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Effect of different levels of saline irrigation water on growth and yield of spider lily cv local

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Abstract
A pot experiment was conducted on spider lily cv. Local during 2013-2014 and 2014-2015 at Department of floriculture, Aspee College of Horticulture and Forestry, Navsari Agricultural University, Navsari. Spider lily cv Local was irrigated with water of different salinity levels (2.0, 4.0, 6.0, 8.0, 10.0 and 12.0) along with control (best available water) to evaluated for growth and yield parameters. Different levels of salinity were significantly reduced growth and yield parameters of spider lily. The growth parameters exhibited significantly reduced above 8.0 dSm^{-1} salinity level in spider lily plants. Flowers per stalk, flower stalks per plant, flower yield and bulbs per plant were prominently decreased above 8.0 dSm^{-1} salinity level. In case of leaf chlorophyll content was also decreased with increase in salinity level. Based on results, Spider lily cv. Local gives good flower yield up to 8.0 dSm^{-1} salinity of irrigation water with overall good plant growth and flowering. Thus, spider lily cv. Local has been found to be moderately salt tolerant crop.

Keywords: Saline irrigation water, yield of spider, leaf chlorophyll

Introduction
The supply of high-quality water has become increasingly limited in many areas of the world, especially in arid and semiarid regions. With a rapid increase in the urban population, the intense competition for high-quality water among agriculture, industry, and recreational users has promoted the use of alternative water sources for irrigation. These sources include recycled water, treated effluents, and saline ground (well) waters that contain relatively high levels of soluble salts. Soil salinity is already a problem in arid and semiarid areas where irrigation is practiced. This phenomenon is mainly due to massive fertilization activity, soil erosion, and the incursion of sea water into ground water in coastal areas (Marschner 1998; FAO 2005) [12, 9]. Over 50% of all irrigated lands are affected by salinity, yet the water used in these lands is seldom saline (Pasternak and Malach, 1994) [17].
Salinity is considered one of the major factors limiting crop production, because of its negative effects on plant growth and nutrition (Munns 2002; Parida and Das 2005) [13, 16]. The first effect of salts is reducing the ability of plants to absorb water (osmotic effect), which leads to slower growth; second, salts may enter the transpiration stream and injure leaf cells, further reducing growth (Munns, 2005) [14]. The high concentration of Na^+ and $Cl^–$ in soil solution is generally the main cause of the saline stress (Hasegawa *et al*., 2000) [11] and the consequent slower growth is an adaptive feature for plant survival because it allows plants to rely on multiple resources to combat stress.
India has coastal line of 7516kms, Gujarat state having large coastal line in country covering about 1660kms. In saline conditions, the presence of excessive salts in the root zone lead to various physiological changes in the plants which ultimately affect the growth and flowering of the plant. Plants that are able to survive in rugged coastal environment must withstand the prevailing winds, tolerate the salt spray and be capable to set their roots in saline conditions. Costal landscape can be enhancing by using flowering plants, which can tolerate salinity up to some limit. The effort towards utilization of saline soil and water for growing flowering plants mainly aims to make the beauty of seashore landscape even more enchanting. Various irrigation strategies devised can be used for the purpose of controlling salinity with in the threshold limit of plants, through the conjunctive use of saline irrigation water by avoiding salt stress at critical period of their growth.

Material and Methods

The experiment was carried out at Department of floriculture and landscape architecture, Aspee College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Navsari, India 20^0 57’ N latitude and 72^0 54’ E longitudes) during 2013-14 and 2014-15. The soil of the experimental pots was collected from Regional Horticultural Research Station, Navsari. Corms of spider lily cv. Local were planted in pot having capacity of 20 kg filled with mixture of farm soil and FYM along with NPK as per recommended dose (200-200-200 NPK kg/ha). Average two-three bulbs per pot were placed by dibbling in the soil and irrigated immediately with normal water (best available water). Different levels of saline water (2.0, 4.0, 6.0, 8.0, 10.0 and 12.0 dSm^{-1}) were made up with sea water (approx. 55 dSm^{-1}) mixed with fresh water (1.48 dSm^{-1}). The experiment was laid out in completely randomized design. Each treatment was applied in four separate repetitions. All the plants were initially grown with fresh water up to one month; saline water treatment was given after establishment of plants (one month). In each treatment, irrigation water was checked every time for EC and pH. Appropriate drain holes should be kept for leaching.

The soil samples were drawn at the time of planting (before experiment) and finally at harvesting. Growth and flowering data were collected at regular interval during both the seasons, including plant height (cm), number of leaves per plant, leaf area (cm^2), root length (cm), days taken to flower initiation, number of flower stalks per plant, number of flowers per stalk, flower yield, bulbs per pant and leaf chlorophyll content. The influence of saline irrigation water on plant growth, flower production, bulb production and chlorophyll content were assessed through ANOVA.

Results and Discussion

Growth parameters

The growth parameters *viz.*, plant height, number of leaves per plant, leaf area and root length were affected significantly due to different levels of salinity of irrigation water in spider lily cv. Local. Spider lily plants appear good (Visual appearance) even at 10.0 dS m^{-1} salinity level without much affecting growth. Above 8.0 dS m^{-1} salinity level of irrigation water, growth in spider lily cv. Local was decreased prominently.

Reduced plant growth is a common phenomenon when plants are grown under increased salinity and usually expressed as stunted plant growth. The first responses of plants to salinity is a decreased rate of plant growth primarily due to osmotic effect of salt around the roots, which leads to reduction in water supply to plant cells as explained by Blum, (1986) [4]. Further, Wild (1988) [25] and Shannon & Grieve (1999) [19] stated inhibition of root growth and its function owing to high external salt concentration. Explaining, the mechanism of salt tolerance in plants, due to increasing EC_{iw} probably resulting into limited cell division and expansion (Munns and Tester, 2008) [15]. Reduction in cell elongation and division in plant cell reduce their final size, resulting in decrease in plant height, number of leaves, leaf area and root growth as elucidated by earlier workers (Cabrera, 2003; Cassaniti *et al*, 2009) [5, 6]. Growth reduction in different ornamental plants due to salinity have been also reported in *Nerium oleander* (Banon *et al.*, 2005), in marigold (Valdez-Aguilar *et al*., 2009), in gladiolus (Haouala and Sahli 2011) [10] and (Ahir and Singh, 2017) [1], in gladiolus and heliconia (Cerquera *et al*., 2008) and in zinnia (Zivder *et al*., 2011) [26].

Flowering parameters

In flowering parameters *viz.* days taken to flower initiation, number of flower stalks per plant, number of flowers per stalk, flower yield and bulbs per plant were significantly influenced by salinity levels of irrigation water. Flower production (yield) was reduced above 8.0 dSm^{-1} salinity level. Delay in flowering due to the specific mechanism that alter the growth stage of flowering have been known to occur due to multiple stresses (osmotic imbalance, nutritional deficit and cellular toxicity) exerted by salinity (Risse and Shenk, 1990; Stanton *et al*., 2000) [21]. Besides, reduction in root biomass caused due to salinity has also been indicated as a factor impeding flowering by affecting energetic reserves (Van Zandt and Mopper, 2002) [23]. Saline water irrigation reduced crop growth and production in sensitive species (Volkmar *et al* 1998) [24] due to negative effects on water and mineral relations, carbon assimilation and biomass partitioning. Crop response to salinity depends on cultivar and growing conditions (Bass *et al*., 1995; De Kreij and Van Os, 1989; Sonneveld *et al*., 1999) [3, 8, 20]. In our work, spider lily appeared moderate salt tolerant crop. The use of saline water irrigation significantly reduced plant growth, flower production and bio-chemical parameters (table-1).

Table 1: Effect of different levels of salinity of irrigation water on plant growth and flowering of Spider lily cv. Local

Treatments	**Growth parameters**				**Flowering parameters**					
Different salinity levels of Irrigation water	**Plant height (cm)**	**No. of leaves/ plant**	**Leaf area (cm^2)**	**Root length (cm)**	**Days taken to flower initiation**	**No. of flowers /stalk**	**No. of flower stalks/ plant**	**No. of bulbs/ plant**	**Flower longevity (Days)**	**Chlorophyll content (mg/g FW)**
2.0 dSm^{-1}	76.09	45.11	287.53	28.17	107.61	13.50	4.51	7.02	2.42	5.87
4.0 dSm^{-1}	71.13	43.72	281.18	26.97	110.75	13.27	4.40	6.81	2.16	5.20
6.0 dSm^{-1}	60.78	40.00	269.44	24.36	112.71	12.73	4.23	6.06	1.82	4.84
8.0 dSm^{-1}	62.14	35.92	242.24	19.46	115.75	10.11	3.52	5.95	1.61	3.96
10.0 dSm^{-1}	57.26	34.22	225.32	15.13	118.40	9.46	3.13	5.54	1.62	3.46
12.0 dSm^{-1}	51.82	32.51	211.02	12.26	120.84	8.98	3.08	5.47	1.58	2.85
BAW	82.33	48.36	310.52	29.87	102.00	14.01	4.69	7.49	2.48	6.42
SEM $\pm$	2.94	1.95	10.55	1.00	4.04	0.50	0.17	0.28	0.05	0.12
CD at 5 %	8.64	5.73	31.03	2.93	11.87	1.46	0.51	0.83	0.15	0.34
CV	8.92	9.74	8.08	8.93	7.17	8.47	8.76	8.95	5.12	4.99

* BAW = Best Available Water

Conclusion

Spider lily cv. Local gives good flower yield up to 8.0 dSm^{-1} salinity of irrigation water with overall good plant growth and flowering. Thus, spider lily cv. Local has been found to be moderately salt tolerant crop.

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