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Research Paper

Salinity tolerance studies of ornamentals

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Abstract

Salinity is of rising importance in landscaping because of the increase in green spaces in the urban environment where scarcity of water has led to the reuse of waste waters for irrigation. Salinity affects about one third of irrigated land, causing a significant reduction in crop productivity. Due to the rapid increasing populations and industrialization in many parts of the world, the demand for fresh water supply is increasing for irrigating ornamentals in gardens. On other hand, it is noted that the availability of fresh water is meager in expansion of gardening in all parts of the country. In many gardens, farm ponds are utilized for irrigation without analyzing the quality of the water. A potential problem of using these pond waters are salt levels, which are detrimental to sensitive plants if not managed properly. Therefore, identifying salt-sensitive plant species and categorizing salt tolerance of commonly used landscape plants may aid the selection of appropriate species for landscapes where alternative sources of water are used for irrigation. Keeping this in mind, an experiment was laid out in completely randomized design with three replications. Salinity was induced by adding *NaCl* of four different concentrations *viz.*, 0.4 , 0.8, 1.2 and 1.6 % and was irrigated on alternative days for two ornamental flowering annuals *viz., Zinnia* and *Petunia*. Twenty days old seedlings were subjected to treatments as per the schedule with a control. Phenological observations viz., plant height, number of branches, number of leaves, earliness in flowering, number of flowers, flower diameter are observed at initial, 40 and 55 days after sowing/transplanting. From the results, it was found that suppression of plant growth increases with the increase in *NaCl* concentration. The plants treated with *NaCl* had attained an earlier blooming upto 1.2% and with the increased salinity levels.

Key words: Salinity, tolerance, irrigation, plant growth, supression.

Introduction:

Due to the rapid increasing populations and industrialization in many parts of the world, the demand for fresh water supply is increasing for irrigating gardens. On other hand it was noted that the availability of fresh water is meager in expansion of gardening in all the countries. In many gardens, farm ponds are utilized for irrigation without analyzing the quality of the water. A potential problem of using these pond waters are salt levels, which are detrimental to sensitive plants if not managed properly. Therefore, identifying salt-sensitive plant species and categorizing salt tolerance of commonly used landscape plants may aid the selection of appropriate species for landscapes where alternative sources of water are used for irrigation. In some places, groundwater or shallow aquifer saline water and agricultural drainage water are available (Boland, 2008; Duncan *et al.*, 2009). The salinity and composition of these alternative waters vary with locations and sources. The salinity of reclaimed water measured as electrical conductivity, which varies depending on the water source and treatment processes, ranged from 1.0 to 1.9 dS m^{-1} (Schuch, 2005; Wu *et al.*, 2001). Keeping this in mind an experiment was laid out to determine the salinity stress on growth and flowering of certain ornamental flowering annuals and also to find out the susceptibility nature of the annuals under different salinity levels.

Materials and Methods:

Pot culture experiments were carried out in the department of Horticulture, Faculty of Agriculture during 2017 to find the saline tolerant flowering annuals. The experiment was laid out in completely randomized design with three replications. Salinity was induced by adding NaCl of four different concentrations viz., 0.4 , 0.8, 1.2 and 1.6 % and was irrigated on alternative days on three ornamental flowering annuals viz., *Zinnia and Petunia* . Fifteen days old seedlings were subjected to treatments as per the schedule with a control. Phenological observations viz., plant height, number of branches, number of leaves, earliness in flowering and number of flowers are observed initially and at 40 and 55 days after sowing respectively.

Results and Discussion:

The data observed during the experiment are presented in table 1. It was observed that the salinity levels inhibit the plant height in both Zinnia and Petunia. The relative percentage of growth rate in observed plants was ranged from 100 % in control plants to 53.9 % from the treatment T6 (Nacl @ 2.0%) in Zinnia and 33.7% in Petunia. Reduction in the plant height was recorded with the increased dosage of Nacl. Plants treated with Nacl @ 0.8 % (T3) recorded 11.2 cm which is 79.4 % decrease over control in Zinnia. Similarly, in Petunia the plants treated with 0.8% Nacl (T3) showed a plant height of 17.9 cm with 92.7 % over control. Plants treated above 0.8% Nacl recorded reduced plant height in both the flower crops. These results were in consonance with the findings of Ivanova (1999) and Zapryanova & Atanassova (2009).

The data on number of branches showed also showed marked differences among the treatments. From the table 2, it was revealed that the number of branches decreased with the increase in NaCl concentration. The growth rate in case of number of branches was reduced from 83.0 % to 3.38 % and 98.7 % to 42.1 % in Zinnia and Petunia respectively. Reduced number of branches (8.3 to 2.3 and 11.2 to 6.3) was recorded under Nacl treated plants than control in both zinnia and petunia respectively.

Similar results were also reported by Grieve *et al*. (2008) and Niu and Rodriguez (2008). Considering the number of

Table 1. Effect of salinity levels on plant height of Zinnia and Petunia

Treatments	Plant height (cm) of Zinnia							Plant height (cm) of Petunia						
	Initial	40 DAS		55 DAS		Total Growth Rate		Initial	40 DAS		55 DAS		Total Growth Rate	
	Cm	Cm	%	Cm	%	Cm	%	Cm	Cm	%	Cm	%	Cm	%
T1 –Control	10.2	18.5	100.0	24.3	100.0	14.1	100.0	16.5	25.8	100.0	35.8	100.0	19.3	100.0
T2 –Plants treated with Nacl 0.4%	10.5	18.3	101.6	22.4	92.2	11.9	84.4	16.7	25.5	98.8	34.7	96.9	18.0	93.3
T3 –Plants treated with Nacl 0.8%	10.6	17.6	95.1	21.8	89.7	11.2	79.4	16.2	24.7	95.7	34.1	95.2	17.9	92.7
T4–Plants treated with Nacl 1.2 %	10.4	16.4	88.6	19.4	79.8	9.0	63.8	15.8	22.1	85.6	26.4	73.7	10.6	54.9
T5 –Plants treated with Nacl 1.6%	10.7	16.2	87.5	18.2	74.8	7.5	53.2	16.9	20.3	78.7	25.2	70.4	8.3	43.0
T6 –Plants treated with Nacl 2.0%	10.5	16.2	87.5	18.2	74.7	7.6	53.9	16.6	20.1	77.9	23.1	64.5	6.5	33.7
				ns							ns			

Table 2. Effect of salinity levels on number of branches in Zinnia and Petunia

Treatments	Number of branches in Zinnia							Number of branches in Petunia						
	Initial	40 DAS		55 DAS		Total Growth Rate		Initial	40 DAS		55 DAS		Total Growth Rate	
	Cm	Cm	%	Cm	%	Cm	%	Cm	Cm	%	Cm	%	Cm	%
T1 –Control	2.4	4.5	100.0	8.3	100.0	5.9	100.0	3.1	7.6	100.0	11.2	100.0	7.6	100.0
T2 –Plants treated with Nacl 0.4%	2.5	4.3	95.5	7.4	89.1	4.9	83.0	3.2	7.4	97.4	10.9	97.3	7.7	98.7
T3 –Plants treated with Nacl 0.8%	2.3	3.8	84.4	4.8	57.8	2.5	42.4	3.1	7.3	96.1	10.8	96.4	7.7	98.7
T4–Plants treated with Nacl 1.2 %	2.0	2.7	60.0	2.7	32.5	0.7	11.8	3.4	6.1	80.2	7.9	70.5	4.5	59.2
T5 –Plants treated with Nacl 1.6%	2.4	1.8	40.0	2.9	22.9	0.5	8.57	3.0	5.2	68.4	7.5	66.9	4.5	59.2
T6 –Plants treated with Nacl 2.0%	2.1	1.7	37.8	2.3	27.7	0.2	3.38	3.1	4.8	63.2	6.3	56.2	3.2	42.1
				ns							ns			

Table 3. Effect of salinity levels on number of leaves in Zinnia and Petunia

Treatments	Number of leaves in Zinnia							Number of leaves in Petunia						
	Initial	40 DAS		55 DAS		Total Growth Rate		Initial	40 DAS		55 DAS		Total Growth Rate	
	Cm	Cm	%	Cm	%	Cm	%	Cm	Cm	%	Cm	%	Cm	%
T1 –Control	5.2	15.8	100.0	29.2	100.0	24.0	100.0	10.5	22.8	100.0	34.9	100.0	24.4	100.0
T2 –Plants treated with Nacl 0.4%	5.3	16.4	100.4	28.4	97.2	23.1	96.2	11.2	21.9	96.0	33.7	96.6	22.5	92.2
T3 –Plants treated with Nacl 0.8%	5.1	16.7	100.7	26.2	89.7	21.1	87.9	11.3	21.7	95.2	24.5	70.2	13.2	54.1
T4–Plants treated with Nacl 1.2 %	5.2	14.9	94.3	26.1	89.4	20.9	87.0	11.2	18.2	79.8	21.4	61.3	10.2	41.8
T5 –Plants treated with Nacl 1.6%	5.2	13.7	86.7	24.3	83.2	19.1	79.6	11.2	17.1	75.0	20.1	57.6	8.9	36.5
T6 –Plants treated with Nacl 2.0%	5.2	11.5	72.8	24.0	82.2	18.8	78.3	11.3	15.2	66.7	19.4	55.6	8.1	33.2
					ns						ns			

leaves of zinnia and petunia, maximum numbers of leaves (29.8 and 34.9) were found in T1 control. However, the lowest growth rate of 18.8 and 8.1 leaves in Zinnia and Petunia with 78.3 % and 33.2 % over control respectively. Reduced number of leaves was noticed at higher concentrations of Nacl. Elevated salinity in irrigation water reduces plant size, branches and leaves. Reduction in cell elongation and cell division in leaves reduces their final size, resulting in decreased leaf area. The reduction in the growth may be due to the fact that the composition of the saline solution, ion toxicities or nutritional deficiencies may also reduce growth due competition between cations and anions (Shannon and Grieve, 1999). When toxin ions such as Na^+ and Cl^- are present in the rhizosphere, they can disrupt the uptake of nutrients by interfering with transporters in the root plasma membrane, such as those for K+ and NO_3- (Tester and Davenport, 2003). The statement given by Munns (2002); Shannon *et al*., (1994) and Mass (1990) are in consonance with the present results.

The data pertaining to the flowering characters also showed similar results with the addition of saline water irrigation (Table 4). Earliness in flowering (25.4 and 28.2 days) was recorded under the treatment T4 in both Zinnia and Petunia respectively. However, in control (T1) plants took 26.2 days and 29.1 days in Zinnia and Petunia respectively. It was also observed that those plants received higher dosage of saline water (exceeding 0.8 %. 1.2%, 1.6 % and 2.0 %) also produced flowers onpar with control. The data on maximum number of flowers (36.4 and 42.1) was noticed in control (T1) in Zinnia and Petunia respectively. The findings of Munns (2002) and Tester and Davenport, 2003) supported the present results.

Similarly, the data on blooming period the control plant (T1) recorded a maximum of 55.1 and 58.4 days in both zinnia and petunia respectively. The Nacl treated plants recorded a blooming period ranging from 53.8 days and 56.9 days and reduced to 38.7 days 39.4 days with an increase in Nacl concentration in both zinnia and petunia respectively.

Table 4. Effect of salinity levels on flowering characters in Zinnia and Petunia

Treatments	Earliness in flowering		Number of flowers per plant		Blooming Period
	Zinnia	Petunia	Zinnia	Petunia	(Days)
T1 –Control	26.2	29.1	36.4	42.4	58.4
T2 –Plants treated with Nacl 0.4%	25.8	28.8	36.2	41.8	56.9
T3 –Plants treated with Nacl 0.8%	25.6	28.9	33.2	37.8	51.3
T4–Plants treated with Nacl 1.2 %	25.4	28.2	30.4	31.9	48.4
T5 –Plants treated with Nacl 1.6%	26.7	28.6	27.6	26.3	41.2
T6 –Plants treated with Nacl 2.0%	26.1	28.4	24.5	24.9	39.4
SE.d	0.06	0.08	2.05	1.04	2.06
CD (P=0.05)	0.03	0.03	1.02	0.51	1.03

Conclusion:

From the experiment, it was found that Zinnia and Petunia are having the tolerance to salinity levels upto 1.2% NaCl when it is grown as ornamental flowering annuals in pots.

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