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Effect of Different Levels Saline Irrigation Water on Growth and Yield of Gladiolus cv American Beauty

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ABSTRACT

During 2013-2014 and 2014-2015, gladiolus cv American Beauty 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 at Department of floriculture, Aspee College of Horticulture and Forestry, Navsari Agricultural University, Navsari. Different levels of salinity were significantly reduced growth and yield parameters. The growth parameters exhibited significantly reduced gladiolus plant growth above 2.0 dSm^{-1} salinity level. Flower yield, corms per plant, cormels per plant were prominently decreased above 2.0 dSm^{-1} salinity level. In case of leaf chlorophyll content and tepal anthocyanine contents were decreased with increase in salinity level. Based on results, gladiolus cv American Beauty was found salt sensitive flower crop.

Key words *Different Levels, Saline Irrigation Water, Growth and Yield, Gladiolus cv American Beauty*

The commercial floricultural industry includes flower crops, garden plants, potted flowering and foliage plants. A dramatic aspect of floriculture is water consumption: it has been estimated that 100-350 kg of water are needed to produce 1 kg of plant dry matter, but it can vary with species and variety, cultivation system and plant growing season (Frornes *et al*., 2007). About half of the fresh water available to support a growing world population is already used for human consumption (Rozema and Flowers, 2008). However, the majority of water on earth is seawater (98%), with only about 1 % being fresh-water. Ever increasing demands for good quality water for domestic and industrial uses in developing countries like India create scarcity of good quality water for agriculture use. Many developing countries are now facing this situation, especially in arid and semiarid regions where limited water availability is already a severe constraint to development.

India has coastal line of 7516 kms, Gujarat state having large coastal line in country covering about1660 kms. The misty and enchanting atmosphere of coastal area attracts more and more people to build their hotels and homes at seashore. In saline soils, 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 the *rabi* season of 2013-14 and 2014-15. The soil of the experimental pots was collected from Regional Horticultural Research Station, Navsari. Corms of gladiolus (*Gladiolus grandiflora)* cv American Beauty were planted in pot having capacity of 20 kg filled with mixture of soil and FYM along with NPK as per recommended dose (200-200-200 NPK kg/ha). Average two-three corms 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 in October, 2013 and October, 2014. 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 time 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, necrotic area percentage (%), leaf area (cm^2), root length (cm), days taken to flower initiation, number of spike per plant, flower yield, corms per pant, cormels per plant, chlorophyll content and anthocyanin content. The influence of saline water irrigation on plant growth, flower production, bulb production, chlorophyll content and anthocyanin 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 gladiolus cv American Beauty. No plant survival was

Effect of different levels of salinity of irrigation water on plant growth and flowering of gladiolus cv American Beauty.

Treatments	Growth parameters				Flowering parameters						
	Plant height (cm)	No. of leaves/ plant	Leaf area (cm^2)	Root length (cm)	Days taken to flower initiation	No. of spike/ plant	Post harvest life of flowers	No. of corms/ plant	No. of cormels/ plant	Chlorophyll content (mg/g FW)	Anthocyanine content (mg/g FW)
Salinity 2.0 dSm^{-1}	51.29	6.42	41.12	11.33	69.95	1.63	6.81	1.70	18.60	6.80	2.817
Salinity 4.0 dSm^{-1}	43.24	6.07	38.77	8.05	76.85	1.26	5.68	1.50	17.11	6.19	2.549
Salinity 6.0 dSm^{-1}	36.08	5.14	34.63	7.05	80.70	1.00	4.59	1.38	14.40	5.76	2.199
Salinity 8.0 dSm^{-1}	29.55	5.12	29.55	5.70	87.30	0.67	4.18	1.28	11.71	5.03	1.923
Salinity 10.0 dSm^{-1}	24.00	4.12	23.29	3.90	0.00	0.00	0.00	1.02	9.52	4.61	0.000
Salinity 12.0 dSm^{-1}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
Best Available Water	56.26	7.87	43.32	12.11	63.59	1.71	7.34	1.87	20.67	7.60	3.158
SEM $\pm$	1.65	0.21	1.70	0.32	2.89	0.03	0.16	0.07	0.79	0.12	0.052
CD at 5 %	4.86	0.61	4.99	0.95	8.49	0.08	0.46	0.19	2.33	0.36	0.152
CV	9.63	8.40	11.27	9.37	10.68	6.05	7.62	10.55	12.07	4.73	5.73

observed in irrigation treatment 12.0 dS^{-1} water. Necrotic area percentage (NAP) was also increased with increase in salinity level of irrigation water and 100 % necrosis was recorded in treatment with 12.0 dS^{-1} saline water. Above 2.0 dS m^{-1} salinity level of irrigation water, growth in gladiolus cv American Beauty was prominently decreased.

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). Further, Wild (1988) and Shannon & Grieve (1999) 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 expansion (Munns and Tester, 2008). 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). 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), in gladiolus and heliconia (Cerquera *et al.*, 2008) and in zinnia (Zivder *et al.*, 2011).

Flowering parameters:

In flowering parameters *viz.* days taken to flower initiation, number of spikes per plant, flower yield, corms per plant and cormels per plant were significantly influenced by salinity levels of irrigation water. No flower production was recorded in irrigation treatment 10.0 dSm^{-1} and above. Gladiolus yield was prominently decreased above 2.0 dS m^{-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). 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). Saline water irrigation reduced crop growth and production in sensitive species (Volkmar *et al* 1998) due to negative effects on water and mineral relations, carbon assimilation and biomass partitioning. Crop response to salinity depends on cultivar and growing conditions (e.g. Bass et al., 1995; De Kreij and Van Os, 1989; Sonneveld et al., 1999). Gladiolus is crop sensitive to salinity (Arnold et al., 2003). In our work, gladiolus plants appeared much more sensitive to salinity. The use of saline water irrigation significantly reduced plant growth, flower production and bio-chemical parameters (table-1).

CONCLUSION

Based on the results of the above experiment, with the data on growth and flowering parameters indicates level of salinity tolerance in gladiolus cv American Beauty has been found salt sensitive crop. Above 2.0 dSm-1 salinity level growth and flowering was prominently decreased.

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