www.hortflorajournal.com
HortFlora Research Spectrum, 3(4): 339-343 (December 2014) ISSN : 2250-2823

EFFECT OF PLANT SPACING AND NITROGEN LEVELS ON QUANTITY AND QUALITY CHARACTERISTICS OF ASIATIC LILY (*Lilium* spp.)

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ABSTRACT: A field experiment was carried out as a Factorial Randomized Complete Block Design (RCBD) with 3 replications at UHSB, COH, Mudigere. Different plant spacing (30x15 cm, 30x30 cm, 40x15 cm) was the first factor and the second factor was the different levels of nitrogen (0, 100, 150 and 200 Kg/ha). The spacing between plants of 30x15 cm and 200 kg per ha of N had a significant effect on quantity and quality characteristics of Asiatic lily. Data showed that the plant spacing of 30x15 cm with nitrogen application of 200 Kg per ha obtained the maximum qualitative and quantitative characteristics of flowers.

Keywords: *Asiatic lily, bulb, flower quality, quantity, spacing, nitrogen.*

Asiatic lily (*Lilium* spp.) is one of the most important cut flowers in temperate and subtropical regions of the world. The turn over of the lilies went up by 10 per cent in 2000, but they still remain fourth in the Dutch auction cut flower ranking. There has been a large scale increase in the area of Asiatic lily grown in the Netherland, from 600 ha in 1975 to nearly 5000 ha in 2001 and now, represents 15 per cent of the total bulbs grown. It is produced both in greenhouses and in open spaces. Nutrients such as nitrogen play a major role in the growth and development of plants (Scott, 8). Nitrogen as an essential element that improves the chemical and biological properties of soil and thereby stimulates the production of higher yield in plants. Optimum plant density is another important factor for high plant growth and yield. Spacing between plants is particularly important for the cultivation of Asiatic lily to maximize flower quality and quantity characteristics. Therefore, inter and intra row spacing together with a balanced supply of nutrients such as nitrogen are important for obtaining optimum quality and quantity of Asiatic lily flowers.

MATERIALS AND METHODS

A field experiment was carried out to study the influence of nitrogen levels, plant density and their interaction on growth and yield of Asiatic lily cv. Gironde, a member of the Liliaceae family. The experiment was conducted at the Department of FLA, College of Horticulture, Mudigere, Karnataka during the period from September 2012 to March 2013. The factors were as follows: plant spacing from S_1 to S_3 (30x15 cm, 30x30 cm and 40x15 cm) as first factor and nitrogen doses from N_1 to N_4 (0, 100, 150 and 200kg/ha) were considered as the second factor. Soil p^H and EC were 5.39 and 0.17 dS per m^2 respectively. Experiment was laid out in Randomized Block Design (RCBD) with 3 replications. All the qualitative and quantitative characteristics (Table 1 and 2) were determined and subjected to analysis of variance (ANOVA).

Received : 07-10-2014 *Accepted : 30-10-2014*

RESULTS AND DISCUSSION

Days to Bulb Spourting

The data pertaining to number of days taken for bulb sprouting in Asiatic lily (Table 1) revealed that spacing, nitrogen level and interaction of both did not had significant influence on the number of days taken for sprouting of bulbs.

Spacing, nitrogen level and interaction of both did not had significant influence on the number of days taken for sprouting of bulbs. It might be due to the fact that sprouting of bulb is an initial process of growth which is completed within 7-8 days after planting by utilizing the stored food materials and external application of nitrogen and spacing might not have influence the sprouting.

Plant Height

The plant height was found to be maximum (51.94 cm) at 30x15 cm (S_1) spacing which was statistically on par with plant height (50.72 cm) at 40x15 cm (S_3) spacing, while minimum height of plant (47.83 cm) was recorded at (S_2) spacing 30x30 cm. (Table 1)

In the present study, plant height increased with the increasing levels of nitrogen. The tallest plant (41.04 cm) was recorded at 200 kg of nitrogen per

hectare, followed by (39.73 cm) nitrogen at 150 kg per hectare. The results are inconsonance with Rathore and Singh (7). With respect to interaction, a vegetative character of Asiatic lily like plant height did not show any significant difference.

Tuberose. It has been observed that, with optimum supply of nitrogen there is an increase in synthesis of protein and as a consequence of which there is increased meristematic activity leading to higher plant

Table 1: Growth and flowering characteristics of Asiatic lily as affected by spacing and nitrogen levels.

Treatment	Days to bulb sprout	Plant height (cm)	Number of leaves per plant	Days taken to flower bud emergence	Days to colour visibility in bud	Days taken to 50 per cent flowering
Spacing (cm)						
S_1= 30X15	6.36	51.94	87.02	27.77	55.47	59.95
S_2= 30X30	6.91	47.83	81.17	28.23	54.41	59.92
S_3= 40X15	6.69	50.72	85.96	28.26	55.44	60.63
C.D. (P=0.05)	NS	3.23	4.84	NS	NS	NS
Nitrogen levels (kg/ha)						
N_1=0	4.63	32.64	59.39	19.38	39.02	41.55
N_2=100	4.93	37.07	62.46	20.69	40.23	44.28
N_3=150	5.06	39.73	64.66	21.14	42.18	46.61
N_4=200	5.34	41.04	67.63	23.05	43.89	48.07
C.D. (P=0.05)	NS	3.72	5.59	1.98	3.61	3.95
Interaction (S x N)						
S_1N_1	5.93	44.37	83.55	25.13	51.85	55.29
S_1N_2	6.13	52.47	84.04	27.33	54.73	59.12
S_1N_3	6.33	54.20	87.44	27.73	56.80	61.07
S_1N_4	7.03	56.73	93.02	30.88	58.50	64.34
S_2N_1	6.33	42.93	73.47	26.33	52.03	55.71
S_2N_2	6.93	44.39	81.84	27.70	52.13	58.57
S_2N_3	7.03	51.67	83.86	28.23	54.33	62.12
S_2N_4	7.33	52.33	85.51	30.67	59.13	63.28
S_3N_1	6.23	43.27	80.55	26.03	52.20	55.20
S_3N_2	6.67	51.43	83.93	27.73	54.07	59.43
S_3N_3	6.87	53.07	87.33	28.60	57.57	63.24
S_3N_4	7.00	55.10	92.00	30.67	57.93	64.67
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

Increased plant height and number of leaves at closer spacing and at higher dose of nitrogen might be due to the fact that optimum use of resources such as light, moisture, space and aeration for proper growth and development of plants and also to harness solar energy. This resulted in elongation of main stem, increase in stem length may be due to elongation of cells and number of cells due to cell division. Similar observations are also made by Mane *et al.* (4) in growth. Similar reports obtained by Naik (5) and Mallikarjuna (3) in marigold and China aster, respectively.

Number of Leaves Per Plant

Leaf production varied significantly with respect to spacing and nitrogen levels. As for as interaction was concerned, the leaf production showed non-significant difference. The number of leaves per plant was found to be maximum (87.02) at 30 x15 cm spacing which

was statistically on par (85.96) with 40x15 cm spacing and minimum (81.17) was recorded at 30x30 cm spacing. The results are in line of Ram *et al.* (6). The number of leaves per plant was found to be maximum (67.63) at 200 kgN/ha (N_4) which was statistically on par with 150 kg N per ha (64.66) and N_2 (62.46) but minimum number of leaves per plant (59.39) was recorded at control (0 kgN/ha).

Days Taken to Flower Bud Emergence and Colour Visibility in Flower Bud

Spacing could not influence number of days taken for flower bud emergence and colour visibility in flower bud, but they were significantly influenced by nitrogen levels. Early emergence of flower bud (19.38 days) and early colour visibility in flower bud (39.02 days) were observed at 0 kgN/ha (N_1) level as compared to 100 kgN/ha (20.69 days and 40.23 days) and N_3 level (21.14 days and 42.18 days respectively). Delayed flower bud emergence (23.05 days) and colour visibility in flower bud (43.89 days) were found at 200 kg/ha (N_4) level. The interaction of spacing and nitrogen levels did not influence this parameter.

Days Taken to 50 Per cent Flowering

Spacing did not influence number of days taken to 50 per cent flowering, but it was significantly influenced by nitrogen levels. The advanced 50 per cent flowering (41.55 days) was observed at N_1 level (0 kg/ha) as compared to N_2 level (44.28 days) and N_3 level (46.61 days), whereas at 200 kgN/ha (N_4) level of nitrogen delayed (48.07 days) the days taken for 50 per cent flowering.

The data on the number of days taken to flower bud emergence, colour visibility in flower bud, days taken to 50 per cent flowering and days taken to first harvesting were found to be significantly influenced by nitrogen. Generally, nitrogen in excess promotes vegetative growth and delays flower bud emergence, colour appearance in flower bud, also takes more number of days for 50 per cent flowering and delays harvesting while, deficient nitrogen causes thrifty growth and early flowering (Naik, 5).

Days Taken to First Harvest

The time taken to first harvesting was not significantly influenced by spacing, however, significantly influenced by nitrogen levels. The minimum number of days taken for first harvest (46.83 days) was observed at N_1 level (0 kgN/ha) as compared to 100 kgN/ha (50.19 days) and 150 kgN/ha (51.35 days), whereas 200 kgN/ha (N_4) level of nitrogen took more number of days (52.84) for first harvesting. The interaction of spacing and nitrogen level did not influence the days taken for first harvesting.

Days Taken for Flower Senescence on Plant

The time taken for flower senescence in the experimental plot was not significantly influenced by spacing, while it was significantly influenced by nitrogen levels. The maximum number of days taken for flower senescence (6.35 days) was observed at 200 kgN/ha level which was on par at 150 kgN/ha level (5.83 days) and advanced senescence occurred (4.51 days) at N_1 level (0 kgN/ha) of nitrogen. Days taken to flower senescence in experimental plot was significantly influenced by different levels of nitrogen. This might be due to availability and also uptake of optimum nutrients. The interaction of spacing and nitrogen level did not influence the days taken for flower senescence in the experimental plot.

Number of Spikes per Square Meter

The number of spikes per square meter was significantly influenced by spacing, but it was not influenced by nitrogen levels and their interaction. Maximum production of spikes per square meter (21.22) was recorded at 30x15 cm spacing as compared to 30x30 cm spacing (10.44) and S_3 spacing (15.13). Maximum flower weight at the closer spacing may have been due to good plant establishment, which in turn resulted in the production of more and bigger sized flowers per spike, finally led to increased weight in flowers.Number of spikes per meter square increased with closer spacing might be due to that closer spacing occupying more number of plants per unit area. Number of spikes per meter square increased with closer spacing might be due to that closer spacing occupying more number of plants per unit area.

Diameter of Flower

Flower diameter was influenced significantly by spacing, nitrogen levels and their interaction (Table 2). Maximum diameter of flower (9.94 cm) was recorded at 30x15 cm spacing but it was on par at 40x15 cm spacing (9.78 cm) and least diameter of flower (7.64 cm) was under S_2 spacing. The results are in consonance with Karthikeyan and Jawaharlal (1) who advocated that closer planting of carnation resulted quality flowers. Similarly, maximum diameter of flower (7.63 cm) was recorded at 200 kg/ha level of nitrogen which was on par at 150 kgN/ha (7.22 cm) and minimum mean diameter of flower (6.54 cm) was

recorded at N_1 level. The biggest sized flowers (12.70 cm) were obtained from treatment combination of 200 kgN/ha and 30x15 cm spacing which was on par at S_1N_3 (11.33 cm) while, the lowest size (6.90 cm) was recorded in combination of S_2N_2 (100 kgN/ha + 30 x 30 cm).

Number of Florets Per Spike

Spacing exhibited significant effect on number of florets per spike. 30x15 cm (S_1) spacing recorded maximum florets per spike (5.56) which was on par with S_3 (5.03), while the lowest florets per spike (4.93) was recorded with S_2 (Table 2). Nitrogen level also had significant effect on number of florets per spike. 200 kgN/ha yielded significantly higher florets per spike (4.60) followed by N_3 (4.09), while N_1 level recorded least florets per spike (3.11). Present findings are in agreement with Rathore and Singh (7) in tuberose. The interaction effect due to spacing and nitrogen level was also found to be significant. The florets per spike were highest (7.40) with the treatment combination of 30 x 15 cm + 200 kgN/ha (S_1N_4) followed by S_1N_3 (6.00). Whereas, the lowest number of florets (3.87) per spike was observed in a combination of S_3N_1.

An increase in number of florets may be due to possible role of nitrogen, less competition for nutrients and water, higher leaf number and area. More photosynthesis enhanced food accumulation which might have resulted in better plant growth and subsequently higher number of florets per spike. This finding is in agreement with that of Khalaj and Edrisi (2) and Ram *et al.* (6)

Flower Weight

Flower weight was significantly influenced by spacing and nitrogen levels (Table 2). Maximum flower weight (7.22 g) was recorded at S_1 spacing followed by S_2 spacing (6.00 g) and least under S_3 spacing (5.74 g).

Table 2: Flowering, quantity and quality parameters of Asiatic lily as affected by spacing and nitrogen levels.

Treatment	Days taken to first harvest	Days to flower senescence	Number of spikes per m^2	Flower weight (g)	Diameter of flower (cm)	Number of florets per spike
Spacing (cm)						
S_1= 30X15	66.01	7.60	21.22	7.22	9.94	5.56
S_2= 30X30	67.58	6.74	10.44	6.00	7.64	4.93
S_3= 40X15	67.63	7.42	15.13	5.74	9.78	5.03
C.D. (P=0.05)	NS	NS	1.21	0.66	0.79	0.53
Nitrogen levels (kg/ha)						
N_1=0	46.83	4.51	11.25	3.17	6.54	3.11
N_2=100	50.19	5.06	12.00	4.70	5.97	3.73
N_3=150	51.35	5.83	11.33	5.24	7.22	4.09
N_4=200	52.84	6.35	11.83	5.84	7.63	4.60
C.D. (P=0.05)	4.23	0.84	NS	0.76	0.92	0.61
Interaction (S × N)						
S_1N_1	61.66	6.07	20.55	5.00	8.04	4.27
S_1N_2	65.63	7.07	22.22	7.00	7.70	4.57
S_1N_3	67.27	8.23	20.56	7.73	11.33	6.00
S_1N_4	69.47	9.04	21.55	9.15	12.70	7.40
S_2N_1	62.90	5.97	9.78	3.77	8.03	4.30
S_2N_2	67.07	6.15	10.44	5.22	6.90	4.77
S_2N_3	69.53	7.10	10.44	7.27	8.20	5.47
S_2N_4	70.80	7.74	11.11	7.77	7.43	5.20
S_3N_1	62.77	6.00	14.66	3.93	10.10	3.87
S_3N_2	68.06	7.03	15.33	6.60	9.30	5.57
S_3N_3	68.61	8.00	14.33	5.96	9.33	4.90
S_3N_4	71.08	8.63	14.66	6.45	10.40	5.80
C.D. (P=0.05)	NS	NS	NS	NS	1.59	1.06

Among different nitrogen levels, maximum flower weight (5.84 g) was observed at N_4 level which was on par at N_3 (5.24 g) and minimum weight of flower (3.17 g) was observed at N_1 level of nitrogen. Interaction effect of spacing and nitrogen did not influence the flower weight significantly.

Maximum flower weight at the closer spacing may have been due to good plant establishment, which in turn resulted in the production of more and bigger sized flowers per spike, finally led to increased wight in flowers.

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Citation : Vedavathi R.S., Manjunatha B., Basavanagowda M.G., Thippana K.S. and Patil R.M. (2014). Effect of plant spacing and nitrogen levels on quantity and quality characteristics of Asiatic lily (*Lilium* spp.). *HortFlora Res. Spectrum,* **3**(4) : 339-343