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IRRIGATION WATER QUALITY IMPACT ON SALINITY TOLERANT AND SUSCEPTIBLE ORNAMENTAL TREE SPECIES IN THE SEMI-ARID REGION OF BATHINDA, PUNJAB, INDIA

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ABSTRACT

On the basis of morpho-physiological, biochemical and anatomical parameters during the 1st and 2nd years of the experiment, plants were classified as salt-tolerant and susceptible. From these plants, salt-tolerant (*Casuarina equisetifolia*, *Pongamia pinnata, Acacia auriculiformis, Callistemon lanceolatus,* and *Cassia Fistula*) and salt-susceptible tree species (*Milatia ovalifolia, Putranjiva roxburghii, Koelreutaria paniculata, Bauhinia purpurea,* and *Ficus benjamina*) were planted at the PAU regional research station, Bathinda. The field experiments were conducted in a randomized block design with 20 treatments and replicated three times. The treatments were comprised of two irrigation water qualities (saline water and canal water) and ten ornamental tree species. The pH and EC of the soil increased as it was irrigated with Saline water (pH 8.99, EC 3.65 dS/m) and Canal water (pH 8.1, EC 0.46 dS/m). Among different tree species, the highest mean value of all parameters in salt-tolerant tree species was found when the plants were irrigated with canal water up to the estimated salinity of 0.46 dS/m. During the first year of the experiment the maximum percent decrease in plant height (28.57%), Number of branches per plant (28.65%), stem girth (28.15%), plant spread (29.03%), and survival percent (40%), was observed in *F. benjamina, and the* minimum percent decrease in plant height (6.11%), Number of branches per plant (6.25%), stem girth (8.80%), plant spread (8.97%), and survival percent (100.00%), was observed in *C. equisetifolia,* During the second year of the experiment, the maximum percent decrease in plant height (30.37%), Number of branches per plant (29.32%), stem girth (30.83%), plant spread (30.50%), and survival percent (60.00%) was observed in *F. benjamina, and the* minimum percent decrease in plant height (10.48%), Number of branches per plant (11.66%), stem girth (16.31%), plant spread (15.38%), and survival percent (100.00%) was observed in *C. equisetifolia.*
***Keywords* :** Saline water, Canal water, salt tolerant and Susceptible Ornamental tree species, impact of irrigation water quality on tree growth.

Introduction

The European Union, the United States, and Japan account for the majority of the 250 to 400 billion USD (Chandler & Sanchez, 2012) in annual revenue generated by the global market for ornamental plants. Due to the diversity of temperature, soil, and flora in India, there is potential for growth in the agribusiness of decorative plants, which will lead to an increase in the cultivation of both native and foreign species (IBRAFLOR, 2017). The cultivation of cut flowers, potted flowers, and garden plants are also offers a significant potential for employment creation and high profitability (Bezerra, 1997). However, the agricultural industry is concerned due to the quantity, and inefficient use of available water (Munns, 2002, Singh & Gupta, 2009 and Niu *et al.,* 2013).

This necessitates for the identification of a few tree species that can endure irrigation water or soil salts. By re-establishing uneven and damaged landscapes, salinity is becoming more significant in landscaping as a result of the rise in green spaces in urban and modern places where a severe water shortage is a problem. This highlights the value of using recycled waste water as a backup source for irrigation. As they are frequently utilized in gardening and landscaping, ornamental plants come in a range of sizes and shapes, each with their own significance in horticulture.

Casuarina equisetifolia L. belongs to family Casuarinaceae and is commonly known as beefwood. It belongs to the group of actinorhizal plants that establish nitrogen-fixing root nodule symbiosis with actinomycetes of the genus *Frankia*. It has suitability to grow in the areas, where the level of nitrogen is low such as disturbed, desert and coastal areas and in the land rehabilitation. It has good salt-tolerant capacity. *Bauhinia purpurea* L (Kachnar) and *Cassia fistula* (Amaltas) are widely used in India as avenue trees for road side plantation and group planting. *Acacia auriculiformis* Benth (Australian wattle) has attractive shape and foliage. It is mostly planted for shade in garden, roadside, parks etc. *Milletia ovalifolia* Roxb. (Moulmein rose wood) is a dwarf tree with small lilac-coloured flowers. It produces flowers in leafless condition during April and is suitable for compounds of houses, parks and public places. *Koelreuteria paniculata* Laxm. (Golden Rain Tree) is a yellow flowering plant belongs to family Sapindaceae. *Callistemon lanceolatus* Sm., commonly known as bottle brush, is a member of the Myrtaceae family. On the old branches, dense clusters of crimson flowers with free stamens are carried in spikes 5 to 10 cm long. With the weeping branches cascading over the pool, it is particularly ideal for areas near ponds or lily pads. The plant *Pongamia pinnata* syn. *P. glabra* (L.) Pierre. (Karanj), which is a member of the Fabaceae family and is native to India, blooms without leaves from April to May. The tree serves as a lovely and protective hedge when it is covered in lilac blooms. *Putranjiva roxburghii* Wall. belongs to the family Putranjivaceae, is commonly known as child life tree. *Ficus benjamina* L. belongs to family Moraceae and is native of the Indo-Malaya region. It is a medium to large, evergreen tree and is planted for its attractive foliage, suitable for planting in parks as specimen, groups and alongside the roads for shade. All these ornamental trees are widely used in landscaping, so there is a need to evaluate these ornamental trees for landscaping of salt-affected lands (Arora 1990, Randhawa and Mukhopadhyay, 1986). The genus Acacia, Casuarina and Eucalyptus have been found to be salt tolerant (Craig *et al.,* 1990).

These ornamental trees are crucial to landscaping. In order to restore salt-affected land by planting possibly tolerant trees, it is important to evaluate these species' salinity tolerance reactions. The establishment of perennial plants on salt-affected soil will result in decreased maintenance expenses as a result of the trees' deep-rooted tendencies, which aid in water management, a salinity mitigation technique (Marcar *et al.,* 1999).

The use of salt-tolerant species, such as decorative plants, is suggested by biosaline agriculture in this context as an alternative to the use of low-quality waters (Cassaniti *et al.,* 2009, Alvarez & Sanchez-Blanco, 2014 and Garcia-Caparros *et al.,* 2016). In addition to the cultivation of resistant species, the use of saline and brackish waters in agriculture is made possible by the selection of appropriate irrigation techniques and the application of leaching fractions to remove the excess salts in the root zone (Ayers & Westcot, 1999 and Muyen *et al.,* 2011). Ramoliya *et al.,* 2004 reported that soil salinity hinders the shoot development more as compare to root growth. Irrigating plants with water having high salts can leads to deterioration of the soil properties which adversely affects growth, productivity and yield of different crops (Choudhary *et al.,* 2002).

Soil salinity affects one third of the total irrigated land which causes a considerable reduction in the crop growth and productivity (Ravindran *et al.,* 2007). It is estimated that approximately 20% of the arable land is subjected to salt stress. Based on the soil map of the world, saline and sodic soils constitute 15% of the global land area. These were distributed essentially in the Asia and the Pacific, primarily in Australia (8%) and Europe (3.6%). In India, out of the total geographical area (329 Mha), 6.727 Mha i.e., 2.1% area is affected by salt stress (Arora *et al.,* 2017) while in Punjab out of its total geographical area 6.4% is affected by salinity (Sharma *et al.,* 2011).

There isn't much information in the literature about the use of saline and canal water to irrigate ornamental plants. Although certain species can grow successfully in salty environments, some tree species were susceptible to the excessive salt content of the irrigation water, necessitating research into better management techniques. It is vital to discover species with potential for growth using moderately saline water, expanding the potentialities of this sector in the semi-arid region of Punjab, given the importance of the cultivation of flowers and ornamental plants.

Material and Methods

Experimental site

The field trials were carried out between 2021 and 2022 at the Punjab Agricultural University Regional Research Station in Bathinda, India (30° 9'36" North, 74° 55'28" East, and 211 metres above sea level), which is located in the extreme south-western region of Punjab. The location is a part of the Indo Gangetic alluvial plains and located in the north-western area of India. The site has a semi-arid, subtropical climate with an average annual rainfall of 436 mm, 80% of which falls during the first week of July and mid-September during the South-Western monsoon season. In June, the average maximum and minimum temperature ranged from 40 to 450 C and 4 to 50 C, respectively. Mid-December through mid-February is when frosty evenings and frigid breezes are most frequent. The texture of experimental soil was classified as a sandy loam with 75.0% sand, 16.8% silt and 8.2% clay.

Field experiment

On the basis of morpho-physiological, biochemical and anatomical parameters during the 1st and 2nd year of the experiment, plants were classified as salt tolerant and susceptible. From these plants salt tolerant and salt susceptible tree species were planted at PAU regional research station, Bathinda. With twenty treatments were duplicated three times in the field studies, which used a randomised block design. Ten of ornamental tree species were used in the treatments, which included two types of irrigation water (canal water and saline water).

Irrigation water quality treatments

Table 1 shows the components of the two types of irrigation water that were used in this investigation. Two distinct 1.5 million litres of water storage in tanks were used to store both types of water.

Table 1: Average composition of saline and canal irrigation water qualities used in the experiment.

Variable	Saline Water	Canal Water
pH	8.99	8.10
EC (dS	3.650	0.460
Ca^{2+} (me/ L)	2.69	2.08
Mg^{2+} (me/ L)	5.70	0.83
Na^{+}(me/L)	24.48	0.38
K^{+}(me/L)	0.26	0.10
CO_3^{2-}(me/ L)	0.62	0.19
HCO_3^{-} (me/ L)	6.80	1.35
Cl^{-} (me/L)	9.35	0.96
SO_4^{2-} (me/ L)	9.21	0.46

Result and Discussion

Morphological Parameters

Plant height (meter)

On the basis of morpho-physiological, biochemical and anatomical parameters during the 1st and 2nd year of the experiment, tree species were classified as salt tolerant and susceptible. From these, plants highly salt tolerant and the salt susceptible tree species were planted at PAU regional research station, Bathinda.

Among different tree species, the maximum plant height in salt-tolerant tree species were found when the plants were irrigated with canal water up to the estimated salinity of 0.46 dS/m. Maximum mean plant height (Fig. 2) was recorded (4.14 meter) in salt-tolerant tree species, decreased in plant height was observed in all tree’s species. The maximum decreased in plant height (28.57%) during the first year in (Table. 2) was for the *F. benjamina* followed by *B. purpura* (24.65%), *K. panniculata* (24.24%), *P. roxburghii* (22.77%), *M. ovalifolia* (21.33%), *C. fistula* (19.21), *C. lanceolatus* (17.64), *A. auriculiformis* (15.67), *P. pinnata* (9.60%) and *C. equisetifolia* (6.11%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species. During the second year in (Table. 3) highest decreased plant height (30.37%) was observed in *F. benjamina* followed by *B. purpurea* (28.57%), *K. paniculata* (24.24%), *P. roxburghii* (21.24%), *M. ovalifolia* (21.33%), *C. fistula* (21.11%), *C. lanceolatus* (20.58%), *A. auriculiformis* (20.00%), *P. pinnata* (11.6%) and *C. equisetifolia* (10.48%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species.

When treated with modest concentrations of soluble salt, salt bush *Atriplex nummularia* also showed an increase in plant height (Araujo *et al.,* 2006) probably as a result of enhanced water intake (Munns and Tester, 2008). These plants may engage in osmotic adjustment activity in response to low salt concentrations, which may enhance plant development. In *Azadirachta indica*, similar outcomes were also observed (Kumari *et al.,* 2012). In salt susceptible species, all trees' plant heights decreased as a result of treatment with a higher concentration of sodium chloride solution, possibly as a result of the detrimental effects on the rate of photosynthesis as well as the carbohydrates' use as osmolytes, both of which can inhibit plant growth (Mazher *et al.,* 2007). Furthermore, a decrease in growth under salinity may be linked to an increase in soluble carbohydrates in the leaves. Reduced water potential in the cell, which leads to stomata closing and reduced CO_2 assimilation, may be the cause of the decreased plant height. According to many researchers, the height of salt-tolerant tree species increases at low salt concentrations and decreases at increasing salt concentrations (Dantus *et al.,* 2005, Memon *et al.,* 2010, Qados, 2011).

By decreasing the osmotic potential in the root environment, which can result in a lack of water and toxicity through the specific action of the ions, particularly Na^+ and Cl^-, on the protoplasm, increases in ECw levels hindered the growth of plant height (Munns 2002, Alves *et al.,* 2011, Himabindu *et al.,* 2016 and Acosta-Motos *et al.,* 2017). Cell elongation and division are related to growth reduction brought on by salt, as seen in the current study (Schossler *et al* 2012, Araújo *et al.,* 2013 and Coelho *et al.,* 2014). When the amount of potentially hazardous ions absorbed exceeds the limit tolerable by the cells, there were direct impacts on metabolism, which can cause damage and plant death (Munns, 2002), it is thought that the osmotic effect initially limits plant development.

Number of branches per plant

In (Fig. 3) shows the effect of saline water and canal water on number of branches per plant in selected ornamental tree species. Among different tree species, maximum number of branches per plant (12.65) were recorded in *C. equisetifolia*. All tree species exhibited a slight decreased in number of branches under the saline water as shown in (Table. 2) and this decreased was more in irrigated tree species with saline water. The maximum decreased in number of branches per plant (28.65%) during the first year in (Table. 2) was for the *F. benjamina* followed by *B. purpura* (24.48%), *K. panniculata* (24.17%), *P. roxburghii* (22.67%), *M. ovalifolia* (20.76%), *C. fistula* (18.14), *C. lanceolatus* (13.05), *A. auriculiformis* (13.97), *P. pinnata* (10.13%) and *C. equisetifolia* (6.25%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species. During the second year in (Table. 3) highest decreased plant height (29.32%) was observed in *F. benjamina* followed by *B. purpurea* (28.65%), *K. paniculata* (24.17%), *C. fistula* (22.67%), *P. roxburghii* (22.13%), *M. ovalifolia* (20.76%), *C. lanceolatus* (20.76%), *A. auriculiformis* (19.35%), *P. pinnata* (12.00%) and *C. equisetifolia* (11.60%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species.

Optimum temperature and light intensity led to higher photosynthesis and thus more growth and number of branches. Machado *et al.* (2002) worked on citrus and reported that lowest photosynthetic rates and photo assimilate supply in saline condition, when plants have reduced metabolic activities with reduced carbohydrate consumption and thus less growth and number of branches. Many researchers found that the number of branches per plant decreased with increasing salt concentration in irrigation water (El Juhany and Aref, 2005, Mansour *et al.,* 2010, Ali *et al.,* 2013).

Stem girth

In Fig. 4 shows significant effect of saline water and canal water irrigation on stem girth. In the all trees, stem girth slightly decreased when irrigated with saline water (EC 3.65 dS/m). The maximum decreased in stem girth (28.15%) during the first year in (Table. 2) was for the *F. benjamina* followed by *B. purpura* (25.45%), *P. roxburghii* (24.81%), *K. panniculata* (24.05%), *M. ovalifolia* (21.92%), *C. fistula* (20.76%), *C. lanceolatus* (19.16%), *A. auriculiformis* (18.70%), *P. pinnata* (9.98%) and *C. equisetifolia* (8.80%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species. During the second year in (Table. 3) highest decreased plant height (30.83%) was observed in *F. benjamina* followed by *B. purpurea* (28.15%), *K. paniculata* (24.05%), *P. roxburghii* (22.66%), *C. lanceolatus* (22.01%), *M. ovalifolia* (21.92%), *C. fistula* (21.31%), *A. auriculiformis* (20.03%), *P. pinnata* (16.65%) and *C. equisetifolia* (16.31%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species.

A similar decrease in stem girth was reported by (Farahat *et al* 2013) in *Grevillea robusta* seedlings as salt concentration increased in irrigation water and when foliar application of ascorbic acid was done then growth parameters increased. Sun and Dickinson (1995) also reported slight decrease in the stem girth of *Casuarina cunninghamia* at a high level of salinity. The adverse effect of salt irrigation on stem diameter in the present investigation concurs with the other results (Bernstein *et al.,* 2001, Elfeel and Bakhashwain 2012).

Plant spread

Among different tree species, the maximum plant spread in all tree species was found when the plants were irrigated with canal water. Maximum mean plant spread (Fig. 5) was recorded (1.92 meter) in salt-tolerant tree species, decrease in plant spread was observed in all tree's species. The maximum decreased in plant spread (29.03%) during first year in (Table. 2) was for the *F. benjamina* followed by *B. purpura* (28.57%), *P.roxburghii* (25.92%), *K. panniculata*

(23.07%), *M. ovalifolia* (22.36%), *C. fistula* (20.23%), *C. lanceolatus* (19.04%), *A. auriculiformis* (18.60%), *P. pinnata* (9.52%) and *C. equisetifolia* (8.97%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species. During the second year in (Table. 3) highest decreased plant height (30.50%) was observed in *F. benjamina* followed by *B. purpurea* (29.03%), *K. paniculata* (25.92%), *P. roxburghii* (25.42%), *C. lanceolatus* (22.36%), *C. fistula* (21.90%), *M. ovalifolia* (21.53%), *A. auriculiformis* (20.93%), *P. pinnata* (16.19%) and *C. equisetifolia* (15.38%) when irrigated with saline water (EC 3.65 dS/m) compared with the canal water (EC 0.46 dS/m) irrigated tree species.

When salt concentration increased in the soil, it became difficult for plants to extract water from soil, which led to the closing of stomata and thus photosynthesis reduced and hence growth was reduced. Plant spread decreased in salt-sensitive tree species compared with the salt-tolerant tree species, whereas in salt-tolerant tree species plant spread slightly increased in tree species irrigated with canal water as compared with the saline water irrigated tree species. In salt-sensitive tree species, plant spread was inversely related to increased concentration of salt in irrigation water. The per cent decrease in plant spread was minimum in *C. equisetifolia* and the maximum in *A. auriculiformis* irrigated with saline water relative to the canal water (Araujo *et al* 2006).

Survival percentage

Table 2 and 3 represents the effect of saline water and canal water on the survival percentage of different tree species under experimentation. Survival percentage was the maximum when the trees were irrigated with canal water (EC 0.46 dS/m) and saline water (EC 3.65 dS/m). According to salt tolerance is often described on the basis of survival percentage. *C. equisetifolia, C. fistula,* and *P. pinnata* showed 100% survival at the termination of the experiment with canal and saline water irrigated. Tree species like, *A. auriculiformis* showed 60% survival irrigated with saline water compared with canal water. This indicates that *C. equisetifolia, C. fistula, P. pinnata* and *C. lanceolatus* were the salt tolerant species.

A study conducted by (Tomar *et al* 2003) on 31 tree species showed that tree species like *Acacia auriculiformis, A. farnesiana, A. tortilis, C. fistula, C. siamea, P. pinnata, Melia azedarach* and *Terminalia arjuna* showed satisfactory early growth and 100% survival after one year, when supplied with saline irrigation water.

Chaum and Kirdemanee (2008) reported maximum survival of salt-tolerant clones of eucalyptus, rain tree and neem than salt-sensitive clones of these species. They also reported maximum survival of these species during rainy season followed by winter and summer. In our results, *C, equisetifolia, C. fistula, P. pinnata* and *C. lanceolatus*, could survive in saline water. *A. auriculiformis*, *F. banjaminana* and *P. roxburhii* could survive only 80-60% irrigated with saline water. *Eucalyptus tereticornis* and *Melia azedarach* recorded 78 and 70% survival, respectively one year after transplanting in an agroforestry system irrigated with saline water (Garg *et al.,* 2017).

Chemical parameters of growing media and irrigation water

pH

The pH is one of the important chemical properties of soil as a medium for plant growth. Fig.1 shows the effect of saline water and canal water on pH of soil at the end of the experiment. In general, pH of soil increased as concentration of H^+ decreased, but sometime there was a slight change in pH as salt concentration in soil was more precisely discussed on the basis of the concentration of soluble salts.

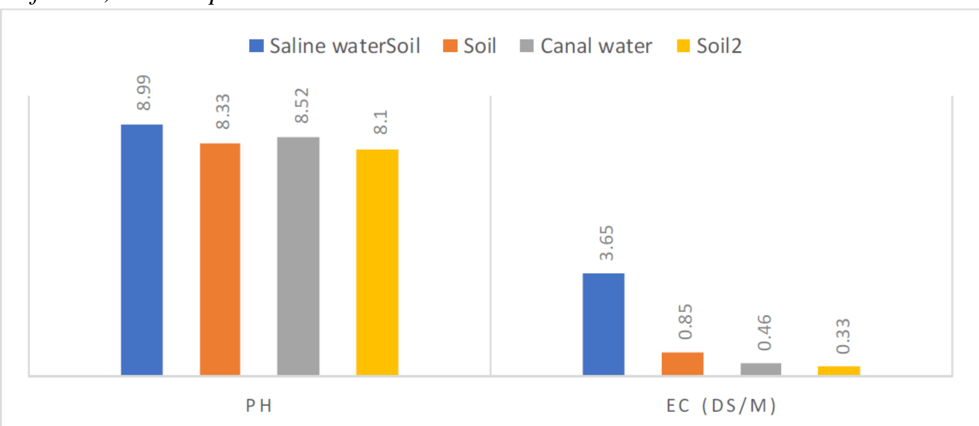

Fig. 1 : pH and EC (dS/m) of saline, canal irrigation water and Soil

In the present investigations, pH of the soil increased as the irrigated Saline water (8.99 pH) and soil pH (8.33) were observed irrigated with Saline water. Canal water pH (8.52) and Soil pH was (8.10) observed irrigated with canal water. Salinity had no effect on pH of the growing medium and was the same within the saline and canal water irrigated soil. In all tested soil pH was a little bit higher in the saline water irrigated of the growing medium

Electrical conductivity (dS/m)

Fig.1 represents the effect of Saline and canal water on the EC of soil. As shown in the figure, as the salt concentration increased, the number of soluble salts increased and thus the EC of soil increased.

In the present investigations, EC of the soil increased as the irrigated with Saline water (3.65 dS/m) and soil EC (0.85 dS/m) was observed irrigated with Saline water. Canal water EC (0.46 dS/m) and Soil EC (0.33 dS/m) irrigated with canal water.

By decreasing the osmotic potential in the root environment, which can lead to a water deficit and toxicity through the specific action of the ions, particularly Na^+ and Cl^-, on the protoplasm, increases in EC levels restricted the growth of plant height (Munns, 2002, Alves *et al.,* 2011, Himabindu *et al.,* 2016 and Acosta-Motos *et al.,* 2017). Zapryanova & Atanassova (2009), on the growth of neem (*Azadirachta indica* and *A. Juss*.) and chinaberry tree (*Melia azedarach* Linn.) in different soils with EC of 0.49, 4.15, 6.33, and 10.45 dS m^{-1}, respectively, it was found that EC had a negative impact on plant growth.

Conclusions

Salt-tolerant and susceptible ornamental tree species irrigated with saline water and canal water. The pH and EC of the soil increased as it was irrigated with Saline water (pH 8.99, EC 3.65 dS/m) and Canal water (pH 8.1, EC 0.46 dS/m). Among different tree species, all parameters with a maximum mean value were found in salt-tolerant tree species when the plants were irrigated with canal water. up to the estimated salinity of 0.46 dS/m. The maximum decrease in plant height, plant spread, Number of branches per plant, and stem girth was observed in *F. benjamina,* followed by *B. purpura*, *P. roxburghii*, *K. panniculata*, *M. ovalifolia*, *C. fistula*, *C. lanceolatus*, *A. auriculiformis*, *P. pinnata,* and *C. equisetifolia* when irrigated with saline water (EC 3.65 dS/m) compared with canal water (EC 0.46 dS/m) irrigated tree species.

Future scope

These ornamental trees are crucial to landscaping and environmental. In order to restore salt-affected land by planting possibly tolerant trees, it is important to evaluate these species' salinity tolerance reactions. The establishment of perennial plants on salt-affected soil will result in decreased maintenance expenses as a result of the trees' deep-rooted tendencies, which aid in water management, a salinity mitigation technique.

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No Conflict of interest

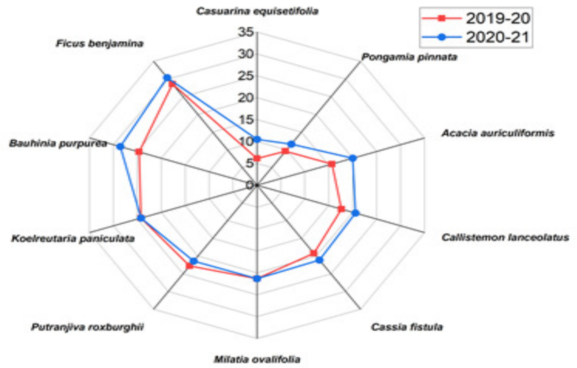

Fig. 2 : Decrease % in plant height

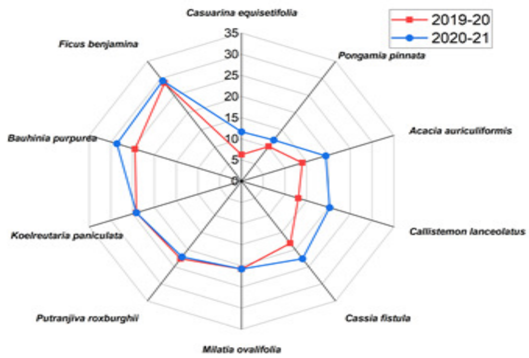

Fig. 3 : Decrease % in number of branches

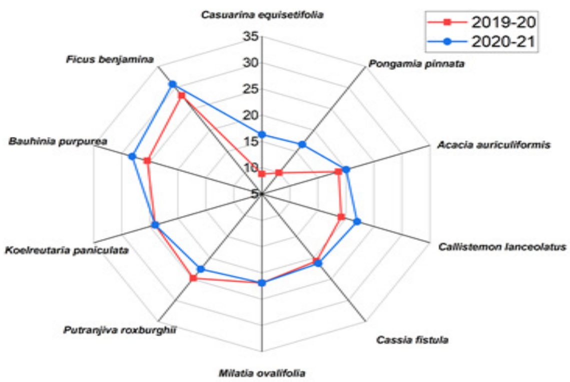

Fig. 4 : Decrease % in stem girth

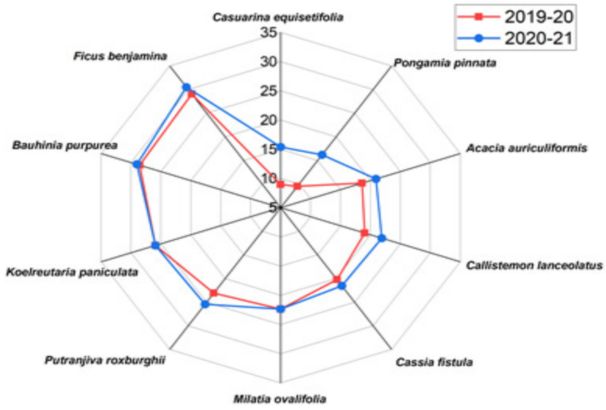

Fig. 5 : Decrease % in plant spread

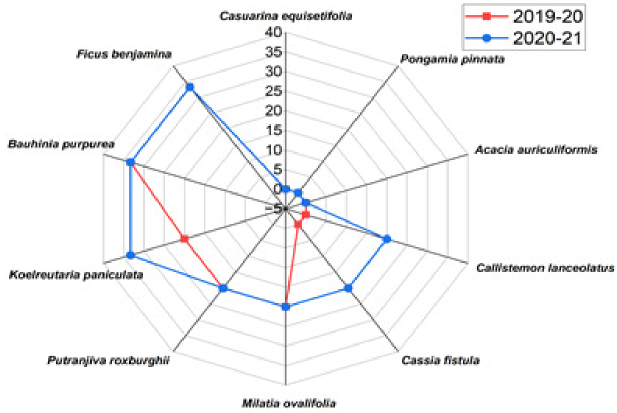

Fig. 6 : Decrease % in survival

Fig. 2, 3, 4, 5 and 6 : Showed Irrigation water quality impact on decrease plant height, Number of branches, stem girth, plant spread and survival of salinity tolerant and susceptible ornamental tree species in 2019-20 and 2020-21.

Table 2 : Irrigation water quality impact on plant height, Number of branches, stem girth, plant spread and survival of salinity tolerant and susceptible ornamental tree species in 2019-20.

Tree species	Plant height (m)			Number of branches			Stem girth (mm)			Plant spread (m)			Survival (%)		
	Canal water	Saline water	% Decrease	Canal water	Saline water	% Decrease	Canal water	Saline water	% Decrease	Canal water	Saline water	% Decrease	Canal water	Saline water	% Decrease
Casuarina equisetifolia	2.29	2.15	6.11	8.00	7.50	6.25	80.28	73.18	8.80	0.78	0.71	8.97	100.00	100.00	0.00
Pongamia pinnata	2.50	2.26	9.60	5.33	4.79	10.13	90.15	81.15	9.98	1.05	0.95	9.52	100.00	100.00	0.00
Acacia auriculiformis	1.85	1.56	15.67	4.65	4.00	13.97	85.06	69.15	18.70	0.86	0.70	18.60	80.00	80.00	0.00
Callistemon lanceolatus	1.70	1.40	17.64	7.66	7.00	13.05	71.81	58.05	19.16	1.05	0.85	19.04	100.00	100.00	0.00
Cassia fistula	2.29	1.85	19.21	7.33	6.00	18.14	79.64	63.10	20.76	0.84	0.67	20.23	100.00	100.00	0.00
Milatia ovalifolia	1.50	1.18	21.33	6.50	5.15	20.76	75.15	58.67	21.92	0.76	0.59	22.36	100.00	80.00	20.00
Putranjiva roxburghii	1.80	1.39	22.77	6.66	5.15	22.67	51.66	38.85	24.81	0.65	0.50	23.07	100.00	80.00	20.00
Koelreutaria paniculata	1.65	1.25	24.24	6.66	5.05	24.17	70.05	53.20	24.05	0.81	0.60	25.92	100.00	80.00	20.00
Bauhinia purpurea	2.15	1.62	24.65	7.35	5.55	24.48	78.64	58.63	25.45	0.84	0.60	28.57	60.00	40.00	33.33
Ficus benjamina	1.40	1.00	28.57	8.62	6.15	28.65	46.43	33.50	28.15	0.62	0.44	29.03	60.00	40.00	33.33
Mean	1.91	1.56		6.87	5.63		72.88	58.74		0.82	0.66		90.00	80.00	
Factor A	0.05			0.17			2.11			0.02			1.19		
Factor B	0.02			0.09			1.12			0.01			0.59		
Factor (AxB)	0.07			0.24			2.98			0.02			1.56		

Table 3 : Irrigation water quality impact on plant height, Number of branches, stem girth, plant spread and survival of salinity tolerant and susceptible ornamental tree species in 2020-21.

	Plant height (m)			Number of branches			Stem girth (mm)			Plant Spread (m)			Survival %		
Tree species	**Canal water**	**Saline water**	**% Decrease**	**Canal water**	**Saline water**	**% Decrease**	**Canal water**	**Saline water**	**% Decrease**	**Canal water**	**Saline water**	**% Decrease**	**Canal water**	**Saline water**	**% Decrease**
Casuarina equisetifolia	2.29	2.05	10.48	8.66	8.00	11.66	80.28	67.18	16.31	0.78	0.66	15.38	100.00	100.00	0.00
Pongamia pinnata	2.50	2.21	11.60	5.33	4.33	12.00	90.05	75.05	16.65	1.05	0.88	16.19	100.00	100.00	0.00
Acacia auriculiformis	1.85	1.48	20.00	4.65	3.75	19.35	85.06	68.02	20.03	0.86	0.68	20.93	100.00	100.00	0.00
Callistemon lanceolatus	1.70	1.35	20.58	7.66	6.10	20.26	71.85	56.05	22.01	1.05	0.82	21.90	100.00	80.00	20.00
Cassia fistula	1.80	1.42	21.11	6.66	5.15	22.67	51.66	40.65	21.31	0.65	0.51	21.53	100.00	80.00	20.00
Milatia ovalifolia	1.50	1.18	21.33	6.50	5.15	20.76	75.15	58.67	21.92	0.76	0.59	22.36	100.00	80.00	20.00
Putranjiva roxburghii	1.40	1.10	21.42	5.33	4.15	22.13	50.46	39.05	22.66	0.59	0.44	25.42	100.00	80.00	20.00
Koelreutaria paniculata	1.65	1.25	24.24	6.66	5.05	24.17	70.05	53.20	24.05	0.81	0.60	25.92	60.00	40.00	33.33
Bauhinia purpurea	1.40	1.00	28.57	8.62	6.15	28.65	46.43	33.50	28.15	0.62	0.44	29.03	60.00	40.00	33.33
Ficus benjamina	1.35	0.94	30.37	5.33	4.00	29.32	50.46	34.90	30.83	0.59	0.41	30.50	60.00	40.00	33.33
Mean	1.83	1.48		6.74	5.48		70.05	55.13		0.80	0.63		88.00	74.00	
Factor A	0.06			0.22			2.52			0.03			1.62		
Factor B	0.02			0.09			1.12			0.01			0.72		
Factor (AxB)	0.08			0.31			3.56			0.05			2.30		

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