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Optimization of spacing and nitrogen dose for growth and flowering of statice (*Limonium sinuatum*)

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ABSTRACT

A field study was conducted at the Experimental Farm of Division of Floriculture and Landscaping, ICAR-IARI, New Delhi during 2014-15 and 2015-16 with the objective of determining the effect of spacing, nitrogen and their interaction on growth and flowering of statice (*Limonium sinuatum* Mill.). The experiment was laid out in factorial randomized block design with twelve treatments. The treatments consisted of three spacing viz. 30cm × 30cm (S_1), 30cm × 45cm (S_2) and 45cm × 45cm (S_3) and four nitrogen doses viz. 10 g/m^2 (N_1), 20 g/m^2 (N_2), 30 g/m^2 (N_3) and was compared with control (N_0). Data were collected for vegetative growth, flowering and biomass parameters of statice. Maximum plant height (83.60 cm) and spike length (23.89 cm) was recorded under S_1N_3, while the maximum plant spread (71.67 cm), number of cymes/spike (16.03), number of cut flowers/plant (19.66), cyme width (37.25 mm), spike diameter (5.67 mm) and flower longevity in the field (60.97 days) was observed under S_3N_2. However, the maximum number of primary branches/plant (30.78), number of secondary branches/plant (15.93), number of leaves (68.80), cyme length (65.50 mm), shoot fresh weight (851.83 g), root fresh weight (11.72 g), dry weight of shoot (194.23 g), dry weight of roots (5.28 g) and shoot root ratio (69.57) was recorded with S_3N_3.

Key words: Biomass, Flowering, Limonium sinuatum, Nitrogen, Planting density, Statice, Vegetative traits.

Limonium sinuatum Mill.*,* is commonly known as statice and belongs to family Plumbaginaceae. Globally it is the most commonly used cut flower and filler crop. The flowers present in short, papery clusters in colours ranging from white to pink, purple and yellow. Grown for its colourful flowers and its everlasting calyx (the green leaf that encloses the flower bud), the tiny funnel-shaped statice flowers have a delicate, airy, hazy appearance, almost like smoke. It is one of the most widely used flowers in dry flower arrangements (Dole and Wilkins 2005). Type of variety, growing environment and management practices substantially influences the quality and yield of statice. (Burchi *et al.* 2006, Dole and Wilkins 2005, Fascella and Zizzo 2004). Among the management practices, plant density and fertilizer application are the two important approaches affecting the quality and quantity of flower production of any species. Therefore, optimization of plant spacing as well as fertilizers doses would be vital to ensure the best economic return (Khan *et al*. 2003).

To this aim, a study was conducted to determine the effect of spacing, nitrogen application on vegetative growth and flowering of statice.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of Division of Floriculture and Landscaping, ICAR-Indian Agricultural Research Institute, New Delhi during 2014-15 and 2015-16. The experiment was laid out in factorial randomized block design with two factors, viz. spacing as main plot and nitrogen doses as sub plot with three replications. Treatments consisted of three spacing's viz. 30cm × 30cm (S_1), 30cm × 45cm (S_2), 45cm × 45cm (S_3) and four nitrogen doses viz. 10g/m^2 (N_1), 10g/m^2 (N_2), 20g/m^2 (N_3) and 30g/m^2 (N_4). Beds were prepared and a fixed basal dose of fertilizers consisting of P & K @10g/m^2 was applied uniformly to all the beds. The standard cultural practices were followed and five plants were randomly tagged in each plot for recording growth and flower yield characters.

Observations for vegetative growth parameters like plant height, plant spread, days taken to bud formation, days taken to flower opening, number of primary branches per plant, number of secondary branches per plant, number

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of leaves, stem girth, biomass parameters like fresh weight of shoots, fresh weight of roots, shoot: root ratio on fresh weight basis, dry weight of shoot, dry weight of roots and flowering parameters, number of cut flowers, spike length, number of cymes/spike, cyme length, cyme width, flower longevity in the field were recorded for two years and the data were pooled. The data was analysed at 5% level of significance using OPSTAT statistical software of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana.

RESULTS AND DISCUSSION

Vegetative traits

A significant effect on plant height was observed for spacing, nitrogen levels and their interaction (Table 1). Comparison of different spacing reveals that the maximum plant height (80.78 cm) was observed in plant spaced at 30 cm × 30 cm (S_1), whereas the minimum plant height (71.67cm) was observed under 45cm × 45cm spacing. Among nitrogen doses, the maximum plant height of 79.82 cm was found with nitrogen @ 30g/m^2 (N_3) which was significantly superior to all other treatments whereas, the minimum plant height (71.18 cm) was observed in control (N_0). The interaction data reveals that tallest plants (83.60 cm) were observed in treatment combination S_1N_3,which were statistically alike to plants in S_1N_2 and S_2N_3. However, the minimum plant height (66.80 cm) was recorded in plants grown at a spacing of 30cm × 45 cm without nitrogen (S_2N_0). Similarly, Ramesh and Kiranjeet (1997) also observed more plant height in closer spacing in statice. Increase in plant height with more density of plants per unit area might be due to inter-plant competition for space, light and nutrients. Similar explanation was recorded by Forbes and Watson (1994). Increase in plant height under higher nitrogen level is due to increase in cell division and cell enlargement as observed by Barman and Pal (1999) in *Chrysanthemum* and by Jain and Gupta (2004) in marigold.

Comparison of data in Table 1 reveals that the maximum plant spread (66.70 cm) was observed in plants grown at a spacing of 45cm × 45cm (S_3) whereas, the minimum spread (55.00 cm) was observed in S_1. Among nitrogen doses, application of 30g nitrogen/m^2 (N_3) resulted in maximum spread (63.73 cm) which was at par with N_2; however, the minimum plant spread (55.83 cm) was observed under control (N_0). Interaction data shows that the maximum

Table 1 Effect of plants spacing and nitrogen doses on vegetative traits of statice

Treatment	Plant height (cm)	Plant spread (cm)	Number of 1^0 branches	Number of 2^0 branches	Days to bud formation	Days to flower opening	Number of leaves
Spacing (cm)							
30 × 30 (S_1)	80.78	55.00	24.33	11.65	72.13	92.40	54.89
30 × 45 (S_2)	73.90	59.30	25.85	12.98	72.68	92.27	57.23
45 × 45 (S_3)	71.67	66.70	26.76	13.62	73.01	92.81	61.43
$CD_{0.05}$	1.56	3.44	1.68	1.4	0.5	NS	0.73
Nitrogen (g/m^2)							
0 (N_0)	71.18	55.83	22.09	8.96	72.26	91.32	52.40
10 (N_1)	74.29	58.71	24.91	12.42	72.68	92.08	55.34
20 (N_2)	76.50	63.15	26.36	14.40	72.87	92.79	60.27
30 (N_3)	79.82	63.73	29.22	15.22	72.62	93.78	63.38
$CD_{0.05}$	1.80	3.97	1.94	1.62	0.58	NS	0.84
Interaction							
S_1N_0	79.20	51.73	20.00	7.87	71.60	91.17	50.59
S_1N_1	79.27	52.03	23.63	10.33	72.70	92.60	53.30
S_1N_2	81.03	57.20	25.77	13.93	72.00	92.90	56.03
S_1N_3	83.60	59.20	27.90	14.47	72.22	92.93	59.63
S_2N_0	66.80	56.67	22.97	9.33	72.40	91.47	52.40
S_2N_1	73.80	58.43	25.37	12.93	72.53	91.78	54.43
S_2N_2	73.87	60.57	26.07	14.40	72.97	91.87	60.37
S_2N_3	81.13	61.45	28.97	15.27	72.80	93.97	61.70
S_3N_0	67.53	59.10	23.30	9.67	72.77	91.33	54.20
S_3N_1	69.80	65.67	25.73	14.00	72.80	91.87	58.30
S_3N_2	74.60	71.67	27.23	14.87	73.63	93.60	64.40
S_3N_3	74.73	70.53	30.78	15.93	72.85	94.43	68.80
$CD_{0.05}$	3.12	6.87	3.37	2.81	NS	1.45	1.45

plant spread of 71.67 cm was observed in plants spaced at 45cm × 45 cm and fertilized with 20g/m^2 nitrogen (S_3N_2) which was at par with S_3N_1 and S_3N_3. However, minimum plant spread (51.73 cm) was observed under treatment combination S_1N_0. Mishra (1998) also reported increase in plant height and spread of gaillardia plants with increased levels of nitrogen application as nitrogen is an essential part of nucleic acid which plays vital role in promoting plant growth. More height and minimum spread were recorded at closer spacing and minimum height with maximum spread was observed in larger spacing which might be due to availability of proper space to the plants for proper growth as per requirement (Mohanthy *et al.* 1993).

Significant effect of spacing, nitrogen and their interaction was observed on number of primary and secondary branches (Table 1). Maximum number of primary branches per plant (26.76) and secondary branches per plant (13.62) were observed in plants spaced at 45cm × 45cm (S_3) but were at par with branches observed in S_2 spacing. However, minimum number of primary branches (24.33) and secondary branches (11.63) were recorded in 30cm × 30 cm spacing. Among different doses of nitrogen fertilizer, maximum number of primary branches (29.22) and secondary branches (15.22) were found in plants fertilized with nitrogen @ 30g/m^2 (N_3), whereas minimum number of primary branches (22.09) and secondary branches (8.96) were observed in control (N_0). The interaction data reveals that maximum number of primary branches (30.78) and number of secondary branches (15.93) were observed in plants spaced at 45 cm × 45 cm and fertilized with 30g/m^2 nitrogen (S_3N_3) which was statistically similar with S_3N_1, S_1N_2, S_2N_2, S_3N_2, S_1N_3 and S_2N_3. However, minimum number of primary branches (20.00) and secondary branches (7.87) were recorded in 30cm × 30cm spacing without nitrogen application (S_1N_0). These findings are in consonance with earlier reports of John *et al.* (1984), Singh *et al.* (1996) and Baboo and Sharma (1997) who reported maximum number of branches per plant in *Chrysanthemum* with application of nitrogen and potash.

It was observed that the minimum numbers of days to bud formation (72.13d) were observed in a spacing of 30cm × 30cm (S_1),while maximum (73.01 d) were observed in plants grown at a spacing of 45cm × 45cm (S_3) which was at par with S_2 (Table1). Among nitrogen doses, minimum number of days to bud formation (72.26 d) was observed under control (N_0) while maximum number of days to bud formation (73.01 d) was recorded with 30g/m^2 nitrogen (N_3). Similarly, Jain and Gupta (2004) observed maximum delay in bud formation in marigold with higher dose of nitrogen, whereas, minimum days to bud formation were recorded in control. It might be due to the fact that the application of nitrogen may lead to more protein formation resulting in less amount of carbohydrate deposit in vegetative part of the plant and more in protoplasm formation. Since the nature of protoplasm is highly hydrated, thus plant becomes succulent and results in delayed bud formation.

Minimum number of days to flowering (91.17d) was observed under treatment combination S_1N_0 (Table 1) which was statistically at par with number of days to flowering observed in S_2N_0, S_3N_0, S_1N_1, S_2N_1 and S_3N_1. However, maximum number of days to flowering (94.43 d) was recorded in plants grown at a spacing of 45cm x 45 cm and fertilized with 30g/m^2 nitrogen (S_2N_3). These results are in close conformity with those reported by Arora and Khanna (1986) in marigold, Sita Ram *et al.* (1997) in tuberose and Mishra (1998) in gaillardia.

Data presented in Table 1 showed that the maximum number of leaves (61.43) was observed in plants spaced at 45 cm × 45 cm (S_3) while minimum number of leaves (52.40) was observed in 30 cm × 30 cm spacing. Among different doses of nitrogen fertilizer, maximum number of leaves (63.38) was found in plants fertilized with 30g/m^2 nitrogen (N_3) which was significantly superior to all other treatments, whereas minimum number of leaves (52.40) was observed under control (N_0). The interaction effect of nitrogen and spacing reveals that maximum number of leaves (68.80) was observed under treatment combination S_3N_3 which was significantly superior over all other treatments. However, minimum number of leaves (50.59) was recorded in plants grown at a spacing of 30 cm x30 cm without nitrogen (S_1N_0). As number of leaves/ plant depends upon number of vegetative buds formed on branches. Minimum number of leaves/plant in control might be due to absence of nitrogen for leaf bud formation. These results were in concurrence with the findings of Sita Ram *et al.* (1997) in tuberose. The increase in vegetative growth of the plant might be attributed to the association of nitrogen in the formation of amino acids, which play vital role in increasing meristematic activities and consequently the vegetative growth.

Flowering traits

The data presented in Table 2 reveals that the maximum number of cut flowers (15.55) was observed in plants grown at a spacing of 30 cm × 45 cm (S_2) which was at par with S_3 whereas, minimum number of cut flowers (13.50) was observed with S_1. This may be due to the fact that with the increase in spacing, number of primary and secondary branches increases leading to increased plant spread and ultimately number of cut flowers.

Among nitrogen doses, application of nitrogen @ 20g/ m^2 (N_2) resulted in maximum number of cut flowers (16.72), however, minimum number (13.15) was observed under control (N_0). Interaction data shows that maximum number of cut flowers (19.66) was observed in plants spaced at 30 cm × 45 cm and fertilized with 20g/m^2 nitrogen (S_2N_2). However, minimum number of cut flowers (12.73) were observed under treatment combination S_1N_0. Such types of observations are also reported earlier in *Chrysanthemum* (Rao *et al.* 1992). Maximum number of flower and yield per plant observed in wider spacing might be due to lesser plant population which enhanced the availability of sunlight and promoted plant growth hence the better yield which is in line with the findings of Mohanthy *et al.* (1993)

Table 2 Effect of plants spacing and nitrogen doses on floral traits of statice

Treatment	Number of cut flowers	Spike length (cm)	Number of cymes	Cyme length (mm)	Cyme width (mm)	Spike diameter (mm)	Flower longevity in field (days)
Spacing (cm)							
30 × 30 (S_1)	13.50	21.44	11.71	56.82	29.96	5.19	57.88
30 × 45 (S_2)	15.55	20.50	12.47	60.45	32.13	5.31	57.36
45 × 45 (S_3)	15.15	19.77	13.42	62.81	34.17	5.45	58.39
$CD_{0.05}$	0.69	0.57	NS	3.29	0.65	0.11	0.70
Nitrogen (g/m^2)							
0 (N_0)	13.15	18.91	11.03	55.18	28.64	5.10	55.41
10 (N_1)	14.13	19.44	12.38	60.45	31.77	5.24	57.70
20 (N_2)	16.72	21.65	13.99	61.75	34.22	5.46	59.92
30 (N_3)	14.92	22.28	12.73	62.73	33.71	5.46	58.47
$CD_{0.05}$	0.79	0.65	1.14	3.80	0.76	0.12	0.80
Interaction							
S_1N_0	12.73	19.28	10.54	51.30	25.77	5.02	56.27
S_1N_1	13.27	19.92	11.51	57.35	29.44	5.14	58.76
S_1N_2	14.20	23.89	12.77	58.66	31.59	5.27	58.39
S_1N_3	13.80	22.67	12.00	59.95	33.04	5.32	58.10
S_2N_0	13.30	19.19	11.25	56.19	28.83	5.05	55.28
S_2N_1	13.87	19.24	12.45	60.73	32.12	5.25	55.23
S_2N_2	19.66	22.12	13.17	62.15	33.83	5.43	60.41
S_2N_3	15.37	21.47	13.01	62.74	33.74	5.49	58.51
S_3N_0	13.43	18.25	11.30	58.05	31.33	5.22	54.69
S_3N_1	15.25	19.15	13.17	63.27	33.74	5.32	59.11
S_3N_2	16.30	20.85	16.03	64.43	37.25	5.67	60.97
S_3N_3	15.60	20.82	13.18	65.50	34.34	5.58	58.79
$CD_{0.05}$	1.37	1.13	1.98	6.58	1.31	0.21	1.39

and Janakiram and Rao (1995) in African marigold. The increase in number of flowers and yield with application of nitrogen might be due to the fact that applied nitrogen had significantly increased the growth parameters, which might have synthesized more plant metabolites which ultimately lead to increased flower production. The results were in conformity with the findings of Rupinder and Ramesh (1998) who observed increase in number of flowers per plant upto 30 g/m^2 nitrogen in pansy.

A significant effect on spike length was found with spacing, nitrogen and their interaction (Table 2). Maximum spike length (21.44 cm) was observed in plants planted at a spacing of 45 cm × 45 cm (S_3) which was significantly superior over all other treatments. However, minimum spike length (19.77 cm) was observed in plants spaced at 30cm × 30 cm. Among different doses of nitrogen fertilizers, maximum spike length (22.28 cm) was found in plants fertilized with nitrogen @ 30g/m^2 (N_3) which was significantly at par with N_2 whereas, minimum spike length (18.91 cm) was observed under control (N_0). The interaction data reveals that tallest spike (23.89 cm) was observed under treatment combination S_1N_2 which was significantly higher than all the other treatment combinations. However, minimum spike length (18.25 cm) was recorded in plants grown under control at a spacing of 45cm × 45 cm (S_3N_0).

Effect of nitrogen and interaction between spacing and nitrogen (S×N) was found to be significant for number of cymes (Table 2). Among nitrogen doses, application of 20g/m^2 (N_2) resulted in maximum number of cymes (13.99) which was significantly superior over all other treatments, whereas minimum number of cymes (11.03) was observed under control (N_0). Interaction data reveals that maximum number of cymes (16.03) observed in plants spaced at 45cm × 5cm and fertilized with 20g/m^2 nitrogen (N_2S_3) and were significantly superior over all other treatments. However, minimum number of cymes (10.54) was observed under treatment combination S_1N_0.

Cyme length and width was significantly affected by spacing, nitrogen and their interaction effect (Table 2). Maximum cyme length (62.81 mm) was observed at a spacing of 45cm × 45cm (S_3) which was significantly at par with S_2, whereas minimum cyme length (56.82

mm) was recorded under S_1. Among different doses of nitrogen fertilizers, maximum cyme length (62.73 mm) was found in plants fertilized with nitrogen @ 30g/m^2 (N_3) which was significantly superior over all other treatments whereas, minimum cyme length of plants (55.18mm) was observed under control (N_0). The interaction data reveals that maximumcyme length (65.50 mm) was observed under treatment combination S_3N_3 which was at par with S_2N_1, S_3N_1, S_2N_2, S_3N_2, S_1N_3 and S_2N_3. However, minimum cyme length (51.30 mm) was recorded in plants grown at a spacing of 30cm × 30 cm without nitrogen (S_1N_0). Maximum cyme width (34.17 mm) was observed in plants grown at a spacing of 45cm × 45cm (S_3) whereas, minimum (29.96 mm) was observed with 30cm x 30cm. Among nitrogen doses, application of 20g N/m^2 (N_2) resulted in maximum cyme width (34.22 mm) which was at par with N_3, however, minimum cyme width (28.64 mm) was observed under control (N_0). Maximum cyme width (37.25 mm) was observed in plants at a spacing of 45cm × 45cm (S_3N_2) and fertilized with 20g N/m^2 which were significantly higher than all other treatments. However, minimum cyme width (25.77 mm) was observed under treatment combination S_1N_0. This may be attributed to pronounced vegetative growth, which resulted in more yield due to less competition for light, nutrients and moisture under widest spacing. These results were in close conformity with Lodhi and Tiwari (1993) in *Chrysanthemum* and Mishra (1998) in gaillardia. Similar to our findings, Rupinder and Ramesh (1998) observed increase in flower number and flower size with increase in nitrogen dose upto certain level but after that there was slight decrease in the yield. Arora and Khanna (1986) also observed the same results and quoted the possible reason that once the optimum requirement is met, further increase in nitrogen may not be beneficial to the plant.

Data presented in Table 2 shows that among different spacing's, maximum spike diameter (5.45 mm) was observed at 45cm × 45cm (S_3) which was at par with S_2, while minimum was observed under control. Among different doses maximum spike diameter (5.46 mm) was found in plants fertilized with nitrogen @ 30g/m^2 (N_3) which was at par with N_2 whereas, minimum (5.10 mm) was observed under control (N_0). The interaction data reveals that maximum spike diameter (5.67 mm) was observed under treatment combination S_3N_2 which was at par with S_2N_3 and S_3N_3. However, minimum spike diameter (5.02 mm) was recorded in plants grown at 30cm × 30 cm under control (S_1N_0).

Maximum longevity of flowers in the field (58.39 d) was observed in plants grown at a spacing of 45cm × 45 cm (S_3) which was significantly at par with S_1 whereas, minimum (57.36 d) was observed with S_2 (Table 2). Among nitrogen doses, application of 10g/m^2 nitrogen (N_1) resulted in maximum longevity of flowers (59.92 d) which was significantly superior over all other treatments, however, minimum longevity of flowers (55.41 d) was observed under control (N_0). A perusal of interaction data shows that maximum longevity of flowers in the field (60.97 d) was observed in plants spaced at 45cm x 45 cm and fertilized with 20g/m^2 nitrogen (S_3N_2) which was at par with S_2N_2. However, minimum longevity of flowers (54.69 d) was observed under treatment combination S_3N_0. The application of nitrogen, results in greater assimilation of carbohydrates in plant, which might have increased duration of flowering in rose (Saini *et al.* 1978). Jana and Paul (1991) compared different doses of nitrogen for cosmos and found that 20 g N/m^2 was optimum for both vegetative and flowering parameters.

Biomass traits

Effect of spacing, nitrogen and interaction between spacing and nitrogen was significant with respect to biomass traits (Table 3). Maximum fresh weight of shoot (660.93g) per plant was observed with a spacing of 45cm × 45 cm (S_3) while minimum (441.41 g) per plant was observed in plants grown at a spacing of 30 cm × 30 cm (S_1). Among nitrogen doses application, the maximum fresh weight of shoot (735.31 g) was observed with 30g/m^2 nitrogen (N_3) which was superior with all the other treatments while minimum fresh weight of shoot (409.63 g) was recorded under control (N_0). Interaction data shows that maximum fresh weight of shoot (851.83 g) was observed in plants spaced at 45cm x45 cm and fertilized with 30g/m^2 nitrogen(S_3N_3) which was significantly higher than all other treatments. However, minimum fresh weight of shoot (321.18 g) was observed under treatment combination S_1N_0. The occurrence of variation in flower stem fresh weight due to differences in plant density might be credited to the limited dry matter accumulation in the stems at higher plant density owing to the severe competition for light and nutrients and inherent variability of the genotypes (Christine 1996).

Maximum root fresh weight (9.61 g) per plant was observed with a spacing of 45cm × 45 cm (S_3) while minimum (8.16 g) was observed in plants grown at a spacing of 30cm × 30 cm (S_1). Among nitrogen doses application, the maximum root fresh weight (11.10 g) was observed under N_3 while minimum root fresh weight (6.61 g) was recorded under control (N_0). Interaction data shows that maximum fresh weight (11.72 g) was observed under spacing of 45cm × 45 cm with 30g/m^2 N(S_3N_3) which was significantly at par with S_2N_3 and higher than all other treatments. However, minimum fresh weight (6.08 g) was observed under treatment combination S_1N_0. Hence, we can conclude that increasing fresh weight of statice correspond to increasing productivity, as the number of stems produced increases with the measured amount of fresh weight per square meter.

Comparison of different spacing reveals that the maximum shoot dry weight (142.10 g) was observed in plants grown at a spacing of 45cm × 45cm (S_3) which was significantly superior over all other treatments. Among different doses of nitrogen fertilizer, maximum shoot dry weight (175.64 g) was found in N_3which was superior over all other treatments whereas, minimum shoot dry weight (110.04 g) was observed under control (N_0). The interaction

Table 3 Effect of plants spacing and nitrogen doses on biomass traits of statice

Treatment	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of roots (g)	Shoot root ratio on fresh weight basis
Spacing (cm)					
30 × 30 (S_1)	441.41	121.85	8.16	2.95	53.70
30 × 45 (S_2)	516.59	128.70	8.87	3.56	58.12
45 × 45 (S_3)	660.93	142.10	9.61	3.71	69.26
$CD_{0.05}$	14.2	10.74	0.22	0.25	1.55
Nitrogen (g/m^2)					
0 (N_0)	409.63	110.04	6.61	3.23	61.52
10 (N_1)	479.04	118.60	7.92	2.76	60.05
20 (N_2)	534.59	119.25	9.87	3.27	53.70
30 (N_3)	735.31	175.64	11.10	4.36	66.18
$CD_{0.05}$	16.40	12.40	0.26	0.29	1.79
Interaction					
S_1N_0	321.18	99.78	6.08	3.05	52.82
S_1N_1	389.05	100.53	7.52	2.10	51.73
S_1N_2	416.80	116.68	9.15	3.18	45.55
S_1N_3	638.62	170.42	9.87	3.48	64.70
S_2N_0	406.53	117.20	6.67	3.22	60.95
S_2N_1	431.37	118.13	7.88	3.48	54.74
S_2N_2	512.98	117.20	9.22	3.22	55.64
S_2N_3	715.48	162.28	11.70	4.32	61.15
S_3N_0	501.17	113.13	7.08	3.42	70.79
S_3N_1	616.70	137.15	8.37	2.70	73.68
S_3N_2	674.00	123.87	11.25	3.42	59.91
S_3N_3	851.83	194.23	11.72	5.28	72.68
$CD_{0.05}$	28.40	21.48	0.44	0.51	3.09

data reveals that maximum shoot dry weight (194.23 g) was observed under treatment combination S_3N_3. However, minimum shoot dry weight (99.78 g) was recorded in plants at a spacing of 30cm × 30cm (S_1N_0) grown under control.

Maximum root dry weight (3.71 g) was observed in plants grown at a spacing of 45cm × 45 cm (S_3) which was significantly at par with S_2 whereas, minimum (2.95 g) was observed inS_1. Among nitrogen doses, application of 30 g/m^2 nitrogen (N_3) resulted in maximum root dry weight (4.36 g) which was superior over all the treatments, however, minimum root dry weight(2.76 g) was found with 10g/m^2 N (N_1). A perusal of interaction data shows that maximum root dry weight (5.28 g) was observed under treatment combination S_3N_3which was significantly higher than all other treatments. However, minimum dry weight (2.10 g) was observed in treatment combination S_1N_1. Higher leaf dry matter content with increased nitrogen rate was reported by Magdatena (2003) in Chile pepper. Similarly, results of Tei *et al*. (2000) in lettuce also support the present findings wherein increased rate of nitrogen fertilizer, significantly increased the dry weight of lettuce leaves. It was observed that plant density had remarkable effect on leaf dry matter content as higher plant density restricts light penetration and dry matter accumulation, thus reducing flowering bud development in capsicum (Aminifard *et al*. 2012).

Spacing of 45cm × 45cm (S_3)resulted in maximum shoot root ratio (69.26) while minimum shoot root ratio (53.70) was observed in plants grown at a spacing of 30cm x 30cm (S_1). Among nitrogen doses application, the maximum shoot root ratio (66.18) was observed with 30g/m^2 nitrogen (N_3) which was superior to all other treatments, while minimum shoot root ratio (53.70) was recorded under control (N_2). A perusal of interaction data shows that maximum value of ratio (69.57) was observed in plants spaced at 45cm × 45cm (S_3N_3) and fertilized with 30g/m^2 nitrogen and which was significantly higher than all other treatments. However, minimum value of ratio (36.71) was observed under treatment combination S_2N_0.

From the present study it can be concluded that spacing of 45cm × 45cm and nitrogen dose of 20g/m^2 is optimum

for growth and flowering of statice.

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