mentioned that *Acacia auriculiformis* has high WUE under varying conditions which is advantageous for the plant to compete during harsh conditions of drought and temperature. RLWC is more during rainy season in all species and decreases during summers.

Electrolyte leakage

Several studies suggest that the plasma membrane (PM) might be a primary site for salt injury (Cramer *et al*. 1985, Mansour and Salama 2004). In addition, PM permeability has been reported as an effective selection criterion for salt tolerance in various crops (Tuna *et al*. 2007 and Tiwari *et al*. 2010). The alteration in PM permeability varies significantly between species and cultivars of different salt tolerance. PM permeability was reported to increase in salt sensitive cultivars upon salt treatment (Mansour and Salama 1996, 2004). Changes in PM permeability of salt tolerant cultivars under salt stress were, always marginal. Our results indicate increase in electrolyte leakage (Table 1 and 2) of *Bauhinia purpurea* and *Milletia ovalifolia* during both years, whereas in *Acacia auriculiformis* and *Cassia fistula*, the electrolyte leakage was maintained with increasing salt conc. in first year (Table 1) and during second year electrolyte leakage were slightly decreases (Table 2). During 2015, Electrolyte leakage in *Acacia auriculiformia* and *Cassia fistula* decreases by 0.02 and 0.03 % respectively and in *Bauhinia purpurea* and *Milletia ovalifolia* increases by 4.30 and 3.59 % respectively in summer months at greatest concentration of salts, whereas during rainy season 2015, Electrolyte leakage in *Acacia auriculiformia* and *Cassia fistula* decreases by 0.05 and 0.04 % respectively and in *Bauhinia purpurea* and *Milletia ovalifolia* increases by 4.99 and 2.47 % respectively at highest concentration of salts. During 2016 in summer month, the Electrolyte leakage increases by 3.22, 7.75 and 18.15 % in *Acacia auriculiformis, Cassia fistula* and *Milletia ovalifolia* respectively at highest concentration of salts, whereas in rainy season the increase in leakage were 1.74, 2.84 and 9.8 % in *Acacia auriculiformis, Cassia fistula* and *Milletia ovalifolia* respectively at highest concentration of salts. Plants of *Bauhinia purpurea* were died at greatest concentration of salts during second year. Electrolyte leakage was more during summer than rainy season. This may be due more water content during rainy season. Water deficiency is one of the most common consequences of salt stress (Tabaei-Aghdaei *et al*., 2000) and results in the mal-functioning of the cellular membranes by increasing their ion leakage. The deleterious effect of salinity on the plasma membrane is essentially due to the action of salt ions (Mansour, 1997). It has also reported that salinity induces increase in electrolyte leakage (Bhattacharjee and Mukherjee, 1996).

On the basis of physiological response of four ornamental trees to salinity stress induced by NaCl as 0, 30, 40, 50 and 60 mM till October and after that 0, 30, 60, 90 and 120 mM, it may be concluded that *Acacia auriculiformis* is suitable for plantation in saline soil condition up to a salinity strength of 120 mM NaCl and *Cassia fistula* up to a salinity strength of 60 mM. During second year all plants of *Bauhinia purpurea* treated with 90 mM and 120 mM NaCl were died. The order of tolerance to salinity stress as indicated by the quantification of total chlorophyll, carotenoid, relative leaf water content and membrane permeability is *Acacia auriculiformis* > *Cassia fistula* > *Bauhinia purpurea* > *Milletia ovalifolia*.

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SUMMARY

An experiment was conducted to explore the possibility about saline irrigation water may be used to grow ornamental tree species in pots under sub tropical condition of Punjab for two years (2015-16). Five salinity treatments of NaCl (analytical reagent) as 0 mM, 30 mM, 40 mM, 50 mM and 60 mM were given to one year old seedlings planted in earthen pots (10") containing soil : FYM (2:1). These concentrations were given till October. After October month, i.e. in first week of November the treatments of NaCl as 0 mM, 30 mM, 60 mM, 90 mM and 120 mM were given. The results indicated that the increased salinity concentration in *Bauhinia purpurea* and *Milletia ovalifolia* significantly reduced the total chlorophyll, carotenoid and relative water content, whereas increased the cell membrane injury during both years. In *Acacia auriculiformis* and *Cassia fistula*, total leaf chlorophyll and carotenoids were maintained or slightly increased during first year and after that decreased, whereas relative water content increased with increase in salinity concentrations in first year and after that decreased. Electrolyte leakage in *Acacia auriculiformis* and *Cassia fistula* were maintained or slightly decreased during first year and during second year increased. It has been concluded that depending on the physiological responses, *viz.* total chlorophyll content, carotenoid content, relative water content and membrane permeability index, maximum salt tolerance was observed in *Acacia auriculiformis* followed by *Cassia fistula, Bauhinia purpurea* and *Milletia ovalifolia*.

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