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## Assessment of lotus (*Nelumbo nucifera*) genotypes for growth and flowering for landscaping

P Gokul, K Rajamani, M Ganga and K Vanitha

### Abstract

The study was conducted to evaluate the growth and flowering performance of ten lotus accessions for container gardening in landscaping. The experiment was conducted at Botanical Garden, Department of Floriculture and Landscape Architecture, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experimental results shows the performance of all accessions in Coimbatore region. All the accessions showed significant variation in growth and flowering. The results prove that all the accessions are able to produce flower while grown in containers. *Nelumbo nucifera* 'Amiry Camelia', *Nelumbo nucifera* 'Amiry Peony', *N. Nucifera* 'Almond Sunshine', *N. Nucifera* 'White Peony' and *N. Nucifera* 'Yellow Peony' are highly recommended for landscaping.

**Keywords:** Lotus, landscaping, *Nelumbo nucifera*, horticulture

### Introduction

Lotus (*Nelumbo nucifera* Gaertn) is a herbaceous perennial aquatic plant belonging to the family Nelumbonaceae. Nelumbonaceae is a monogeneric family with only one genus with two species namely *N. nucifera* (Asian lotus) with pink and white variants and *N. lutea* (American lotus) with pale sulfur yellow flowers. Both the species have same chromosome number (2n=16). In Asia, India and China are considered as a primary centre of origin and centre of cultivation for *N. nucifera*. Sayre (2004) [10] considered lotus as an endangered and threatened species in few parts of America. *N. nucifera* is classified into three types based on the plant parts used viz., flower lotus, seed lotus and rhizome lotus. The flower lotus is widely grown in aquatic gardens as an ornamental plant for its attractive flowers and pleasant fragrance. Lotus flowers are not only beautiful but also radiating fragrance, with symbolizing the purity and nobility. Sharma and Goel (2000) [11] reported that in India, Lotus is found from Kashmir in the North to Kanyakumari in the South, showing high phenotypic diversity with different shapes, sizes and shades of pink and white flowers.

The Sacred Lotus (*Nelumbo nucifera*) produces large flowers, 10-25 cm in diameter, solitary and bisexual arising from the nodes of rhizome. *Nelumbo nucifera* 'Zhizun Qianban' is a newly named cultivar discovered in southern China in 2009 and registered by the International Waterlily and Water Garden Society in 2010. It is a large-sized lotus with a double pink flower composed of up to 1650 petals. It can be planted in ornamental ponds, containers, or grown potentially as a cut flower. The flower is protogynous in nature and the crosspollination is aided by the insect pollinators. Nguven (1999) [7] reported that seeds are highly heterozygous in nature, commercial propagation by seeds is unusual. In addition, the germination is also uneven due to hard seed coat and the germinated seedlings do not produce blooms till the flowering season. *Nelumbos* are generally propagated by the clonal propagation through rhizomes. Sacred lotus has ornamental, religious, medicinal, and edible significance in Asia, especially in India, Thailand, and China (Sinha *et al.* 2000; Guo 2009). Wang and Zhang (2004) [13] reported that lotus plant has been used as traditional medicine in India and China. The sacred lotus has been cultivated for a long time, and currently, more than 800 cultivars are found in the world. Studies on the performance of *Nelumbo* under container gardening is limited. With this perspective, the present study was carried out to identify the promising ecotypes for container gardening.

### Materials and Methods

The experiment was carried out at Tamil Nadu Agricultural University, Horticultural College and Research Institute in the Department of Floriculture and Landscape Architecture, at

Botanical Garden, Coimbatore to assess the various *Nelumbo* ecotypes for growth and flowering. A total of 10 genotypes was collected from different garden centres in Tamil Nadu, Kerala and Puducherry. Table 1. Lists the name of the different genotypes collected. The design was laid out in Completely Randomized Block Design (CRD) and replicated thrice. Well matured, freshly harvested rhizomes of uniform size (180-200g) with three nodes are used for planting. Round containers are preferable because the tubers and runners can jam up in the corners of square planters (Slocum *et al.*, 1996)<sup>[3]</sup>. The rhizomes were planted in the plastic round tubs with height of 10 inches, bottom diameter of 16 inches and top diameter with 21 inches. The tubs were filled up to the three fifth of its height with potting mix (pond clay, vermicompost, neem cake + groundnut) in the ratio 3:1:1 as reported by (Yamini. R, 2019).The tubs were watered and left for two days before planting. After settling of media and water the rhizomes were planted slanted at 15 °angle in such a way that the crown should remain above the media level.

**Table 1:** Treatment details

Treatments	Name of Accessions
T <sub>1</sub>	<i>Nelumbo nucifera</i> ‘Amiry Camelia’
T <sub>2</sub>	<i>Nelumbo nucifera</i> ‘Amiry Peony’
T <sub>3</sub>	<i>Nelumbo nucifera</i> ‘Almond Sunshine’
T <sub>4</sub>	<i>Nelumbo nucifera</i> ‘Little Rain’
T <sub>5</sub>	<i>Nelumbo nucifera</i> ‘Red Peony’
T <sub>6</sub>	<i>Nelumbo nucifera</i> ‘Siam Ruby’
T <sub>7</sub>	<i>Nelumbo nucifera</i> ‘Ultimate Thousand Petals’
T <sub>8</sub>	<i>Nelumbo nucifera</i> ‘White Peony’
T <sub>9</sub>	<i>Nelumbo nucifera</i> ‘Yellow Peony’
T <sub>10</sub>	<i>Nelumbo nucifera</i> ‘ZhizunQianban’



**Fig 1:** Flower colour exhibited by lotus accessions used for evaluation

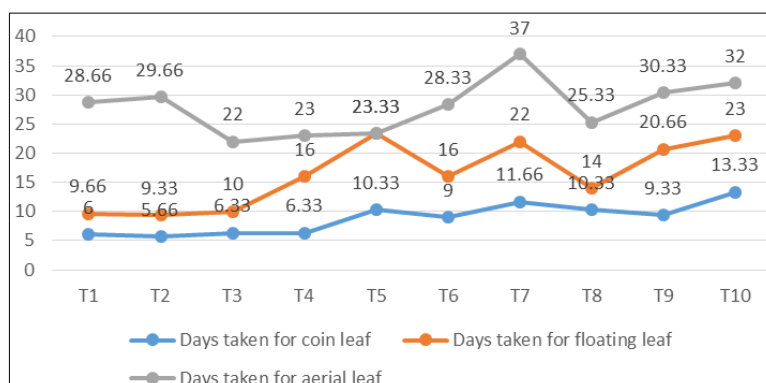
The water level was maintained at one-inch height till it producing coin leaves. Then water level was gradually increased up to the brim of the tubs. The tubs are refilled at three days interval for proper establishment of the plants. The dried leaves were removed periodically to maintain the plants healthy. To avoid the breeding of mosquitoes in water, bleaching powder at 2gram per tub was dissolved at 10 days interval. Plants are fertilized with 19:19:19 NPK 4 gram per plant at 30 days after planting and 10 gram per plant at 60 days after planting for better growth and flowering. Aphid infestation was found during flowering phase and it was controlled by spraying Clothidion at 2ml per litre. The observations recorded at periodical intervals were days taken for emergence of coin leaf, floating leaf and aerial leaf, no. of leaves at growing phase, plant height, no. of flowers and field life of flowers.

**Results and Discussion**

Data on Days taken for emergence of coin leaf, floating leaf and aerial leaf, No. of leaves at growing phase, Plant height, No. of flowers and Field life of flowers, were recorded at periodical intervals and analysed statistically. The experiment indicated that all the accessions significantly varied from each other for both vegetative and reproductive parameters. Table 2. Indicates the average number of days taken for development of coin leaf, floating leaf and aerial leaf by different accessions. The results indicates that the number of leaves varied significantly among the treatments. Earlier emergence of coin leaf (5.66) was recorded in T<sub>2</sub> followed by T<sub>1</sub> (6.00). T<sub>10</sub> took more no. of days (13.33) for emergence of coin leaf.

**Table 2:** Average number of days taken for emergence of coin leaf, floating leaf and aerial leaf

Treatments	Days taken for coin leaf	Days taken for floating leaf	Days taken for aerial leaf
T <sub>1</sub>	6.00	9.66	28.66
T <sub>2</sub>	5.66	9.33	29.66
T <sub>3</sub>	6.33	10.00	22.00
T <sub>4</sub>	6.33	16.00	23.00
T <sub>5</sub>	10.33	23.33	23.33
T <sub>6</sub>	9.00	16.00	28.33
T <sub>7</sub>	11.66	22.00	37.00
T <sub>8</sub>	10.33	14.00	25.33
T <sub>9</sub>	9.33	20.66	30.33
T <sub>10</sub>	13.33	23.00	32.00
MEAN	8.33	16.39	27.96
S Ed	0.49	1.07	1.73
CD	1.03	2.24	3.61



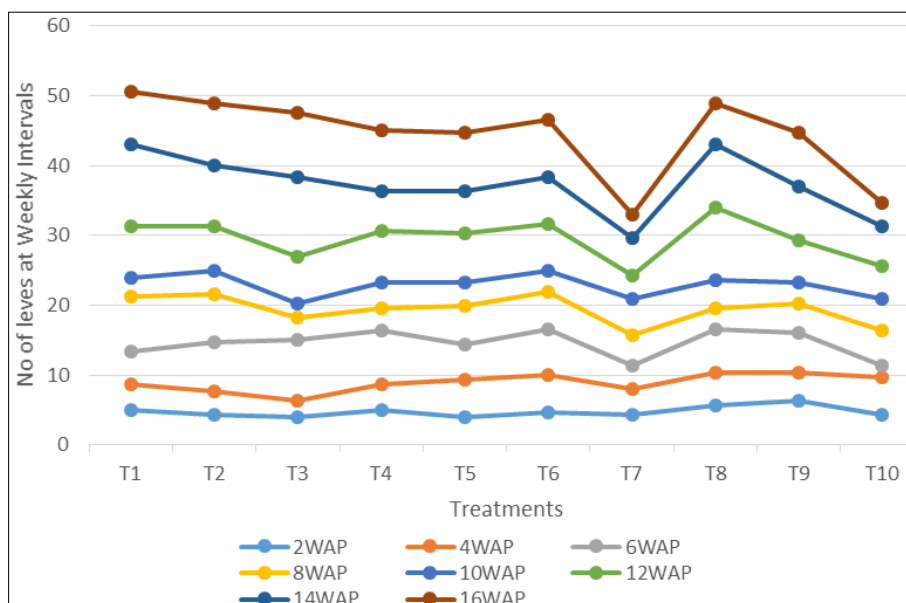
**Fig 2:** Average number of days taken for emergence of coin leaf, floating leaf and aerial leaf

Stitt *et al.* (2010) [4]; Foyer *et al.*,(2017) reported that photosynthesis is one of the most widely studied plant processes and has gained renewed focus in efforts to increase yields. Higher number of leaves will act for higher yield by source-sink relationship in crop plants. More no. of leaves

(50.66) was recorded in T<sub>1</sub> and lower no. of leaves (33.00) was noticed in T<sub>7</sub>. More no. of flowers was recorded in T<sub>1</sub> (11.33) and minimum no. of flowers was recorded in T<sub>7</sub> (1.00).

**Table 3:** Average number of leaves produced at weekly intervals

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP	14WAP	16WAP
T <sub>1</sub>	5.00	8.66	13.33	21.33	24.00	31.33	43.00	50.66
T <sub>2</sub>	4.33	7.66	14.66	21.66	25.00	31.33	40.00	49.00
T <sub>3</sub>	4.00	6.33	15.00	18.33	20.33	27.00	38.33	47.66
T <sub>4</sub>	5.00	8.66	16.33	19.66	23.33	30.66	36.33	45.00
T <sub>5</sub>	4.00	9.33	14.33	20.00	23.33	30.33	36.33	44.66
T <sub>6</sub>	4.66	10.00	16.66	22.00	25.00	31.66	38.33	46.66
T <sub>7</sub>	4.33	8.00	11.33	15.66	21.00	24.33	29.66	33.00
T <sub>8</sub>	5.66	10.33	16.66	19.66	23.66	34.00	43.00	49.00
T <sub>9</sub>	6.33	10.33	16.00	20.33	23.33	29.33	37.00	44.66
T <sub>10</sub>	4.33	9.66	11.33	16.33	21.00	25.66	31.33	34.66
MEAN	4.76	8.89	14.56	19.79	22.99	29.56	37.33	44.49
S.Ed	0.57	0.84	1.08	1.30	1.11	1.56	1.94	2.68
CD	1.20	1.75	2.26	2.72	2.32	3.26	4.06	5.59



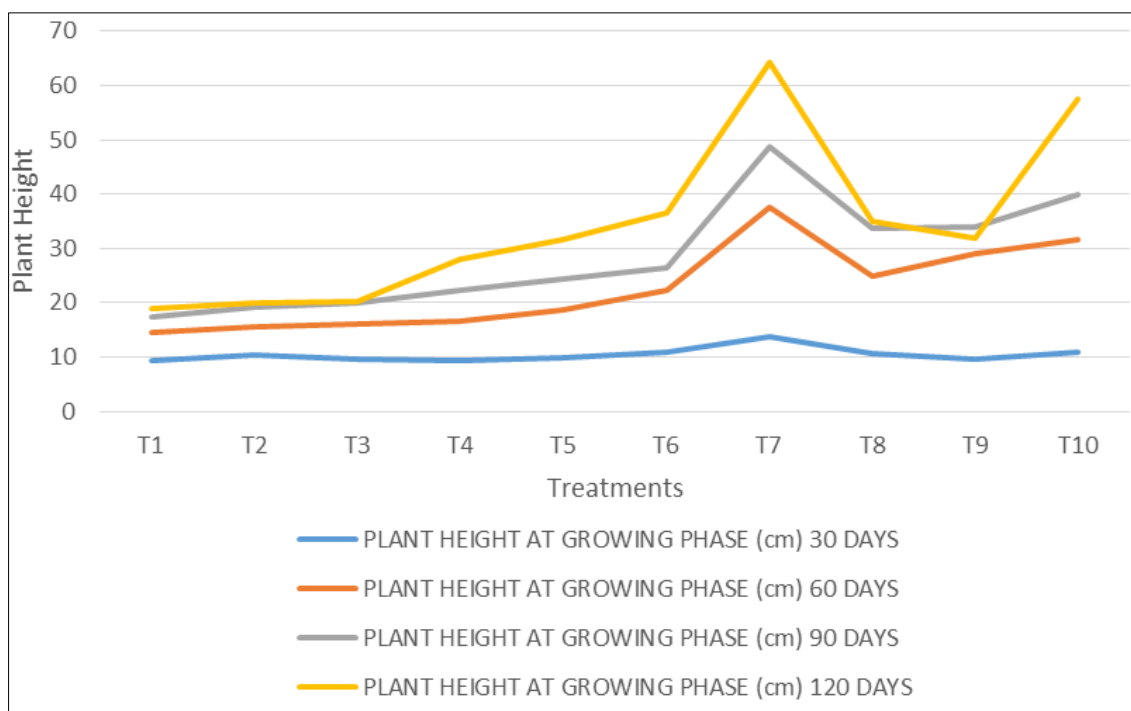
**Fig 3:** Average number of leaves produced at weekly intervals

Table 4. Indicates the results recorded on plant height after 30, 60, 90, 120 days after planting (DAP) respectively. The growth of lotus plants was slow in first 2 weeks then it was moderate till floral bud production. Zou (1997) [14] reported that after the emergence of aerial leaves, the full depth of the

water is to be maintained for getting better growth and yield. The maximum plant height (64.33 cm) was recorded in T<sub>7</sub> followed by T<sub>10</sub> with the height of (55.66 cm). The lowest height was recorded in T<sub>1</sub> which is (19.00 cm) and followed by T<sub>2</sub> with the height of (20.00 cm)

**Table 4:** Average on plant height (cm) at growing phase

Treatments	Plant height at growing phase (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP
T <sub>1</sub>	9.33	14.66	17.33	19.00
T <sub>2</sub>	10.33	15.66	19.33	20.00
T <sub>3</sub>	9.66	16.00	20.00	20.33
T <sub>4</sub>	9.33	16.66	22.33	28.00
T <sub>5</sub>	10.00	18.66	24.33	31.66
T <sub>6</sub>	11.00	22.33	26.33	36.66
T <sub>7</sub>	13.66	37.66	48.66	64.33
T <sub>8</sub>	10.66	25.00	33.66	35.00
T <sub>9</sub>	9.66	29.00	34.00	32.00
T <sub>10</sub>	11.00	31.66	40.00	57.66
MEAN	10.46	22.72	28.59	34.46
S.Ed	0.74	1.27	1.93	1.76
CD	1.55	2.65	4.04	3.67



**Fig 4:** Average on plant height (cm) at growing phase

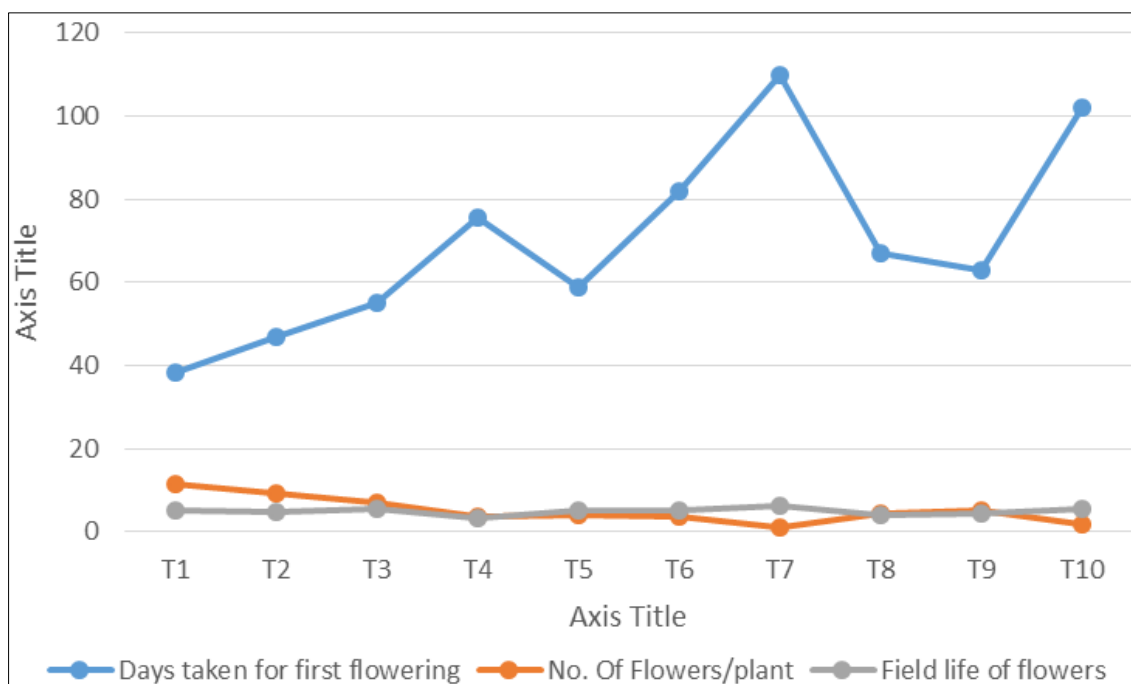
Lotus plants grow well and produce more flowers in pre-summer months and gradually the number of flowers get reduced during the winter months. Peak season of bloom falls from mid-February to June in Tamil Nadu. Nguven (1999) [7] reported that seeds are highly heterozygous in nature, commercial propagation by seeds is unusual. In addition, the germination is also uneven due to hard seedcoat and the germinated seedlings do not produce blooms till the flowering season. Masude *et al.*, (2005) [6] examined that enlarged rhizomes from past season crop are widely used for commercial cultivation. (Nguyen 2001) [8] reported that the rhizomes are planted in media at 15 degrees angle. Nguyen 1999 [7] recommended to save 20 percent of rhizomes for next season planting. The matured rhizomes will produce flowers soon then seeds. Mandal and Bar (2013) [5] reported that the

growth of lotus occurs in active and dormant period. Vegetative and reproductive growth occurs in active period and rhizome and growth happens in dormant period. The active stage lasts for 6-7 months, starting from March and ending in October.

The average number of flowers produced and field life of flowers by different accessions are listed in Table 5. Among all accessions the earlier flowering was recorded in T<sub>1</sub> with (38.33) days followed by T<sub>2</sub> with (47.00) days. T<sub>7</sub> took more no. days (110.00) for initial flowering. Higher No. of flowers was recorded in T<sub>1</sub> (11.33) followed by T<sub>2</sub> (9.33) and lower No. of flowers was recorded in T<sub>7</sub> (1.00) and T<sub>10</sub> (1.66) respectively. Among all accessions longest field life was recorded in T<sub>7</sub> (6.33) followed by T<sub>10</sub> (5.66) and shortest field life was noticed in T<sub>4</sub> with (3.33) days.

**Table 5:** Average number of days taken for first flowering, number of flowers and field life of flowers

Treatments	Days taken for first flowering	No. of flowers/plant	Field life of flowers
T <sub>1</sub>	38.33	11.33	5.00
T <sub>2</sub>	47.00	9.33	4.66
T <sub>3</sub>	55.00	7.00	5.66
T <sub>4</sub>	75.66	3.66	3.33
T <sub>5</sub>	58.66	4.00	5.00
T <sub>6</sub>	82.00	3.66	5.33
T <sub>7</sub>	110.00	1.00	6.33
T <sub>8</sub>	67.00	4.33	4.00
T <sub>9</sub>	63.00	5.33	4.33
T <sub>10</sub>	102.00	1.66	5.66
MEAN	69.86	1.16	0.39
S.Ed	2.93	2.42	0.82
CD	6.11	5.13	4.93



**Fig 5:** Average number of days taken for first flowering, No. of flowers and field life of flowers

### Conclusion

From the present study, it could be inferred that the growth and performance especially the flowering in *Nelumbo* is highly influenced by the seasonal and temperature changes. The accessions *Nelumbo nucifera* 'Amiry Camelia', *Nelumbo nucifera* 'Amiry Peony', *N. Nucifera* 'Almond Sunshine', *N. Nucifera* 'White Peony' and *N. Nucifera* 'Yellow Peony' showed better performance in terms of both vegetative and reproductive parameters. These accessions will be commercially exploited for container aquatic gardening in landscape and well suited for Tamil Nadu conditions.

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