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# Growth pattern, periodicity and seasonality in leaf production of sacred lotus

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## ABSTRACT

**The sacred lotus (*Nelumbo nucifera* Garten) leaves are used as a medicinal herb for well over 1,500 years. Leaves of sacred lotus are also having much nutritional value. They are also used as plates and packing materials. Study about leaf development and seasonality of leaf production will give the medical practitioners an overview about the availability of leaves in nature. Leaves are with peltate lamina and long petiole. Spined petioles are attached at the centre on the back side of leaf lamina. Lamina will takes 4-5 days to open fully. Leaf longevity ranged from 24 days in Chitoor and Nagarkovil to maximum of 28 days in Bramangalam. A highly irregular fluctuation in leaf lamina size development was observed in all accessions. Leaves are epistomatic with ranunculaceous stomata. Different weather parameters affected various growth parameters of leaf. Highest number of leaves was produced during rainy season and minimum during winter. Summer season experienced minimum longevity.**

**Key words**: *Nelumbo*, sacred lotus, peltate lamina, growth, seasonality.

## INTRODUCTION

Sacred lotus (*Nelumbo nucifera* Garten) is considered to be one of the most ancient plant in existence. The sacred lotus is the foremost symbol of beauty, prosperity and fertility, and it is one of the worlds most celebrated flower. From time immemorial to the present day, it has always been in folklore, religion and the arts in one form or the other. Lotus is a very important symbol of Indian cultural heritage.

The sacred water lotus has been used as a medicinal herb for well over 1,500 years. All parts of the plants are used in one or the other way in herbal medicines. Leaves are rich in starch, vitamin A and C, asparagines, nelumbine, etc. The lotus leaves are bitter, but neutral, and are said to benefit the stomach, spleen, and liver. They are used for treatment of summer heat syndrome and dampness accumulation. louts alkaloids present in leaves have hypotensive effect. Lotus leaf has become popular for lowering blood lipids and treating fatty liver, it is commonly combined with crataegus, which promotes blood circulation and lowers blood fats for that purpose. The leaf juice decocted with liquorice (*Glycyrrhiza* spp.) is used in the treatment of diarrhoea and also for the treatment of sunstroke. In addition to its medicinal properties, the leaves are also used as plates and packing materials. The size and growth of leaves varies with accessions and the availability of these leaves are seasonal. In spite of its immense potential use no detailed study was conducted about morphogenesis, periodicity and seasonality of leaf production. Hence, this study was envisaged to study the above objectives.

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## MATERIALS AND METHODS

The study was carried out at Department of Plant Breeding and Genetics, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur. Six different accessions *viz*., Nagarkovil, Bramangalam, Nelliyampathy, Chitoor, Chemmenda and Chandiroor were used for the study. The accessions were evaluated under *ex situ* conditions in cement tanks of two feet diameter and three feet height. Clay and water levels were retained at uniform height throughout the experiment period.

Growth and development pattern of leaves in all the selected accessions were studied by taking observations on various morphological characters. Daily observations were taken right from leaf initiation till abscission all throughout the year. The observations were taken for two consecutive years. The following biometric characters like longevity of leaves (days from visual appearance stage to abscission), petiole length (cm), length and breadth of lamina at full expansion (cm), length and breadth of lamina at the time of abscission (cm), mean number of days from visual appearance to full expansion of lamina, stomatal frequency and type, number of leaves produced and frequency of leaf formation were recorded from ten different plants in each accessions. The stomatal type was described following the classification proposed by Van Cotthem (2).

Correlations of different weather parameters with various growth parameters of leaves were also studied

The time duration taken between formation of two consecutive leaves were observed in all accessions throughout the year to find out periodicity of leaf formation. Number of leaves produced in each month for each accessions were also recorded and expressed as percentage of total number of leaves produced per year. For the convenience of above two studies the whole year was divided into four seasons *i.e.,* December-February representing winter, March-May representing summer, June-August representing rainy and September-November representing spring season. Seasonal effects on various growth parameters of leaves were also studied.

## RESULTS AND DISCUSSION

The leaves of all the accessions studied were found to be simple with long petiole and peltate lamina (Welsh, 4). Spines were present on the petiole. Petiole is attached to the centre on the back side of leaf lamina.Leaves are either floating or held above the water surface. Lamina is having a waxy coating on its surface. The lamina retained in rolled condition at the time of its appearance. Once the leaf is above the water surface the lamina started unfolding in both direction. Lamina took 4-5 days to open fully. Only after unfolding expansion of lamina takes place.

The observations on various leaf characters were taken and presented in Table 1. From Table 1 it is clear that significant variability was observed among the accessions for all leaf characters studied. Maximum leaf longevity of 28 days was observed in Bramangalam. The accessions Chittoor and Nagarkovil registered the minimum value of 24 days. In the case of petiole length, the lowest value of 25.93 cm was registered by Chitoor and the highest value of 34.91 cm by Chemmenda. The accessions Nelliyampathy and Nagarkovil were having the largest leaves and Chitoor with smallest leaves with short petiole and low longevity. The growth pattern of leaves from different accessions based on the length and breadth of lamina during peak season is presented in Table 2 and Figs. 1 and 2. Size measurement of lamina was recorded only after it's unrolling. Fluctuations were observed in both length and breadth of lamina in all the accessions. These fluctuations did not follow a regular pattern and were observed to be highly irregular as it is evident from Table 2. The stomatal count /unit area in different accessions of lotus is presented in Table 3 . There is no much significant difference in stomatal count per unit area between accessions. Leaves of all the ecotypes evaluated were epistomatic .The stomata was found to be anomocytic or ranunculaceous in all the accessions studied (Watson and Dallwitz, 3). Brosch and Barthlott, 1) had also reported ranunculaceous stomata in *Nelumbo* genus.

Correlation studies on different growth parameters like longevity of leaves, petiole length and leaf lamina length at full expansion with various weather parameters were studied. All the accessions except Chittoor and Chandiroor showed significant negative correlation for the character longevity of leaves with temperature (Table 4). Longevity showed no significant correlation with any other weather parameters. Nelliyampathy showed significant negative correlation with evaporation. The life span of leaf was only influenced by temperature.

Irrespective of the accessions, petiole length showed significant negative correlation with mean maximum and high maximum temperatures,

**Table 1.** Variability in leaf characters of six ecotypes.

| Accession | Longevity of leaves (days) | Petiole length (cm) | Length of lamina at full expansion (cm) | Length of lamina at the time of abscission (cm) | Breadth of lamina at full expansion (cm) | Breadth of lamina at the time of abscission (cm) | Mean number of days for the leaf to open fully |
|---|---|---|---|---|---|---|---|
| Nagarkovil | 23.63 | 33.21 | 13.88 | 14.56 | 18.58 | 18.23 | 3.90 |
| Bramangalam | 28.39 | 32.47 | 12.40 | 12.38 | 16.11 | 14.95 | 4.40 |
| Chandiroor | 24.86 | 30.79 | 12.86 | 12.80 | 15.51 | 14.41 | 4.65 |
| Nelliyampathy | 27.35 | 33.77 | 14.53 | 15.21 | 17.92 | 17.73 | 4.27 |
| Chittoor | 24.00 | 25.93 | 10.29 | 10.67 | 13.63 | 13.15 | 4.10 |
| Chemmanda | 27.27 | 34.91 | 13.04 | 12.73 | 16.05 | 16.46 | 4.59 |
| $CD_{0.05}$ | 0.57 | 1.19 | 0.68 | 0.65 | 0.84 | 0.70 | 0.28 |
| CV (%) | 3.11 | 5.27 | 7.55 | 6.30 | 7.27 | 6.24 | 9.05 |

**Table 2.** Growth pattern of leaf in six different ecotypes of sacred lotus based on length and breadth of lamina.

| Nagarkovil | | Bramangalam | | Chemmanda | | Nelliyampathy | | Chittoor | | Chandiroor | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) |
| 3.8 | - | 3.9 | - | 5.0 | - | 3.7 | - | 2.8 | - | 4.0 | - |
| 5.7 | - | 5.0 | - | 6.9 | - | 12.4 | - | 5.3 | - | 5.8 | - |
| 8.4 | - | 7.0 | - | 9.0 | - | 14.5 | - | 6.0 | - | 9.9 | - |
| 9.7 | - | 8.3 | - | 11.0 | - | 16 | - | 7.8 | - | 12.1 | - |
| 12.2 | 15.0 | 11.6 | - | 13.7 | - | 20.1 | - | 9.2 | - | 14.5 | - |
| 13.4 | 16.7 | 14.1 | 17.5 | 15.0 | - | 23.9 | 29.0 | 10.6 | - | 17.0 | - |
| 13.8 | 17.1 | 16.5 | 21.5 | 17.7 | 20.2 | 25.2 | 33.0 | 12.2 | 14.2 | 19.4 | 21.5 |
| 14.0 | 17.2 | 18.4 | 24.0 | 19.4 | 22.5 | 27.0 | 35.7 | 13.8 | 17.3 | 20.8 | 26.3 |
| 14.0 | 17.2 | 18.5 | 24.7 | 19.7 | 23.6 | 27.0 | 35.8 | 14.4 | 19 | 22.3 | 27.2 |
| 14.0 | 17.2 | 18.5 | 24.8 | 19.7 | 24.0 | 27.0 | 35.8 | 14.5 | 19.6 | 22.3 | 27.5 |
| 13.9 | 17.2 | 18.5 | 24.8 | 19.7 | 23.8 | 27.0 | 35.8 | 14.6 | 19.7 | 22.4 | 27.5 |
| 13.9 | 17.2 | 18.5 | 24.8 | 19.7 | 23.8 | 27.0 | 35.8 | 14.6 | 19.7 | 22.4 | 27.5 |
| 13.9 | 17.2 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 36.0 | 14.6 | 19.7 | 22.4 | 27.5 |
| 13.8 | 17.3 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 36.0 | 14.6 | 19.7 | 22.4 | 27.7 |
| 13.8 | 17.3 | 18.6 | 25.0 | 19.6 | 23.7 | 27.0 | 36.0 | 14.7 | 19.7 | 22.5 | 27.7 |
| 13.8 | 17.3 | 18.6 | 25.0 | 19.6 | 23.7 | 27.0 | 36.0 | 14.7 | 19.7 | 22.5 | 27.7 |
| 13.8 | 17.2 | 18.6 | 25.0 | 19.6 | 23.7 | 26.8 | 35.9 | 14.7 | 19.8 | 22.5 | 27.5 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.5 | 24.0 | 26.8 | 35.9 | 14.7 | 19.8 | 22.5 | 27.5 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.5 | 24.0 | 26.8 | 35.9 | 14.7 | 19.8 | 22.5 | 27.5 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.5 | 24.0 | 27.0 | 35.9 | 14.7 | 19.8 | 22.3 | 27.6 |
| 13.8 | 17.2 | 18.5 | 26.0 | 19.5 | 23.7 | 27.0 | 35.9 | 14.7 | 19.7 | 22.3 | 27.6 |
| 13.8 | 17.2 | 18.5 | 26.1 | 19.5 | 23.7 | 27.0 | 35.9 | 14.6 | 19.7 | 22.3 | 27.6 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.5 | 23.7 | 27.0 | 35.8 | 14.6 | 19.7 | 22.3 | 27.6 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.6 | 23.7 | 27.0 | 35.8 | 14.6 | 19.7 | 22.3 | 27.6 |
| 13.8 | 17.2 | 18.5 | 25.0 | 19.6 | 23.7 | 27.0 | 35.8 | 14.6 | 19.8 | 22.3 | 27.6 |
| 14.4 | 17.4 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 35.8 | 14.6 | 19.8 | 22.3 | 27.6 |
| 15.0 | 17.4 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.5 |
| 15.6 | 17.9 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.5 |
| 15.8 | 18.6 | 18.5 | 25.0 | 19.7 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.5 |

Contd...

*Contd...*

| Nagarkovil | | Bramangalam | | Chemmanda | | Nelliyampathy | | Chittoor | | Chandiroor | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) | Length (cm) | Breadth (cm) |
| 16.2 | 20.0 | 18.8 | 25.0 | 19.7 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.5 |
| 17.0 | 21.2 | 18.8 | 24.9 | 19.8 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.5 |
| 17.0 | 21.5 | 18.8 | 24.9 | 20.0 | 23.8 | 27.0 | 35.8 | 14.7 | 19.8 | 22.5 | 27.7 |
| 17.0 | 21.5 | 19.0 | 24.9 | 20.0 | 23.9 | 27.0 | 35.8 | 14.5 | 19.8 | - | - |
| 17.0 | 21.5 | 19.0 | 25.0 | 20.0 | 23.9 | 27.0 | 35.8 | 14.5 | 19.8 | - | - |
| 17.1 | 21.5 | 19.0 | 25.0 | 20.0 | 23.9 | 27.0 | 35.8 | 14.5 | 19.7 | - | - |
| 17.1 | 21.5 | 19.0 | 25.0 | 20.0 | 23.9 | 27.0 | 35.8 | 14.5 | 19.7 | - | - |
| 17.1 | 21.5 | 19.0 | 25.0 | 20.0 | 23.9 | 27.0 | 35.8 | 14.5 | 19.7 | - | - |
| - | - | 19.0 | 25.0 | 19.8 | 23.9 | 27.0 | 35.8 | 14.5 | 19.7 | - | - |
| - | - | 19.0 | 25.0 | 19.8 | 23.9 | 27.0 | 35.8 | - | - | - | - |
| - | - | 18.7 | 25.0 | 19.8 | 23.9 | 27.0 | 35.8 | - | - | - | - |
| - | - | 18.7 | 25.0 | 19.8 | 23.9 | - | - | - | - | - | - |
| - | - | 18.7 | 25.0 | 19.8 | 23.9 | - | - | - | - | - | - |
| - | - | 18.7 | 25.0 | 19.8 | 23.9 | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | 19.8 | 23.7 | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | 19.5 | 23.7 | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | 19.5 | 23.7 | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | - | - | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | - | - | - | - | - | - | - | - |
| - | - | 19.0 | 25.0 | - | - | - | - | - | - | - | - |

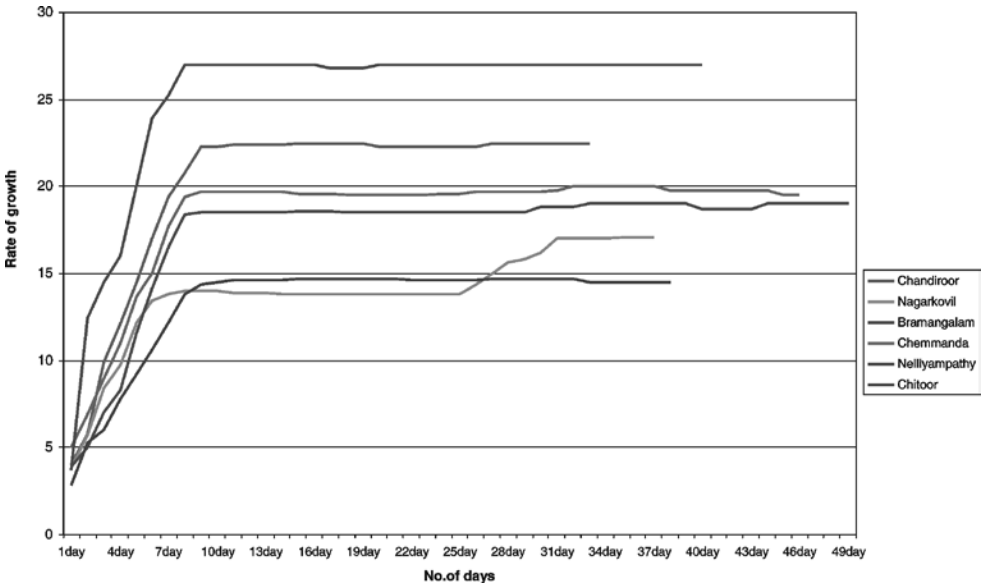


**Fig. 1.** Growth pattern of *Nelumbo* leaf based on lamina length.

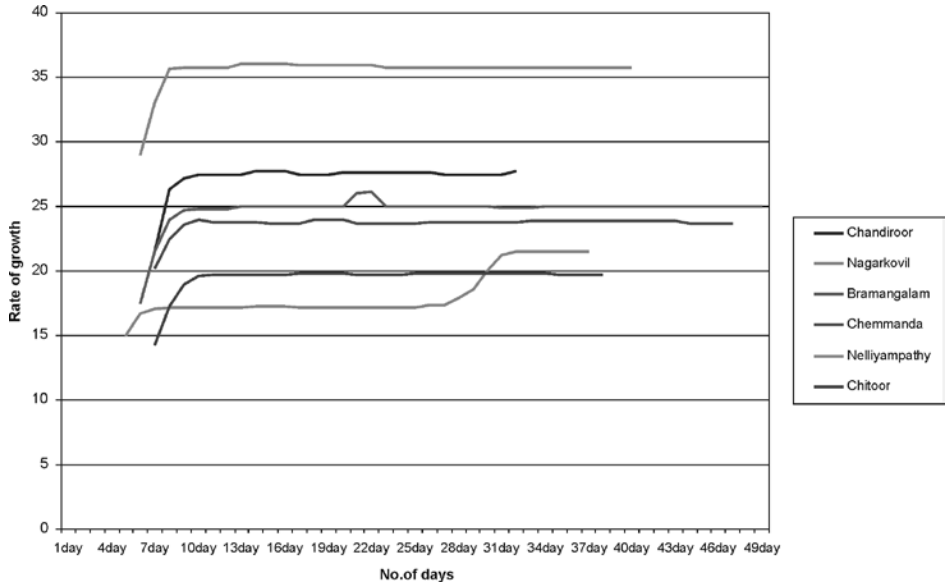


**Fig. 2.** Growth pattern of *Nelumbo* leaf based on lamina breadth.

evaporation, mean sunshine hours and wind speed. Positive correlation was registered with low minimum temperature, relative humidity and rainfall (Table 5). Long petiole during rainy season is to facilitate the leaf lamina to come above the increasing water level. It is evident from Table 6 that lamina length at the time of full expansion in Chemmanda and Nelliyampathy had significant negative correlation with mean maximum and high maximum temperature and evaporation. Same accessions showed significant positive correlation with mean relative humidity, rainfall and rainy days.

The periodicities of leaf formation in different accession in different seasons are presented in Table 7 and Fig. 3. From the Table 7, it is evident that the periodicity of leaf formation varied with the accessions as well as seasons. Leaf production was very low during December to February, period representing winter season and indicated by the high number of days between successive leaf formations.

The influence of season on various leaf characters of lotus are presented in Table 8 and Fig. 4. The study has relived that seasonal effects

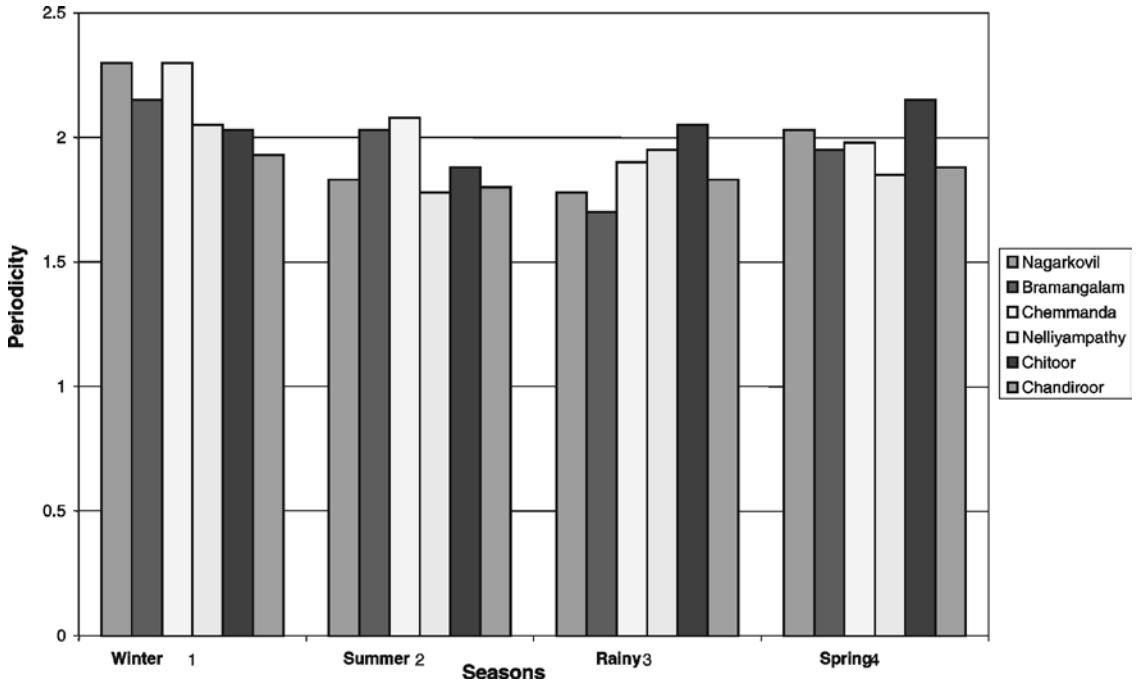


**Fig. 3.** Periodicity of leaf formation in different *Nelumbo* accessions.

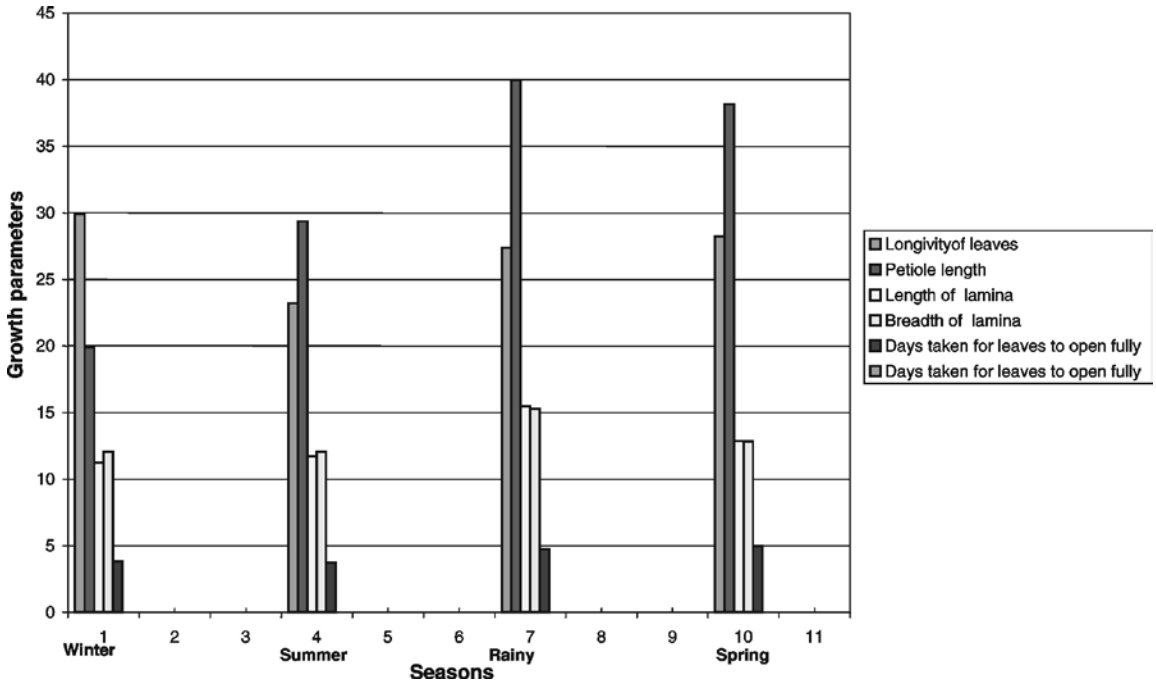


**Fig. 4.** Effect of season on various leaf characters in *Nelumbo* accesions.

on leaf characters are significant. Longevity of the leaves and days taken for the leaves to open fully were the highest in spring season, *i.e.* followed by rainy season and the least in the summer. However, the petiole length and size of the leaf as represented by length and breadth of lamina were the highest during rainy season (June-August) followed by spring season (September-

**Table 3.** Stomatal count in different lotus accessions.

| Accession | Stomatal count / $mm^2$ |
|---|---|
| Nagarkovil | 520 |
| Bramangalam | 490 |
| Chemmanda | 510 |
| Nelliyampathy | 510 |
| Chitoor | 500 |
| Chandiroor | 490 |
| $CD_{0.05}$ | NS |
| CV (%) | 4.08 |

**Table 4.** Correlation of weather parameters with longevity of lotus leaves.

| Accession | Mean Max temperature | Mean Min temperature | High Max temperature | Low Min temperature | Mean relative humidity | Rainfall | Rainy days | Evaporation | Mean sun shine hours | Wind speed |
|---|---|---|---|---|---|---|---|---|---|---|
| Nagarkovil | -0.192 | -0.271* | -0.282* | -0.017 | -0.091 | -0.283* | -0.139 | 0.095 | 0.071 | 0.244 |
| Bramangalam | -0.355** | -0.353* | -0.441** | -0.033 | 0.126 | -0.03 | 0.113 | -0.157 | -0.186 | 0.07 |
| Chemmanda | -0.283* | -0.274* | -0.309* | -0.026 | 0.081 | -0.169 | -0.013 | -0.157 | -0.078 | 0.077 |
| Nelliyampathy | -0.434** | -0.324* | -0.458** | -0.041 | 0.202 | 0.031 | 0.173 | -0.263* | -0.229 | -0.014 |
| Chitoor | -0.189 | 0.242 | -0.15 | 0.493** | 0.243 | 0.033 | 0.157 | -0.089 | -0.147 | -0.178 |
| Chandiroor | 0.007 | -0.007 | -0.113 | 0.208 | 0.037 | -0.03 | 0.047 | -0.005 | -0.067 | -0.008 |

**Correlation significant at the 0.01 and 0.05 levels.

**Table 5.** Correlation of weather parameters with lotus petiole length.

| Accession | Mean Max temperature | Mean Min temperature | High Max temperature | Low Min temperature | Mean relative humidity | Rainfall | Rainy days | Evaporation | Mean sun shine hours | Wind speed |
|---|---|---|---|---|---|---|---|---|---|---|
| Nagarkovil | -0.438** | 0.196 | -0.370** | 0.570** | 0.796** | 0.778** | 0.652** | -0.815** | -0.776** | -0.632** |
| Bramangalam | -0.451** | 0.238 | -0.409** | 0.614** | 0.779** | 0.463** | 0.611** | -0.652** | -0.614** | -0.636** |
| Chemmanda | -0.517** | 0.121 | -0.404** | 0.468** | 0.817** | 0.751** | 0.654** | -0.823** | -0.786** | -0.635** |
| Nelliyampathy | -0.465** | 0.152 | -0.426** | 0.521** | 0.802** | 0.680** | 0.576** | -0.761** | -0.730** | -0.646** |
| Chitoor | -0.610** | -0.205 | -0.574** | 0.249 | 0.697** | 0.666** | 0.529** | -0.726** | -0.755** | -0.519** |
| Chandiroor | 0.586** | 0.048 | -0.553** | 0.489** | 0.826** | 0.766** | 0.703** | -0.824** | -0.824** | -0.562** |

*,**Correlation significant at 0.01 and 0.05 levels.

**Table 6.** Correlation of weather parameters with lotus leaf lamina length at full expansion.

| Accession | Mean Max temperature | Mean Min temperature | High Max temperature | Low Min temperature | Mean relative humidity | Rainfall | Rainy days | Evaporation | Mean sun shine hours | Wind speed |
|---|---|---|---|---|---|---|---|---|---|---|
| Nagarkovil | 0.226 | 0.335** | 0.220 | 0.167 | 0.131 | -0.002 | 0.096 | -0.029 | 0.052 | -0.303* |
| Bramangalam | 0.215 | 0.154 | 0.135 | 0.264 | 0.157 | -0.054 | -0.123 | -0.080 | -0.013 | -0.342* |
| Chemmanda | -0.577** | -0.272* | -0.561** | 0.087 | 0.356** | 0.552** | 0.472** | -0.416** | -0.585** | -0.064 |
| Nelliyampathy | -0.532** | -0.261* | -0.557** | 0.098 | 0.461** | 0.536** | 0.494** | -0.481** | -0.608** | -0.282* |
| Chitoor | 0.026 | 0.107 | 0.014 | 0.340* | -0.041 | -0.143 | -0.099 | 0.168 | 0.045 | -0.016 |
| Chandiroor | -0.532** | -0.178 | -0.545** | 0.338** | 0.421** | 0.336** | 0.427** | -0.374** | -0.524** | -0.150 |

*,**Correlation significant at 0.01 and 0.05 levels.

**Table 7.** Periodicity of leaf formation in different accessions of sacred lotus in different seasons (days).

| Accession | Seasons | | | | Mean |
|---|---|---|---|---|---|
| | Winter Dec-Feb | Summer Mar-May | Rainy Jun-Aug | Spring Sep-Nov | |
| Nagarkovil | 2.03 | 1.83 | 1.78 | 2.03 | 1.91 |
| Bramangalam | 2.15 | 2.03 | 1.70 | 1.95 | 1.96 |
| Chemmanda | 2.30 | 2.08 | 1.90 | 1.98 | 2.06 |
| Nelliyampathy | 2.05 | 1.78 | 1.95 | 1.85 | 1.91 |
| Chitoor | 2.03 | 1.88 | 2.05 | 2.15 | 2.02 |
| Chandiroor | 1.93 | 1.80 | 1.83 | 1.88 | 1.86 |
| Mean | 2.08 | 1.90 | 1.87 | 1.97 | |

$CD_{0.05}$ for season = 0.08 $CD_{0.05}$ for ecotype = 0.022
$CD_{0.05}$ for interaction = 0.202 CV (%) = 17.31

**Table 8.** Effect of season on various leaf characters.

| Season | Longevity of leaves (days) | Petiole length (cm) | Length of lamina at full expansion (cm) | Lamina length at the time of abscission (cm) | Leaf lamina breadth at full expansion (cm) | Leaf laminz breadth at the time of abscission (cm) | Days taken for the leaves to open fully |
|---|---|---|---|---|---|---|---|
| Winter (Dec - Feb) | 24.94 | 19.90 | 11.25 | 12.04 | 13.50 | 12.48 | 3.82 |
| Summer (Mar - May) | 23.21 | 29.36 | 11.73 | 12.06 | 14.78 | 15.40 | 3.71 |
| Rainy (Jun - Aug) | 27.38 | 39.96 | 15.47 | 15.28 | 19.82 | 19.02 | 4.76 |
| Spring (Sep - Nov) | 28.21 | 38.17 | 12.88 | 12.84 | 17.09 | 16.39 | 4.98 |
| $CD_{0.05}$ | 0.47 | 0.97 | 0.56 | 0.48 | 0.68 | 0.57 | 0.23 |
| CV (%) | 3.11 | 5.27 | 7.55 | 6.30 | 7.27 | 6.24 | 9.05 |

November). Rainy season favoured growth in size of leaves and spring season favoured the longevity and days taken for the leaf to open fully.

The leaves of sacred lotus are simple with long petiole and peltatate lamina. Lotus possesses two types of leaves floating and upright. Variability was observed in different biometric characters like size of lamina, longevity of leaves, petiole length, etc. among the accessions evaluated. Stomata were found to be rananculaceous. Size of the leaves both lamina and petiole length had negative correlation with temperature. Minimum number of leaves were produced during winter. Study on seasonal effect of these characters showed that rainy season favoured growth in size of leaves and spring season favoured longevity.

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