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Evaluation of Different Lilium Hybrids (*Longiflorum asiaticum*) for Better Growth, Flower and Bulb Yield under Shadenet in Prayagraj Agro Climatic Conditions

M. K. Mahesh [a++*], V. M. Prasad [a#] and A. Shivani Reddy [a++]

[a] *Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj - 211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled, Evaluation of Different Lilium Hybrids (*Longiflorum asiaticum*) for Better Growth, Flower and Bulb Yield Under Shadenet in Prayagraj Agro Climatic Conditions was under taken in the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P, during winter season (2022-2023). The experiment was laid out in Randomized block design (RBD) with 09 hybrids and each replicated thrice. The H_3-Hybrid (Masai) reported significantly better Performance compared to other Hybrids in the parameters like plant height (84.67 cm), Number of leaves per plant (70.20),

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[++] *M.Sc. Scholar;*
[#] *Professor;*
**Corresponding author: E-mail: mm7628825@gmail.com;*

Leaf length (13.37 cm), Leaf width (3.77 cm), Basal stem diameter (0.97 cm), Leaf area (40.17 cm^2), Leaf area index (6.30), Number of Spikes per plant (1.14), Number of Spikes per ha (2,62,200), Bulb diameter (45.57 mm), Weight of single bulb (39.07 g), Number of bulbs per plant (1.40) and Number of bulbs per ha (3,22,000).

Keywords: Bulb; evaluation; growth; lilium; LA hybrids; masai; shadenet; yield.

1. INTRODUCTION

Lilium is a genus of bulbous beautiful flowering plant with basic chromosome number 12. Most of Lilium species originated from the Northern Hemisphere (Lim and Van, 2011). It is a species of great economic importance in the production and commercialization of cut flowers in the international market [1] Lilium as cut flowers occupy 4th position in the world cut flower trade. They are extensively grown in greenhouses as cut flower in global flower trade due to a wider choice of growing periods, an array of colours and everlasting quality.

LA-hybrids were introduced in 1992 through a cross between Longiflorum lilies (*Lilium longiflorum*) and Astatic lilies (*Lilium asiatic*). The Longiflorum traits produce more of a trumpet shape and provide a longer vase life. The Astatic traits are responsible for the warmer colours and the upright calyx which causes the flower heads to face upward. The LA-hybrids bloom from mid-summer to late summer and may include colours like rich orange, yellow, violet, White and pink. Hybrid lilies are exceptionally useful as cut flowers and pot plants. Many lilies also produce a charming effect when planted in front of shrubs in the garden in large beds or borders lilies produce a showy display.

Liliums are propagated commercially through bulbs. The Netherlands has the largest production area of lily bulbs (4280 ha, 77%) followed by France (401 ha, 0.8), Chili (205 ha, 0.4%), USA (200 ha, 0.4%), Japan (189 ha, 0.3%) and New Zealand (110 ha, 0.2%). The Netherlands annually produces 2.21 billion lily bulbs which 2.11 billion (95%) are used as starter material for the cultivation of cut flowers from this total production around 0.41% billion bulbs (19%) are grown in the Netherlands itself for the cultivation and harvest of cut flowers. The remaining quantity is exported to other countries [2]. Considering the Indian scenario, lily bulbs are imported from the Netherlands to meet the local demand, as starter material for the production and sale of cut flowers (Misra and Datta, 2001).

The cut Liliums although fetches a good price, often the cost of bulbs constitutes a major expenditure of Lilium production especially in those areas where bulb formation is poor (such as tropical and sub-tropical areas). Fresh purchase of planting material every season results in increased cost of production. Further, the growers are to be assured of the supply of quality planting material without which Lilium production is not sustainable. Keeping the above said facts in view, the present investigation has been planned to evaluate LA hybrids for their better growth, flower and bulb production under protected conditions (Chaudhary et al., 2020).

2. MATERIALS AND METHODS

The experiment was conducted during the winter season 2022-2023, in Horticulture research field, Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25°39' 42''N latitude, 81°67'56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The area of Prayagraj district comes under a subtropical belt in the South east of Uttar Pradesh, which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^oC – 48^oC and seldom falls as low as 4^oC – 5^oC. The relative humidity ranges between 20 to 94 per cent. The average rainfall in this area is around 1013.4 mm annually. The experiment was laid out in Randomized Block Design with nine hybrids each replicated thrice. Bulbs were planted at 20 cm x 20 cm spacing.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height

At 75DAP, among all the hybrids, Maximum plant height was observed in the hybrid Masai (84.67 cm) which was found to be at par with Fangio (83.50 cm) and Beau soliel (81.30 cm)

While, Minimum Plant Height was observed in the hybrid Rodengo (52.10 cm).

The reason that all the hybrids under study had significantly different plant heights could be attributed to genetic makeup that was further modified by the environmental factors present at the time the crop was growing. Similar variation in plant height of different varieties of Lilium was also reported by Sindhu et al., [3] under northern plains.

3.1.2 Number of leaves per plant

At 75DAP, among all the hybrids, Maximum Number of Leaves per plant was observed in the hybrid Masai (70.20) which was found to be at par with Beau soliel (64.80) and Yerseke (64.33) While, Minimum Number of Leaves was observed in the hybrid Reload (51.40).

The variation in the number of leaves per plant among the hybrids may be the result of differences in the rates of vegetative development across the genotypes, which may be related to their genetic make-up and may have been further influenced by Agro-climatic conditions. Similar results were in accordance with those of Jefferson Pyruth and U. Fatmi [4].

3.1.3 Leaf length

At 75DAP, among all the hybrids, Maximum Leaf Length was observed in the hybrid Arbatax (13.37 cm) which was found to be at par with Masai (12.93 cm), Nashville (12.60 cm) and Reload (12.47 cm) While, Minimum Leaf Length was observed in the hybrid Rodengo (9.57 cm).

The highest vegetative growth is currently observed. This is a result of improved absorption of nutrients, moisture, and sunlight. Similar observation was made by Sneha et al., [5].

3.1.4 Leaf width

At 75DAP, among all the hybrids, Maximum Leaf Width was observed in the hybrid Masai (3.77 cm) which was found to be at par with Beau soliel (3.60 cm) While, Minimum Leaf Width was observed in the hybrid Rodengo (2.17 cm).

The highest vegetative growth is currently observed. This is a result of improved absorption of nutrients, moisture, and sunlight. Similar observation was made by Sneha et al., [5].

3.1.5 Basal stem diameter

At 75DAP, among all the hybrids, Maximum Basal Stem Diameter was observed in the hybrid Masai (0.97 cm) which was found to be at par with Arbatax (0.90 cm) While, Minimum Basal Stem Diameter was observed in the hybrid Reload (0.67 cm).

Different phenotypic expression is expected due to the potential for different growth rates and genetic makeups to cause differences in vegetative development characteristics between cultivars. Similar results with respect to vegetative characters were also observed by Deeptimayee and Chitta [6].

3.1.6 Leaf area

At 75DAP, among all the hybrids, Maximum Leaf area was observed in the hybrid Masai (40.17 cm^2) which was found to be at par with Arbatax (38.93 cm^2), Nashville (37.53 cm^2) and Beau Soleil (35.57 cm^2) with While, Minimum Leaf area was observed in the hybrid Rodengo (17.03 cm^2).

Leaf area was maximum under shade net which may be due to the change in leaf morphology, wherein plants grown under shade conditions develop large thin leaves with lesser stomata to compensate for the reduction in light intensity by increasing the surface area for the process of Photosynthesis. This might be the reason for more leaf area. Similar observation was made by Urfi Fatmi et al., [7].

3.1.7 Leaf area index

At 75DAP, among all the hybrids, Maximum Leaf area index was observed in the hybrid Masai (6.30) which was found to be at par with Arbatax (6.20), Beau soleil (5.63) and Nashville (5.03) While, Minimum Leaf area index was observed in the hybrid Rodengo (2.13). Minimum Leaf area was observed in the hybrid Rodengo (17.03).

Leaf area index was maximum under shade net which may be due to the change in leaf morphology, wherein plants grown under shade conditions develop large thin leaves with lesser stomata to compensate for the reduction in light intensity by increasing the surface area for the process of Photosynthesis. This might be the reason for more leaf area index. Similar observation was made by Urfi Fatmi et al., [7].

Table 1. Growth parameters of Different lilium hybrids

Notation	Hybrids	Plant Height (cm)	Number of Leaves per plant	Leaf length (cm)	Leaf width (cm)	Basal stem diameter (cm)	Leaf area (cm^2)	Leaf area index
H_1	Reload	69.97	51.40	12.47	2.63	0.67	27.87	3.47
H_2	Nashville	64.20	55.60	12.60	3.33	0.80	37.53	5.03
H_3	Masai	84.67	70.20	12.93	3.77	0.97	40.17	6.30
H_4	Rodengo	52.10	51.67	9.57	2.17	0.70	17.03	2.13
H_5	Arbatax	67.30	52.67	13.37	3.27	0.90	38.93	6.20
H_6	Fangio	83.50	57.27	9.63	2.33	0.70	18.83	3.03
H_7	Yerseke	61.83	64.33	10.77	2.50	0.80	22.87	3.57
H_8	Beau Soleil	81.30	64.80	11.30	3.60	0.77	35.57	5.63
H_9	Caesars Palace	62.97	60.13	12.03	2.57	0.77	28.27	4.23
	Sem (±)	2.33	2.24	0.41	0.10	0.04	2.16	0.43
	CD(5%)	7.00	6.73	1.24	0.29	0.11	6.47	1.28

Table 2. Yield parameters of different lilium hybrids

Notation	Hybrids	Flower yield parameters		Bulb yield parameters			
		Number of Spikes per plant	Number of Spikes per ha	Bulb diameter (g)	Wt. of single bulb (g)	Number of Bulbs /plant	Number of Bulbs/ha
H_1	Reload	1.02	233833.33	38.07	28.40	1.03	236900
H_2	Nashville	1.03	236133.33	36.47	23.73	1.05	240733
H_3	Masai	1.14	262200.00	45.57	39.07	1.40	322000
H_4	Rodengo	1.01	231533.33	31.27	12.47	1.01	231533
H_5	Arbatax	1.05	242266.67	41.80	33.07	1.06	243800
H_6	Fangio	1.02	235366.67	32.07	22.33	1.04	238433
H_7	Yerseke	1.02	235366.67	28.67	14.60	1.03	237666
H_8	Beau Soleil	1.04	239966.67	35.53	22.73	1.04	239966
H_9	Caesars Palace	1.03	236900.00	31.47	18.93	1.03	236900
	Sem (±)	0.02	3705.56	0.45	0.72	0.07	15340.25
	CD (5%)	0.05	11109.25	1.36	2.16	0.20	45990.06

3.2 Flower Yield Parameters

3.2.1 Number of spikes per plant

Among all the hybrids, Maximum Number of Spikes per plant was observed in the hybrid Masai (1.14) However, there was a significant difference among the hybrids. While, Minimum Number of Spikes per plant was observed in the hybrid Rodengo (1.01).

The greater number of spikes per plant might be due to wide variation in floral parameters due to different hybrids. Similar observations were made by Deeptimayee and Chitta [6].

3.2.2 Number of Spikes per ha

Among all the hybrids, Maximum Number of Spikes per ha was observed in the hybrid Masai (262200.00) However, there was a significant difference among the hybrids. Minimum Number of Spikes per ha was observed in the hybrid Rodengo (231533.33).

Flower spikes per hectare increase in direct proportion to spikes output per plant, flower quality, and flower size. These discrepancies might be attributable to the fact that the performance of cultivars can vary depending on the meteorological conditions in the Allahabad region. Similar findings were reported by Shukla et al., 2018 in Dahlia.

3.3 Bulb Yield Parameters

3.3.1 Bulb diameter (mm)

Among all the hybrids, Maximum Bulb diameter was observed in the hybrid Masai (45.57 mm)

However, there was a significant difference among the hybrids While, Minimum Bulb diameter was observed in the hybrid Yerseke (28.67 mm).

Such variability in bulb parameters might be attributed to the influence of the genetic makeup of different hybrids. Similar results were also observed by Balaram and Janakiram [8] and Jefferson Pyruth and U. Fatmi [4].

3.3.2 Weight of single bulb (g)

Among all the hybrids, Maximum Weight of Single Bulb was observed in the hybrid Masai (39.07g) However, there was a significant difference among the hybrids While, Minimum Weight of Single Bulb was observed in the hybrid Rodengo (12.47 g).

Such variability in bulb parameters might be attributed to influence of genetic makeup of different hybrids. Similar results were also observed by Balaram and Janakiram [8] and Jefferson Pyruth and U. Fatmi [4].

3.3.3 Number of bulbs per plant

Among all the hybrids, Maximum Number of Bulbs per plant was observed in the hybrid Masai (1.40) However, there was a significant difference among the hybrids While, Minimum Number of Bulbs per plant was observed in the hybrid Rodengo (1.01).

Such variability in bulb parameters might be attributed to influence of genetic makeup of different hybrids. Similar results were also observed by Balaram and Janakiram [8] and Jefferson Pyruth and U. Fatmi [4].

3.3.4 Number of bulbs per ha

Among all the hybrids, Maximum Number of Bulbs per ha was observed in the hybrid Masai (322000.00) However, there was a significant difference among the hybrids While, Minimum Number of Bulbs per ha was observed in the hybrid Rodengo (231533.33) [9-12].

Number of bulbs per hectare increases in direct proportion to Bulb output per plant, bulb weight, and bulb size. These discrepancies might be attributable to the fact that the performance of cultivars can vary depending on the meteorological conditions in the Allahabad region. Similar findings were reported by Shukla et al., 2018. In Dahlia.

4. CONCLUSION

On the basis of the research trial conducted under shadenet conditions, it is concluded that H_3 (Hybrid - Masai) reported significantly better performance in terms of growth parameters, flower yield parameters and bulb yield parameters as compared to other hybrids. Hence the H_3 (Hybrid - Masai) could be recommended for commercial purposes under shadenet in Prayagraj Agro climatic conditions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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