

Original Research Article

EVALUATION OF THE DIFFERENT VARIETIES OF LOTUS (*Nelumbo nucifera*) IN PRAYAGRAJ AGRO CLIMATIC CONDITIONS, UTTAR PRADESH

ABSTRACT

Lotus is an aquatic perennial flowering plant holds significant economical value. The study conducted in Prayagraj , Uttar Pradesh, evaluates the performance of six lotus varieties under local agro climatic conditions using a Random Block Design replicated four times. Lotus varieties under study named: Yellow Peony, Pastel Pink , Bucha, Rani Red, White Buddha and Pink Cloud showed significant variations in all the parameters observed . This present research data focuses on various characters of Lotus viz ., growth parameters , floral parameters , quality parameters and yield parameters to determine the most suitable variety for cultivation in similar climatic conditions. The variety Bucha reported significantly better perform in terms of plant height (41.31cm) , leaf length (14.94cm) , leaf width (19.68cm),flower diameter (16.28cm),total number of flower per plant (38.13),total number of flower per hectare (1525000) , yield of rhizome per plant (1.74 kg) and yield of rhizome per hectare (69.73tonne) . The longest vase life reported in the variety Pink Cloud (6.25 days) followed by Bucha (5.75 day) . Best gross return(4444500 Rs.ha⁻¹) reported in Bucha with best net return (3437050 Rs.ha⁻¹) and benefit cost ratio (4.41). Based on the findings of the experiment the variety Bucha performs best in this agro climatic region, so it is recommended to cultivate Lotus variety Bucha for Prayagraj agro climatic conditions , Uttar Pradesh.

Keywords : Lotus, Better performance, varieties, Number of flowers, Rhizome , Yield.

1. INTRODUCTION

The Lotus (*Nelumbo nucifera*), is an aquatic perennial plant, belongs to the genus *Nelumbo* renowned for its striking flowers and significant cultural symbolism all over the world. For fact the Lotus is the national flower of India and Vietnam. *N. nucifera* has a long history in cultivation as a vegetable, medicinal and ornamental plant basically in Eastern countries (Wang and Zhang , 2004) [19]. Botanically the Lotus is a member of the nelumbonaceae family , characterized by its robust rhizomes ,the elongated creeping structures anchored in the muddy substrate which gives rise to long , flexible stems. The lotus grows in shallow mucky waters. The plants

ability to flourish in less than ideal conditions has earned it a revered status in numerous religious and cultural traditions. Lotus became an important crop in Australia [9] and United States (Tian *et al.*, 2006) [18]. Growth and yield of Lotus flower and rhizomes depends on various factor like genotype (Zhou *et al.* 2004) [21]. , planting time and propagation methods [3], temperature [4] and other environmental factors [9]. The timing of the lotus rhizome planting starts from February last week, mainly late spring to April specifically in early summer. The Lotus flowers come in different hues of white, pink, yellow and various other colors. Each flower can grow 10 to 30 cm of diameter when fully bloomed. Along with the long stem the leaves of the lotus also long, broad and have orbicular shape. The leaves have epicuticular wax on it, which repels the water and prevent them from sinking. Lotus can grows in water at the depth of 30 cm to 2.5 meters. The lotus plant's root system consists of long, tuberous rhizomes that extend horizontally in the media anchoring the plant and facilitating nutrient uptake and storage. These roots possess aerenchyma, specialized tissue that enhances gas exchange and regulation in aquatic environments. The lotus morphology reflects adaptations to its aquatic habitat, allowing it to thrive in various freshwater ecosystems worldwide. The Lotus native to Asia, *Nelumbo nucifera* which mainly grows in warm temperature and tropical region prefer the temperature 25 °C to 30 °C. Lotus need full sunlight for optimal growth, at least six hours of direct sunlight daily. In winter the lotus plant goes into dormancy, with rhizomes surviving under water until warmer temperatures return. Lotus plant grows from rhizomes take less time to grow compares to lotus grows from seeds. Commercial cultivation of lotus in India holds great potential due to its multifaceted uses and cultural importance's. Commercial production is being done in states viz. Bihar, West Bengal, Uttar Pradesh, Odisha, Kerala.

2. MATERIALS AND METHODS

The experiment was carried out into the Research field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the month of March, 2023 to September , 2023 . The area is situated in South Prayagraj in the right bank of Yamuna river at Rewa road , Naini about 6 km distance from Prayagraj city . The area situated at 25.8 °N latitude and 81.50 °E longitudes ,with 98 meters from the sea level . The area of Prayagraj district comes into the subtropical belt in the South East of Uttar Pradesh . Prayagraj have extremely hot summer and fairly cold winter. The maximum

temperature reaches up to 45 °C to 48 °C and winter temperature falls up to 4 °C to 6 °C . The relative humidity varies between 20 to 94 percent. The average rainfall follows around 1013.4 mm annually. The six varieties included into the experiment were, V₁: Yellow Peony, V₂: Pastel Pink, V₃: Bucha, V₄: Rani Red, V₅: White Buddha and V₆: Pink Cloud. The varieties were arranged in Random Block Design (RBD) with six varieties in 4 replications. Lotus plants were planted in 56 cm diameter tubs with 30cm height and each tubs one rhizome planted. For each variety in a replication there are two tubs. In this experiment different characters of Lotus like growth parameters, floral parameters, quality parameters and yield parameters were observed in the interval of 30, 60, 90, 120 days. The data on growth, quality and yield components were analyzed using Fisher's method of analysis of variance (ANOVA) as recommended by Panse and Sukhatme.

3. RESULTS AND DISCUSSION

In the present study "Evaluation of the different varieties of Lotus (*Nelumbo nucifera*) in Prayagraj agro climatic conditions , Uttar Pradesh" data were recorded for numerous characters , which are described below:

3.1 Growth Parameters

Significant variations were observed among six varieties as presented in Table 1 and Table 2 for growth parameters and graphically presented in Fig 1.

For the plant height (cm) maximum plant height of lotus was observed with V₃:Bucha at all the days i.e– 30,60,90,120days (18.13cm,24.13cm,39.78cm, 41.31 cm respectively) followed by the variety V₆ : Pink Cloud (16.25cm, 18.20cm, 35.31cm, 37.59cm respectively) .The lowest plant height observed in V₂:Pastelpink(8.16cm,10.53cm,16.21cm,16.56cm) different plant height may be due to the varietal character and vigor of the genotypes under study . Similar results in Lotus reported by Sahu *et al.* (2017)[13].

Among all six tested varieties ,maximum number of leaves was observed at the interval of 30, 60, 90,120 days with V₅ : White Buddha (17.25,34.38,36.38,37.50 respectively) followed by V₃ : Bucha (16.50, 22.25 ,30.38 ,32.25 respectively). Minimum number of leaves was observed in V₂ : Pastel Pink (8.25, 12.25, 18.38, 19.25 respectively).The number of leaves in lotus plants can vary due to genetic factors, environmental conditions, and developmental stages. Different varieties may have evolved to produce varying numbers of leaves as an adaptation to their specific habitats and ecological niches. Among all six

tested varieties ,maximum leaf length was observed in V₃:Bucha (8.28cm,13.38cm, 14.51cm, 14.94cm) . For first 30 days, leaf length of the Yellow Peony(7.26 cm) was second highest but for 60,90 and 120 days V₆: Pink Cloud(12.49 cm, 13.18 cm ,13.39 cm) occupied the second position . However , minimum leaf length observed in V₄ : Rani Red (5.13cm,11.30cm,11.58cm,11.68cm).Environmental factors such as sunlight, temperature, soil nutrients, and water availability play significant roles in determining leaf length, as they influence the growth and development of the plant. Additionally, the stage of development of the plant can affect leaf length. Similar result were recorded in Lotus by Mukherjee and Bera (2016) [5]. The maximum leaf width observed at the interval of 30, 60, 90,120 days was V₃ : Bucha (13.30cm, 17.30 cm, 19.33 cm , 19.68cm respectively). For first 30 days and 60 days the V₆: Pink Cloud (12.23 cm, 16.28 cm respectively) perform second best but for the 90 and 120 days V₁ :Yellow Peony (17.30 cm ,17.15 cm respectively) perform second best The minimum leaf width observed in V₄: Rani Red (9.08cm, 13.20cm, 13.46 cm , 13.75 cm) .

3.2 Floral Parameters

Significant variations were observed among six varieties as presented in Table 3 and Table 4 for floral parameters and graphically presented in Fig 2.

The maximum number of flower buds was observed in first 30 and 60 days with V₁: Yellow Peony (4.25, 9.13) and for next 90 and 120 days, it was observed with V₃: Bucha (13.50 & 17.75) .The second highest numbers of flower bud was observed in 30 days was V₂ : Pastel Pink (2.88), for 60, 90 and 120 days the second highest number of buds was recorded in V₆ : Pink Cloud (7.25,10.25,16.23 respectively) . However minimum number of buds observed in 120 days after planting was V₂: pastel pink (1.13, 4.00, 4.13, 7.63 respectively). The maximum number of days to open the flower bud observed in V₃ : Bucha (17.25 days), followed by Pink Cloud (15.50 days) and Rani Red (14.25 days) . Minimum days to open the flower bud observed in V₂ : Pastel Pink (10.63 days). Similarly, maximum flower diameter (cm) recorded in the variety V₃: Bucha (16.28 cm) followed by V₆ : Pink Cloud (14.25 cm) and White Budhha (13.11 cm) respectively. However, minimum flower diameter was recorded in V₄ : Rani Red (10.13 cm) .

3.3 Quality Parameters

Significant variations were observed among six varieties as presented in Table 4 for quality parameters.

The maximum duration of flowering observed in V₁: Yellow Peony (115.13 days) followed by V₆ : Pink Cloud (

113.00 days) and White Budhha (111.75 days) . However, minimum flower duration recorded in V₄ : Rani Red (108.00 days) . The flowering duration of lotus varieties can vary due to factors such as genetics, environmental conditions, and cultivation practices. Some varieties may have been bred to bloom for longer periods, while others may have natural variations in their flowering cycles. Among all six tested varieties, maximum vase life of flowers was observed in the variety V₆ : Pink Cloud (6.25 days) followed by V₃ : Bucha (5.75 days) and V₁ : Yellow Peony (4.88 days) . However , minimum vase life recorded in V₄ : Rani Red (3.0 days) . Some varieties may naturally have longer-lasting blooms or sturdier stems, while others might be more delicate or sensitive to environmental stressors. Similar findings were recorded by Salaemae *et al.* (2018) [16] and Sahu (2023) [14].

3.4 Yield Parameters

Significant variations were observed among six varieties as presented in Table 5 for yield parameters.

The maximum number of flower per plant was observed in V₃: Bucha (38.13), followed by V₁: Yellow peony (36.63). However, minimum numbers of flower per plant observed in V₂: Pastel pink (20.00). Significantly among all six tested varieties, maximum number of flower per hectare was observed in V₃ : Bucha (1525000) followed by V₁ : Yellow peony (1465000) and V₆: Pink Cloud (1440000) . However, minimum number of flower per hectare observed in V₂ (800000). Among all six tested varieties, maximum yield of rhizome per plant was observed in V₃: Bucha (1.74 kg) followed by V₆ : pink cloud (1.55 kg) .However, minimum yield of rhizomes per plant observed in V₂: pastel pink (1.00 kg). Similar results in Lotus reported by Sahu *et al.* (2017)[13]. The maximum yield of rhizome per hectare was observed in V₃: Bucha (69.73 t) followed by V₆: Pink Cloud (61.83 t) . However, minimum yield of rhizomes per hectare observed in V₂: Pastel Pink (39.8 t) .

3.5 Economic Parameter

The variations were observed among six varieties as presented in Table 6 for economic parameters. The cost of cultivation was recorded maximum among all six tested varieties are Yellow Peony , Bucha and Pink Cloud (1007450 Rs . ha⁻¹). Whereas minimum cost of cultivation was recorded in the variety Rani Red (847450 Rs.ha⁻¹).Maximum gross returns (Rs.ha⁻¹) was recorded in the variety V₃ : Bucha (4444500 Rs . ha⁻¹) , followed by V₆ : Pink Cloud (4116500 Rs.ha⁻¹) . Minimum gross returns (Rs.ha⁻¹) was recorded in the variety V₂ : Pastel Pink (1998000 Rs.ha⁻¹). The net returns (Rs.ha⁻¹) was observed maximum in the variety Bucha (3437050 Rs

. ha⁻¹), followed by Pink Cloud (3109050 Rs.ha⁻¹). Minimum net returns (Rs.ha⁻¹) was observed in the variety Pastel Pink (1090550 Rs.ha⁻¹). The benefit cost ratio was maximum with the variety Bucha (4.41:1), followed by Pink Cloud (4.09:1) significantly whereas the minimum benefit cost ratio observed in the variety V₂: Pastel Pink (2.20:1).

UNDER PEER REVIEW

Table 1: Varietal evaluation of different varieties of Lotus on basis of growth parameters

Notation	Variety names	Plant height (cm)				Number of leaves			
		30 dap	60 dap	90 dap	120 dap	30 dap	60 dap	90 dap	120 dap
V ₁	Yellow Peony	13.13	15.45	20.30	22.39	12.25	20.25	27.25	28.13
V ₂	Pastel Pink	8.16	10.53	16.21	16.56	8.25	12.25	18.38	19.25
V ₃	Bucha	18.13	24.13	39.78	41.31	16.50	22.25	30.38	32.25
V ₄	Rani Red	10.44	13.14	18.30	20.56	9.13	14.38	22.38	23.13
V ₅	White Buddha	14.19	16.23	22.69	24.66	17.25	34.38	36.38	37.50
V ₆	Pink Cloud	16.25	18.20	35.31	37.59	10.25	17.25	24.25	25.13
F – TEST		S	S	S	S	S	S	S	S
SEd		0.177	0.521	0.563	0.231	0.138	0.204	0.149	0.213
CD (5%)		0.381	1.12	1.21	0.497	0.297	0.439	0.321	0.459
CV%		1.872	4.526	3.128	1.203	1.593	1.434	0.796	1.094

Table 2: Varietal evaluation of different varieties of Lotus on basis of growth parameters

Notation	Variety names	Leaf length (cm)				Leaf width (cm)			
		30 dap	60 dap	90 dap	120 dap	30 dap	60 dap	90 dap	120 dap
V ₁	Yellow Peony	7.26	11.36	12.81	13.26	11.20	15.33	17.15	17.30
V ₂	Pastel Pink	6.16	12.18	12.10	12.40	10.18	14.18	14.63	14.78
V ₃	Bucha	8.28	13.38	14.51	14.94	13.30	17.30	19.33	19.68
V ₄	Rani Red	5.13	11.30	11.58	11.68	9.08	13.20	13.46	13.75
V ₅	White Buddha	5.45	11.55	12.34	12.73	9.75	13.68	13.88	14.10
V ₆	Pink Cloud	6.43	12.49	13.18	13.39	12.23	16.28	16.70	17.08
F – TEST		S	S	S	S	S	S	S	S
SEd		0.104	0.065	0.085	0.065	0.066	0.043	0.069	0.065
CD (5%)		0.225	0.14	0.182	0.139	0.142	0.092	0.149	0.14
CV%		2.289	0.767	0.939	0.701	0.854	0.404	0.617	0.569

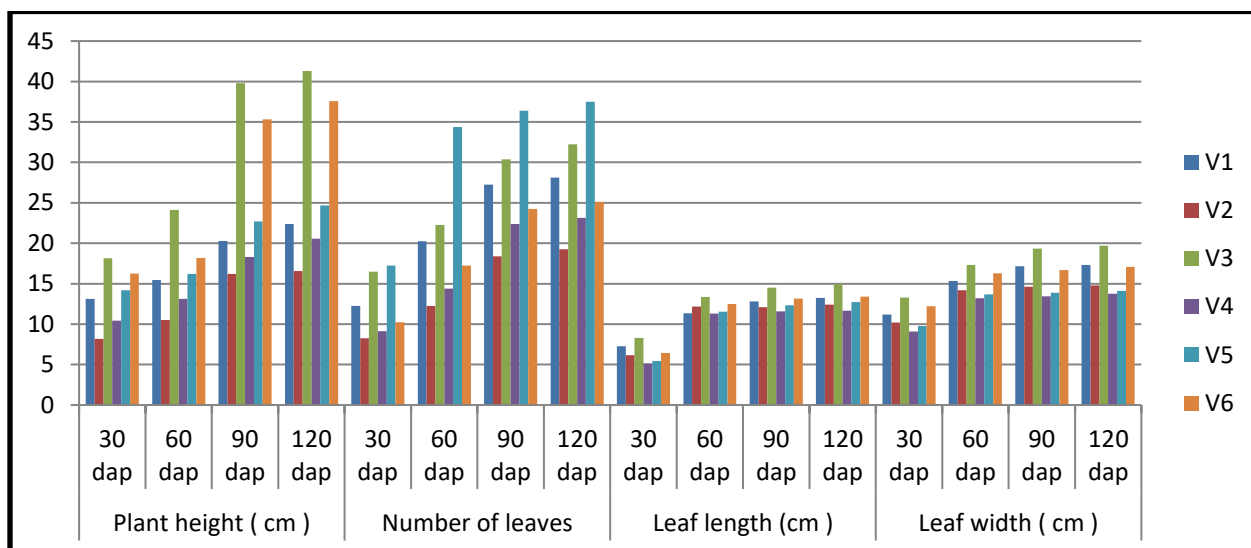


Fig 1: Varietal evaluation of different varieties of Lotus on basis of growth parameters

Table 3: Varietal evaluation of different varieties of Lotus on basis of floral parameters

Notation	Variety names	Number of flower bud per plant				Days to open the flower bud
		30 dap	60 dap	90 dap	120 dap	
V ₁	Yellow Peony	4.25	9.13	12.13	11.125	12.00
V ₂	Pastel Pink	2.88	5.38	4.13	7.625	10.63
V ₃	Bucha	2.50	4.38	13.50	17.75	17.25
V ₄	Rani Red	1.38	4.00	6.25	8.75	14.25
V ₅	White Buddha	1.13	6.38	7.25	12.375	11.50
V ₆	Pink Cloud	2.38	7.25	10.25	16.125	15.50
F - TEST		S	S	S	S	S
SEd		0.224	0.569	0.186	0.194	0.247
CD (5%)		0.481	1.224	0.401	0.417	0.53
CV%		13.085	13.809	2.955	2.228	2.578

Table 4: Varietal evaluation of different varieties of Lotus on basis of floral parameters and quality parameter

Notation	Variety names	Flower diameter (cm)	Vase life	Duration of flowering
V ₁	Yellow Peony	12.14	4.88	115.13
V ₂	Pastel Pink	11.40	3.38	109.63
V ₃	Bucha	16.28	5.75	110.63
V ₄	Rani Red	10.13	3.00	108.00
V ₅	White Buddha	13.11	4.25	111.75
V ₆	Pink Cloud	14.25	6.25	113.00
F – TEST		S	S	S
SEd		0.04	0.179	0.339
CD (5%)		0.086	0.384	0.729
CV%		0.439	5.515	0.431

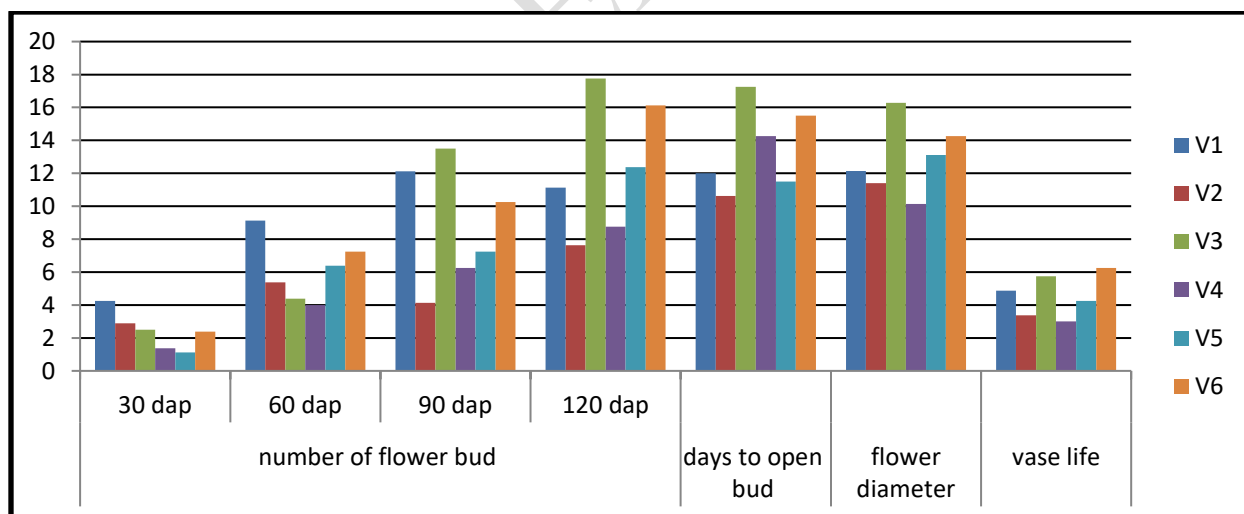


Fig 2: Varietal evaluation of different varieties of Lotus on basis of floral parameters and quality parameter

Table 5: Varietal evaluation of different varieties of Lotus on basis of yield parameters

Notation	Variety names	Total number of flower per plant	Yield of rhizome per plant(kg)	Yield of rhizome per hectare(t)
V ₁	Yellow Peony	36.63	1.15	45.88
V ₂	Pastel Pink	20.00	1.00	39.80
V ₃	Bucha	38.13	1.74	69.73
V ₄	Rani Red	20.38	1.10	43.83
V ₅	White Buddha	27.13	1.50	59.88
V ₆	Pink Cloud	36.00	1.55	61.83
F – TEST		S	S	S
SEd		0.42	0.003	0.119
CD (5%)		0.903	0.007	0.256
CV%		1.999	0.325	0.314

Table 6: Economic evaluation of different varieties of Lotus

Notation	Variety names	Variable cost of cultivation	Gross return	Net return	C: B ratio
V ₁	Yellow Peony	1007450	3847500	2840050	1:3.82
V ₂	Pastel Pink	907450	1998000	1090550	1:2.20
V ₃	Bucha	1007450	4444500	3437050	1:4.41
V ₄	Rani Red	847450	2068250	1220800	1:2.44
V ₅	White Buddha	907450	2768750	1861300	1:3.05
V ₆	Pink Cloud	1007450	4116500	3109050	1:4.09

4. CONCLUSION

Based on the results, it is concluded that out of the 6 Lotus varieties, variety V₃: Bucha excelled over others in growth parameters like plant height, leaf number, leaf length and leaf width, followed by the variety V₆: Pink cloud and V₁: Yellow peony. The variety V₃: Bucha also performed better in all the floral parameters studied. The maximum vase life was recorded in V₁: Yellow Peony. As per yield parameters and economic parameters V₃: Bucha performed better in number of flower per plant, number of flower per hectare (1525000), yield of rhizome per plant, yield of rhizome per hectare and gross return, net return, benefit and cost ratio. Hence, the variety V₃: Bucha gave the best performance under the agro climatic conditions of Prayagraj so this variety could be recommended and promoted for cultivation in open field conditions in Prayagraj.

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