EVALUATION OF PHILODENDRONS FOR LANDSCAPING AND INTERIOR PLANTSCAPING

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **"Evaluation of philodendrons for landscaping and interior plantscaping"** is a bonafide record of research work done by me during the course of research and this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Evaluation of philodendrons for landscaping and interior plantscaping"** is a record of research work done independently by Ms. K. Sadhana, under my guidance and supervision and that it has not previously formed the basis for award of any degree, fellowship or associateship to him.

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Introduction

1. INTRODUCTION

Foliage plants include plants grown for their attractive leaves rather than flowers and fruits. The use of foliage plants for interior decoration or interior plantscaping has become an integral part of contemporary design, playing an important role in our life (Manaker, 1997). Philodendron is one among them. Foliage ornamental industry has created as major breakthrough in floriculture business in recent years. Dependance of potted plants, especially foliage is growing very fast on account of non-availability of ground space in cities.

The genus *Philodendron* contains approximately 700 species, making it the second largest genus in the family Araceae (Croat and Thomas 1997). Philodendrons are native to tropical America and comprise a conspicuous component of the native flora because of their abundance, different growth styles, and attractive, durable leaves which are able to survive and grow indoors.

Philodendrons are highly appreciated for their attractive foliage and tolerance to interior environments and have been produced for use extensively in interiorscaping. Based on their growth habits, philodendrons are divided into three groups by McColley and Miller (1965). The first group is the vining/scandent type. This type dominated in sale from the 1950s to the early 1970s (Chen *et al.,* 2002).The second group has a self-heading and upright growing style and has become popular in the last 40 years due to an increasing number of new hybrids with red, yellow or orange foliage that were released to the market (Chen *et al.,* 2002). The third group is the erect-arborescent or tree type, which appear self-heading when they are young, but assume a more woody and treelike shape as they mature.

Philodendrons are popular ornamental foliage plants, constituting an important share in the foliage plant market and the rising popularities of self-heading cultivars have made them rank among the top ten most popular plants in the floricultural trade. Though commonly grown as houseplants many species/varieties of philodendrons are suited for the landscape in tropical and subtropical climates. There are even some that can be grown outdoors in Central Florida.

Philodendrons are among the most common and easy-to-grow house plants which are popularly used for interiorscaping. The diverse groups of plants range from vines with three inch heart shaped green leaves to vines with leaves of three feet long. They are well adapted to home growing and are maintained at fairly uniform moisture (Trinklein, 1999).

Indoor plants are not only decorative but are surprisingly useful in absorbing potentially harmful gases and cleaning the air inside modern buildings. Since most of the outdoor areas are being reduced due to rapid urbanization, indoor plants must be considered as a boon that will bring a bit nature to indoors.

In some circumstances, poor indoor air quality may pose serious health risks, particularly in susceptible types. The air pollution tolerance index (APTI) in indoor plants can be used to maintain the quality of indoor air for the occupants of the building APTI indices will help to classify plants from the sensitive group and tolerant ones that can survive even if the indoor atmosphere is slightly polluted.As philodendrons form a group of beautiful indoor plants, assessing the APTI of different species/varieties will help to identify the types suitable for specific indoor atmosphere.

With this background, the present study "Evaluation of Philodendrons for landscaping and interior plantscaping" was undertaken to evaluate the performance of philodendron species/varieties, to assess their potential under indoor conditions, to compute their Air Pollution Tolerance Index and to evaluate its use as cut foliage.

Review of Literature

2. Review of Literature

Most of the foliage plants in trade are native to the tropics which enhance the possibility of their successful cultivation in many parts of the country. As a result of urbanization, most of the foliage plants are grown as indoor plants. This paves way to bring nature indoors. The foliage plants with their variegations not only adapt well to the conditions but would also enhance the aesthetic and positive effects, in addition to controlling atmospheric pollution.

Philodendrons constitute the most popular group of house plants today. There are many species and varieties, with leaves ranging from small to very large and variety of shapes offered by no other house plants. Most are climbers and appreciate a support that can be kept moist.

2.1. History of philodendron

Philodendrons are known to have been collected from the wild. The first partly successful scientific attempt to collect and classify the genus was done by Charles Plumier. He collected approximately six species from the islands of Martinique, Hispaniola and St. Thomas. Since then, many exploration attempts were made to collect new species by others. These include those by N.J. Jacquin who collected new species in the West Indies, Colombia, and Venezuela. At this time in history, the names of the philodendrons they were discovering were being published with the genus name *Arum*, since most aroids were considered to be belonging to this genus. Throughout the late 17th, 18th and early 19th centuries, many plants were removed from the genus *Arum* and placed into newly created genera in an attempt to improve the classification. Heinrich Wilhelm Schott addressed the problem of providing improved taxonomy and created the genus *Philodendron* (1829). The genus was first spelled as '*Philodendrum*'.

Schott in 1832 published a system for classifying plants in the family Araceae titled *Meletemata Botanica* in which he provided a method of classifying philodendrons based on flowering characteristics. Schott in 1856 published a revision of his previous work titled '*Synopsis aroidearum*', and then published his final work *Prodromus Systematis Aroidearum* in 1860, in which he provided even more details about the classification of *Philodendron* and described 135 species (Schott, 2007).

2.2. Different species/varieties of *Philodendron*

Philodendron is a large genus of flowering plants in the Araceae family, consisting of about 900 species. This genus is the second largest member of the arum family. The name derives from the Greek words philo or "love" and dendron or "tree". Various *Philodendron* species/varieties can be introduced into the market and growers will also have wide range of choice for their gardens and interiors.

Philodendron bipinnatifidum is a tropical plant that is usually grown in full sun, but can tolerate and adapt to deep shade. Greatly known for its ease in covering a land mass and spread its tree-like trunk eight to ten feet. This grows best in rich, moisture retentive, slightly alkaline soil. However, it cannot tolerate high salt concentration in soil. Plant is capable of supporting itself at massive heights by producing tree-like bases. However, it will exhibit epiphytic characteristics if given the opportunity to attach itself to a nearby supporting tree and climb upon it. Trunk of the plant sends down many strong aerial roots that not only give support to the overall plant mass, but also serve to absorb water and nutrients from the soil. Alternatively, if grown in cooler climates with at least some freezing winter weather, its entire aboveground structures will die back completely at a hard frost and then sprout back from the roots the following spring. Leaves can grow up to 4–5 m tall and wide. This plant also contains a spadix and spathe that are usually white or inflorescent (Randhawa and Mukhopadhyay, 1986).

Philodendron 'Black Beauty' is a shrub, well suitable for the home or greenhouse. Bright indirect sunlight coming from the south/east/west is best. Stem cuttings and air-layering in the summer are used for propagation. Requires care in the beginning, humidity required is medium. *Philodendron* 'Black Cardinal' is a climbing epiphyte. Produce cordate shaped leaves alternatively. Leaves are red glossy in juvenile stage, later turns to deep green. *Philodendron* 'Black Prince' grows to a height of 1- 1.2m.This is suitable for interior plantscaping, due to compact growth. Produce red glossy leaves that gradually turn to green (Anon, 2011).

Philodendron 'Ceylon Gold' is a climber with yellow colored glossy leaves. Produces alternate leaves (Alex, 2012). *Philodendron elegans,* a climber, with pinnatifid leaves, that shows a slow growth in the initial stage, picked up very fast and had the highest values in

later stages as to show its adaption to indoor conditions (Alex, 2012). *Philodendron hederaceum*, an evergreen climber grows to 3–6 m (10–20 ft) height, with heart-shaped glossy leaves, 30 cm long, and occasionally spathes of white flowers in mature plants. Minimum temperature requirement is 15 °C (59 °F), thus it must be grown in glasshouse in temperate region (Neil *et al.*, 2006).

Philodendron karstenianum produces deep green, oblong leaves alternatively. This is a climber growing to a height of 3-6 mt. *Philodendron lacerum* is a vine with large platter-sized foliage that is slightly palmate lobed. This is used to cure abdominal pains, arthritis, contusions, sores, toothache (Quiros-Moran, 2009). Kelly (1985) observed *Philodendron lacerum* growing as an epiphyte, a secondary hemiepiphyte, and a terrestrial in different Jamaican locations. Sometimes variation in habit seems to be the most decisive factor. *Philodendron lacinatum* 'Variegata' has a multi-lobed leaf with a single large lower lobe. The plant with its 15 to 23cm long leaves is a climber and will soon climb any totem it is offered. This can be planted in a fast draining soil mixture and over watering should be avoided. *Philodendron X Magnificum,* produces cordate shaped leaves. Stem grows horizontally producing leaves at each node. This grows well under high shade condition, so suitable for indoor conditions. *Philodendron* 'Majesty' is one of the few really dark leaf philodendron hybrids. It is a climber and produces very dark leaves in bright light. The leaves are hastate and a bit sharp and narrow, usually 8 inches long and 3 to 4 inches wide. As the leaves age they turn to dark green to maroon depending on the amount of light they get. Plants should be given a totem to climb and kept warm (Anon, 2011).

Philodendron 'Moon Shine' is a stout, compact plant with no stem. Leaves are whorled alternately, glossy light green in juvenile stage, later turns to green color (Anon, 2011). *Philodendron pertusum* is a heavy root-climber, forms long hanging cord-like aerial roots. The leaves are large, 90 cm across, leathery, perforated with oblong holes and pinnatifid (clefted) at the margin. It is the only aroid grown for its compound fruit. Another English name for the vine is 'monstera'. Also known as 'Mexican breadfruit', 'hurricane plant' 'Swiss-cheese plant', 'Split leaf philodendron' and 'Windowleaf'. The species is native to the wet forest of southern Mexico, Guatemala, and parts of Costa Rica and Panama. In 1908, it was reported to be cultivated in Florida, Portugal and Algeria. Though no longer cultivated on any scale for its fruit, it is found for sale on roadside markets in southern Florida. It has been spread around the world as an ornamental foliage plant that can be used

indoors or outdoors generally climbing on some structure or tree (Randhawa and Mukhopadhyay, 1986).

Philodendron 'Pluto Red' is a slow growing shrub. Produces serrate leaves, dark red in initial stage later turns to green. Stem is compacted or absent (Neil *et al.*, 2006). *Philodendron* 'Red Dutches' is a climber, grows well when provided with a support, an epiphyte produces aerial roots. Leaves are purple colored in juvenile stage, gradually turns into green color. *Philodendron* 'Red Sunlight' is an attractive shrub. Leaves are red during juvenile stage and green in mature stage. Plant compact in growth with leaves upright, arranged spirally. *Philodendron sagittifolium* is a hemi epiphytic climbing vine that can begin life from a seed on the ground. This species is not found to grow on the ground and if so, only rarely. The petioles range from an average of 20 to 65cm in length but have been observed at over 90cm long also (Neil *et al.*, 2006).

Philodendron scandens oxycardium, also called as heart leaf plant is a vine growing half an inch thick, leaves are long and thin, the roots wind its way up to the top of the trees. Leaves can be from 2 to 6 inches diameter (Randhawa and Mukhopadhyay, 1986). *Philodendron serratum* is a tropical shrub and tender perennials, grown for foliage, evergreen shiny/glossy or rubbery textured. This grows upto a height 90-120 cm, suitable for growing indoors. It is propagated by dividing rhizomes, tubers, corms or bulbs. *Philodendron* 'Smithi' commonly called as 'Arrowhead Philodendron' is a climber, producing leaves alternatively at each node. Leaves are ovate, deep green in color (Anon, 2011).

Philodendron superbum was known, for a long time as a form of *Santa leopoldina*. Later this plant was commonly called *Santa leopoldina* species 2. Then it was given its correct species name of *superbum*. Large narrow leaved epiphytic climber, growing under humid shade and is variable in appearance. The adaxial (upper) leaf blade surface is glossy and the underside is matte (Neil *et al.*, 2006). *Philodendron wend-imbe* is a cross between *Philodendron wendlandii* and *Philodendron* imbe. *Philodendron wendlandii* has a rosette habit without back lobes so it looks like a birdnest. Leaves are long obovate, entire, simple, pinnate, spirally arranged, green and purple below in juvenile later turns to light green (Randhawa and Mukhopadhyay, 1986).

Philodendron williamsii, a noble aroid of which the base is immersed forming a crown of bright green foliage, six feet in diameter, and four to five feet height. Trunk two to

four feet high, two to three inches in diameter, branched, brown, covered with sub orbicular leaf scars, emitting numerous cylindrical brown roots half an inch in diameter. Leaves numerous, one to two and a half feet long, sagittate, bright green, with pale veins above, paler beneath, with dull purple midrib and veins, coriaceous, acute or cuspidate, anterior portion obscurely lobed, with five to six pairs of spreading principal veins and innumerable intermediate ones; posterior lobes oblong-ovate, obtuse, costa of these marginal at the base of the sinus only; petiole 2.0 to 2.5 feet long, slender, terete, grooved above, thickened at the base but not at the top, quite smooth and green (Randhawa and Mukhopadhyay, 1986).

2.3. Growing Environment of philodendrons

Microclimate is the key factor deciding the growth of any plant. Growth and quality of philodendrons depend on the interactions between environmental factors and genetic constitution of the plant. Factors like temperature, light intensity and humidity can limit the quality of foliage of the plants including colour, size, shape etc (Swapna, 1996).

2.3.1. Temperature

To accommodate philodendrons in different types and locations of indoors from air conditioned office space to machineries filled workplace their temperature requirement has to be evaluated. Temperatures affect growth rate of philodendrons as much as any other factor by influencing the rates of photosynthesis and respiration (Went, 1953; Gates, 1968; Hadfield, 1968). There is no specific temperature at which all philodendrons grow best (Manaker, 1997). However, Mortensen (1991) grouped *Philodendron scandens oxycardium* into high-temperature plants with optimal temperature at 24-27° C. Moes (1976) recommended minimum day and night temperatures for *Philodendron* cv. Tuxla production in early spring at a minimum bench temperature of 22^0C as 19^0C and 13^0C respectively with soil heating and 19^0C and 16^0C respectively without soil heating.

While Wetteren (1962) recommended minimum temperature of 16-18° C for winter production while in summer, temperature may rise to 35° C. Soil temperature of 26-28° C is desirable during the rooting of cuttings. Belgium and Bloemisterij (1989) reported that the percentage rooting of apical shoots was much higher than that of stem cuttings.

Sandved (1975) stated that during November-February plant quality of *Philodendron* was good at all temperatures ranging from 12^0 and 24^0 C. A temperature of 95^0C was found

to be optimum for plant grade, fresh weight and plant height parameters of *Philodendron scandens* ssp. *oxycardium* (Poole and Conover 1987). *Philodendron scandens* ssp. *oxycardium* was economically most viable at 60-65°C temperature (Poole and Conover (1988).

Conover and Poole (1988) also observed that healthy cuttings of *Philodendron* can be stored for as long as 12 days at 10-19°C without serious detrimental effects.

2.3.2. Relative Humidity

Under greenhouse conditions relative humidity is one of the main environmental factors to be considered. Commercial growers generally maintain relative humidity levels of 50 percent or more in greenhouses for the philodendrons growth (Conover and Poole, 1981). For the production of philodendron, humidity level should be maintained between 60 and 70 per cent and humidity beyond this limit will invite leaf diseases as well as increase the susceptibility of plants to diseases (Naqvi, 1999).

Foliage plants also raise relative humidity to healthier and more comfortable levels in interior space (Lohr, 1992). Relative humidity was raised by foliage plants up to 30 per cent by merely occupying two per cent of space. According to trials done by Mortensen *et al.*, (1988) philodendrons grow equally well at 60-85 per cent relative humidity.

Campiotti *et al.*, (1987) also observed the performance of philodendrons regarding microclimate (temperature and humidity), crop growth and quality plants. Plant response has shown that optimum temperature and relative humidity ensures better growing conditions.

2.3.3. Light requirement

By evaluating philodendrons for their light requirements and adaptability to various light conditions, proper arrangements can be done in the indoor either by placing the plant in an appropriate area of a house or by providing supplementary artificial lighting may be provided to enhance the growth of philodendrons.

Taylor *et al.*, (1958) reported the significant increase in the stem diameter of *Philodendron scandens oxycardium* and *Philodendron micans* by increasing the light intensity from 90% shade to 30-60% shade whereas leaf area, color, stem length and node

numbers remained unaffected. Sharma *et al.*, (1992) also observed that *Philodendron erubescens* responded best to light intensity of 4000-5000 lux with respect to height of plants, number of leaves and size of leaves. More compact growth and better leaf and inflorescence colour are obtained at 3000-4000 foot candle (Plever, 2006). Light requirements of most foliage plants fall between 1500 and 8000 foot candles (Bionda and Noland, 2006). Thompson and Miller (1963) also observed light intensity had the influence on cell enlargement and differentiation and thus influenced height, growth, leaf size and the structure of leaves stems of plants.

Gastra (1963) found a linear relationship between photosynthesis and light intensity at low levels but Crocker (1949) observed that light quality and not the intensity decided the morphological characters of plants. Whiting *et al.*, (2010) also recommended fluorescent cool white lamps which are high in blue range at juvenile stage whereas for flowering as plants needs more red lights, broad spectrum fluorescent bulb is best.

Milks (1977) observed that chlorophyll content increased in plants kept under low light indoor conditions, but was the greatest in plants grown under 63 per cent shade, increasing from 0.027 to 0.081 mg/cm^2. High chlorophyll content and characteristic increase in grana stacking was observed at low light intensity with no change in chlorophyll a/b ratio.

Swapna (1996) studied the environmental effects on the growth of *Philodendron wendlandii* and concluded that 50 per cent shade produced good quality plants. The excellent ability of most of the foliage plants to adapt to low light intensities has enabled their use for interior decoration. Studies in Kerala Agricultural University have shown that foliage plants grown under 50 per cent shade were superior in terms of growth, visual appearance and plant quality rating (Geetha *et al.*, 2002). Toussaint (1980) stated that there were no marked significant differences in the growth or quality of *Philodendron pertusum* grown in 4 small greenhouses glazed with ordinary glass (control).

2.3.4. Pest and disease incidence Philodendron

Okuda *et al.*, (1979) observed that *Philodendron selloum* plants infected by Dasheen mosaic virus contains filamentous virus particles c. 13 X 750 nm, mostly arranged along members of tonoplast and cytoplasmic inclusions, mostly circular, sometimes pinwheel. Murillo and Hiller (2009) observed *Cithaerias pireta* on *Philodendron herbaceum* which grows in the dark understory areas in very humid habitats.

2.4. Evaluation under indoor conditions

Several studies were conducted on the use of ornamental plants for interiorscaping all over the world (Russ and Pertuit, 2001; Stamps, 2002). Plants from the world's tropical or subtropical regions provide the basis for today's foliage plant industry. The industry has been enjoying steady growth with a wholesale value of $574 billion in 2000 (Chen *et al.*, 2001).

Philodendrons are used as living adornments for interior decoration. Low light is the most important factor influencing the performance of Philodendrons under interior conditions (chen *et. al.*, 2005). A distinct characteristic of many Philodendrons is their ability to tolerate low light levels. Philodendrons have been predominantly cultivated in shaded greenhouses. Finished plants can be directly placed in interiorscapes if produced under an appropriate light intensity or they must be acclimatized during the final production process (Conover and Poole, 1984; Chen *et al.*, 2001). Aclimatization is a serialized process of adapting the plants to interior conditions.

Alex (2012) recommended rosette species for indoors due to compact nature and minimum space required by the plants. *Philodendron wendlandii* were found to be good to keep under various indoor conditions. Alex (2012) also stated that *Philodendron* 'Ceylon Gold' lasted for a longer period in medium and high light level zones. The plant spread (east-west) in the air conditioned zone with supplementary light was negatively correlated with light intensity.

Alex (2012) also reported the *Philodendron elegans* were the best to be recommended for indoor places among climbing and trailing type. Showed a slow growth in the intial stage, picked up very fast and had the highest values in later stages as to show its adaption to indoor conditions. Height and spread of plants were highest in high, supplementary light and air conditioned zone with supplementary light but leaf area was highest in low light zone.

2.4.2. Beneficial effects of *Philodendrons*

Philodendrons provide a valuable weapon in the fight against rising levels of indoor air pollution. Those plants in office or home are not only decorative, but NASA scientists found them to be useful in absorbing potentially harmful gases and cleaning the air inside modern buildings. Philodendrons can remove several toxic chemicals from the air in building interiors, improve quality of the air to make it a more pleasant place to live and work- where

people feel better, perform better, any enjoy life more. Of all the species/varieties *Philodendron scandens-oxycardium* and *Philodendron domesticum* are recommended by NASA (Anon, 2011)

Many of the research studies documenting the beneficial effects of plants on people have focused on plants outdoors or on scenes of nature. Research has shown that interior plants in individual containers can also produce the same benefits. Research has confirmed the stress-reducing benefits of passively viewing plants. It has demonstrated that people's impressions of a room and their mental well-being can be significantly improved when plants are added. It also has shown that productivity and mental functioning are improved and that pain perception can be reduced. Research on the effects of plants on people has shown, in essence, that plants are essential for people to be at their best. Plants are needed in our lives, all around us, everyday. They have a civilizing effect; they humanize our surrounding (Lohr, 2010).

Foliage plants reduced levels of some interior pollutants, including formaldehyde and carbon monoxide, from small, sealed test chambers (Wolverton *et al.*, 1984; 1985; Zhou, 2011). Further research has shown that plants remove many indoor air pollutants, including ozone, toluene, and benzene (Darlington *et al.*, 2001; Wood *et al.*, 2002; Papinchak *et al.*, 2009).The pollution reduction was largely due to bacteria growing on the plant roots (Wolverton *et al.*, 1989; Wood *et al.*, 2002). The influence of interior plants on dust accumulation has also been explored (Lohr and Pearson-Mims, 1996). Plants were shown to reduce noise under certain conditions as they can reflect, diffract, or absorb sounds, depending on the frequency (Freeman 2003).

2.5. Evaluation of susceptibility levels of plants to air pollution

India witnessed rapid growth of industrialization in the last decade which lead to unplanned expansion of urban areas by large scale felling of trees. Rapid migration and increase in population also lead to large scale spreading of air and water pollution, garbage etc., and also impairing aesthetic value of land. In response, urban greening has to be promoted to maintain the social and natural sustainability in cities by increasing vegetated surface in urban landscape in outdoors (Joshi and Gautam, 2010). The studies showed that *Philodendrons* reduced levels of some interior pollutants, from small, sealed test chambers (Wolverton *et al.*, 1984; 1985). Indoors also has to be spaced for plants based on their

tolerance and susceptibility to various pollutions. Thus by adding vegetation in urban areas and also by providing ecological diversity, we can mitigate several negative effects of urbanization physically and psychologically, especially, the air pollution and its effects.

Philodendrons vary considerably in their susceptibility to air pollutants. The identification and categorization of plants into sensitive and tolerant groups is important because the former can serve as indicators and the latter as sinks for the abatement of air pollution in the indoors and proper care can be provided to those sensitive plants from the effect of pollution. To screen plants for their sensitivity/tolerance level to air pollutants, a proper selection of plant characteristics is of vital importance. Singh and Rao (1983) has computed a formula to obtain an empirical value signifying the Air Pollution Tolerance Index (APTI) of species using four parameters namely ascorbic acid, total chlorophyll content, relative water content and leaf extract pH.

Singh *et al.* (1991) evaluated 69 plant species, including herbs, shrubs and trees with the APTI values and categorized them into sensitive, intermediate, moderately tolerant and tolerant classes. APTI can be used as a good indicator of the impact of pollution on plants (Singh, 1993). Wood and Burchett (1995) emphasized the application of APTI estimation in interior foliage plants, as it can be used to assist in the routine maintenance and management of indoor plants, and in the concomitant quality of the indoor air for the occupants of the building.

Gowda and Jayanti (1988) stated that Philodendrons are sensitive to ethylene. According to Junhui *et al.,* (2011) *Philodendron sodiroi* cv. Wendimbe has high absorption ability to formaldehyde and receives less damage, recommended for formaldehyde purification but *Philodendron selloum* showed the worst resistance to formaldehyde pollution damage. Alex (2012) computed APTI of 50 foliage plants including *Philodendron* and reported high level of APTI in *Philodendron wendlandii* (20.56) and low in *Philodendron* 'Ceylon Gold'(10). He recommended the former for pollution control in indoors and the later as are indicator plant for indoor pollution.

2.6. Evaluation of *Philodendron* species/varieties for use as cut foliage

Holding solutions are meant to hold the foliage continuously till termination of their vaselife.

The longevity of cut foliage of 15 conifer species held in preservative solution (vase life) ranged from 14 days to 56 days (Tingley mand Prince, 1990). Vase life of cut fronds of *Adiantum raddiantum* was extended by addition of chlorine bleach/silver nitrate/ cobaltous nitrate or citric acid (pH 3.0) to the vase water, compared to tap water control (Doorn *et al.*, 1991).

Studies on the keeping quality of sut green *Ruscus hypoglossum* L. and *Nephrolepsis exalta* schott (Nooh *et. al.*, 1986) showed that 150 ppm/300 ppm 8-HQC combined with 21/4 per cent sucrose was effective in increasing the vase life comparing control. Broschat and Donselman (1987) evaluated 57 species of tropical ornamental plants for use as cut foliage and reported deionized water is better than other solutions for 46 species of plants.

The best holding solution for Asparagus plumosus contained 8-HQS at 77 x 10-5 moles/l and 3, 4, 5,-trichlorophenol at 1 x 10-5 moles/lgiving a vase life of 30 days compared with 15 days in distilled water (Dolci *et al.*, 1989).

Marousky (1980) observed 8-HQC as an effective bactericide in water containing small amounts of iron or copper ions than in distilled or deionized water. The results indicated a greater vase life of cut flowers when 8-HQC + sucrose were used as vase solutions. Meng (2001) reported that sugars supply energy to cut flowers and give them a longer vase life.

Studies on the role of sucrose on the vase life of cut Liatris spicata (L) Willd (Han, 1992) showed a 2- fold increase in vase life, in holding solutions containing 5 per cent sucrose, compared to non-sucrose treated ones. Criley and Parvin (1993) reported that 21 potential cut foliages had a vase life of 14 days in water or preservatives. A study on the evaluation of post harvest performance of Moluccella laevis (skutnik, 1995) showed the longest vase life (15 days) in water compared to preservatives (8-HQC + sucrose). the addition of 8-HQ to the vase water markedly inhibited the growth of bacteria and fungi even with concentrations as low as 100 mg/l and increased the leaf catalase and superoxide dimutase activities by 15.6 per cent and 63.4 per cent, respectively, compared to control (Xia *et al.*, 1997).

A floral preservative solution containing 8-HQC (200ppm), sucrose (3%) and BA at 20ppm extended the vase life of cut stems of *Cyperus papyrus* L. (Hasegawa *et. al.*, 1998).

Wirthensohn *et al.*, (1996) reported that holding solution containing 1 per cent or 2 per cent sucrose significantly increased the vase life of *Eucalyptus globules* and *E. cinerea* over control. Research indicates that the use of floral preservatives may be detrimental to the longevity of croton leaves (Stamps and Osborne, 2003)

Eapen (2003) observed that distilled water and acidified water proved to the best among holding solution. A significant higher vase life was observed with a combination of any pulsing treatment with a holding solution of either tap water or distilled water. Packing with a wet cotton plug at the petiole end also increased the vase life of the foliage.

Materials and Methods

Materials and Methods

3. MATERIALS AND METHODS

The investigation entitled "Evaluation of philodendrons for landscaping and interior plantscaping" was conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, Thrissur during 2011-13. The materials used and the methodology adopted for the investigation is presented in this chapter.

3.1. Location

The area is situated at a latitude of 10°31`N and longitude of 76°13`E geographically and lies 22-25m above the mean sea level.

3.2. Climate

The climate is humid tropical. The weather parameters recorded during the period of observation is presented in Appendix 3.

3.3. Performance evaluation of different species/varieties of *Philodendron*

3.3.1. Materials

Twenty-five species/varieties of philodendrons, representing a wide spectrum of morphological variability were selected for the study. The following species/varieties of Philodendrons were used for the study.

1. *Philodendron bipinnatifidum*
2. *Philodendron* 'Black Beauty'
3. *Philodendron* 'Black Cardinal'
4. *Philodendron* 'Black Prince'
5. *Philodendron* 'Ceylon Gold'
6. *Philodendron elegans*
7. *Philodendron hederaceum*
8. *Philodendron karstenianum*
9. *Philodendron lacerum*
10. *Philodendron lacinatum* 'Variegata'
11. *Philodendron* x *Magnificum*
12. *Philodendron* 'Majesty'
13. *Philodendron* 'Moon Shine'

Plate 1a. General view of Rain shelter

Plate 1b. Inner view of Rain shelter

14. *Philodendron pertusum*
15. *Philodendron* 'Pluto Red'
16. *Philodendron* 'Red Dutches'
17. *Philodendron* 'Red Sunlight'
18. *Philodendron sagittifolium*
19. *Philodendron scandens-oxycardium*
20. *Philodendron serratum*
21. *Philodendron* 'Smithi'
22. *Philodendron superbum*
23. *Philodendron wend-imbe*
24. *Philodendron wendlandii*
25. *Philodendron williamsii*

3.3.2. Growing system

Twenty five species/varieties of *Philodendron* were maintained in a rain shelter under 50 per cent light intensity.

3.3.3. Planting and general management

Planting was done in pots of 30 cm diameter. Sand, well rotten FYM and red earth in 1:1:1 ratio was used as the medium. Six month old uniform sized plants were selected for the study. Uniform management practices were adopted for all the species. Plants were irrigated once in a day. Application of plant protection chemicals was done as and when needed.

3.3.4. Design of the experiment

The field experiment was laid out in a completely randomised design with three replications. In each species/variety nine plants were used for recording biometric observations. The parameters recorded during the course of the experiment were the following:

3.3.5. Quantitative characters

The following quantitative characters were recorded.

3.3.5.1. Plant height

The height of the plant was measured from collar region to the tip of the youngest mature leaf at fortnightly intervals and expressed in centimetres.

3.3.5.2. Plant spread

Plate 2a.Heading type species/variety of *Philodendron* used for the study

Philodendron 'Black Beauty'

Philodendron 'Black Prince'

Philodendron hederaceum

Philodendron lacinatum 'Variegata'

Philodendron x *Magnificum*

Philodendron 'Majesty'

Plate 2b.Heading type species/variety of *Philodendron* used for the study

Philodendron 'Moon Shine'

Philodendron 'Pluto Red'

Philodendron 'Red Sunlight'

Philodendron serratum

Philodendron wend-imbe

Philodendron wendlandii

Plate 3a. Climbing type of species/varieties of *Philodendron*

Philodendron bipinnatifidum

Philodendron 'Black Cardinal'

Philodendron 'Ceylon Gold'

Philodendron elegans

Philodendron karstenianum

Philodendron lacerum

Philodendron pertusum

Plate 3b.Climbing type of species/varieties of *Philodendron*

Philodendron 'Red Dutches'

Philodendron sagittifolium

Philodendron scandens oxycardium

Philodendron 'Smithi'

Philodendron superbum

Philodendron williamsii

The spread of the plant in East -West and North -South directions were measured and recorded in centimetres and the spread is expressed in square centimetres.

3.3.5.3. Number of leaves

The total number of leaves present on the plant at the time of each observation was counted and recorded.

3.3.5.4. Length of leaves

The length of the leaf from the basal lobe to the tip was measured and expressed in centimetres.

3.3.5.5. Breadth of leaves

Maximum leaf width at the centre of the leaf was measured and expressed in centimetres.

3.3.5.6. Leaf area

Dot method (Bleasdale, 1977) was used to measure the leaf area and it was expressed in square centimetres.

3.3.5.7. Petiole length

The length of the petiole from the point of its emergence to the base of the leaf lamina was measured and recorded in centimetres.

3.3.5.8. Petiole girth

The circumference of the middle portion of the petiole was measured and expressed in centimetres as the petiole girth.

3.3.5.9. Internodal length

The length between two successive nodes was measured and expressed in centimetres.

3.3.5.10. Leaf producing interval

Time interval (days) between the emergence of two successive leaves was counted and recorded.

3.3.5.11. Longevity of leaves

Longevity was measured in days from the day on which the leaf is fully unfurled to the day the leaf became unfit (as indicated by drying, wilting, twisting, drooping, yellowing, blackening, etc.).

3.3.5.12. Incidence of pests and diseases

Plants were observed for the incidence of pests and diseases, if any.

3.3.6. Qualitative characters

Leaf characters, which directly contributed towards their use as cut foliage, were observed.

3.3.6.1. Texture-smooth, verrucose, leathery or cereous

3.3.6.2. Shape-linear, lanceolate, ovate or cordate

3.3.6.3. Margin-entire, wavy, serrate or spinous

3.3.6.4. Tip- acute, obtuse or accuminate

3.3.6.5. Bending/drooping of leaves- whether they are bent or drooped

3.3.6.6. Pigmentation-colour changes during maturity

3.3.6.7. Plant quality rating

The *Philodendron* species/varieties were rated according to its fullness, growth, tolerance capacity (suitability to indoor conditions) and visual appearance *viz*., colour and pigmentation, texture, shape and pattern and size of the foliage during the growth period. The grades ranged from 1-10 for each character and the total values for each species/varieties are given.

3.3.7. Weather parameters

Daily readings of temperature, relative humidity and light intensity were recorded at 09.00, 12.00 and 15.00 hrs.

3.4. Evaluation under indoor conditions

Plants found suitable for interior plantscaping were selected and were evaluated under different indoor light conditions.

3.4.1. Light intensities

i) Low light: less than 800 lux

ii) Medium light: 800-2000 lux

iii) High light: more than 2000 lux

iv)With supplementary light (800-2000 lux) in non air conditioned rooms

v) With supplementary light (800-2000 lux) in air conditioned rooms

3.4.2. Observations

All the observations were taken as in 3.3.5 and 3.3.6.

3.5. Evaluation of susceptibility levels of plants to air pollution

Plate 4a. Evaluation of selected Philodendron species/varieties under Indoor conditions

Low light intensity zone (LL)
(<800 lux)

Medium light intensity zone (ML)
(800-2000 lux)

High light intensity zone (HL)
(>2000 lux)

Supplementary light zone (SL)
(800-2000 lux)

Air conditioned supplementary
light zone (A/C) (800-2000 lux)

Plate 4b. Evaluation of selected Philodendron species/varieties under Indoor conditions

Low light intensity zone (LL)
(<800 lux)

Medium light intensity zone (ML)
(800-2000 lux)

High light intensity zone (HL)
(>2000 lux)

Supplementary light zone (SL)
(800-2000 lux)

Air conditioned supplementary
light zone (A/C) (800-2000 lux)

Plate 4c. Evaluation of selected Philodendron species/varieties under Indoor conditions

Low light intensity zone (LL)
(<800 lux)

Medium light intensity zone (ML)
(800-2000 lux)

High light intensity zone (HL)
(>2000 lux)

Supplementary light zone (SL)
(800-2000 lux)

Air conditioned supplementary
light zone (A/C) (800-2000 lux)

Plate 4d . Evaluation of selected Philodendron species/varieties under Indoor conditions

Low light intensity zone (LL)
(<800 lux)

Medium light intensity zone (ML)
(800-2000 lux)

High light intensity zone (HL)
(>2000 lux)

Supplementary light zone (SL)
(800-2000 lux)

Air conditioned supplementary
light zone (A/C) (800-2000 lux)

Air Pollution Tolerance Index (APTI) of philodendron species/varieeties was computed after determining four parameters viz., ascorbic acid, total chlorophyll, relative water content and leaf extract pH. The plants were categorized into sensitive (≤ 10), intermediate (11 to 14), moderately tolerant (15 to 18) and tolerant (>18) based on APTI values. The air pollution tolerance index [APTI] was computed and plants were categorized by the method and values respectively suggested by Singh *et al.* (1991) using the equation,

APTI = [A (T+P) +R]/ 10

Where, A = Ascorbic acid content (mg/g)

T = Total chlorophyll (mg/g)

P = pH of leaf extract and

R = Relative water content of leaf (%)

Fully mature physiologically active leaves (third or fourth from above) in triplicates were collected in morning hours and the fresh leaf samples were analyzed for total chlorophyll, ascorbic acid, leaf extract pH and relative water content. Chlorophyll was extracted in DMSO (dimethyl sulfoxide) and the absorption at 663 nm and 645 nm were read in a spectrophotometer. Using the absorption coefficients, the amount of chlorophyll was calculated (Arnon, 1949). For the determination of ascorbic acid content, a homogenate was prepared by using 4% oxalic acid, and was dehydrogenated by bromination. The dehydroascorbic acid was then reacted with 2, 4-nitrophenyl hydrazine to form osazone and dissolved in sulphuric acid to give an orange-red colour solution which was measured at 540 nm (Sadasivam and Manickam, 1996). Fresh leaf (0.5 g) sample was homogenized using 50 ml distilled water and the supernatant was fed into digital pH meter for detection of pH (Varshney, 1992). The percentage relative water content was calculated by using the initial weight, turgid weight and dry weights of leaf samples (Beadle *et al.*, 1993).

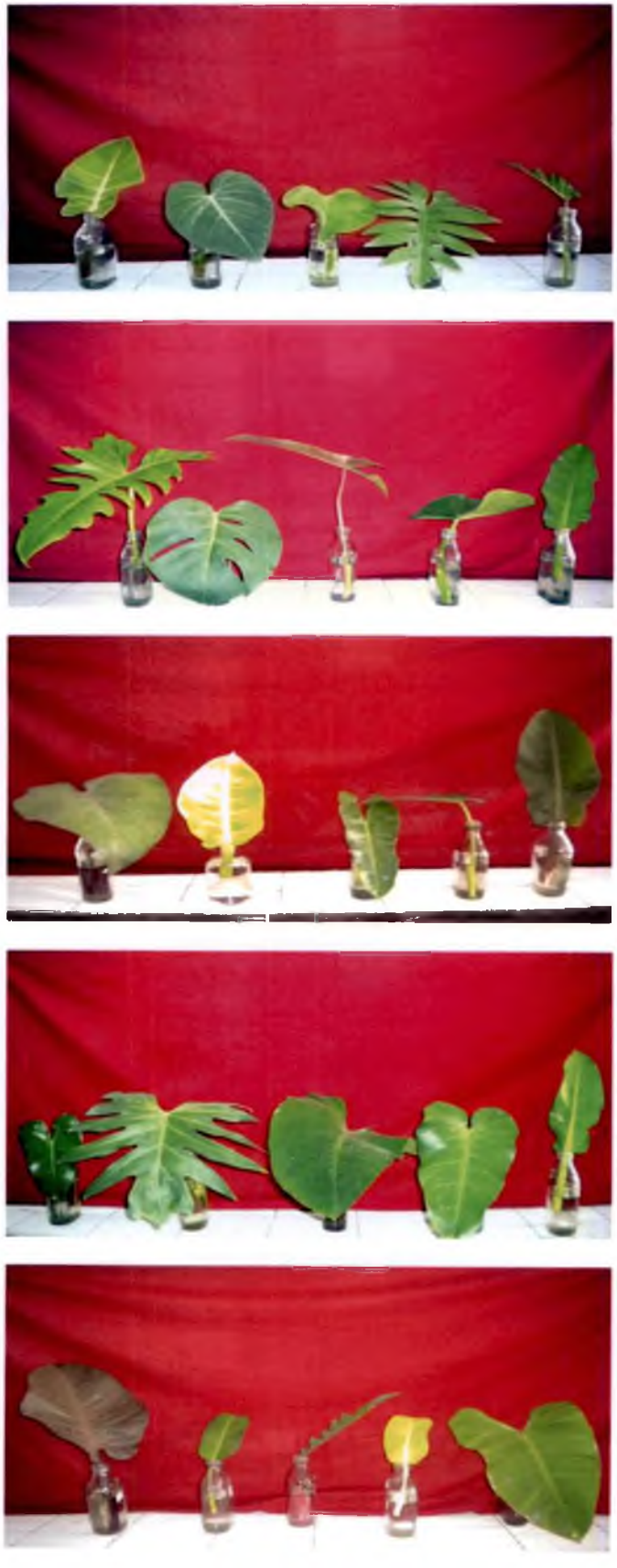
3.6. Evaluation of Philodendron species/varieties for use as cut foliage

The fully matured physiologically active leaf is collected in early morning for the study (Eapen, 2003).

Visual Evaluation

The leaves of different philodendron species/varieties were visually scored by fifteen individuals for use as cut foliage and their general acceptability in different arrangements was observed. Scoring was done based on colour and pigmentation, texture, shape and pattern and

Plate 5. Evaluation of Philodendron species/varieties for use as cut foliage



size of the foliage. The grades ranged from 1-10 for each character totalling to 40 for each species/variety.

The vase life was calculated by observing the time taken to develop the various symptoms like leaf drop, yellowing, blackening and wilting which made the foliage unfit for arrangements. The observations for vase life were noted for a period of six weeks.

3.6.2 Postharvest characters

i. Fresh weight of leaf (g)
ii. Water uptake in (ml)
iii. Physiological loss in weight of leaf (g)
iv. Days taken to develop symptoms like leaf drop, yellowing, blackening and wilting.

3.7. Statistical analysis

Statistical analysis of the data collected was done by adopting the standard procedure of Panse and Sukhatme (1978) and using the software M-STAT for general analysis and SPSS for correlation studies.

Results

4. RESULTS

4.1. Evaluation of philodendrons under Rain shelter

The performance of twenty-five species/varieties of philodendrons under rain shelter was evaluated and the data on quantitative and qualitative plant characters are presented in tables 1 to 12.

4.1.1. PLANT CHARACTERS

The *Philodendron* species/varieties showed considerable variations in the growth habit /pattern. Based on growth habit, they could be grouped into two viz., climbing (13) and heading (12) types and the comparisons were made within the group.

4.1.1.1. Quantitative characters

4.1.1.1.1. Plant height (cm)

Plant height significantly varied among the species/varieties of philodendrons Table 1a, 1b and fig 1 and 2.

Plant height of climbing type of philodendrons was taken till 5th month as later, they grew beyond the reach. However, the height of heading type were measured throughout the year and found that they were significantly different with each other and the results were presented in the Table 1a, 1b and fig 1 and 2.

Among climbing type philodendrons the highest plant height was observed in *Philodendron williamsii* throughout the period except in I & II fortnight of 5^{th} month when the maximum height was in *Philodendron superbum*. The lowest height was observed in *Philodendron scandens oxycardium* throughout the year.

When plant height of heading type philodendrons was compared, the highest and lowest heights were observed in *Philodendron* x *Magnificum* and *Philodendron* 'Pluto Red' throughout the period respectively.

Table 1a: Height of climbing type philodendron during different months

S. No.	species/variety	Plant height (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	79.2	80.8	82.16	83.83	85.63	87.45	90.91	91.37	92.11	92.56	93.17	93.75
2	*P* 'Black Cardinal'	53.45	63.12	72.24	83.42	83.72	90.38	94.84	99.28	103.58	106.58	-	-
3	*P.* 'Ceylon Gold'	50.17	61.68	71.71	83.88	84.58	99.23	104.5	110.58	110.88	112.88	-	-
4	*P. elegans*	53.14	61.03	69.88	79.31	85.97	95.67	104.4	107.01	109.01	109.87	-	-
5	*P. karstenianum*	44.68	50.97	57.06	63.03	69.87	76.07	85.08	90.78	96	100	-	-
6	*P. lacerum*	74.14	75.41	76.6	77.57	79.4	80.31	81.73	82.75	83.96	85.45	87.16	88.15
7	*P. pertusum*	65.38	70.2	72.16	77.67	85.4	94.25	101.67	108.11	105.32	106.96	-	-
8	*P.* 'Red Dutches'	67.63	79.21	76.64	77.46	80.56	84.84	88.16	92.24	93.93	95.28	-	-
9	*P. sagittifolium*	69.36	74.72	83.51	93.56	100.96	103.95	107.23	111.41	112.31	113.68	-	-
10	*P. scandens oxycardium*	16.23	22.47	29.34	37.67	47.67	47.47	62.11	68.81	76.84	81.48	-	-
11	*P.* 'Smithi'	39.86	49.33	59.08	68.54	80.86	93.93	106.37	112.02	118.42	123.38	-	-
12	*P. superbum*	43.36	52.83	62.58	72.04	84.36	97.43	109.87	115.52	121.92	126.88	-	-
13	*P. williamsii*	85.51	87.31	90.26	92.02	93.87	96.28	98.77	100.65	102.73	104.12	106.4	108.81
CD (0.05)		9.58	10.17	10.35	10.89	11.09	11.75	13.67	13.00	13.41	13.34	5.19	6.72

(Contd...)

Table 1a: Height of climbing type philodendron during different months (Contd...)

S. No.	species/variety	Plant height (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	94.41	95.05	96.14	97.03	97.87	98.6	100.5	101	103.82	104.74	106.12	108.36
2	*P* 'Black Cardinal'	-	-	-	-	-	-	-	-	-	-	-	-
3	*P.* 'Ceylon Gold'	-	-	-	-	-	-	-	-	-	-	-	-
4	*P. elegans*	-	-	-	-	-	-	-	-	-	-	-	-
5	*P. karstenianum*	-	-	-	-	-	-	-	-	-	-	-	-
6	*P. lacerum*	87.16	88.15	89.18	90.07	90.88	91.63	92.2	92.48	92.73	94.55	95.72	96.04
7	*P. pertusum*	-	-	-	-	-	-	-	-	-	-	-	-
8	*P.* 'Red Dutches'	-	-	-	-	-	-	-	-	-	-	-	-
9	*P. sagittifolium*	-	-	-	-	-	-	-	-	-	-	-	-
10	*P. scandens oxycardium*	-	-	-	-	-	-	-	-	-	-	-	-
11	*P.* 'Smithi'	-	-	-	-	-	-	-	-	-	-	-	-
12	*P. superbum*	-	-	-	-	-	-	-	-	-	-	-	-
13	*P. williamsii*	110.36	106.4	108.81	110.36	110.86	111	111.7	112.2	112.78	112.26	112.74	114.31
CD (0.05)		9.58	7.17	6.83	7.11	6.96	6.99	6.96	7.30	7.66	7.76	7.95	8.04

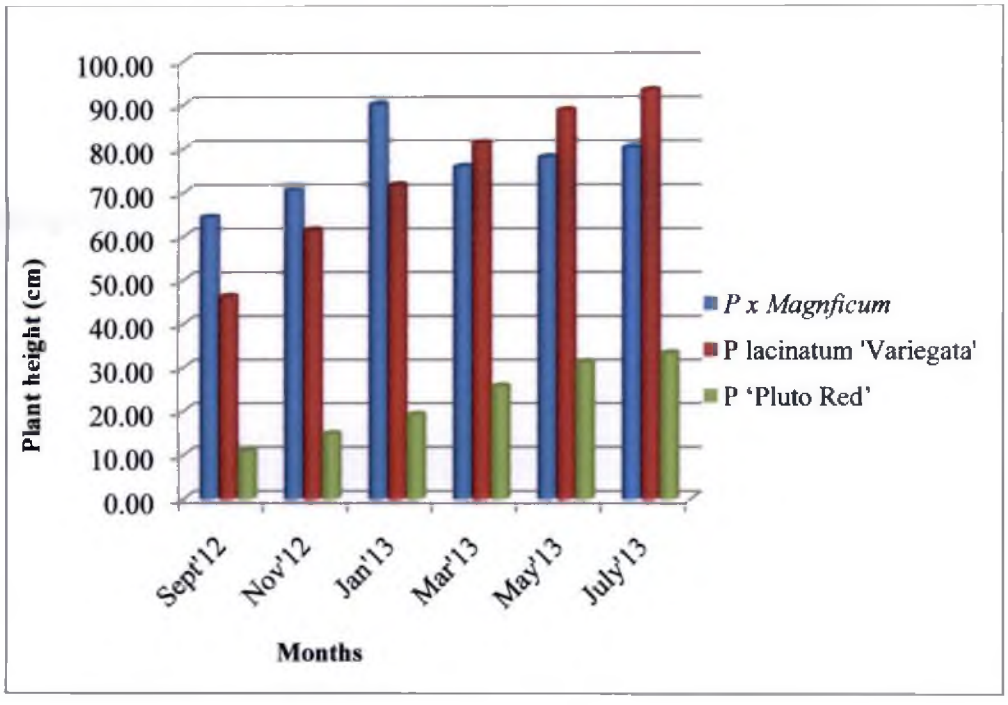


Fig 1. Height of heading type philodendrons at bimonthly interval

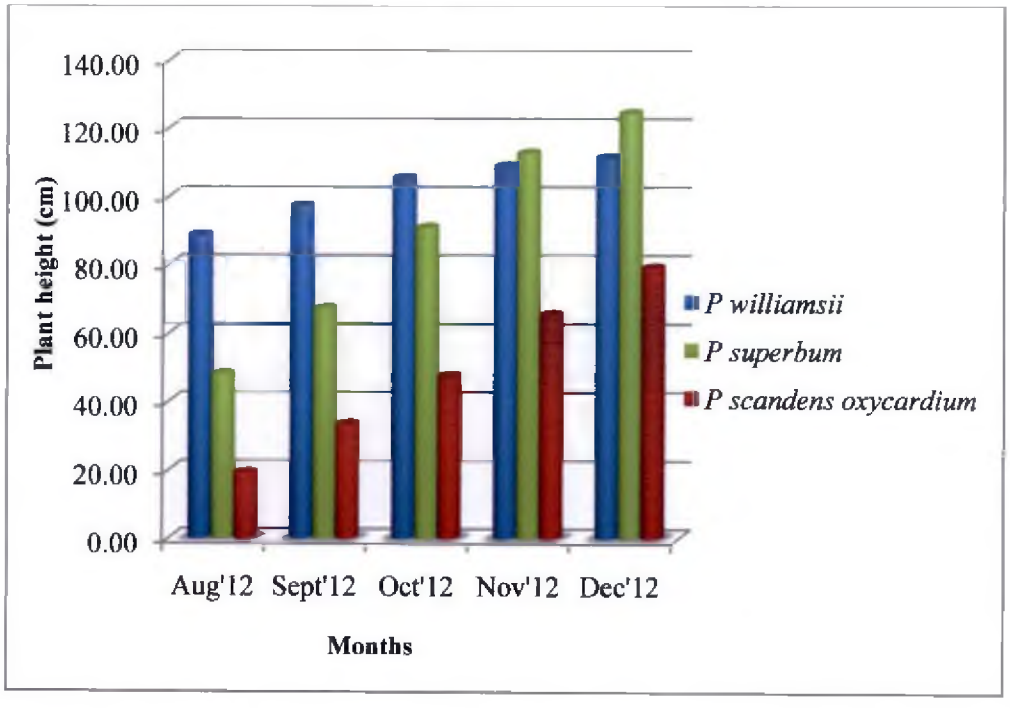


Fig 2. Height of climbing type philodendrons at monthly interval

Table 1b: Height of heading type philodendron during different months

S. No.	species/variety	Plant height (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	29.26	29.26	29.26	35.01	39.93	40.1	40.1	40.1	45.85	45.85	43.71	43.71
2	*P.* 'Black Prince'	37.23	38.46	43.18	42.37	51.2	49.23	49.23	50.98	51.37	54.34	56.31	57.24
3	*P. hederaceum*	32.58	32.58	41.3	41.3	50.08	50.08	54.52	55.98	60.05	60.26	60.6	63.5
4	*P. lacinatum*'Variegata'	35.38	42.55	50.32	56.61	58.32	60.53	62.21	64.61	66.84	71.28	73.41	75.2
5	*P. x Magnificum*	62.6	63.78	64.70	66.47	67.51	71.76	71.78	71.11	71.36	71.42	71.42	73.32
6	*P.* 'Majesty'	44.43	44.43	48.63	50.31	54.47	58.72	61.47	62.2	63.24	63.41	64.16	66.06
7	*P.* 'Moon Shine'	29.21	30.45	30.74	31.43	32.23	32.76	32.2	32.72	35.01	36.06	35.64	36.23
8	*P.* 'Pluto Red'	10.68	10.68	10.68	11.36	13.96	13.96	13.96	17.22	17.22	17.22	20.41	21.77
9	*P.* 'Red Sunlight'	35.28	36.54	37.51	38.7	39.93	40.45	40.33	40.95	41.35	41.72	42.6	43.07
10	*P. serratum*	28.76	30.61	32.47	34.97	40.92	43.88	45.98	43.44	43.93	44.26	44.26	44.65
11	*P. wend-imbe*	26.6	30.93	34.7	38.7	42.53	46.38	47.36	49	50.38	52.94	56.4	58.26
12	*P. wendlandii*	25.61	31.1	34.8	37.87	43.46	48.12	51.91	55.71	57.74	57.84	59.22	60.86
CD (0.05)		5.19	5.27	3.38	5.42	6.53	5.72	5.66	4.54	5.49	5.42	5.59	5.59

(Contd...)

Table 1b: Height of heading type philodendrons during different months (Contd...)

S. No.	species/variety	Plant height (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	43.71	43.71	46.73	46.73	49.31	49.31	49.31	53.24	53.24	55.8	55.8	55.8
2	*P.* 'Black Prince'	57.6	63.83	66.21	68.47	70.37	72.94	75.62	78.02	79.5	79.38	81.44	66.96
3	*P. hederaceum*	64.44	65.86	68.03	69.07	71.44	73.48	75.83	78.28	81.24	83.84	91.55	93.72
4	*P. lacinatum*'Variegata'	77.32	80.88	82.24	84.45	85.35	86.8	87.36	95.51	91.97	91.97	94.2	95.07
5	*P. x Magnificum*	74.43	75.51	76.33	77.14	77.4	77.8	78.28	78.66	79.15	79.64	79.93	81.97
6	*P.* 'Majesty'	66.18	66.18	68.01	68.26	68.26	69.2	69.2	71.07	71.57	73.24	81.93	81.93
7	*P.* 'Moon Shine'	36.22	37.01	37.37	38.03	38.5	38.8	38.95	39.3	39.63	41.02	42.27	43.84
8	*P.* 'Pluto Red'	21.77	24.1	28.46	28.46	30.42	30.4	30.42	33.68	34.08	34.08	32.22	32.61
9	*P.* 'Red Sunlight'	43.61	46.31	48.74	50.7	53.35	56.1	58.56	60.14	61.73	63.37	64.75	66.96
10	*P. serratum*	44.87	45.18	45.42	45.64	46.2	46.8	47.03	47.03	47.56	47.25	47.7	48.92
11	*P. wend-imbe*	60.51	63.36	65.02	67.05	68.96	71.9	75.01	77.85	81.77	84.46	86.96	90.61
12	*P. wendlandii*	63.9	62.51	65.65	68	70.72	73.6	76.01	78.45	81.3	83.45	86.01	88.56
CD (0.05)		6.41	6.41	4.60	4.60	4.65	4.65	4.94	4.94	5.40	5.40	6.90	6.90

4.1.1.1.2. Plant spread (cm^2)

The plant spread was recorded in two ways viz., north-south and east-west and presented by multiplying both the values in such a way to show the total area covered by a plant (Tables 2a , 2b and fig 3 ,4).

Among climbing type, *Philodendron williamsii* had the highest spread throughout the year which was on par with *Philodendron lacerum* till I fortnight of 4^{th} month and the lowest spread was observed in *Philodendron karstenianum. Philodendron elegans* and *Philodendron scandens oxycardium,* were on par with the lowest at one period or the other.

Among heading type, *Philodendron* x *Magnificum* had the highest spread during initial period later *Philodendron lacinatum*'Variegata' was observed to have highest spread. Lowest plant spread was observed in *Philodendron* 'Pluto Red' throughout the year.

4.1.1.1.3. Length and breadth of leaves (cm)

When the philodendrons are concerned for interior plantscaping, the leaf characters are to be studied completely, so as to recommend them for particular conditions. Length and breadth of leaves are the important parameters to be considered while evaluating philodendrons. In the present study, they were measured throughout the year at fortnightly intervals and the results are presented in Tables 3a, 3b, 4a, 4b and fig 5 and 6.

4.1.1.1.3.1. Leaf length (cm)

The longest leaf length was observed in *Philodendron bipinnatifidum* till I fortnight of 6^{th} month while for the rest of the period, the maximum leaf length was observed in *Philodendron williamsii.* Among Philodendrons the shortest leaf length was observed in *Philodendron scandens oxycardium* throughout the year which was on par with *Philodendron karstenianum, Philodendron* 'Pluto Red', *Philodendron* 'Red Sunlight', *Philodendron serratum* and *Philodendron* 'Smithi' during different periods.

4.1.1.1.3.2. Leaf breadth (cm)

Among Philodendrons, during the initial period, the maximum leaf breadth was observed in *Philodendron bipinnatifidum,* and for rest of the period broadest leaf was observed in

Table 2a: Spread (NS x EW) of climbing type philodendrons during different months

S. No.	species/variety	Plant spread (sq.cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	3903	4062	4142	4292	4575	4745	4932	5020	5132	5261	5472	5583
2	*P* 'Black Cardinal'	2444	2444	2444	2444	2444	2444	2444	2444	2444	2450	2450	2457
3	*P.* 'Ceylon Gold'	2350	2350	2350	2350	2350	2350	2350	2394	2693	2693	2805	2805
4	*P. elegans*	1239	1239	1239	1239	1239	1239	1239	1239	1239	1242	1242	1242
5	*P. karstenianum*	760	760	760	760	760	774	774	1011	1062	1064	1064	1064
6	*P. lacerum*	5279	5813	5884	6033	5911	6346	7083	6443	6497	6817	6970	6993
7	*P. pertusum*	2661	2661	2661	2661	2661	573	2701	2732	2732	2798	2850	2850
8	*P.* 'Red Dutches'	1528	1894	2290	2732	3054	839	3839	3575	3573	3562	3756	3923
9	*P. sagittifolium*	1771	1887	1996	1760	2212	522	2419	2613	2824	2819	2824	2883
10	*P. scandens oxycardium*	633	710	781	854	941	448	1063	964	1026	1293	1385	1509
11	*P.* 'Smithi'	1921	2037	2146	1910	2362	522	2569	2763	2974	2629	2974	3033
12	*P. superbum*	1971	2087	2196	1960	2412	522	2619	2813	3024	3019	3024	3083
13	*P. williamsii*	4519	5019	5493	5967	6548	2144	7957	8442	8396	9872	11043	12534
CD (0.05)		11.01	11.17	11.20	11.21	10.72	10.43	10.77	10.76	10.70	10.64	10.53	10.26

Data subjected to square root transformation to obtain CD

(Contd...)

Table 2a: Spread (NS x EW) of climbing type philodendrons during different months (Contd...)

S. No.	species/variety	Plant spread (sq.cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	5832	6098	6160	6328	6741	6758	10525	7084	7469	7647	8042	8142
2	*P* 'Black Cardinal'	2457	2427	2457	2458	2458	2460	2460	2460	2460	2460	2583	2666
3	*P.* 'Ceylon Gold'	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805	2928	3003
4	*P. elegans*	1252	1254	1254	1268	1268	1268	1268	1268	1268	1268	1391	1466
5	*P. karstenianum*	1064	1064	1064	1064	1064	1064	1077	1077	1077	1077	1200	1275
6	*P. lacerum*	7045	7299	7489	7858	8116	8529	8937	9222	9535	10173	10433	10575
7	*P. pertusum*	2850	2879	2879	2929	2972	2972	2885	2907	2907	2917	3040	3190
8	*P.* 'Red Dutches'	4284	4655	4853	2201	5507	5643	5779	6169	6233	6358	6572	6697
9	*P. sagittifolium*	2930	4567	2999	3156	3034	3089	3157	3163	3166	3203	3209	3334
10	*P. scandens oxycardium*	1690	1849	2064	2201	2381	2530	2793	3060	3285	3599	3965	4090
11	*P.* 'Smithi'	3080	4717	3149	3156	3184	3239	3307	3313	3316	3353	3359	3484
12	*P. superbum*	3130	4767	3199	3206	3234	3289	3357	3363	3366	3403	3409	3534
13	*P. williamsii*	14215	15941	12877	20455	24278	25179	25810	26288	28872	30829	30795	30920
CD (0.05)		11.01	10.45	14.84	10.44	10.65	11.22	11.29	14.80	11.61	11.62	11.79	11.16

Data subjected to square root transformation to obtain CD

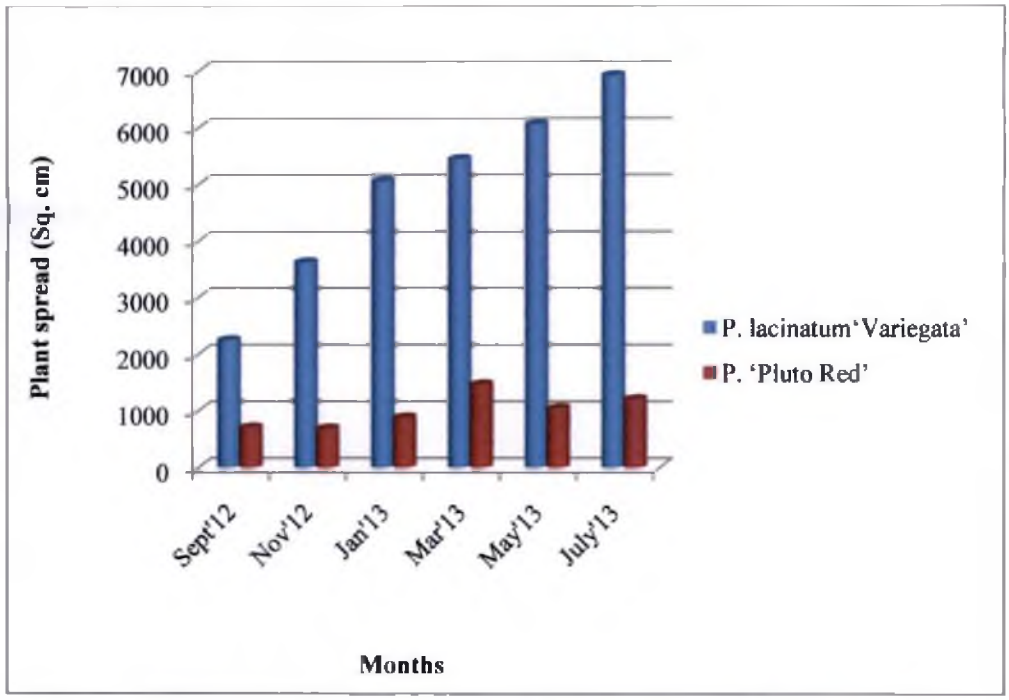


Fig 3. Plant spread of heading type philodendrons at bimonthly interval

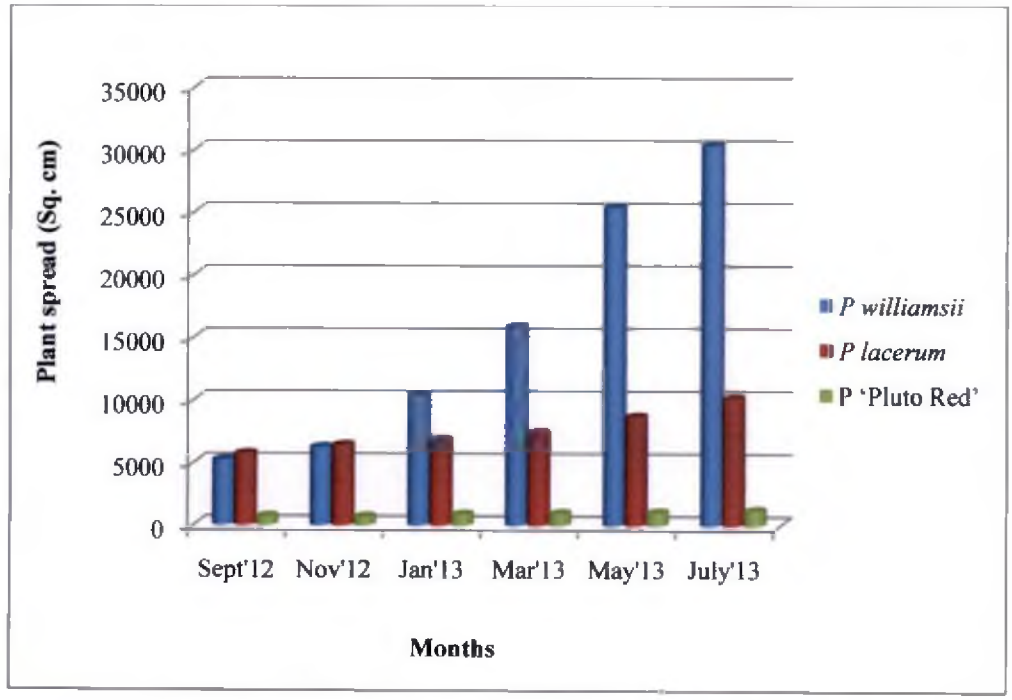


Fig 4. Plant spread of climbing type philodendrons at bimonthly interval

Table 2b: Spread (NS x EW) of heading type philodendrons during different months

S. No.	species/variety	Plant spread (sq.cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	767	767	761	1215	1145	1381	1363	2315	2309	2309	1946	1906
2	*P.* 'Black Prince'	2502	2759	3072	3430	3859	3346	3426	3905	3912	4171	4321	4371
3	*P. hederaceum*	2332	2332	2582	2695	2949	1081	3679	3882	4204	4204	4537	4634
4	*P. lacinatum*'Variegata'	1667	2034	2465	2841	3123	3511	3789	4065	5003	5005	5024	5183
5	*P. x Magnificum*	3390	3485	3483	3580	3722	3709	3831	3465	3497	3741	4078	3829
6	*P.* 'Majesty'	2632	2632	2882	2995	3249	3500	3979	4182	4504	4504	4837	4934
7	*P.* 'Moon Shine'	815	832	899	981	1059	273	1361	1407	1375	1375	1428	1489
8	*P.* 'Pluto Red'	693	693	693	757	767	371	767	845	845	845	917	936
9	*P.* 'Red Sunlight'	2180	2268	2371	2485	2571	737	2626	2722	2955	2849	2914	2960
10	*P. serratum*	2136	2297	2498	2630	2966	397	2941	3124	3182	3346	3453	3677
11	*P. wend-imbe*	1340	1530	1651	1930	2204	2375	2827	2750	2896	4171	4232	4361
12	*P. wendlandii*	1720	2059	2414	2767	3295	3732	4183	4266	4244	4447	4450	4550
C.D (0.05)		9.48	9.50	9.47	9.49	9.12	8.90	9.32	9.43	9.65	9.36	9.24	8.94

Data subjected to square root transformation to obtain CD

(Contd...)

Table 2b: Spread (NS x EW) of heading type philodendrons during different months (Contd...)

S. No.	species/variety	Plant spread (sq.cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	1977	2560	2560	2560	2560	4761	4821	5838	5838	5838	6637	6737
2	*P.* 'Black Prince'	4471	4546	4638	4445	4277	5026	5706	6099	6227	5720	5882	5957
3	*P. hederaceum*	4566	4972	4989	5134	5353	5353	5353	5597	5441	5441	5567	5717
4	*P. lacinatum*'Variegata'	5298	5353	5487	5637	5778	5965	6127	6360	6529	6932	7082	7157
5	*P. x Magnificum*	3990	4231	4326	4335	4355	4385	4382	4393	4423	4442	4888	5038
6	*P.* 'Majesty'	4866	5272	5289	5434	5653	5653	5653	5897	5741	5741	5687	6017
7	*P.* 'Moon Shine'	1588	1769	1699	1745	1764	1766	1781	1694	1790	2264	2103	2253
8	*P.* 'Pluto Red'	936	960	984	3006	1008	1029	1071	1089	1085	1085	1281	1388
9	*P.* 'Red Sunlight'	2892	3012	2998	4434	2736	2902	3063	3340	3660	3558	4011	4136
10	*P. serratum*	3750	4021	4192	4434	4643	4855	5051	5166	5293	4628	4918	5043
11	*P. wend-imbe*	4470	4443	4200	4200	4278	3897	3897	4363	4397	4452	4497	4585
12	*P. wendlandii*	4475	4445	4469	4403	4510	4343	4343	4350	4405	4517	4532	4546
CD (0.05)		9.22	12.12	9.40	9.44	9.61	9.65	11.94	9.89	9.98	10.21	9.68	9.59

Data subjected to square root transformation to obtain CD

Table 3a: Leaf length of philodendrons during different months

S. No.	species/variety	Leaf length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	41.02	41.02	41.33	41.33	45.12	45.12	45.12	45.12	46.26	46.26	46.26	44.16
2	*P.* 'Black Beauty'	31.23	31.23	31.23	32.66	32.66	32.31	32.31	33.21	33.21	33.21	30.85	30.85
3	*P.* 'Black Cardinal'	32.23	32.23	33.6	36.37	36.25	37.74	36.94	37.04	28.97	35.4	34.84	34.84
4	*P.* 'Black Prince'	26.93	28.17	30.04	31.22	31.76	30.85	30.66	29.46	28.97	28.61	32.4	33.34
5	*P.* 'Ceylon Gold'	21.03	22.03	20.08	22.68	23.9	22.32	23.56	23.23	20.69	23.41	23.51	24.4
6	*P. elegans*	21.57	24.05	23.24	24.37	26.51	22.53	26.82	23.18	22.13	25.36	23.4	24.42
7	*P. hederaceum*	22.73	23.67	24.02	25	25.06	24.94	25.7	26.5	27.55	27.85	25.22	24.5
8	*P. karstenianum*	17.04	15.84	14.71	14.83	13.16	13.8	14.53	13.23	14.1	13.7	11.82	13.2
9	*P. lacerum*	35.06	35.06	33.74	32.6	45.61	45.61	45.61	45.61	45.56	45.56	45.56	45.55
10	*P. lacinatum*'Variegata'	23.91	25.5	29.27	26.04	28.45	28.43	30.1	30.15	36.16	37.78	32.62	34.21
11	*P.* x *Magnificum*	23.91	23.93	23.15	25.95	25.42	26.01	25.71	25.04	26.27	26.27	25.63	24.3
12	*P.* 'Majesty'	28.07	28.07	26.22	27.31	29.6	31.86	31.7	32.61	31.65	31.65	31.32	33.17
13	*P.* 'Moon Shine'	20.3	20.95	21.4	21.72	21.56	22.01	22.47	22.47	20.27	20.37	21.23	21.58
CD (0.05)		3.71	3.40	3.54	3.18	2.87	2.95	3.59	3.25	4.14	4.24	3.42	3.64

(Contd...)

Table 3a: Leaf length of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	23.75	27.14	26.56	26.48	25.86	26.15	26.73	25.04	26.77	26.4	27.45	26.3
15	*P.* 'Pluto Red'	15.58	15.58	15.58	16.6	18.93	18.93	18.93	19.2	19.2	19.2	21.07	21.91
16	*P.* 'Red Dutches'	33.73	33.73	35.1	37.87	37.75	39.24	38.4	38.54	36.9	36.9	36.34	36.34
17	*P.* 'Red Sunlight'	15.12	21.46	21.81	22.15	21.72	21.9	19.84	19.84	19.84	25.08	27.01	27.65
18	*P. sagittifolium*	28.81	23.48	32.02	29.35	29.17	27.58	29.53	29.24	29.14	28.67	28.41	26.67
19	*P. scandens oxycardium*	13.33	14.43	13.56	13.95	13.58	14.46	14.64	14.4	14.53	13.53	14.75	14.38
20	*P. serratum*	14.92	17.64	19.02	16.22	16.61	17.48	17.1	16.84	16.18	16.01	16.1	14.4
21	*P.* 'Smithi'	14.83	23.48	25.91	26.15	19.86	25.47	25.72	24.83	28.51	28.38	23.7	23.61
22	*P. superbum*	24.21	29.01	26.68	26.53	24.52	26.24	29.74	26.5	22.75	25.33	26.75	23.73
23	*P. wend-imbe*	25.92	25.84	27.11	25.68	26.97	26.17	25.31	25.42	26.51	25.11	26.63	22.56
24	*P. wendlandii*	23.63	24.64	26.23	24.28	22.77	22.77	29.8	28.32	29.04	28.45	29.88	29.15
25	*P. williamsii*	39.14	41.75	43.73	37.31	43.03	41.21	41.41	40.55	41.3	39.18	42.13	49.57
CD (0.05)		3.71	3.40	3.54	3.18	2.87	2.95	3.59	3.25	4.14	4.24	3.42	3.64

Table 3b: Leaf length of philodendrons during different months

S. No.	species/variety	Leaf length (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	38.51	38.5	38.51	41.24	41.24	41.24	43.22	42.21	42.21	43	40.5	40.5
2	*P.* 'Black Beauty'	30.85	31.03	31.03	31.03	31.03	33.78	33.78	33.7	33.7	33.7	33.11	33.11
3	*P.* 'Black Cardinal'	35.93	35.93	36.22	36.4	35.81	35.36	35.36	35.71	35.48	35.48	34.01	30.73
4	*P.* 'Black Prince'	27.47	22.71	29.72	33.88	30.6	29.05	23.97	28.35	31.34	30.36	28.63	31.07
5	*P.* 'Ceylon Gold'	23.58	24	22.94	23.61	24.52	25.84	21.04	23.73	22.98	21.07	19.48	24.58
6	*P. elegans*	25.02	24.88	23.15	25.05	25.66	25.07	24.84	25.44	25.6	24.56	24.48	24.02
7	*P. hederaceum*	24.81	24.3	22.87	25.08	25.06	23.23	25.01	24.45	24.02	31.58	27.3	26.96
8	*P. karstenianum*	13.56	12.7	12	12.22	12.54	16.17	12.55	13.61	14.1	15.01	16.66	17.27
9	*P. lacerum*	49.71	49.71	49.71	44.52	44.03	43.54	43.22	47	47	47	47.53	47.5
10	*P. lacinatum*'Variegata'	31.36	34.21	27.6	26.85	27.87	28.83	24.6	25.92	29.85	27.8	32.81	33.85
11	*P.* x *Magnificum*	24.72	26.48	26.53	25.85	24.83	26.46	25.18	22.33	25.8	24.34	25.17	25.97
12	*P.* 'Majesty'	33.17	33.72	33.72	34.14	33.34	33.34	33.87	34.14	33.41	32.43	32.43	34.78
13	*P.* 'Moon Shine'	24.14	19	21.38	20.56	18.96	20.15	21.98	21.9	24.9	24.61	25.84	26.56
CD (0.05)		3.63	4.02	3.78	3.88	3.53	3.37	3.50	3.62	3.544	3.48	3.68	4.10

(Contd...)

Table 3b: Leaf length of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf length (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	24.14	26.4	30.08	29	25.5	24.43	26.11	26.56	26.94	29.74	29.63	32.55
15	*P.* 'Pluto Red'	21.91	22.8	22.14	22.67	22.67	22.62	23.71	24.44	24.44	24.44	25.01	26.36
16	*P.* 'Red Dutches'	37.43	37.43	37.72	37.9	37.31	36.86	36.86	37.21	36.98	36.98	24.48	32.23
17	*P.* 'Red Sunlight'	19.21	15.43	29.87	20.73	21.86	24.62	24.44	25.36	23.57	22.37	24.17	23.28
18	*P. sagittifolium*	29.56	27.36	27.81	29.24	27.77	27.45	29.86	29.97	31.05	31.58	28.78	28.27
19	*P. scandens oxycardium*	13.62	14.4	12.4	13.61	14.57	13.8	13.78	13.1	14.07	13.84	14.56	14.8
20	*P. serratum*	16.58	15.67	15.32	15.78	14.32	17.28	15.6	13.88	19.55	13.88	19.55	21.17
21	*P.* 'Smithi'	23.41	23.41	23.94	26.23	24.56	24.18	20.67	19.38	19.54	26.17	26.78	23.95
22	*P. superbum*	26.88	29.07	31.13	29.15	30.36	29.83	25.9	24.87	26.78	25.6	27.81	24.66
23	*P. wend-imbe*	25.33	30.25	28.2	24.06	17.66	26.88	23.83	27.27	27.62	25.52	30.11	28.14
24	*P. wendlandii*	31.06	28.45	28.15	25.33	21.37	22.98	20.05	22.44	28.32	30.11	28.14	30.12
25	*P. williamsii*	44.85	47.32	48.8	54.16	59.35	57.35	51.83	56.46	58.11	51	58.84	61.1
CD (0.05)		3.63	4.02	3.78	3.88	3.53	3.37	3.50	3.62	3.544	3.48	3.68	4.10

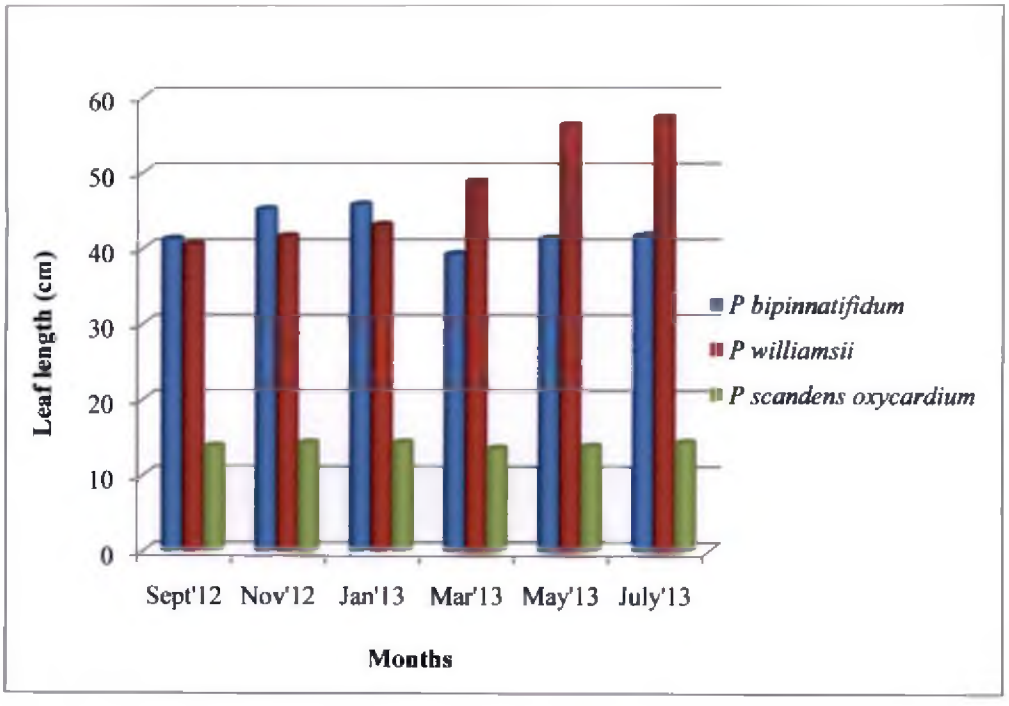


Fig 5. Leaf length of species/varieties of *Philodendron* at bimonthly interval

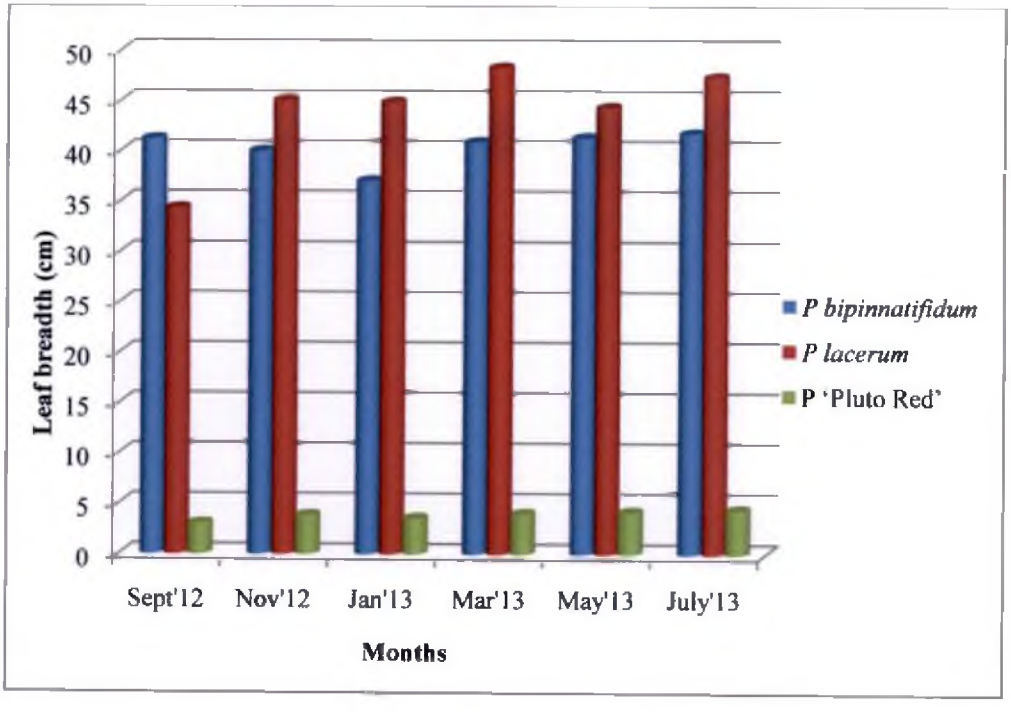


Fig 6. Leaf breadth of species/varieties of *Philodendron* at bimonthly interval

Table 4a: Leaf breadth of philodendrons during different months

S. No.	species/variety	Leaf breadth (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	41.28	41.32	41.28	41	41.28	39.53	39.53	39.68	36.5	37.2	37.22	37.26
2	*P.* 'Black Beauty'	9.73	9.73	9.73	10.75	10.75	12.57	12.57	13.7	13.7	13.7	13.51	13.51
3	*P.* 'Black Cardinal'	15.41	15.41	43.37	45.8	43.9	20.78	20.72	21.97	21.03	21.03	21.45	21.45
4	*P.* 'Black Prince'	12.26	12.61	13.03	14.76	16.02	15.72	13.16	12.63	14.27	18.53	14.62	15.56
5	*P.* 'Ceylon Gold'	8.65	7.7	7..31	7.76	7.64	8.4	7.41	7.82	7.77	7.54	7.21	7.83
6	*P. elegans*	19.1	21.21	24.45	19.71	20.95	18.42	21.36	21.2	21.36	23.76	19.24	21.9
7	*P. hederaceum*	14.15	13.52	13.54	14.64	14.35	13.96	15.23	16.16	15.97	13.68	15.41	15.93
8	*P. karstenianum*	6.55	7.48	8.17	7.98	8.37	16.94	8.72	8.63	8.48	8.75	9.24	8.51
9	*P. lacerum*	35.06	35.06	33.63	33.63	45.07	45.07	45.07	45.07	44.86	44.86	44.86	44.96
10	*P. lacinatum*'Variegata'	19.35	20.85	23.27	23.05	28.45	23.37	24.94	26.18	22.68	24.36	24.56	23.23
11	*P.* x *Magnificum*	22.01	21.33	22.8	24.41	24.9	26.02	25.71	25.04	26.7	26.27	22.01	24.3
12	*P.* 'Majesty'	15.28	15.28	15.23	15.28	14.98	14.35	14.74	16.55	17.2	17.21	18.33	18.25
13	*P.* 'Moon Shine'	12.77	12.46	8.1	12.73	13.05	13.23	12.43	2.42	12.68	12.74	13.56	13.1
CD (0.05)		2.50	2.31	13.28	13.13	13.25	5.46	2.85	3.05	3.16	2.81	6.87	2.59

(Contd...)

Table 4a: Leaf breadth of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf breadth (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	17.81	19.81	33.63	19.73	18.72	19	22.95	18.73	24.5	19.93	21.93	19.56
15	*P.* 'Pluto Red'	2.95	2.95	2.95	3.27	4.05	4.05	4.05	3.37	3.37	3.37	3.71	3.82
16	*P.* 'Red Dutches'	16.31	16.31	21.16	23.58	21.68	21.68	21.62	22.87	22.87	21.93	22.35	22.35
17	*P.* 'Red Sunlight'	8.85	10.23	10.46	11.1	10.03	10.12	9.27	9.27	9.27	13.77	15.2	17.91
18	*P. sagittifolium*	15.28	14.98	14.9	14.35	14.98	15.08	15.38	16.66	16.66	15.32	16.17	16.22
19	*P. scandens oxycardium*	9.92	10.48	11	10.47	10.48	10.47	10.92	11.45	11.45	10.85	12.62	10.97
20	*P. serratum*	8.74	9.02	9.01	8.28	7.42	8.12	7.67	8.13	8.78	8.53	8.78	8.54
21	*P.* 'Smithi'	9.02	7.84	8.68	8.91	9.32	7.22	8.3	7.64	8.95	7.52	8.95	9.08
22	*P. superbum*	13.13	17.12	15.30	15.46	14.3	15.03	15.46	14.12	13.23	14.78	26.74	13.65
23	*P. wend-imbe*	8.26	8.04	8.1	7.88	7.9	7.98	7.37	7.7	8.57	8.57	9.81	9.01
24	*P. wendlandii*	6.91	9.01	10.3	7.80	5.62	5.66	9.56	10.17	9.311	11.07	10.8	9.77
25	*P. williamsii*	22.56	23.5	22.31	22.83	21.55	25.53	21.55	26.18	25.85	24.36	25.54	31.48
CD (0.05)		2.50	2.31	13.28	13.13	13.25	5.46	2.85	3.05	3.16	2.81	6.87	2.59

Table 4b: Leaf breadth of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf breadth (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	40.86	40.9	40.9	40.92	41.07	41.07	41.48	41.77	41.78	41.78	41.78	41.78
2	*P.* 'Black Beauty'	13.51	14.51	14.51	14.51	14.51	15.45	15.45	14.36	14.36	14.36	15.12	15.12
3	*P.* 'Black Cardinal'	22.08	22.08	20.48	23.32	24.66	23.51	23.51	24.61	22.54	22.54	21.54	21.54
4	*P.* 'Black Prince'	11.7	11.62	12.16	13.77	12.6	11.3	12.86	10.6	13.61	12.83	11.07	13.3
5	*P.* 'Ceylon Gold'	7.63	7.16	7.38	8.07	7.67	8.78	7.96	7.43	7.72	7.66	7.37	7.37
6	*P. elegans*	21.5	23.76	20.48	23.43	23.62	19.64	22.08	21.36	22.9	21.8	24.06	20.78
7	*P. hederaceum*	15.97	13.26	13.03	14.74	14.6	13.9	14.27	14.61	14.64	22.31	16.14	15.97
8	*P. karstenianum*	9.08	9.08	9.27	8.5	9.02	8.62	8.87	8.25	8.48	9.2	9.14	9.13
9	*P. lacerum*	49.08	49.08	49.08	46.02	43.85	43.85	42.23	47.51	47.51	47.51	47.56	46.9
10	*P. lacinatum*'Variegata'	23.97	22.6	19.33	20.51	20.76	21.92	26.37	21.57	23.52	24.08	24.92	25.73
11	*P.* x *Magnificum*	24.72	26.47	26.53	25.85	21.75	20.86	19.23	19.45	23.07	22.72	21.68	22.91
12	*P.* 'Majesty'	18.25	18.48	18.48	18.32	17.92	18.01	18.02	18.21	18.15	17.7	18.04	18.04
13	*P.* 'Moon Shine'	11.97	12.14	12.48	13.07	12.43	12.47	13.01	13.4	17.22	18.21	20.63	23.62
CD (0.05)		2.88	3.03	3.05	3.68	3.26	2.88	3.14	2.86	2.84	2.99	3.20	3.05

Table 4b: Leaf breadth of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf breadth (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	21.45	22.14	25.35	24.25	20.57	21.13	20.82	20.45	25.6	29.13	28.27	30.02
15	*P.* 'Pluto Red'	3.82	4.06	4.05	4.2	4.2	4.07	4.28	4.34	4.34	4.34	4.5	4.52
16	*P.* 'Red Dutches'	22.98	22.98	23.18	24.22	25.56	24.41	24.41	25.51	23.4	23.4	22.4	20.25
17	*P.* 'Red Sunlight'	8.07	15.43	15.51	11.1	12.48	12.65	12.68	14.08	13.54	11.8	13.68	12.18
18	*P. sagittifolium*	16.17	15.05	15.46	14.62	14.93	14.93	15.10	15.61	16.26	14.3	14.31	16.5
19	*P. scandens oxycardium*	9.48	10.85	10.43	11.41	11.04	10.35	9.97	11.33	11.24	11.6	13.0	13.04
20	*P. serratum*	7.96	8.15	7.36	7.6	8.33	7.5	8.01	7.43	9.23	7.43	9.23	10.46
21	*P.* 'Smithi'	10.53	8.06	8.57	8.08	10.22	7.85	8.1	7.62	8.67	9.35	7.12	8.33
22	*P. superbum*	14.66	17.21	19.17	20.05	20.01	16.97	14.18	13.53	15.23	15.21	16.81	15.51
23	*P. wend-imbe*	8.76	10.68	12.91	12.24	9.97	8.2	8.6	9.92	11.22	11.62	12.27	11.38
24	*P. wendlandii*	10.07	10.13	10.37	15.92	8.71	9.4	7.58	8.45	12.27	11.38	11.6	9.92
25	*P. williamsii*	28.9	31.85	32.95	32.95	45.27	47.62	43.17	45.88	46.17	50.41	50.83	53.02
CD (0.05)		2.88	3.03	3.05	3.68	3.26	2.88	3.14	2.86	2.84	2.99	3.20	3.05

Philodendron lacerum except during the last month when *Philodendron williamsii* has maximum leaf breadth. The narrowest leaf was observed in *Philodendron* 'Pluto Red' throughout the year.

4.1.1.1.4. Leaf area (cm^2)

Leaf area is one of the main parameters that indicate the adaptability of plants to indoors. It was found that species/varieties differed significantly among them with respect to this characters. Leaf area of Philodendrons was recorded fortnightly and presented in Table 5a, 5b and fig 7.

Among climbing types, *Philodendron bipinnatifidum* was found to have the maximum leaf area during the first and second months and *Philodendron lacerum,* during later stage. Minimum leaf area was observed in *Philodendron karstenianum.* The other species/varieties were on par with the smallest leaves in one or the other months.

Among the heading type philodendrons, the maximum leaf area was recorded in *Philodendron* 'Majesty' during the initial two months and second fortnight of 8^{th} and 10^{th} month, while in *Philodendron lacinatum*'Variegata' during rest of the period. Minimum leaf area was recorded in *Philodendron* 'Pluto Red'.

4.1.1.1.5. Internodal length (cm)

Internodal length is also an important character to be considered because it determines compactness and appearance of the plant. A few philodendrons did not have measurable internodal length. However, the internodal length of remaining species/varieties were measured and found that they were significantly different with each other and the results were presented in Tables 6a, 6b and fig 8. So the comparison was made with the available species/varieties with internodes.

Among climbing types, *Philodendron williamsii* had the longest internodes throughout the year and *Philodendron* 'Ceylon Gold', the shortest.

Among heading types, *Philodendron* 'Majesty' has maximum intermodal length throughout the period. *Philodendron lacinatum*'Variegata' and *Philodendron* x *Magnificum* were

Table 5a: Leaf area of climbing type philodendrons during different months

S. No.	species/variety	Leaf area (sq. cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	1681.9	1683.1	1631.4	1616	1566.6	1490.8	1490.8	1496.2	1568.1	1596.9	1599.6	1497.2
2	*P* 'Black Cardinal'	523	523	758.5	649.5	649.5	700.5	701.2	741.5	635.2	635.2	636.5	636.5
3	*P.* 'Ceylon Gold'	185.3	180	132.6	132.2	182.2	139.1	161.3	159.7	91.6	156.8	136.3	318.6
4	*P. elegans*	450.2	437.3	361.7	382.7	464	363.1	398.2	403.7	300.6	514.1	463.6	295.3
5	*P. karstenianum*	101.6	104.4	130	105.2	114.7	467.1	137.9	106.7	124.6	96.5	98.8	2168.4
6	*P. lacerum*	1071.2	1071.2	880.2	880.2	1896.9	1896.9	1896.6	1896.9	2006.1	2006.1	2006.1	696.3
7	*P. pertusum*	327.1	499.4	463.1	579.4	489.3	462.7	531	450.6	626.8	491.3	625.1	790
8	*P.* 'Red Dutches'	612.2	612.2	762.1	875.9	744.5	797.1	797.8	839.0	729.0	729	730.5	443.2
9	*P. sagittifolium*	441.1	452.6	483.9	393.5	414.8	406.4	448.9	415.2	382.6	380	466.1	435.8
10	*P. scandens oxycardium*	126.9	136.8	136.5	140.9	134.7	142.2	121.7	122.1	120	171.3	187.9	184
11	*P.* 'Smithi'	137.6	138	200.3	220.9	134.7	167	187.7	159.1	247.2	161.66	200.2	202.1
12	*P. superbum*	306.4	441.8	420.4	403.7	326.5	326.9	484.4	389.1	343.1	383.8	281.9	286.5
13	*P. williamsii*	773.3	784.2	694.8	902.5	945.1	1087.6	1180.6	1266	786.1	11003	1294	970
CD (0.05)		2.68	2.58	4.16	2.06	3.06	3.64	3.72	2.55	4.53	2.93	3.07	4.14

Data subjected to square root transformation to obtain CD

(Contd...)

Table 5a: Leaf area of climbing type philodendrons during different months (Contd...)

S. No.	species/variety	Leaf area (sq. cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	1382.3	1383.4	1383.4	1695	1695	1695	1788.4	1642.7	1643.8	1707.4	1660.6	1660.6
2	*P* 'Black Cardinal'	694.6	694.6	757	763	872.5	852	852	847.3	706.5	706.5	628.5	654.6
3	*P.* 'Ceylon Gold'	128.3	153.5	144.5	189.3	170.6	202.1	154.8	133	150.7	124.1	95.4	136
4	*P. elegans*	500.7	506.9	492.6	474.2	441.1	346.5	481.3	438.5	413	472.8	487.3	469.4
5	*P. karstenianum*	104.2	105.4	89.4	93.8	89.3	119.2	87.4	106	61.6	143	144.9	176.2
6	*P. lacerum*	2729.1	2729.1	2729.1	2277.9	2224.1	2224.1	1785.6	2168.1	2168.1	2168.1	2108.1	2162.7
7	*P. pertusum*	408.9	493.1	742.3	708.7	548.9	579.9	427.8	665	893.4	876.8	924.3	887.9
8	*P.* 'Red Dutches'	791	791	856	862.3	976.6	955.4	955.4	950.5	803.6	803.6	722.2	612.2
9	*P. sagittifolium*	488.7	418.2	471.1	433.3	414.9	431.7	430	517.7	499.2	409.4	409.3	482
10	*P. scandens oxycardium*	109.5	196.3	127.9	139.9	169.2	142.5	121.4	101.6	187	175.9	214.1	212.1
11	*P.* 'Smithi'	255.4	198.1	178.3	165.9	352.9	173.3	155.6	517.7	130	237	183.2	170.8
12	*P. superbum*	328.9	377.2	590.9	566.7	509.7	518.3	303.3	263.2	431.7	306.3	385.8	366.6
13	*P. williamsii*	1408.3	1804.6	1816.4	2324.1	2464.2	2120.5	2594	2463.6	1975.7	2258.8	2475.8	2475.8
CD (0.05)		3.29	3.13	3.36	3.71	3.7	3.52	1.68	3.02	3.85	3.07	3.33	3.33

Data subjected to square root transformation to obtain CD

Table 5b: Leaf area of heading type philodendrons during different months

S. No.	species/variety	Leaf area (sq. cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	237	237	237	296.3	296.3	262.6	262.6	272.5	272.5	272.5	234	234
2	*P.* 'Black Prince'	311.4	358.5	366.6	398.3	530.7	490.5	416.6	399.2	418.3	574	500.5	197.6
3	*P. hederaceum*	336.8	245.3	363.4	308.1	414.9	357.5	363.8	452.2	369.1	350.1	315.9	112.7
4	*P. lacinatum*'Variegata'	333	383.4	581.6	390	780.7	671	838	894	767	1103	841.1	493.4
5	*P. x Magnificum*	307.9	422.7	458.5	580.9	444.1	435.1	476.2	484.2	503.1	502.2	349	601.6
6	*P.* 'Majesty'	495.9	495.9	466.5	526.7	523.5	595.5	564.8	721.3	630.4	630.4	596.3	265.9
7	*P.* 'Moon Shine'	195.2	190.6	223.9	243.7	252.4	265.4	236.5	235.7	246.4	249.5	257.5	440.2
8	*P.* 'Pluto Red'	33.9	33.9	33.9	38.5	71	71	71	59.8	59.8	59.8	71.2	730.5
9	*P.* 'Red Sunlight'	85.4	173.8	179.6	194.6	199.8	202.8	196.6	196.6	196.6	266.4	396.1	435.8
10	*P. serratum*	123.7	147.0	1457	115	104.9	119.1	115.9	127.4	107.6	155.8	124.4	136.8
11	*P. wend-imbe*	199.0	185.2	214.4	189.1	233.7	207.9	179.1	177	195.1	177.2	1294	191.2
12	*P. wendlandii*	115.3	194.8	227.2	224.8	140.3	140.3	272.9	305.4	278.9	301	281.9	324.7
CD (0.05)		2.21	2.12	2.26	2.86	2.99	3.24	3.06	2.69	3.24	3.75	2.73	2.87

(Contd...)

Data subjected to square root transformation to obtain CD

Table 5b: Leaf area of heading type philodendrons during different months (Contd...)

S. No.	species/variety	Leaf area (sq. cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	234	244.8	244.8	244.8	244.8	470.6	470.63	477.7	477.7	477.7	439.7	439.7
2	*P.* 'Black Prince'	286.1	281.9	333	238.2	364.6	275.9	403.6	352.6	406.4	382.4	347.3	433.8
3	*P. hederaceum*	348.2	324.8	237.9	314.8	377.2	289.1	327.3	265.6	290.9	686.7	417.6	407.4
4	*P. lacinatum*'Variegata'	651.4	566.7	413	421.2	386.7	515	461.8	624.8	515.8	614.2	738.7	1136.7
5	*P. x Magnificum*	558.4	597.9	627.7	578.7	449.3	513.7	346.6	287.3	503.4	498.3	599.1	651.3
6	*P.* 'Majesty'	601.6	587.5	587.5	582.2	585.1	617.9	648	263.2	604.1	519.4	510.9	541.1
7	*P.* 'Moon Shine'	210.4	192	207.3	234.1	199.7	225.9	258.5	260	405.9	430.2	474.1	564
8	*P.* 'Pluto Red'	79	87.8	78.7	96.5	96.5	96.5	88.1	113.7	113.7	113.7	116	115.7
9	*P.* 'Red Sunlight'	168.7	253.4	478.9	255.8	251.7	285.8	237.2	345.2	210.6	244.3	343.9	262.3
10	*P. serratum*	99.6	121.9	112.7	138	115	126.2	129.6	345.2	183.2	79.4	183.28	222.9
11	*P. wend-imbe*	216.1	302.1	362..7	289.1	167.4	214.4	201.4	234	261.6	260	379.5	350.5
12	*P. wendlandii*	288.1	274.4	256.9	406.9	140.2	216.2	146.6	190.6	307.2	335.6	374.0	212.3
CD (0.05)		3.10	2.76	2.86	3.76	3.13	1.78	2.25	2.10	1.97	2.90	3.21	2.96

Data subjected to square root transformation to obtain CD

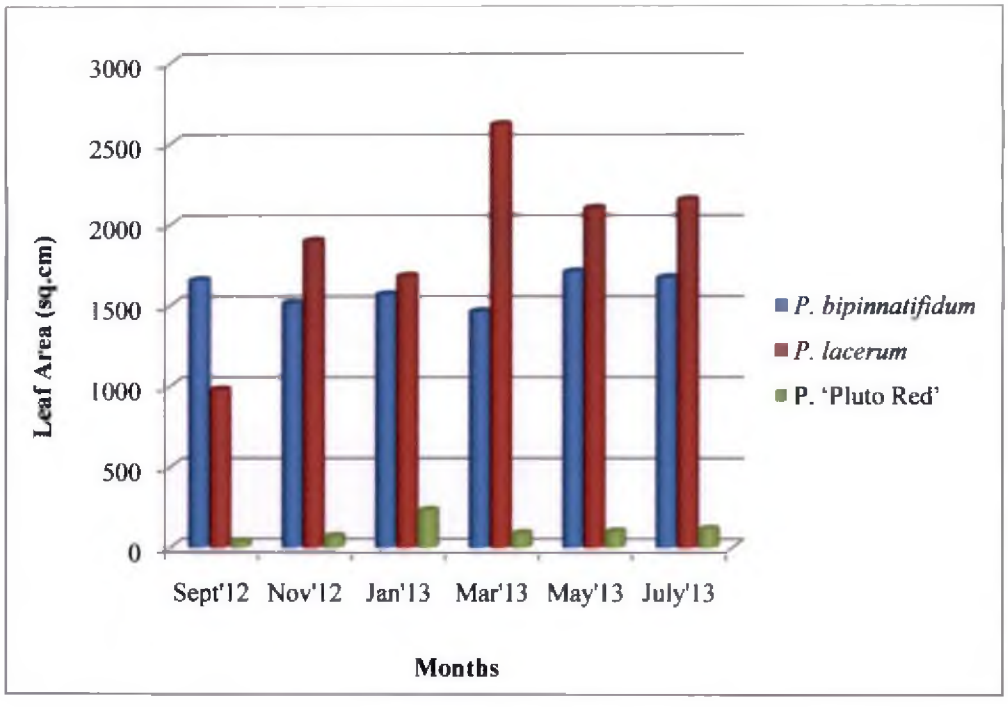


Fig 7. Leaf Area of species/varieties of *Philodendron* at bimonthly interval

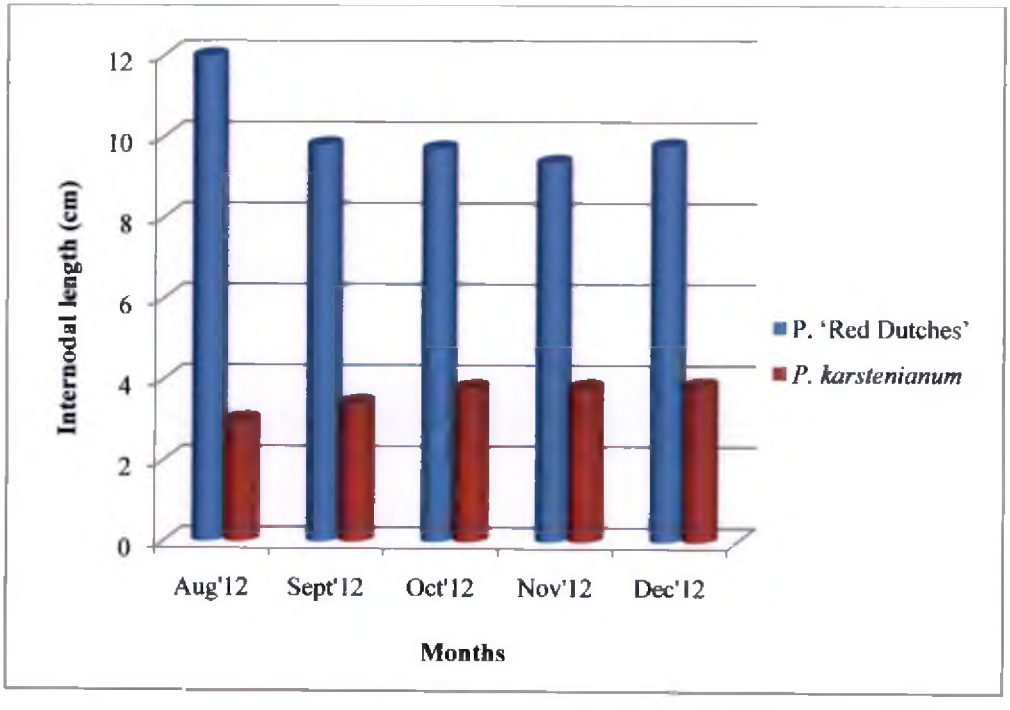


Fig 8. Internodal length of climbing type philodendrons at monthly interval

Table 6a: Internodal length of climbing type philodendrons during different months

S. No.	species/variety	Internodal length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	-	-	-	-	-	-	-	-	-	-	-	-
2	*P* 'Black Cardinal'	6.7	7.5	7.62	8.16	8.22	8.41	8.24	8.62	8.91	7.91	-	-
3	*P.* 'Ceylon Gold'	2.7	3.3	3.81	4.11	3.97	4.45	4.46	4.59	4.44	3.44	-	-
4	*P. elegans*	5.3	5.2	5.89	6.01	6.32	5.95	5.93	5.4	5.01	12.5	-	-
5	*P. karstenianum*	3.1	2.9	3.52	3.38	3.93	3.72	3.85	3.82	3.91	3.83	-	-
6	*P. lacerum*	-	-	-	-	-	-	-	-	-	-	-	-
7	*P. pertusum*	7.6	8.1	7.96	7.97	8.66	9.26	9.74	10.09	9.89	9.59	-	-
8	*P.* 'Red Dutches'	12	12	10.29	9.34	9.82	9.6	9.16	9.58	9.76	9.81	-	-
9	*P. sagittifolium*	5.7	5.8	6.05	6.52	6.53	6.38	6.18	5.97	5.7	5.64	-	-
10	*P. scandens oxycardium*	3.4	4.1	4.77	4.73	4.79	4.2	5.32	4.94	4.93	4.66	-	-
11	*P.* 'Smithi'	5.3	6	6.55	7.22	7.71	8.4	8.79	8.33	8.21	8.29	-	-
12	*P. superbum*	4.6	5.2	5.67	6.25	6.73	7.37	7.75	7.45	7.39	7.49	-	-
13	*P. williamsii*	10.27	10.1	10.02	9.14	8.87	8.92	8.58	8.65	8.73	8.23	-	-
CD (0.05)		1.63	1.59	1.49	1.36	1.45	1.40	1.50	1.53	1.55	1.52	-	-

Table 6b: Internodal length of heading type philodendrons during different months

S. No.	species/variety	Internodal length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1*	*P.* 'Black Beauty'	-	-	-	-	-	-	-	-	-	-	-	-
2*	*P.* 'Black Prince'	-	-	-	-	-	-	-	-	-	-	-	-
3	*P. hederaceum*	2.92	2.88	3.46	3.33	3.87	3.7	3.81	3.78	3.86	3.8	3.76	3.8
4	*P. lacinatum*'Variegata'	4.07	4.29	4.75	4.69	4.6	4.77	5.01	5.2	5.21	5.36	5.28	5.22
5	*P. x Magnificum*	5.19	4.68	4.57	4.42	4.13	4.08	3.92	3.57	3.37	3.25	6.29	3.03
6	*P.* 'Majesty'	4.62	4.62	5.2	5.22	5.56	5.88	5.95	5.86	5.58	5.59	5.45	5.5
7*	*P.* 'Moon Shine'	-	-	-	-	-	-	-	-	-	-	-	-
8*	*P.* 'Pluto Red'	-	-	-	-	-	-	-	-	-	-	-	-
9*	*P.* 'Red Sunlight'	-	-	-	-	-	-	-	-	-	-	-	-
10*	*P. serratum*	-	-	-	-	-	-	-	-	-	-	-	-
11*	*P. wend-imbe*	-	-	-	-	-	-	-	-	-	-	-	-
12*	*P. wendlandii*	-	-	-	-	-	-	-	-	-	-	-	-
CD (0.05)		1.55	2.58	1.39	1.26	1.33	1.33	1.45	1.44	1.39	1.38	3.07	4.14

(Contd...)

* Plants with no internodes

Table 6b: Internodal length of heading type philodendrons during different months (Contd...)

S. No.	species/variety	Internodal length (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1*	*P.* 'Black Beauty'	-	-	-	-	-	-	-	-	-	-	-	-
2*	*P.* 'Black Prince'	-	-	-	-	-	-	-	-	-	-	-	-
3	*P. hederaceum*	3.79	3.57	3.64	3.53	3.5	3.46	3.44	3.46	3.44	3.49	3.63	3.58
4	*P. lacinatum*'Variegata'	5.26	5.28	5.23	5.08	5.12	5.01	4.96	5.36	4.96	4.86	4.79	4.69
5	*P. x Magnificum*	3.06	2.91	2.82	2.73	2.67	2.58	2.66	2.6	2.66	2.51	2.43	2.42
6	*P.* 'Majesty'	5.43	5.21	5.35	5.07	4.98	4.94	4.8	4.8	4.8	4.73	5.02	5.02
7*	*P.* 'Moon Shine'	-	-	-	-	-	-	-	-	-	-	-	-
8*	*P.* 'Pluto Red'	-	-	-	-	-	-	-	-	-	-	-	-
9*	*P.* 'Red Sunlight'	-	-	-	-	-	-	-	-	-	-	-	-
10*	*P. serratum*	-	-	-	-	-	-	-	-	-	-	-	-
11*	*P. wend-imbe*	-	-	-	-	-	-	-	-	-	-	-	-
12*	*P. wendlandii*	-	-	-	-	-	-	-	-	-	-	-	-
CD (*0.05)		3.29	3.13	3.36	3.71	3.70	3.52	1.68	3.02	3.85	3.07	3.33	3.36

* Plants with nointernodes

on par with the maximum throughout the period. *Philodendron hederaceum* was observed to have minimum intermodal length.

4.1.1.1.6. Length and girth of petiole (cm)

As like any other characters, length and girth of petiole were also equally important as they support the leaves. The petiole length and girth were measured fortnightly and the results are presented in Tables 7a, 7b, 8a, 8b and fig 9, 10.

4.1.1.1.6.1. Petiole length (cm)

Throughout the year *Philodendron bipinnatifidum* had the longest petiole, which was on par with *Philodendron lacerum*. *Philodendron* 'Moon Shine' and *Philodendron* 'Pluto Red' recorded the shortest petiole throughout the year and they were on par with each other. Other species/varieties which produced short petioles were *Philodendron karstenianum, Philodendron wend-imbe, Philodendron hederaceum* and *Philodendron* 'Black Beauty'.

4.1.1.1.6.2. Petiole girth (cm)

The same kind of pattern as that of petiole length was observed in petiole girth also. *Philodendron bipinnatifidum* had the maximum petiole girth throughout the period except second fortnight of 7^{th} and 12^{th} months. *Philodendron lacerum* was observed at par with the thickest at later stages of the period. The lowest girth was recorded in *Philodendron* 'Pluto Red' till 9^{th} month and *Philodendron scandens oxycardium* during the rest of the period.

4.1.1.1.7. Number of leaves

The number of leaves is an important parameter to be considered because it denotes the health status of a plant. The various physiological functions like photosynthesis, transpiration and the capability to tolerate air pollution etc. depend on the number of leaves in a plant. The number of leaves per plant was observed at fortnightly interval and presented in the Tables 9a, 9b and fig 11, 12.

Among climbing type philodendrons, *Philodendron karstenianum* had maximum number of leaves throughout the year. *Philodendron bipinnatifidum* and *Philodendron lacerum* were the

Table 7a: Petiole length of philodendrons during different months

S. No.	species/variety	Petiole length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	46.63	46.63	43.56	43.56	56	56	56	56	56.96	56.96	56.96	58.56
2	*P.* 'Black Beauty'	11.76	11.76	11.76	12.43	12.43	13.03	13.03	11.95	11.95	11.95	16.1	16.1
3	*P.* 'Black Cardinal'	19.22	19.22	21.58	22.06	22.24	22.51	23.26	23.47	23.14	23.14	21.95	21.95
4	*P.* 'Black Prince'	14.47	15.38	13.52	15.16	15.66	15.56	14.42	14.53	13.23	13.46	13.03	14.03
5	*P.* 'Ceylon Gold'	14.21	14.98	15.86	15.78	13.62	15.8	14.91	15.61	15.23	15.46	15.03	16.03
6	*P. elegans*	17.08	19.61	24.71	20.72	20.78	21.78	17.61	21.47	17.56	19.05	20.1	21.85
7	*P. hederaceum*	12.1	14.65	12.62	13.78	13.63	14.37	14.16	14.25	16.18	14.41	13.9	17.98
8	*P. karstenianum*	9.97	10.86	10.65	10.86	11.52	12.24	12.51	12.03	10.81	11.95	13.37	12.82
9	*P. lacerum*	42.97	42.97	44.41	44.41	55.07	55.07	55.07	55.07	54.86	54.86	54.86	54.96
10	*P. lacinatum*'Variegata'	23.68	24.37	30.07	26.62	26.26	23.98	25.96	28.61	31.21	343.7	25.63	27.13
11	*P.* x *Magnificum*	38.34	40.46	45.43	43.74	39.62	40.94	38.01	38.04	39.44	38.82	40.98	40.23
12	*P.* 'Majesty'	20.07	20.07	18.22	19.31	21.6	23.86	23.78	24.61	23.65	23.65	23.32	25.17
13	*P.* 'Moon Shine'	6.37	7.02	7.31	7.83	7.91	7.91	8.16	7.91	8.65	8.65	9.18	9.4
CD (0.05)		3.01	2.7	2.89	4.90	3.11	3.37	3.14	3.34	3.85	3.50	3.55	3.60

(Contd...)

Table 7a: Petiole length of philodendrons during different months (Contd...)

S. No.	species/variety	Petiole length (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	17.71	20.63	18.25	23.41	21.96	22.46	23.56	23.62	23.66	19.76	21.23	11.11
15	*P.* 'Pluto Red'	8.17	8.17	8.17	8.9	10.13	10.13	10.13	8.12	8.12	8.12	10.55	11.28
16	*P.* 'Red Dutches'	20.12	20.12	22.48	22.96	23.14	23.41	24.16	24.37	24.04	24.04	22.85	22.85
17	*P.* 'Red Sunlight'	7.1	12.46	12.81	13.15	12.72	12.9	11.82	11.82	11.82	16.08	18.01	18.65
18	*P. sagittifolium*	23.43	24.18	23.46	25.63	24.77	15.14	15.51	15.27	16.68	22	23.73	22.76
19	*P. scandens oxycardium*	10.47	11.14	12.06	12.08	10.87	11.36	11.02	12.18	13.77	9.8	11.76	12.45
20	*P. serratum*	21.24	22.82	24.27	25.18	25.98	26.24	25.88	25.65	25.98	23.75	23.17	20
21	*P.* 'Smithi'	21.24	23.15	24.61	28.85	26.32	26.91	25.88	26.35	26.65	23.75	23.17	20
22	*P. superbum*	23.43	25.22	25.45	28.44	29.14	28.43	28.08	24.5	26.07	25.94	27.2	28.13
23	*P. wend-imbe*	9.68	11.8	12.32	13.8	12.85	12.73	12.22	11.02	12.36	15.13	15.16	14.52
24	*P. wendlandii*	12.95	15.13	14.37	14.3	14.1	15.05	15.35	15.16	14.52	21.24	17.51	11.11
25	*P. williamsii*	30.32	27.26	27.55	28.36	31.28	29.23	40.43	37.55	42.58	42.14	41.01	48.14
CD (0.05)		3.01	2.7	2.89	4.90	3.11	3.37	3.79	3.14	3.34	3.85	3.50	3.55

Table 7b: Petiole length of philodendrons during different months

S. No.	species/variety	Petiole length (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	64.3	64.3	64.33	60.8	59.7	59.7	55.26	59.26	59.26	59.26	57.6	44.27
2	*P.* 'Black Beauty'	16.1	16.77	16.77	16.77	16.77	19.88	19.88	22.24	22.24	22.24	23.02	24.22
3	*P.* 'Black Cardinal'	21.91	21.91	23.22	23.44	23.68	24.27	24.27	23.47	23.47	23.41	23.61	23.91
4	*P.* 'Black Prince'	13.05	12.84	13.16	11.62	13.02	10.95	12.37	11.82	11.82	11.17	11.52	12.33
5	*P.* 'Ceylon Gold'	15.05	14.84	15.16	13.62	15.02	12.95	14.37	13.82	13.82	13.17	13.74	16.76
6	*P. elegans*	31.62	24.11	20.72	22.52	23.74	19.13	22.11	21.64	21.64	26.17	21.36	21.73
7	*P. hederaceum*	15.52	15.33	14.17	16.91	15.11	15.02	13.2	18.8	18.8	16.2	14.56	13.36
8	*P. karstenianum*	12.52	12.17	12.74	12.47	11.78	11.55	11.18	11.43	11.43	13.57	12.92	30.94
9	*P. lacerum*	59.03	59.03	59.03	56.02	53.85	53.85	52.23	57.51	57.51	57.51	57.56	45.6
10	*P. lacinatum*'Variegata'	24.51	22.77	20.86	19.72	19.75	20.83	25.66	21.92	21.92	24.35	27.73	32.41
11	*P.* x *Magnificum*	40.34	40.04	42.66	42.67	39.42	39.27	39.17	40.86	40.86	41.57	38.47	34.65
12	*P.* 'Majesty'	25.17	25.72	25.72	26.14	25.34	25.74	26.04	26.22	26.22	24.06	24.06	17.47
13	*P.* 'Moon Shine'	9.45	10.36	9.96	8.83	10.13	10.85	10.95	11.23	11.23	17.68	9.74	18.86
CD (0.05)		3.54	3.54	3.74	3.46	3.17	3.31	3.24	3.35	3.35	3.70	3.48	8.86

(Contd...)

Table 7b: Petiole length of philodendrons during different months (Contd...)

S. No.	species/variety	Leaf length (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	18.63	18.25	18.16	17.75	20.14	17.24	18.25	22.95	22.95	25.47	24	22.71
15	*P.* 'Pluto Red'	11.28	11.74	11.14	11.58	11.58	11.93	12.08	12.18	12.18	12.64	12.64	16.9
16	*P.* 'Red Dutches'	22.81	22.81	24.12	24.34	24.58	25.17	25.17	24.37	24.37	24.31	24.51	17.45
17	*P.* 'Red Sunlight'	10.21	6.43	20.87	11.73	12.86	15.62	15.44	16.36	16.36	13.37	15.17	19.12
18	*P. sagittifolium*	25.77	24.26	20.35	24.63	22.12	24.31	22.41	26.07	26.07	30.42	27.24	21.07
19	*P. scandens oxycardium*	9.65	11.87	11.4	10.54	10.46	11.04	12.17	12.14	12.14	11.74	11.57	14.07
20	*P. serratum*	21.73	19.96	21.44	22.96	20.74	21.94	18.77	18.25	18.25	21.64	21.55	13.37
21	*P.* 'Smithi'	21.73	19.96	21.44	22.96	20.74	21.94	18.77	18.25	18.25	21.64	21.55	13.37
22	*P. superbum*	29.08	23.21	29.8	27.98	28.08	23.66	24.6	25.44	25.44	23.76	16.71	16.71
23	*P. wend-imbe*	21.24	11.44	12.95	15.13	12.95	15.13	12.73	12.22	12.22	15.51	15.56	16.44
24	*P. wendlandii*	11.42	15.56	12.58	11.44	12.07	9.93	16.35	15.51	15.51	11.45	13.36	29.58
25	*P. williamsii*	41.85	48.06	48.84	51.94	57.37	55.82	50.78	53.71	53.71	50.55	51.06	53.23
CD (0.05)		3.54	3.54	3.74	3.46	3.17	3.31	3.24	3.35	3.35	3.70	3.48	8.86

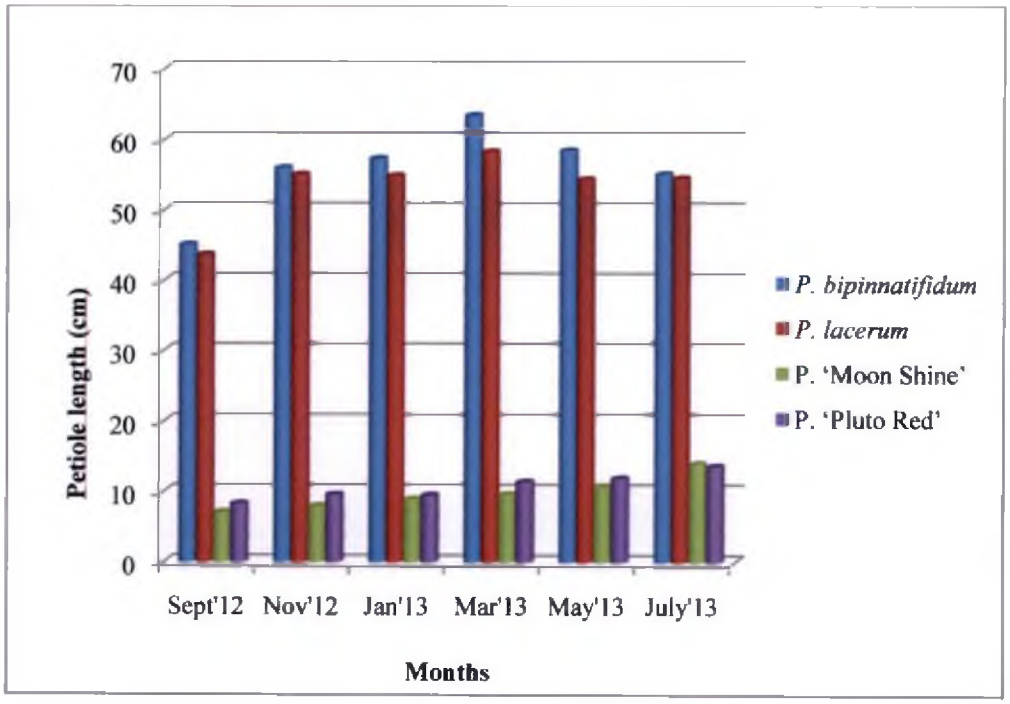


Fig 9. Petiole length of species/varieties of *Philodendron* at bimonthly interval

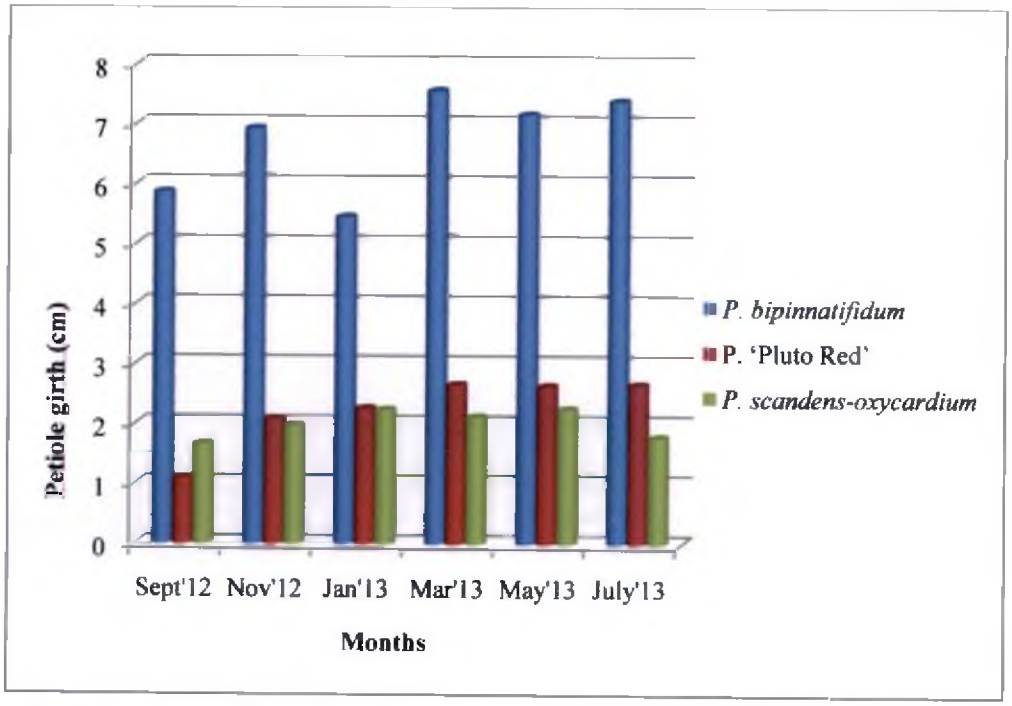


Fig 10. Petiole girth of species/varieties of *Philodendron* at bimonthly interval

Table 8a: Petiole girth of philodendrons during different months

S. No.	species/variety	Petiole girth (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	5.9	5.9	5.83	5.83	6.93	6.93	6.93	6.93	6.56	6.56	6.56	22.16
2	*P.* 'Black Beauty'	3.42	3.42	3.42	3.32	3.32	3.76	3.76	3.22	3.22	3.22	3.46	3.46
3	*P.* 'Black Cardinal'	3.14	3.14	3.48	3.66	3.85	3.91	3.8	3.83	3.66	3.66	3.35	3.35
4	*P.* 'Black Prince'	5.34	5.1	5.1	4.82	4.82	4.82	5.06	5.06	5.06	5.15	5.15	5.15
5	*P.* 'Ceylon Gold'	2.76	2.97	2.92	3.05	2.81	3.15	3.03	3	3.43	3.01	3.02	3.02
6	*P. elegans*	2.08	2.77	3.26	3.26	2.7	2.74	2.78	2.93	2.23	2.33	2.86	3.1
7	*P. hederaceum*	3.73	4.51	4.02	4.05	4.16	4.31	3.86	4.13	4.31	3.91	3.73	4.43
8	*P. karstenianum*	2.06	2.77	2.16	2.11	2.33	2.43	2.38	2.34	2.66	2.68	2.68	2.84
9	*P. lacerum*	5.28	5.28	5.85	5.85	6.96	6.96	6.96	6.96	6.42	6.42	6.42	22.52
10	*P. lacinatum* 'Variegata'	3.96	3.96	3.88	3.81	3.82	3.78	3.76	3.76	4.05	4.05	3.7	3.53
11	*P.* x *Magnificum*	3.02	3.52	3.38	2.92	3.01	3.26	3.05	3.41	3.48	3.37	3.42	3.6
12	*P.* 'Majesty'	4.96	4.96	4.88	4.81	4.82	4.78	4.76	4.76	5.05	5.05	4.7	4.53
13	*P.* 'Moon Shine'	2.81	3.2	3.42	4.02	4.02	3.94	4.11	4.43	4.57	4.33	4.48	4.57
CD (0.05)		0.49	0.52	14.98	0.49	0.45	0.55	0.48	0.52	0.57	0.54	0.65	6.18

(Contd...)

Table 8a: Petiole girth of philodendrons during different months (Contd...)

S. No.	species/variety	Petiole girth (cm)											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	3.31	3.56	3.1	3.33	2.92	3.21	3.88	3.94	3	3.15	3.21	3.25
15	*P.* 'Pluto Red'	0.97	0.97	0.97	1.44	2.08	2.08	2.08	2.07	2.07	2.07	2.36	2.56
16	*P.* 'Red Dutches'	3.44	3.44	3.78	3.96	4.15	4.21	4.1	4.13	3.96	3.96	3.65	3.65
17	*P.* 'Red Sunlight'	3	3.14	3.17	3.15	4.13	4.16	4.08	4.08	4.08	3.25	3.48	3.98
18	*P. sagittifolium*	2.4	2.38	2.72	2.51	2.41	2.53	2.53	2.46	2.67	3.08	2.72	3.13
19	*P. scandens oxycardium*	1.45	1.56	1.7	1.91	1.8	1.82	2.02	2.27	2.27	2.2	2.27	2.2
20	*P. serratum*	2.88	3.01	3.21	3.52	3.06	3.78	3.4	3.31	3.6	2.57	3.84	3.92
21	*P.* 'Smithi'	2.4	2.34	2.53	2.8	3.100	3.07	2.95	2.77	2.7	2.68	2.06	2.12
22	*P. superbum*	2.58	2.71	2.91	3.22	2.76	3.48	3.1	3.01	3.3	2.27	3.54	3.62
23	*P. wend-imbe*	4.47	3.72	3.94	3.58	3.56	4.07	3.78	3.98	3.67	4.02	3.6	3.3
24	*P. wendlandii*	4.25	3.93	4.48	3.73	4.13	4.14	4.11	4.08	4.1	4.38	5.3	5.32
25	*P. williamsii*	3.11	2.98	3.4	3.61	3.37	3.47	4.1	4.07	4.33	4.13	4.1	4.72
CD (0.05)		0.49	0.52	0.14	0.49	0.45	0.55	0.48	0.52	0.57	0.54	0.65	0.61

Table 8b: Petiole girth of philodendrons during different months

S. No.	species/variety	Petiole girth (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	7.6	7.6	7.6	7.46	7.3	7.3	6,86	7.2	7.2	7.2	7.53	7.63
2	*P.* 'Black Beauty'	3.46	3.8	3.8	3.8	3.8	3.95	3.95	3.97	3.97	3.97	3.83	3.83
3	*P.* 'Black Cardinal'	3.32	3.32	3.25	3.56	3.76	3.81	3.81	3.9	3.9	3.76	4	4.08
4	*P.* 'Black Prince'	5.15	5.31	5.31	5.35	5.35	5.35	5.23	5.23	5.23	5.32	5.11	5.2
5	*P.* 'Ceylon Gold'	3.28	3.13	3.34	2.87	2.95	3.35	3.23	3.23	3.23	3.32	3.11	3.2
6	*P. elegans*	3.4	3.45	2.28	2.2	2.4	2.2	2.36	2.75	2.65	2.73	1.81	2.12
7	*P. hederaceum*	4.07	3.77	4.34	4.06	4	4.38	4.13	4.28	3.98	4.22	3.82	3.67
8	*P. karstenianum*	2.73	2.62	2.62	2.62	2.16	3.03	3.01	3.08	3.12	3.25	3.37	3.38
9	*P. lacerum*	7.03	7.03	7.03	6.91	6.74	6.74	6.67	7.17	7.17	7.17	7.34	7.23
10	*P. lacinatum*'Variegata'	3.53	3.57	3.62	3.45	3.72	3.72	3.67	3.83	4.04	4.12	3.64	3.64
11	*P.* x *Magnificum*	3.77	3.66	3.67	3.78	3.25	3.62	3.64	3.24	3.48	3.63	4.37	4.06
12	*P.* 'Majesty'	4.53	4.57	4.62	4.45	4.72	4.72	4.67	4.83	5.04	5.12	4.64	4.64
13	*P.* 'Moon Shine'	4.51	9.25	4.38	3.9	3.85	3.97	3.73	3.7	5.22	6.51	8.05	8.82
CD (0.05)		0.80	0.96	0.51	0.55	0.56	0.53	0.56	0.54	0.58	0.51	0.77	0.66

(Contd...)

Table 8b: Petiole girth of philodendrons during different months (Contd...)

S. No.	species/variety	Petiole girth (cm)											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
14	*P. pertusum*	3.25	3.47	3.48	3.12	3.16	2.67	2.7	3.24	3.76	3.14	2.68	2.98
15	*P.* 'Pluto Red'	2.56	2.73	2.73	2.61	2.61	2.64	2.66	2.62	2.62	2.62	2.65	2.75
16	*P.* 'Red Dutches'	3.62	3.62	3.55	3.86	4.06	4.11	4.11	4.2	4.2	4.06	4.3	4.3
17	*P.* 'Red Sunlight'	3.77	3.61	3.5	2.9	3.36	3.26	3.44	3.27	2.9	2.84	2.9	3.08
18	*P. sagittifolium*	2.62	2.4	2.4	2.48	2.56	2.74	2.56	2.85	4.26	2.4	3.02	3.37
19	*P. scandens oxycardium*	1.92	2.18	1.96	2.42	2.31	2.01	2.27	2.41	1.54	1.76	1.77	2.05
20	*P. serratum*	4.47	2.57	3.16	2.97	3	2.5	2.84	2.91	3.01	2.76	3.72	2.1
21	*P.* 'Smithi'	1.95	3.3	2.33	2.27	2.18	2.27	2	1.74	2.75	2.76	2.46	2.48
22	*P. superbum*	4.17	2.27	2.86	2.67	2.7	2.2	2.54	2.61	2.71	2.46	3.42	1.8
23	*P. wend-imbe*	3.88	3.01	1.72	3.42	3.72	3.43	3.77	3.63	2.53	4.41	4.32	4.5
24	*P. wendlandii*	5.04	5.08	5.87	5.02	4.9	4.04	5.98	5.43	4.96	4.57	4.76	4.93
25	*P. williamsii*	4.05	4.67	4.7	5.58	5.67	5.52	5.07	5.41	5.6	5.12	5.23	5.27
CD (0.05)		0.80	0.96	0.51	0.55	0.56	0.53	0.56	0.54	0.58	0.51	0.77	0.66

Table 9a: Number of leaves of climbing type philodendrons during different months

S. No.	species/variety	Number of leaves											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	2	2	2.11	2.11	2.88	2.88	2.88	2.88	3.77	3.77	3.77	4.11
2	*P* 'Black Cardinal'	8.22	8.66	9.66	10.4	10.55	11	11.88	11.88	12	12.11	12.77	13.55
3	*P.* 'Ceylon Gold'	18.77	18.55	18.8	20.66	21.55	22.55	23.77	24.44	25.44	26.33	26.66	29
4	*P. elegans*	11.33	12.88	12.88	14.11	14.55	16.66	18	20.22	22.11	24.11	26.22	28.77
5	*P. karstenianum*	18.33	20.33	22.33	24.33	26.33	26.66	28.88	31.11	33.33	35.55	37.77	40
6	*P. lacerum*	3.77	3.77	4.11	4.77	4.77	4.77	5.66	5.66	5.66	6.11	6.44	6.44
7	*P. pertusum*	8.77	9	9.33	10	10.11	10.55	10.88	11.33	11.22	11.55	12.11	12.44
8	*P.* 'Red Dutches'	6.22	6.66	7.66	8.4	8.55	9	9.88	9.88	10	10.11	10.77	11.55
9	*P. sagittifolium*	12.33	13	13.8	14.44	15.55	16.33	17.44	18.88	20	20.55	21.33	22
10	*P. scandens oxycardium*	5.33	6	6.88	8.66	10.4	12.11	13.22	15.66	17.11	18.88	20.66	22.88
11	*P.* 'Smithi'	7.33	8	8.88	9.4	10.55	11.33	12.44	13.88	15	15.55	16.33	17
12	*P. superbum*	9.33	10	10.88	11.4	12.55	13.33	14.44	15.88	17	17.55	18.33	19
13	*P. williamsii*	8.4	8.77	9.22	10.33	10.77	11	11.66	11.77	12	12.88	13.66	14.55
CD (0.05)		3.14	3.24	3.4	3.67	3.79	4.1	4.2	4.47	4.56	4.54	4.57	4.71

(Contd...)

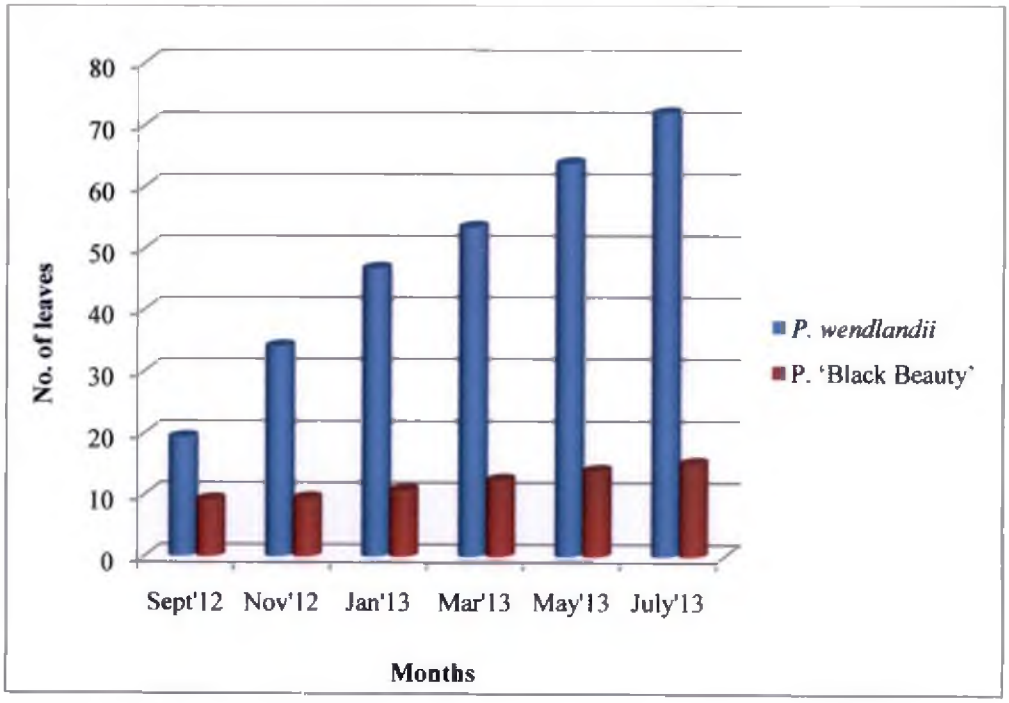


Fig 11. No. of leaves of heading type philodendrons at bimonthly interval

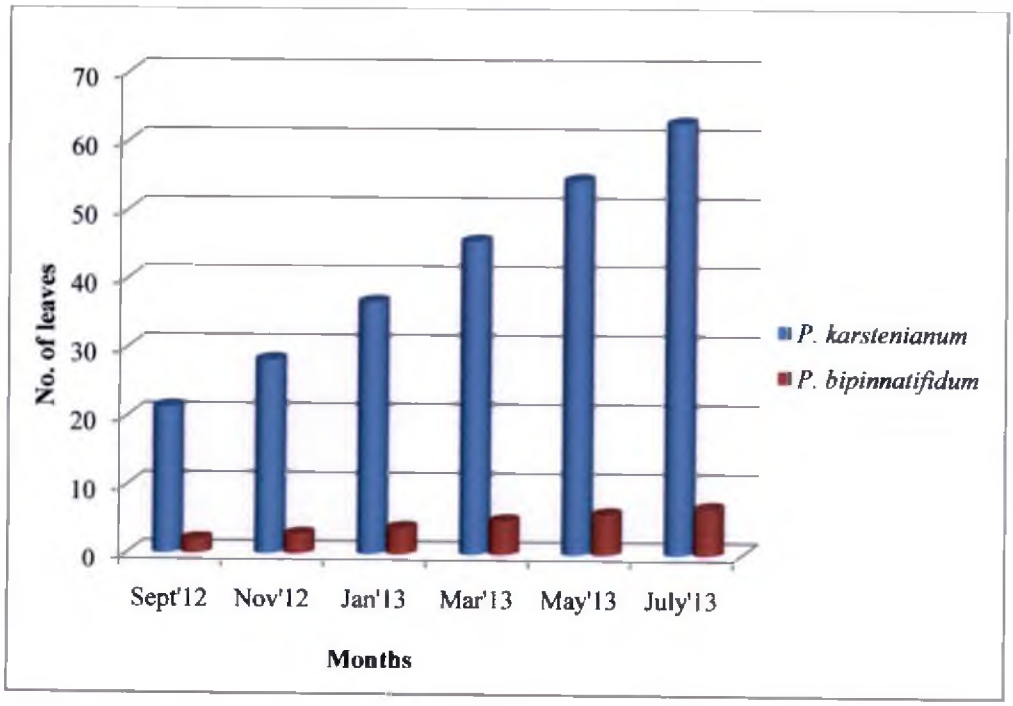


Fig 12. No. of leaves of climbing type philodendrons at bimonthly interval

Table 9a: Number of leaves of climbing type philodendrons in different months (contd...)

S. No.	species/variety	Number of leaves											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P. bipinnatifidum*	4.77	4.77	4.77	5.66	5.66	5.66	6.11	6.44	6.44	6.44	7.33	7.33
2	*P* 'Black Cardinal'	13.88	14.22	14.55	15.22	16	16.44	17	17.77	17.77	19.22	19.44	19.77
3	*P.* 'Ceylon Gold'	30.66	32.66	34.66	36.77	38.55	40.44	42.55	44.33	44.33	48.66	50.88	54.77
4	*P. elegans*	29.66	32.55	34.66	36.66	38.11	40.11	41.88	44.22	44.22	48.22	49.88	51.66
5	*P. karstenianum*	42.22	44.44	46.66	48.88	51.11	53.33	55.55	57.77	57.77	62.22	64.44	66.66
6	*P. lacerum*	6.44	7.33	7.33	8.22	8.22	8.66	9	9.44	9.44	9.66	9.77	10.22
7	*P. pertusum*	12.44	12.66	13.44	13.88	14.66	14.77	14.8	15.77	15.77	17	17.55	18.11
8	*P.* 'Red Dutches'	11.88	12.22	12.55	13.22	14	14.44	15	15.77	15.77	17.22	17.44	17.77
9	*P. sagittifolium*	23.22	23.66	24.22	24.55	25.11	26	26.55	27	27	28.44	29.33	30.11
10	*P. scandens oxycardium*	25	26.77	28.55	30.77	32.66	35.11	37.11	39	39	43.66	45.55	48.44
11	*P.* 'Smithi'	18.22	18.66	19.22	19.55	20.11	21	21.55	22	22	23.44	24.33	24.88
12	*P. superbum*	20.22	20.66	21.22	21.55	22.11	23	23.55	24	24	25.44	26.33	26.88
13	*P. williamsii*	15.55	16.22	17	17.55	18	18	18.77	18.77	18.77	19.88	21.77	21.4
CD (0.05)		4.75	4.85	5.02	5.13	5.19	5.31	5.46	5.61	9.46	5.92	6.10	6.11

Table 9b: No. of leaves of heading type philodendrons during different months

S. No.	species/variety	Number of leaves											
		Months after planting											
		Aug'12		Sept'12		Oct'12		Nov'12		Dec'12		Jan'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	9.22	9.22	9.22	9.11	9.11	9.22	9.22	10.22	10.22	10.22	11.33	11.33
2	*P.* 'Black Prince'	19.22	19.4	19.55	20.22	20.66	21.55	22.44	22.88	24.44	24.77	26.11	27.33
3	*P. hederaceum*	11.11	12	12.77	13.22	13.77	14.44	15.22	15.77	16.55	16.88	17	17.77
4	*P. lacinatum*'Variegata'	9.88	11.11	11.66	13.22	14.44	14.55	14.44	14.44	14.77	15.33	15.66	16.33
5	*P. x Magnificum*	14.11	15.33	16.11	16.77	18.22	19.11	20.11	21.44	22.55	23.33	24.22	25.33
6	*P.* 'Majesty'	10.11	10.11	9.88	10.11	10.22	10.44	10.88	11.22	12.11	12.11	12.55	12.88
7	*P.* 'Moon Shine'	7.4	7.88	8.4	9.22	10.22	10.33	10.66	11	11.33	11.55	11.55	12
8	*P.* 'Pluto Red'	9.11	9.11	9.11	9.77	10.77	10.77	10.77	12	12	12	12.66	12.55
9	*P.* 'Red Sunlight'	12.33	13.44	14.66	15.77	15.77	16	16.44	17.22	17.33	17.55	18.22	19.11
10	*P. serratum*	22.4	24	26.22	29	30.44	30.88	28.88	33.22	32.55	33.33	34.11	34.77
11	*P. wend-imbe*	15.4	16.77	18.22	19.44	20.66	20.88	23.33	25.33	27.55	29.88	31.77	34.44
12	*P. wendlandii*	13.7	17.33	21.4	24.88	29	33.77	33.22	40.11	42.33	45.4	48.44	50.66
CD (0.05)		4.08	4.26	4.55	4.81	4.92	5.02	5.28	5.53	5.57	5.47	5.58	5.67

(Contd...)

Table 9b: No. of leaves of heading type philodendrons during different months (Contd...)

S. No.	species/variety	Number of leaves											
		Months after planting											
		Feb'13		Mar'13		Apr'13		May'13		June'13		July'13	
		I	II	I	II	I	II	I	II	I	II	I	II
1	*P.* 'Black Beauty'	11.33	12.77	12.77	12.77	12.77	14.22	14.22	14.44	14.44	14.44	15.77	15.77
2	*P.* 'Black Prince'	28.33	29.11	29.77	31.11	31.77	32.77	33.66	34.55	34.55	35.88	34.22	34.22
3	*P. hederaceum*	18.11	20.22	20.22	21.11	21.88	22.66	23.44	24.11	24.11	25.55	26.44	27.33
4	*P. lacinatum*'Variegata'	16.66	17.11	17.66	18.33	18.44	18.88	19.22	19.66	19.66	20.33	21.11	21.55
5	*P. x Magnificum*	25.55	27.22	28.22	29.44	30.11	31.33	30.22	31	31	32.4	33.55	34.44
6	*P.* 'Majesty'	13.11	13.55	13.55	14.22	14.44	14.77	15.11	15.55	15.55	16.22	16.88	16.88
7	*P.* 'Moon Shine'	12.11	12.66	12.44	12.88	13.11	13.33	14	14.11	14.11	15.66	16.33	16.77
8	*P.* 'Pluto Red'	12.55	13	14.11	14	14	14	14.22	15	15	14.88	14.88	15.55
9	*P.* 'Red Sunlight'	19.44	19.77	20.33	20.88	21.11	22	22.55	23.33	23.33	24.77	25.44	26
10	*P. serratum*	35.11	36.11	36.77	37.66	38.66	39.55	40.33	41.55	41.55	43.33	43.66	44.33
11	*P. wend-imbe*	36	38.11	39	41.22	43.22	44.55	46	47.88	47.88	51.33	52.55	53.77
12	*P. wendlandii*	53.2	44.44	56.88	59.11	60.77	62.66	64.66	66.77	66.77	71.11	73.44	76.11
CD (0.05)		5.72	5.78	5.9	6	5.98	6.06	6.08	6.15	6.22	6.3	6.34	6.24

species that had the minimum number of leaves throughout the year and they were on par with each other.

Philodendron wendlandii was the species/variety that had the maximum number of leaves throughout the year among heading type philodendrons except during the initial two months when *Phildendron serratum* produced maximum number of leaves. *Philodendron* 'Moon Shine' produced lowest number of leaves. *Philodendron* 'Pluto Red', *Philodendron* 'Black Beauty', *Philodendron hederaceum, Philodendron lacinatum*'Variegata', *Philodendron* 'Majesty' were the species/varieties that were on par with the minimum at one time or the other.

4.1.1.1.8. Leaf producing interval (days)

Leaf producing interval of philodendrons was significally different between the species. The data are presented in Table 10a.

Philodendron scandens oxycardium produced leaves at shorter intervals and it was on par with *Phlodendron superbum*, and *Philodendron* 'Pluto Red', *Philodendron lacerum* produced leaves at longer interval.

4.1.1.1.9. Leaf longevity (days)

The leaf longevity of philodendrons are presented.

Among rosette growth types *Philodendron* 'Pluto Red' had the highest leaf longevity whereas the lowest was in *Philodendron* 'Moon Shine'.

4.1.1.2. Correlation studies

The number of leaves was correlated with leaf producing interval and leaf longevity whereas the results are given in Table 10b.

4.1.1.2.1. Correlation between number of leaves and leaf production interval

Leaf production interval was significantly influenced by the number of leaves. The leaf production interval of all the species/varieties of *Philodendron* was negatively correlated.

Table 10a: Leaf producing interval and leaf longevity of philodendrons in the Rain shelter

S. No.	species/varieties	Leaf producing interval (days)	Leaf longevity (days)
1	*Philodendron bipinnatifidum*	56	60
2	*Philodendron* 'Black Beauty'	52	59
3	*Philodendron* 'Black Cardinal'	36	45
4	*Philodendron* 'Black Prince'	37	45
5	*Philodendron* 'Ceylon Gold'	15	23
6	*Philodendron elegans*	19	37
7	*Philodendron hederaceum*	27	36
8	*Philodendron karstenianum*	10	46
9	*Philodendron lacerum*	38	66
10	*Philodendron lacinatum*'Variegata'	25	34
11	*Philodendron* x *Magnificum*	26	30
12	*Philodendron* 'Majesty'	34	58
13	*Philodendron* 'Moon Shine'	10	12
14	*Philodendron pertusum*	35	47
15	*Philodendron* 'Pluto Red'	80	94
16	*Philodendron* 'Red Dutches'	21	36
17	*Philodendron* 'Red Sunlight'	29	34
18	*Philodendron sagittifolium*	20	25
19	*Philodendron scandensoxycardium*	8	23
20	*Philodendron serratum*	14	24
21	*Philodendron* 'Smithi'	17	26
22	*Philodendron superbum*	12	23
23	*Philodendron wend-imbe*	13	34
24	*Philodendron wendlandii*	10	32
25	*Philodendron williamsii*	34	47
CD (0.05)		2.8	2.94

Table 10b: Correlation between number of leaves, leaf producing interval and leaf longevity of philodendrons in the Rain shelter

S. No.	species/varieties	Leaf producing interval (days)	Leaf longevity (days)
1	*Philodendron bipinnatifidum*	-0.341	-0.285
2	*Philodendron* 'Black Beauty'	-0.399(*)	-0.32
3	*Philodendron* 'Black Cardinal'	-0.447(*)	-0.35
4	*Philodendron* 'Black Prince'	-0.475(*)	-0.365
5	*Philodendron* 'Ceylon Gold'	-0.497(*)	-0.379
6	*Philodendron elegans*	-0.517	-0.394
7	*Philodendron hederaceum*	-0.551	-0.408(*)
8	*Philodendron karstenianum*	-0.548	-0.398(*)
9	*Philodendron lacerum*	-0.562	-0.401(*)
10	*Philodendron lacinatum*'Variegata'	-0.573	-0.400(*)
11	*Philodendron* x *Magnificum*	-0.568	-0.386
12	*Philodendron* 'Majesty'	-0.583	-0.397(*)
13	*Philodendron* 'Moon Shine'	-0.592	-0.402(*)
14	*Philodendron pertusum*	-0.608	-0.418(*)
15	*Philodendron* 'Pluto Red'	-0.587	-0.39
16	*Philodendron* 'Red Dutches'	-0.592	-0.39
17	*Philodendron* 'Red Sunlight'	-0.599	-0.394
18	*Philodendron sagittifolium*	-0.603	-0.397(*)
19	*Philodendron scandensoxycardium*	-0.608	-0.397(*)
20	*Philodendron serratum*	-0.604	-0.39
21	*Philodendron* 'Smithi'	-0.604	-0.39
22	*Philodendron superbum*	-0.62	-0.405(*)
23	*Philodendron wend-imbe*	-0.625	-0.408(*)
24	*Philodendron wendlandii*	-0.625	-0.410(*)
25	*Philodendron williamsii*	-0.888	-0.888

4.1.1.2.1. Correlation between number of leaves and leaf longevity

The number of leaves was also influenced leaf longevity. The leaf longevity of all the species/variety of *Philodendron* was negatively correlated.

4.1.1.3. Qualitative characters

Leaf characters like texture, shape, margin, tip, base, type, pigmentation, venation and arrangement were observed and presented in Table 11.

4.1.1.4. Others

Branching habit, pests and diseases, other symptoms like bending, drooping etc., were observed and presented in Table 12.

4.2. Evaluation of philodendrons under indoor conditions

Among the twenty-five *Philodendron* species/varieties evaluated in the rain shelter, thirteen species/varieties were selected based on their growth, to evaluate their performance under different indoor light levels. Plant characters, longevity, symptoms of damage and pest and disease incidence were observed and presented hereunder.

All the plant characters like height, number of leaves, plant spread, leaf area, leaf length and breadth, internodal length and petiole length and girth of philodendrons were recorded at fortnightly intervals. The data pertaining to plant characters at the time of keeping under different light levels are given in the Table 13.

4.2.1. Plant characters

4.2.1.1. Plant height

The plants kept in medium and low light zones during first fortnight had the maximum height. *Philodendron lacerum* (89.1, 89.3 and 83.5 cm in low light, supplementary light without air condition and air condition zone respectively) and *Philodendron lacinatum* 'Variegata' (129.3 and 115.3 cm in medium and high light levels respectively) had the highest plant height during this period. Lowest plant height was recorded in *Philodendron* 'Pluto Red'(except in high light).

During the second fortnight, *Philodendron hederaceum* (76.2 cm) in low light level zone; *Philodendron laciatum* 'Variegata' in medium light, high light and also in air conditioned zone

Table 11. Qualitative leaf characters of philodendrons

S. No.	Species/varieties	Leaf characters								
		Texture	Shape	Margin	Tip	Base	Type	Venation	Arrangement	Pigmentation
1	*Philodendron bipinnatifidum*	Medium	Eliptical (oval)	Pinnatifid	Acute	Truncate	Simple	Pinnate	Alternate	Deep green
2	*Philodendron* 'Black Beauty'	Coarse	Obovate	Entire	Acute	Cordate	Simple	Pinnate	whorled alternately	Shiny purple in juvenile, deep green in matured
3	*Philodendron* 'Black Cardinal'	Coarse	Oblong	Entire	Acute	Cordate	Simple	Pinnate	Alternate	Red, gradually deep green with age
4	*Philodendron* 'Black Prince'	Medium	Oblong	Entire	Acute	Cordate	Simple	Pinnate	whorled alternately	Red glossy during juvenile, green in matured
5	*Philodendron* 'Ceylon Gold'	Coarse	Oblong	Entire	Acuminate	Cordate	Simple	Pinnate	Alternate	Yellow glossy. Gradually yellowish green
6	*Philodendron elegans*	Coarse	Elliptical (oval)	Pinnatifid	Acute	Truncate	Simple	Pinnate	Alternate	Deep green
7	*Philodendron hederaceum*	Coarse	Obovate	Entire	Acuminate	Cordate	Simple	Pinnate	Alternate	Deep shiny green
8	*Philodendron karstenianum*	Coarse	Oblong	Entire	Acuminate	Cordate	Simple	Pinnate	Alternate	Deep green
9	*Philodendron lacerum*	Medium	Elliptical (oval)	Pinnatifid	Acute	Truncate	Simple	Pinnate	Alternate	Deep green
10	*Philodendron lacinatum* 'Variegata'	Coarse	Oblong	Pinnatifid	Acute	Truncate	Simple	Pinnate	Alternate	Deep green with white strips
11	*Philodendron* x *Magnificum*	Coarse	Cordate	Entire	Acuminate	Cordate	Simple	Pinnate	Alternate	Light green in juvenile later turns into deep green
12	*Philodendron* 'Majesty'	Coarse	Ovate	Entire	Acute	Cordate	Simple	Pinnate	Alternate	Purple in juvenile later turns into green
13	*Philodendron* 'Moon Shine'	Medium	Ovate	Entire	Acute	Cordate	Simple	Pinnate	Whorled alternately	Glossy light green in juvenile later turns green

(Contd...)

Table 11. Qualitative leaf characters of philodendrons (Contd...)

S.No.	Species/varieties	Leaf characters								
		Texture	Shape	Margin	Tip	Base	Type	Venation	Arrangement	Pigmentation
14	*Philodendron pertusum*	Coarse	Elliptical (oval)	Pinnatifid	Acute	Cordate	Simple	Pinnate	Alternate	Dark green
15	*Philodendron* 'Pluto Red'	Coarse	Narrow	Serrate	Acute	Cordate	Simple	Pinnate	Whorled alternately	Purple in juvenile later turns into green
16	*Philodendron* 'Red Dutches'	Coarse	Oblong	Entire	Acute	Cordate	Simple	Pinnate	Alternate	Purple in juvenile later turns into green
17	*Philodendron* 'Red Sunlight'	Coarse	Obovate	Entire	Acute	Cordate	Simple	Pinnate	Whorled alternately	Red in juvenile later turns into green
18	*Philodendron sagittifolium*	Coarse	Saggitate (arrow)	Entire	Acute	Cordate	Simple	Pinnate	Alternate	Deep green
19	*Philodendron scandens-oxycardium*	Medium	Ovate	Entire	Acute	Cordate	Simple	Pinnate	Alternate	Pale green in juvenile later turns into green
20	*Philodendron serratum*	Coarse	Narrow ovate	Serrulate	Accuminate	Truncate	Simple	Pinnate	Whorled alternately	Deep green
21	*Philodendron* 'Smithi'	Coarse	Ovate	Entire	Acuminate	Cordate	Simple	Pinnate	Alternate	Deep green
22	*Philodendron superbum*	Coarse	Ovate	Entire	Accuminate	Cordate	Simple	Pinnate	Alternate	Deep green
23	*Philodendron wend-imbe*	Coarse	Long Obovate	Entire	Acute	Auriculate	Simple	Pinnate	Spiral	Green and purple below in juvenile later turning light green
24	*Philodendron wendlandii*	Coarse	Long Obovate	Entire	Acute	Auriculat	Simple	Pinnate	Spiral	Green and purple below in juvenile later tturns to green
25	*Philodendron williamsii*	Coarse	Saggitate (arrow)	Entire	Acuminate	Truncate	Simple	Pinnate	Alternate	Green above leaf and purple below

Table. 12. Growing habit and incidence of pests and diseases in different species/varieties of *Philodendron*

S.No.	species/variety	Branching habit	Bending/Drooping	Pests & Diseases
1	*Philodendron bipinnatifidum*	With single main stem	bends if not staked	NA
2	*Philodendron* 'Black Beauty'	With single main stem	NA	NA
3	*Philodendron* 'Black Cardinal'	produce adventitious roots in nodes	bends if not staked	NA
4	*Philodendron* 'Black Prince'	With single main stem	NA	NA
5	*Philodendron* 'Ceylon Gold'	produce adventitious roots in nodes	bends if not staked	NA
6	*Philodendron elegans*	produce adventitious roots in nodes	bends if not staked	NA
7	*Philodendron hederaceum*	With single main stem	NA	NA
8	*Philodendron karstenianum*	produce adventitious roots in nodes	bends if not staked	NA
9	*Philodendron lacerum*	With single main stem	NA	NA
10	*Philodendron lacinatum*'Variegata'	With single main stem	NA	NA
11	*Philodendron* x *Magnificum*	With single main stem	NA	NA
12	*Philodendron* 'Majesty'	With single main stem	NA	NA
13	*Philodendron* 'Moon Shine'	With single main stem	NA	NA
14	*Philodendron pertusum*	produce adventitious roots in nodes	bends if not staked	NA
15	*Philodendron* 'Pluto Red'	With single main stem	NA	NA
16	*Philodendron* 'Red Dutches'	produce adventitious roots in nodes	bends if not staked	NA
17	*Philodendron* 'Red Sunlight'	With single main stem	NA	NA
18	*Philodendron sagittifolium*	produce adventitious roots in nodes	bends if not staked	NA
19	*Philodendron scandensoxycardium*	produce adventitious roots in nodes	bends if not staked	NA
20	*Philodendron serratum*	With single main stem	NA	NA
21	*Philodendron* 'Smithi'	produce adventitious roots in nodes	bends if not staked	NA
22	*Philodendron superbum*	produce adventitious roots in nodes	bends if not staked	NA
23	*Philodendron wend-imbe*	With single main stem	NA	NA
24	*Philodendron wendlandii*	With single main stem	NA	NA
25	*Philodendron williamsii*	produce adventitious roots in nodes	bends if not staked	NA

Table 13: Pre-treatment observations of selected philodendrons under different indoor light conditions

S. No	species/variety	Levels of light	Plant height (cm)	Plant spread E-W (cm)	Plant spread N-S (cm)	No. of leaves	Leaf area (sq. cm)	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Petiole girth (cm)	Internodal length (cm)
1*	*P.* 'Black Beauty'	LL	60.3	72.5	75.0	13	563.5	32.3	20.5	20.7	4.7	-
		ML	50.3	52.1	49.7	11	424.5	26.7	16.8	15.3	4	-
		HL	45.0	34.4	39.2	8	263.5	23.1	13.2	15	3.8	-
		SL	53.0	77.0	70.7	8	542.5	32.4	21.2	18	4.7	-
		A/C	50.4	77.3	74.4	6	321.5	24.8	14.7	18.4	3.5	-
2*	*P.* 'Black Prince'	LL	60.5	69.1	75.3	30	457.5	34.8	15.5	12.3	5.2	-
		ML	52.5	70.1	76.3	30	457.5	34.8	15.5	12.3	5.2	-
		HL	57.6	77.7	72.5	22	267.5	27.1	11.3	11.7	5.5	-
		SL	55.0	74.0	72.9	21	5.5.5	26.3	15.3	4.7	5.5	-
		A/C	45.2	35.4	38.4	25	253.5	23.4	10.8	14.1	5	-
3	*P.* 'Ceylon Gold'	LL	45.3	23.3	39.3	17	57.5	13.5	46.4	6.3	1.7	1.1
		ML	35.5	25.1	35.8	18	57.5	13.5	4.5	6.3	1.7	0.9
		HL	41.0	31.2	35.7	17	50.5	13.1	4.1	6.3	1.5	0.5
		SL	58.0	45.0	38.9	29	95.5	14.4	4	8.8	1.8	0.7
		A/C	34.5	53.5	53.5	17	218.5	23.5	9.3	16.3	2.7	1.0
4	*P. hederaceum*	LL	74.5	66.1	76.0	7	306.5	24.5	15.2	13	3.5	3
		ML	64.4	66.1	75.0	8	305.5	24.5	15.2	13	3.5	2.7
		HL	78.7	72.5	65.6	13	485.5	28.6	18.5	23	2.8	2.2
		SL	65.6	73.0	79.0	22	355.5	30.5	15.3	23.5	3.2	2.8
		A/C	51.3	54.5	53.6	14	300.5	21.5	12.8	12.2	2.7	2.0
5*	*P. lacerum*	LL	87.1	91.1	84.7	5	855.5	34.5	32.3	59.1	5.5	-
		ML	90.2	85.6	80.5	5	1242.5	48	43.5	51.5	4.7	-
		HL	98.8	90.2	90.4	5	1199.5	45.5	39	38.2	4	-
		SL	89.0	63.5	56.3	4	904.5	43	28.3	45.3	4.1	-
		A/C	82.5	52.5	85.3	8	904.5	33.5	41.1	39.5	4.2	-
6	*P. lacinatum*'Variegata'	LL	66.8	100.5	74.1	13	488	29	23.5	28.2	3.4	5.4
		ML	127.3	105.3	75.1	14	383.5	29	23.5	28.2	3.4	4.1
		HL	114.8	108.3	78.4	10	438.5	21.3	22.1	28.3	3.3	3.6
		SL	71.0	94.0	68.7	16	694.5	33.1	28.1	28	3	3.9
		A/C	42.4	56.2	48.0	14	593.5	45.1	23.3	26.2	3.5	3.3
7*	*P.* x *Magnificum*	LL	52.0	50.2	43.4	11	397.5	23.3	21.5	36.7	3.7	-
		ML	62.7	30.4	30.4	9	39.4	30.5	30.3	9	3.0	-
		HL	35.8	37.8	41.2	4	36.3	38.1	41.5	4	2.4	-
		SL	55.8	49.0	41.4	4	56.3	49.5	41.4	4	2.0	-
		A/C	52.5	37.4	38.3	6	53.5	37.3	39.3	6	2.4	-

* Plants with no internodes

(Contd...)

Table 13: Pre-treatment observations of selected philodendrons under different indoor light conditions (Contd...)

S. No	species/variety	Levels of light	Plant height (cm)	Plant spread E-W (cm)	Plant spread N-S (cm)	No. of leaves	Leaf area (sq. cm)	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Petiole girth (cm)	Internodal length (cm)
8	*P.* 'Majesty'	LL	57.3	55.8	69.5	8	157.5	18.5	11.1	9	4	4.0
		ML	62.7	58.5	54.5	14	635.5	35.4	20.5	29.3	4.1	2.8
		HL	77.3	49.4	45.5	9	628.5	34.7	20.1	23.1	3.8	2.0
		SL	64.2	59.6	52.5	10	505.5	24	15.5	17.8	4.1	2.9
		A/C	48.5	54.5	57.6	9	515.5	35.1	15.3	19.5	3.5	2.0
9*	*P.* 'Moon Shine'	LL	35.1	35.3	36.3	6	152.5	13.7	12.4	9.4	4	-
		ML	31.7	28.3	52.5	8	194.5	20.1	11.8	9	4	-
		HL	30.4	25.8	24.5	15	215.5	22.6	13.7	6.8	3.5	-
		SL	34.7	35.3	36.6	18	145.5	14.7	11.4	11.6	3.8	-
		A/C	38.8	46.0	42.2	10	215.5	23.4	11.4	8.5	5	-
10*	*P.* 'Pluto Red'	LL	20.3	30.5	29.7	10	53.5	20.5	3.7	10.5	2.7	-
		ML	20.3	21.4	22.3	11	68.5	23.7	3.8	11.8	2.6	-
		HL	29.3	25.1	23.0	33	101.5	16.7	20.3	16.1	1.3	-
		SL	28.3	30.0	30.3	8	48.5	17.7	3.5	7	1.5	-
		A/C	27.4	41.4	29.5	8	60.5	19.3	3	13.1	1.8	-
11*	*P.* 'Red Sunlight'	LL	45.5	56.0	63.0	14	238.5	21.7	10	12.3	2	-
		ML	45.5	49.0	59.1	13	347.5	26.3	12.3	12.2	2.3	-
		HL	15.4	45.2	47.6	19	181.5	22	10.1	12.4	2.8	-
		SL	38.7	50.0	53.2	10	147.5	18.1	8.8	8.2	2	-
		A/C	34.0	47.1	45.0	9	128.5	15.5	9.1	11.5	4	-
12*	*P. serratum*	LL	45.0	53.0	43.1	35	97.5	14.8	8.3	11.1	2.7	-
		ML	45.0	60.3	55.5	39	95.5	15.2	11.2	28.8	2.8	-
		HL	45.4	61.0	51.0	33	151.5	20.2	6.7	24	2.3	-
		SL	48.9	68.3	59.9	38	107.5	18.2	9.1	28.1	3.7	-
		A/C	44.0	53.5	55.3	33	135.5	13.7	19.1	23	1.5	-
13*	*P. wendlandii*	LL	54.4	69.7	56.7	49	193.5	31.5	9.3	16.5	4.1	-
		ML	54.4	78.2	69.4	47	188.5	33.5	8.0	14.4	5.8	-
		HL	48.4	61.3	70.1	56	183.5	30.2	8.6	12.2	4.6	-
		SL	50.9	55.3	52.0	45	154.5	23.5	11.3	12.5	3.2	-
		A/C	72.8	84.5	93.4	5	415.5	41.5	10.5	10.4	4.4	-
CD (0.05)	Species		3.27	3.92	0.031	0.62	0.62	0.03	0.03	2.31	0.03	
	Light levels		2.01	2.43	0.019	0.03	0.39	0.02	0.01	1.43	0.04	
	Species x light levels		7.30	8.76	0.07	1.39	1.42	0.06	0.06	5.18	0.11	

* Plants with no internodes

with supplementary light; and *Philodendron lacerum* in supplementary light without air condition had the maximum plant height. During the third fortnight, *Philodendron* 'Majesty' (66.1 and 63.4 cm in SL and AC zones respectively) and *Philodendron laciatum* 'Variegata' (116.3 cm) in high light zone, *Philodendron* 'Black Prince' (56.3 cm) in medium light level developed the maximum height.

4.2.1.2. Number of leaves

Among the light levels, plants kept in high and supplementary light without air condition was observed to produce more number of leaves during the first fortnight. Among the interactions, *Philodendron wendlandii* produced maximum number of leaves in all light levels. Minimum number of leaves was recorded in *Philodendron lacerum* in low, medium and it was on par with *Philodendron x Magnificum* in supplementary light without air condition.

4.2.1.3. Plant spread

The spread of philodendrons was recorded in two ways viz., north-south and east-west and the results are presented in Table 14.

4.2.1.3.1. North-south

Among the light levels, plants kept in low and medium light were good during the first fortnight. Plants in high light zone had a compact growth.

While considering the interaction effect, it was observed that *Philodendron lacerum* during first fortnight performed well in all light intensities except in supplementary light without air condition zone and air condition zone with supplementary light (86.7, 81.5 and 91.4 cm in low, medium and high light respectively). *Philodendron hederaceum*(79.5 cm) and *Philodendron wendlandii* (95.4 cm) recorded longest plants in air condition zone and air condition zone with supplementary light respectively. *Philodendron* 'Black Prince' and *Philodendron hederaceum* were good in all light intensities except in supplementary light with air condition zone. *Philodendron* 'Pluto Red' produced minimum plant spread in all light intensities with 29.7, 22.3, 23.5, 30.3 and 29.5 cm in low, medium, high, supplementary light without air condition and supplementary light with air condition. Other philodendrons that produced least spread during first fortnight were *Philodendron* 'Moonshine' and *Philodendron x Magnificum* (in all light levels).

Table 14. Plant characters of selected philodendrons under different indoor light conditions

S. No.	species/variety	Levels of light	Plant height (cm)				Plant spread (East -West) (cm)				Plant spread (North -South) (cm)				No. of leaves				Internodal length (cm)			
			Fortnights				Fortnights				Fortnights				Fortnights				Fortnights			
			I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
		LL	61.3	60.8	0.0	0.0	73.5	74.5	0.0	0.0	76	75.3	0.0	0.0	13	13	0.0	0.0	-	-	-	-
		ML	51.3	51.5	48.2	0.0	52.1	53.5	53.4	0.0	50.7	51.3	52.2	0.0	11	11	11	0.0	-	-	-	-
		HL	45.2	47.2	0.0	0.0	34.8	35.5	0.0	0.0	39.5	36.8	0.0	0.0	8	8	0.0	0.0	-	-	-	-
	P. 'Black	SL	53.5	56.2	0.0	0.0	77.5	79.3	0.0	0.0	71.1	73.3	0.0	0.0	8	8	0.0	0.0	-	-	-	-
1	Beauty'	A/C	51.4	54.5	55.5	0.0	78.3	78.4	78.5	0.0	75.4	75.7	73.4	0.0	6	8	8	0.0	-	-	-	-
		LL	61.5	59.3	59	0.0	70.1	73.1	72.5	0.0	77.3	78.3	78	0.0	30	30	31	0.0	-	-	-	-
		ML	54.5	55.1	56.3	0.0	70.1	79.3	80.3	0.0	77.3	79.5	79.5	0.0	30	34	27	0.0	-	-	-	-
		HL	58.1	59.5	0.0	0.0	78.1	81.5	0.0	0.0	73	82.4	0.0	0.0	22	24	0.0	0.0	-	-	-	-
	P. 'Black	SL	55.5	60.3	62.4	0.0	74.1	76.4	76.3	0.0	73.4	75.5	75.3	0.0	21	24	25	0.0	-	-	-	-
2	Prince'	A/C	46.2	48.2	49.4	0.0	36.4	40.5	42.8	0.0	39.4	41.1	43.7	0.0	25	26	30	0.0	-	-	-	-
		LL	46.3	0.0	0.0	0.0	25.3	0.0	0.0	0.0	39.3	0.0	0.0	0.0	.17	0.0	0.0	0.0	1.1		-	-
		ML	37.5	0.0	0.0	0.0	25.3	0.0	0.0	0.0	35.8	0.0	0.0	0.0	18	0.0	0.0	0.0	0.9		-	-
		HL	41.5	0.0	0.0	0.0	31.2	0.0	0.0	0.0	36.2	0.0	0.0	0.0	17	0.0	0.0	0.0	0.5		-	-
	P. 'Ceylon	SL	58.5	61.3	0.0	0.0	45.5	48.2	0.0	0.0	39.4	41.1	0.0	0.0	29	30	0.0	0.0	0.7	0.8	-	-
3	Gold'	A/C	35.5	42.4	0.0	0.0	54.5	61.7	0.0	0.0	59.3	64.5	0.0	0.0	17	19	0.0	0.0	1.0	1.1	-	-
		LL	76.5	76.2	0.0	0.0	67.1	69.3	0.0	0.0	77	77.3	0.0	0.0	7	14	0.0	0.0	3	3	-	-
		ML	66.4	66.3	0.0	0.0	67.1	73.3	0.0	0.0	77	68.3	0.0	0.0	8	12	0.0	0.0	2.7	2.7	-	-
		HL	79.1	83.3	84.5	0.0	73.1	72.5	73.5	0.0	66.1	73.4	73.5	0.0	13	15	18	0.0	2.2	2.3	2.5	-
	P.	SL	65.1	67.7	0.0	0.0	73.5	75	0.0	0.0	79.5	83.5	0.0	0.0	22	23	0.0	0.0	2.8	3	-	-
4	*hederaceum*	A/C	52.3	55.5	0.0	0.0	55.1	58.2	0.0	0.0	52.3	56.3	0.0	0.0	14	15	0.0	0.0	2.0	2.3	-	-
		LL	89.1	0.0	0.0	0.0	93.1	0.0	0.0	0.0	86.7	0.0	0.0	0.0	5	0.0	0.0	0.0	-	-	-	-
		ML	91.2	0.0	0.0	0.0	86.6	0.0	0.0	0.0	81.5	0.0	0.0	0.0	5	0.0	0.0	0.0	-	-	-	-
		HL	99.2	106.3	0.0	0.0	90.3	89.8	0.0	0.0	91.4	92.5	0.0	0.0	5	5	0.0	0.0	-	-	-	-
		SL	89.3	90.1	0.0	0.0	64	66.3	0.0	0.0	57.3	59.4	0.0	0.0	4	4	0.0	0.0	-	-	-	-
5	*P. lacerum*	A/C	83.5	91.5	0.0	0.0	54.5	88.8	0.0	0.0	86.3	90.2	0.0	0.0	8	9	0.0	0.0	-	-	-	-
		LL	68.8	0.0	0.0	0.0	103.5	0.0	0.0	0.0	76.1	0.0	0.0	0.0	13	0.0	0.0	0.0	5.4	-	-	-
		ML	129.3	103.5	0.0	0.0	106.3	61.2	0.0	0.0	76.1	56.3	0.0	0.0	14	12	0.0	0.0	4.1	3.8	-	-
		HL	115.3	118.5	116.3	0.0	109.3	72.5	106.3	0.0	78.8	73.4	80.5	0.0	10	12	12	0.0	3.6	3.7	3.3	-
	P. laciatum	SL	71.5	0.0	0.0	0.0	94.5	0.0	0.0	0.0	69.2	0.0	0.0	0.0	16	0.0	0.0	0.0	3.9	3.5	-	-
6	'Variegata'	A/C	43.4	46.8	0.0	0.0	59.1	58.3	0.0	0.0	49	48.5	0.0	0.0	14	14	0.0	0.0	3.3	-	-	-
		LL	53	0.0	0.0	0.0	51.2	0.0	0.0	0.0	43.4	0.0	0.0	0.0	11	0.0	0.0	0.0	-	-	-	-
		ML	39.4	39.1	39.1	0.0	30.5	29.3	29.3	0.0	30.3	30.5	30.5	0.0	9	9	9	0.0	-	-	-	-
		HL	36.3	40.5	40.8	0.0	38.1	39.8	39	0.0	41.5	42.4	45.5	0.0	4	5	6	0.0	-	-	-	-
		SL	56.3	61.3	61.7	0.0	49.5	52.3	53	0.0	41.4	46.2	43.5	0.0	4	5	6	0.0	-	-	-	-
7	*P. x Magnificum*	A/C	53.5	57.5	60.3	0.0	37.3	40.5	45.8	0.0	39.3	41.5	45.5	0.0	6	8	9	0.0	-	-	-	-

LL -Low light (<800 lux), ML - Medium light (800 -2000 lux), HL-High light (>2000 lux), SL- Supplementary light without a/c (800 - 2000 lux), AC -Supplementary light with a/c (800 -2000 lux)
* Plants with internodes

Table 14. Plant characters of selected philodendrons under different indoor light conditions (Contd...)

S. No.	Plant species	Levels of light	Plant height (cm)				Plant spread (East-West) (cm)				Plant spread (North -South) (cm)				No. of leaves				Internodal length (cm)			
			Fortnights				Fortnights				Fortnights				Fortnights				Fortnights			
			I	**II	III	IV	I	**II	III	IV	I	**II	III	IV	I	**II	III	IV	I	II	III	IV
		LL	58.3	0.0	0.0	0.0	57.8	0.0	0.0	0.0	70.5	0.0	0.0	0.0	8	0.0	0.0	0.0	4.0	-	-	-
		ML	64.7	0.0	0.0	0.0	59.7	0.0	0.0	0.0	55.5	0.0	0.0	0.0	14	0.0	0.0	0.0	2.8	-	-	-
		HL	38.2	0.0	0.0	0.0	50	0.0	0.0	0.0	45.5	0.0	0.0	0.0	9	0.0	0.0	0.0	2.0	-	-	-
		SL	64.7	66.1	66.1	0.0	59.7	50.5	56.1	0.0	53.1	62.2	57.3	0.0	10	10	11	0.0	2.9	3.0	3.0	-
*8	*P.* 'Majesty'	A/C	50.5	52.3	63.4	63.4	55.5	58.5	66.4	66.4	58.6	63.4	73.5	73.5	9	10	10	10	2.0	2.0	2.5	2.5
		LL	35.1	0.0	0.0	0.0	35.3	0.0	0.0	0.0	36.6	0.0	0.0	0.0	7	0.0	0.0	0.0	-	-	-	-
		ML	31.7	0.0	0.0	0.0	28.3	0.0	0.0	0.0	53.5	0.0	0.0	0.0	8	0.0	0.0	0.0	-	-	-	-
		HL	30.4	0.0	0.0	0.0	25.8	0.0	0.0	0.0	24.5	0.0	0.0	0.0	15	0.0	0.0	0.0	-	-	-	-
		SL	35.1	0.0	0.0	0.0	35.3	0.0	0.0	0.0	36.6	0.0	0.0	0.0	18	0.0	0.0	0.0	-	-	-	-
9	*P.* 'Moonshine'	A/C	38.8	40.5	0.0	0.0	46.4	49.1	0.0	0.0	42.4	45.5	0.0	0.0	10	11	0.0	0.0	-	-	-	-
		LL	28.2	0.0	0.0	0.0	30.5	0.0	0.0	0.0	29.7	0.0	0.0	0.0	10	0.0	0.0	0.0	-	-	-	-
		ML	20.3	0.0	0.0	0.0	21.4	0.0	0.0	0.0	22.3	0.0	0.0	0.0	11	0.0	0.0	0.0	-	-	-	-
		HL	29.3	29.3	0.0	0.0	25.1	25.1	0.0	0.0	23.5	23.5	0.0	0.0	33	33	0.0	0.0	-	-	-	-
		SL	28.3	28.5	0.0	0.0	30.5	30.7	0.0	0.0	30.3	30.4	0.0	0.0	8	8	0.0	0.0	-	-	-	-
10	*P.* 'Pluto Red'	A/C	27.4	24.4	0.0	0.0	41.4	45.5	0.0	0.0	29.5	33.4	0.0	0.0	8	8	0.0	0.0	-	-	-	-
		LL	49.5	51.5	0.0	0.0	56	57.3	0.0	0.0	63	63.8	0.0	0.0	14	15	0.0	0.0	-	-	-	-
		ML	45.5	0.0	0.0	0.0	50	0.0	0.0	0.0	59.2	0.0	0.0	0.0	13	0.0	0.0	0.0	-	-	-	-
		HL	15.5	42.5	0.0	0.0	45.2	49.5	0.0	0.0	48.1	49.4	0.0	0.0	19	20	0.0	0.0	-	-	-	-
	P. 'Red	SL	39.1	0.0	0.0	0.0	50	0.0	0.0	0.0	53.7	0.0	0.0	0.0	10	0.0	0.0	0.0	-	-	-	-
11	Sunlight'	A/C	35	37	0.0	0.0	48.1	49.1	0.0	0.0	46	48.1	0.0	0.0	9	10	0.0	0.0	-	-	-	-
		LL	39.5	0.0	0.0	0.0	54	0.0	0.0	0.0	43.1	0.0	0.0	0.0	35	0.0	0.0	0.0	-	-	-	-
		ML	46	46.5	0.0	0.0	61.3	61.5	0.0	0.0	55.5	55.8	0.0	0.0	39	40	0.0	0.0	-	-	-	-
		HL	46	50.3	0.0	0.0	61.4	62.3	0.0	0.0	51.5	52.5	0.0	0.0	33	35	0.0	0.0	-	-	-	-
		SL	49.4	0.0	0.0	0.0	68.3	0.0	0.0	0.0	60.4	0.0	0.0	0.0	38	0.0	0.0	0.0	-	-	-	-
12	*P. serratum*	A/C	45	45.7	0.0	0.0	55.5	58.5	0.0	0.0	56.3	58.2	0.0	0.0	33	34	0.0	0.0	-	-	-	-
		LL	61.2	0.0	0.0	0.0	71.7	0.0	0.0	0.0	57.7	0.0	0.0	0.0	50	0.0	0.0	0.0	-	-	-	-
		ML	56.3	58.5	0.0	0.0	79.2	79.5	0.0	0.0	71.4	72.5	0.0	0.0	49	50	0.0	0.0	-	-	-	-
		HL	49.4	0.0	0.0	0.0	63.3	0.0	0.0	0.0	70.5	0.0	0.0	0.0	58	0.0	0.0	0.0	-	-	-	-
		SL	51.4	55.7	0.0	0.0	56.3	59.3	0.0	0.0	52.5	55.5	0.0	0.0	45	49	0.0	0.0	-	-	-	-
13	*P. wendlandii*	A/C	73.8	75.5	0.0	0.0	85.5	88.2	0.0	0.0	95.4	94.5	0.0	0.0	5	7	0.0	0.0	-	-	-	-
CD	Species		0.86	0.09			0.08	0.09			0.03	0.09			0.62	1.96			-			
(0.0	Light levels		0.019				0.05				0.02				0.03				-			
5)	Species x light levels		0.19				0.18				0.08				1.39				-			

Table 15. Leaf characters of selected philodendrons under different indoor light conditions

S. No.	Plant species	Levels of light	Leaf area (sq. cm)				Leaf length (cm)				Leaf breadth (cm)				Petiole length (cm)				Petiole girth (cm)			
			Fortnights				Fortnights				Fortnights				Fortnights				Fortnights			
			I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1	*P.* 'Black Beauty'	LL	563.5	563.5	0.0	0.0	32.3	32.5	0.0	0.0	20.5	20.5	0.0	0.0	20.7	20.7	0.0	0.0	4.7	4.7	0.0	0.0
		ML	424.5	455.5	455.5	0.0	26.7	29.4	26.7	0.0	16.8	16.8	19.3	0.0	15.3	15.3	15.3	0.0	4	4	4	0.0
		HL	263.5	268.5	0.0	0.0	23.1	25.5	0.0	0.0	13.2	14.4	0.0	0.0	15	15.5	0.0	0.0	3.8	4.1	0.0	0.0
		SL	542.5	542.5	0.0	0.0	32.4	31.4	0.0	0.0	21.2	21.2	0.0	0.0	18	18	0.0	0.0	4.7	4.7	0.0	0.0
		A/C	321.5	321.5	345.5	0.0	24.8	24.8	26.3	0.0	14.7	14.7	16.3	0.0	18.4	18.4	18.5	0.0	3.5	3.5	3.4	0.0
2	*P.* 'Black Prince'	LL	457.5	457.5	423.5	0.0	34.8	32.5	28	0.0	15.5	15.5	12.3	0.0	12.3	12.3	14.4	0.0	5.2	5.5	5.5	0.0
		ML	457.5	257.5	324.5	0.0	34.8	26.4	33.3	0.0	15.5	10	14.1	0.0	12.3	13.1	18.1	0.0	5.2	4.8	5	0.0
		HL	267.5	259.5	0.0	0.0	27.1	28.8	0.0	0.0	11.3	12.5	0.0	0.0	11.7	11.8	0.0	0.0	5.5	5.8	0.0	0.0
		SL	5.5.5	522.5	530.5	0.0	26.3	29.5	31.3	0.0	15.3	16.4	18.3	0.0	4.7	12.3	13.4	0.0	5.5	5.7	5.8	0.0
		A/C	253.5	235.5	282.5	0.0	23.4	21.3	24.4	0.0	10.8	11.5	13.3	0.0	14.1	12.5	14.5	0.0	5	4.8	5.1	0.0
3	*P. 'Ceylon Gold'	LL	57.5	0.0	0.0	0.0	13.5	0.0	0.0	0.0	46.4	0.0	0.0	0.0	6.3	0.0	0.0	0.0	1.7	0.0	0.0	0.0
		ML	57.5	0.0	0.0	0.0	13.5	0.0	0.0	0.0	4.5	0.0	0.0	0.0	6.3	0.0	0.0	0.0	1.7	0.0	0.0	0.0
		HL	50.5	0.0	0.0	0.0	13.1	0.0	0.0	0.0	4.1	0.0	0.0	0.0	6.3	0.0	0.0	0.0	1.5	0.0	0.0	0.0
		SL	95.5	57.5	0.0	0.0	14.4	14.5	0.0	0.0	4	4.4	0.0	0.0	8.8	9	0.0	0.0	1.8	2	0.0	0.0
		A/C	218.5	228.5	0.0	0.0	23.5	24.7	0.0	0.0	9.3	10.5	0.0	0.0	16.3	16.8	0.0	0.0	2.7	2.8	0.0	0.0
4	**P. hederaceum*	LL	306.5	264.5	0.0	0.0	24.5	21.5	0.0	0.0	15.2	14.5	0.0	0.0	13	13	0.0	0.0	3.5	3	0.0	0.0
		ML	305.5	437.5	0.0	0.0	24.5	23.4	0.0	0.0	15.2	14.5	0.0	0.0	13	15.5	0.0	0.0	3.5	3.2	0.0	0.0
		HL	485.5	509.5	515.5	0.0	28.6	28.8	29.4	0.0	18.5	19.3	19.5	0.0	23	24.1	25.5	0.0	2.8	3	3.4	0.0
		SL	355.5	419.5	0.0	0.0	30.5	31.5	0.0	0.0	15.3	18.5	0.0	0.0	23.5	24.4	0.0	0.0	3.2	3.4	0.0	0.0
		A/C	300.5	324.5	0.0	0.0	21.5	22.5	0.0	0.0	12.8	14	0.0	0.0	12.2	12.5	0.0	0.0	2.7	3	0.0	0.0
5	*P. lacerum*	LL	855.5	0.0	0.0	0.0	34.5	0.0	0.0	0.0	32.3	0.0	0.0	0.0	59.1	0.0	0.0	0.0	5.5	0.0	0.0	0.0
		ML	1242.5	0.0	0.0	0.0	48	0.0	0.0	0.0	43.5	0.0	0.0	0.0	51.5	0.0	0.0	0.0	4.7	0.0	0.0	0.0
		HL	1199.5	1345.5	0.0	0.0	45.5	46	0.0	0.0	39	38.8	0.0	0.0	38.2	38.8	0.0	0.0	4	4.1	0.0	0.0
		SL	904.5	964.5	0.0	0.0	43	46	0.0	0.0	28.3	31.4	0.0	0.0	45.3	48.8	0.0	0.0	4.1	4.4	0.0	0.0
		A/C	904.5	952.5	0.0	0.0	33.5	32.5	0.0	0.0	41.1	43	0.0	0.0	39.5	40.1	0.0	0.0	4.2	4	0.0	0.0
6	**P. laciatum* 'Variegata'	LL	488	0.0	0.0	0.0	29	0.0	0.0	0.0	23.5	0.0	0.0	0.0	28.2	0.0	0.0	0.0	3.4	0.0	0.0	0.0
		ML	383.5	525.5	0.0	0.0	29	31.3	0.0	0.0	23.5	18.4	0.0	0.0	28.2	20.4	0.0	0.0	3.4	3.3	0.0	0.0
		HL	438.5	458.5	485.5	0.0	21.3	24.5	26.4	0.0	22.1	25.6	27.8	0.0	28.3	29.5	30.4	0.0	3.3	3.5	3.8	0.0
		SL	694.5	0.0	0.0	0.0	33.1	0.0	0.0	0.0	28.1	0.0	0.0	0.0	28	0.0	0.0	0.0	3	0.0	0.0	0.0
		A/C	593.5	467.5	0.0	0.0	45.1	23.5	0.0	0.0	23.3	21.1	0.0	0.0	26.2	25.1	0.0	0.0	3.5	3	0.0	0.0
7	*P. x Magnificum*	LL	397.5	0.0	0.0	0.0	23.3	0.0	0.0	0.0	21.5	0.0	0.0	0.0	36.7	0.0	0.0	0.0	3.7	0.0	0.0	0.0
		ML	39.4	39.1	39.1	0.0	30.5	29.3	29.3	0.0	30.3	30.5	30.5	0.0	9	9	9	0.0	3.0	-	-	-
		HL	36.3	40.5	40.8	0.0	38.1	39.8	39	0.0	41.5	42.4	45.5	0.0	4	5	6	0.0	2.4	-	-	-
		SL	56.3	61.3	61.7	0.0	49.5	52.3	53	0.0	41.4	46.2	43.5	0.0	4	5	6	0.0	2.0	-	-	-
		A/C	53.5	57.5	60.3	0.0	37.3	40.5	45.8	0.0	39.3	41.5	45.5	0.0	6	8	9	0.0	2.4	-	-	-

Table 15. Leaf characters of selected philodendrons under different indoor light conditions (Contd...)

S. No.	Plant species	Levels of light	Leaf area (sq. cm)				Leaf length (cm)				Leaf breadth (cm)				Petiole length (cm)				Petiole girth (cm)			
			Fortnights				Fortnights				Fortnights				Fortnights				Fortnights			
			I	**II	III	IV	I	**II	III	IV	I	**II	III	IV	I	**II	III	IV	I	**II	III	IV
		LL	157.5	0.0	0.0	0.0	18.5	0.0	0.0	0.0	11.1	0.0	0.0	0.0	9	0.0	0.0	0.0	4	0.0	0.0	0.0
		ML	635.5	0.0	0.0	0.0	35.4	0.0	0.0	0.0	20.5	0.0	0.0	0.0	29.3	0.0	0.0	0.0	4.1	0.0	0.0	0.0
		HL	628.5	0.0	0.0	0.0	34.7	0.0	0.0	0.0	20.1	0.0	0.0	0.0	23.1	0.0	0.0	0.0	3.8	0.0	0.0	0.0
		SL	505.5	505.5	558.5	0.0	24	24	32.3	0.0	15.5	15.5	18.4	0.0	17.8	17.8	22.2	0.0	4.1	4.1	3.1	0.0
8	*P.*'Majesty'	A/C	515.5	523.5	525.5	574.5	35.1	35.5	35.5	29.3	15.3	16.3	16.4	17.7	19.5	21.2	25.3	24.3	3.5	3.4	3.5	3.2
		LL	152.5	0.0	0.0	0.0	14.7	0.0	0.0	0.0	11.4	0.0	0.0	0.0	9.4	0.0	0.0	0.0	4	0.0	0.0	0.0
		ML	194.5	0.0	0.0	0.0	20.1	0.0	0.0	0.0	11.8	0.0	0.0	0.0	9	0.0	0.0	0.0	4	0.0	0.0	0.0
		HL	215.5	0.0	0.0	0.0	22.6	0.0	0.0	0.0	13.7	0.0	0.0	0.0	6.8	0.0	0.0	0.0	3.5	0.0	0.0	0.0
		SL	145.5	0.0	0.0	0.0	14.7	0.0	0.0	0.0	11.4	0.0	0.0	0.0	11.6	0.0	0.0	0.0	3.8	0.0	0.0	0.0
9	*P.* 'Moonshine'	A/C	215.5	253.5	0.0	0.0	23.4	24.5	0.0	0.0	11.4	11.5	0.0	0.0	8.5	8.8	0.0	0.0	5	5.3	0.0	0.0
		LL	53.5	0.0	0.0	0.0	20.5	0.0	0.0	0.0	3.7	0.0	0.0	0.0	10.5	0.0	0.0	0.0	2.7	0.0	0.0	0.0
		ML	68.5	0.0	0.0	0.0	23.7	0.0	0.0	0.0	3.8	0.0	0.0	0.0	11.8	0.0	0.0	0.0	2.6	0.0	0.0	0.0
		HL	101.5	101.5	0.0	0.0	16.7	16.7	0.0	0.0	20.3	20.3	0.0	0.0	16.1	16.1	0.0	0.0	1.3	1.3	0.0	0.0
		SL	48.5	48.5	0.0	0.0	17.7	17.7	0.0	0.0	3.5	3.5	0.0	0.0	7	7.1	0.0	0.0	1.5	1.5	0.0	0.0
10	*P.* 'Pluto Red'	A/C	60.5	68.5	0.0	0.0	19.3	20	0.0	0.0	3	3.8	0.0	0.0	13.1	13.4	0.0	0.0	1.8	2.1	0.0	0.0
		LL	238.5	245.5	0.0	0.0	21.7	24.5	0.0	0.0	10	14.5	0.0	0.0	12.3	14.2	0.0	0.0	2	2.4	0.0	0.0
		ML	347.5	0.0	0.0	0.0	26.3	0.0	0.0	0.0	12.3	0.0	0.0	0.0	12.2	0.0	0.0	0.0	2.3	0.0	0.0	0.0
		HL	181.5	194.5	0.0	0.0	22	23.5	0.0	0.0	10.1	10.8	0.0	0.0	12.4	12.8	0.0	0.0	2.8	3.4	0.0	0.0
	P. 'Red	SL	147.5	0.0	0.0	0.0	18.1	0.0	0.0	0.0	8.8	0.0	0.0	0.0	8.2	0.0	0.0	0.0	2	0.0	0.0	0.0
11	Sunlight'	A/C	128.5	95.5	0.0	0.0	15.5	16.2	0.0	0.0	9.1	6.2	0.0	0.0	11.5	16.2	0.0	0.0	4	4.4	0.0	0.0
		LL	97.5	0.0	0.0	0.0	14.8	0.0	0.0	0.0	8.3	0.0	0.0	0.0	11.1	0.0	0.0	0.0	2.7	0.0	0.0	0.0
		ML	95.5	103.5	0.0	0.0	15.2	15.5	0.0	0.0	11.2	11.4	0.0	0.0	28.8	29.4	0.0	0.0	2.8	3	0.0	0.0
		HL	151.5	158.5	0.0	0.0	20.2	20.7	0.0	0.0	6.7	7.1	0.0	0.0	24	25.8	0.0	0.0	2.3	2.7	0.0	0.0
		SL	107.5	0.0	0.0	0.0	18.2	0.0	0.0	0.0	9.1	0.0	0.0	0.0	28.1	0.0	0.0	0.0	3.7	0.0	0.0	0.0
12	*P. serratum*	A/C	135.5	124.5	0.0	0.0	13.7	14.4	0.0	0.0	19.1	19.4	0.0	0.0	23	23.3	0.0	0.0	1.5	1.7	0.0	0.0
		LL	183.5	0.0	0.0	0.0	30.2	0.0	0.0	0.0	9.2	0.0	0.0	0.0	17.5	0.0	0.0	0.0	4.2	0.0	0.0	0.0
		ML	185.5	204.5	0.0	0.0	33	33.4	0.0	0.0	8	8.3	0.0	0.0	15.4	15.7	0.0	0.0	5.8	6	0.0	0.0
		HL	173.5	0.0	0.0	0.0	29.7	0.0	0.0	0.0	8.5	0.0	0.0	0.0	12.3	0.0	0.0	0.0	4.7	0.0	0.0	0.0
		SL	157.5	203.5	0.0	0.0	24.5	25.3	0.0	0.0	11.3	11.8	0.0	0.0	12.5	15.1	0.0	0.0	3.2	3.5	0.0	0.0
13	*P. wendlandii*	A/C	415.5	335.5	0.0	0.0	41.5	36.3	0.0	0.0	10.5	8.5	0.0	0.0	10.4	8.5	0.0	0.0	4.4	2.7	0.0	0.0
CD (0.05)	Species		0.62	1.96			0.03	0.09			0.03	0.09			2.31	0.09			0.03	0.09		
	Light levels		0.39				0.02				0.01				1.43				0.04			
	Species x Light levels		1.42				0.06				0.06				5.18				0.11			

Plants that produced highest spread during second fortnight were *Philodendron* 'Black Prince' (low and medium light levels), *Philodendron lacerum* (high light), *Philodendron hederaceum* (supplementary light without air condition) and *Philodendron wendlandii* (supplementary light with air condition). During third fortnight, *Philodendron* 'Black Prince' (ML and SL), *Philodendron laciatum* 'Variegata' (HL), *Philodendron* 'Majesty' (AC) had the highest plant spread.

4.2.1.3.2. East-west

The plant spread in east-west direction of philodendrons kept in low light zone during first fortnight was the maximum. Other combinations produced the highest spread during first fortnight were *Philodendron laciatum* 'Variegata' in all light levels (except air condition zone) and *Philodendron wendlandii* in air condition zone (85.5 cm). In *Philodendron lacerum* the spread was good in all levels except supplementary light with air condition and supplementary light without air condition.

From the interaction during second fortnight *Philodendron* Black Beauty (low light and supplementary light) *Philodendron wendlandii* (medium light) *Philodendron lacerum* (high light and air condition) which was on par with *Philodendron x Magnificum* in high light had the maximum plant spread. During the last fortnight, the following combinations produced the highest plant spread *Philodendron* 'Black Prince' (medium light, supplementary light and air condition with supplementary), *Philodendron laciatum* 'Variegata' (high light).

4.2.1.4. Internodal length

Internodal length was recorded only in three philodendrons as the others did not have measurable internodes. *Philodendron laciatum* 'Variegata' (5.4 cm) and *Philodendron* 'Majesty' when kept in low light zone were observed to have maximum internodal length and *Philodendron* 'Ceylon Gold' (0.7 cm) in supplementary light level had the least.

4.2.2. Leaf characters

The various leaf characters of philodendron species/varieties were observed under different light intensities and the values are given in Table 15.

4.2.2.1. Leaf area

During first fortnight, the medium light supplementary light without air condition and high light were found superior compared to other light levels. Interaction effects showed that *Philodendron lacerum* (in all light levels) recorded the highest leaf area and *Philodendron* 'Ceylon Gold' recorded the lowest in low, medium and high light levels.

During the second fortnight, the following combinations produced the highest leaf area values in *Philodendron* 'Black Beauty' (LL), *Philodendron laciatum* 'Variegata' (ML), *Philodendron lacerum* (HL and SL) and *Philodendron* 'Majesty' (AC).

4.2.2.2. Leaf length

The plants kept in light levels of medium, air conditioned with supplementary light and high light zones had the leaf length than others. During the firstfortnight, *Philodendron lacerum* in medium light (48.0 cm), high light (45.5cm) and supplementary light zone (43.0 cm) had the highest leaf length and the lowest was obtained in *Philodendron* 'Ceylon Gold' in all light zones(except air conditioned zone).

4.2.2.3. Leaf breadth

Leaf breadth of philodendrons in zones of low, medium and high light was the maximum. *Philodendron lacerum* had the highest leaf breadth in all light levels.

4.2.2.4. Petiole length

High light, supplementary light and medium light were the good light conditions where the plants had the highest petiole length during the first fortnight. Among the interactions, *Philodendron lacerum* in low light (59.1 cm), medium light (51.5 cm), supplementary light (45.5 cm) and air conditioned zone with supplementary light (39.5 cm) levels had the highest petiole length. *Philodendron* 'Ceylon Gold' in low, medium and high light levels produced the shortest petiole.

4.2.2.5. Petiole girth

The plants kept under low light, medium light and air conditioned zone with supplementary light had the highest petiole girth. *Philodendron lacerum* and *Philodendron wendlandii* had the maximum petiole girth in low and medium light levels respectively and

Philodendron 'Black Prince' in high light supplementary light without air condition and air condition zone with supplementary light.

4.2.3. Indoor life of philodendrons

Indoor life of philodendrons was determined by counting the number of days the plants could be kept in different indoor light conditions without any symptoms/signs of damage.

The species/varieties which did not produce any symptoms for more number of days under different indoor light conditions were *Philodendron x Magnificum*, followed by *Philodendron* 'Black Prince' and *Philodendron* 'Majesty' and the plants that produced the symptoms of damage within a short span were *Philodendron* 'Moonshine', *Philodendron* 'Red Sunlight' , *Philodendron wendlandii* and *Philodendron lacerum.*

When the light conditions were compared, the zones with air condition with supplementary light (800-2000 lux) and supplementary light without air-condition (800-2000 lux) were found good to keep the plants without any sign of damage for more number of days.

The interaction between the species and light levels also produced significant results. *Philodendron* 'Majesty' and *Philodendron x Magnificum* both in air conditioned zone with supplementary light (800-2000 lux) and in supplementary light with non air condition produced no symptoms upto of 59 days. *Philodendron* 'Moonshine' in high light zone (>800 lux) lasted only for 8 days. The quality rating of the plants under indoor conditions was also done Table 16 and fig 13. *Philodendron* 'Majesty' scored the highest in visual scoring done by an expert panel.

4.2.4. Major symptoms/signs of damage

The philodendrons at different light conditions showed different kinds of symptoms/signs of damage when kept for a long period. Symptoms were observed at every part of the plant from leaf tip to main stalk. It ranged from yellowing, wilting, leaf drop, leaf drying, tip browning, bending, etc which were listed in Table 17with respect to each species/variety under different light conditions.

4.2.5. Pests & Diseases

Under indoor conditions, no pest and disease problems were observed in all the light levels.

Table 16. Quality rating of philodendrons by visual scoring

S. No.	Species/Variety	Growth & fullness (Texture, Shape & Pattern) (Out of 10)	Colour & Pigmenta -tion (Out of 10)	Suitability to indoor conditions (Tolerance capacity) (Out of 10)	Pest & Diseases & other problems (Out of 10)	Total (out of 40)
1	*Philodendron bipinnatifidum*	8.4	8.5	7.1	8.8	32.8
2	*Philodendron* 'Black Beauty'	8.6	9.3	5.0	8.9	31.8
3	*Philodendron* 'Black Cardinal'	8.7	8.6	5.4	8.1	30.8
4	*Philodendron* 'Black Prince'	8.1	8.5	5.2	7.8	29.6
5	*Philodendron* 'Ceylon Gold'	8.8	7.4	6.4	8.2	30.8
6	*Philodendron elegans*	8.6	7.6	6.8	7.9	30.9
7	*Philodendron hederaceum*	8.9	8.9	5.1	9.3	32.2
8	*Philodendron karstenianum*	8.4	8.6	4.6	8.6	30.2
9	*Philodendron lacerum*	7.8	8.1	5.2	8.8	29.9
10	*Philodendron lacinatum* 'Variegata'	8.8	8.2	7.9	7.2	32.1
11	*Philodendron* x *Magnificum*	7.6	8.3	8.6	7.1	31.6
12	*Philodendron* 'Majesty'	9.3	9.1	8.5	8.8	35.7
13	*Philodendron* 'Moon Shine'	7.2	7.6	5.0	2.6	25.7

(Contd...)

Table 16. Quality rating of philodendrons by visual scoring (contd...)

S. No.	Species/Variety	Growth & fullness (Texture, Shape & Pattern) (Out of 10)	Colour & Pigmenta -tion (Out of 10)	Suitability to indoor conditions (Tolerance capacity) (Out of 10)	Pest & Diseases & other problems (Out of 10)	Total (out of 40)
14	*Philodendron pertusum*	9.1	8.4	8.7	8.5	34.7
15	*Philodendron* 'Pluto Red'	6.4	8.1	5.0	8.4	27.9
16	*Philodendron* 'Red Dutches'	8.6	8.3	5.5	7.1	29.5
17	*Philodendron* 'Red Sunlight'	7.9	8.6	7.7	8.4	32.6
18	*Philodendron sagittifolium*	8.8	8.6	8.2	8.5	33.5
19	*Philodendron scandens oxycardium*	9.3	7.8	9.1	9.1	35.3
20	*Philodendron serratum*	7.8	7.6	6.1	7.2	28.7
21	*Philodendron* 'Smithi'	8.3	8.5	6.2	8.3	31.3
22	*Philodendron superbum*	8.6	8.3	5.6	8.6	31.1
23	*Philodendron wend-imbe*	8.4	7.1	6.7	8.4	30.6
24	*Philodendron wendlandii*	8.1	7.6	9.0	8.8	33.5
25	*Philodendron williamsii*	9.4	7.8	6.6	8.9	32.7

Table 17. Indoor life, damage symptoms, pests / diseases infection of selected philodendrons under indoor conditions

S. No.	Species/variety	Levels of light	Indoor life (days)	Symptoms of damage
1		LL	26.5	fading of colour
		ML	32.5	wilting, leaf drying
		HL	22	Leaf drying, wilting
		SL	24.5	leaf drying
	Philodendron Black Beauty	A/C	33	Leaf drying
2		LL	32.5	Leaves weak
		ML	36	spots, yellowing, wilting
		HL	17.5	leaf wilting
		SL	41.5	leaf margin brown
	Philodendron Black Prince	A/C	39.5	yellowing, tip brown,
3		LL	10.5	leaf colour fading, drying,
		ML	13.5	Bending
		HL	14	Bending
		SL	23.5	tip scorch, yellow-green
	Philodendron 'Ceylon Gold'	A/C	24	leaf colour fading, drying,
4		LL	16.5	leaf colour fading, drying,
		ML	28.5	Bending
		HL	32.5	Bending
		SL	18	tip scorch, yellow-green
	Philodendron hederaceum	A/C	33	Bending
5		LL	10.5	spots, yellowing, wilting
		ML	14	wilting
		HL	17.5	Bending
		SL	25	yellow-green at margin
	Philodendron lacerum	A/C	28.5	yellowing, margin brown
6		LL	13.5	yellow-green, wilting
		ML	20.5	drying, wilting
		HL	37	Bending
		SL	14	leaves droop, drying, wilting
	Philodendron laciatum 'Variegata'	A/C	21	wilting

(Contd...)

Table 17. Indoor life, damage symptoms, pests / diseases of selected philodendrons under indoor conditions (Contd...)

S. No.	Species/variety	Levels of light	Indoor life (days)	Symptoms of damage
7		LL	11	spots, yellowing, wilting
		ML	42.5	wilting
		HL	39	yellowing
		SL	48.5	yellow-green leaf
	Philodendron x Magnificum	A/C	49	yellowing, margin brown
8		LL	10	leaf drooping, yellow-green
		ML	8.5	drying
		HL	8.5	Bending
		SL	58	leaves droop, wilting
	Philodendron 'Majesty'	A/C	59	no symptoms
9		LL	8	leaf droop
		ML	9	wilting
		HL	6	leaf scorching
		SL	10	drooping
	Philodendron 'Moonshine'	A/C	16	drying
10		LL	10.5	tip brown, oldest leaf dry
		ML	14	tip brown, leaf drying
		HL	17.5	tip brown, yellowish green
		SL	25	tip scorch, wilting
	Philodendron 'Pluto Red'	A/C	25	old leaves dried and shrinken
11		LL	21	margin brown, leaf drying
		ML	11	Leaf colour fading
		HL	19.5	tip and margin brown
		SL	9	leaf blotch, drying
	Philodendron 'Red Sunlight'	A/C	20	margin brown
12		LL	12	tip and margin brown
		ML	28	tip brown, margin yellow
		HL	25	margin brown
		SL	14	margin brown, leaf drying
	Philodendron serratum	A/C	29	margin brown, yellowing
13		LL	10	leaves yellow-green
		ML	23	Bending
		HL	13.5	Bending
		SL	24.5	yellow-green
	Philodendron wendlandii	A/C	24.5	bending

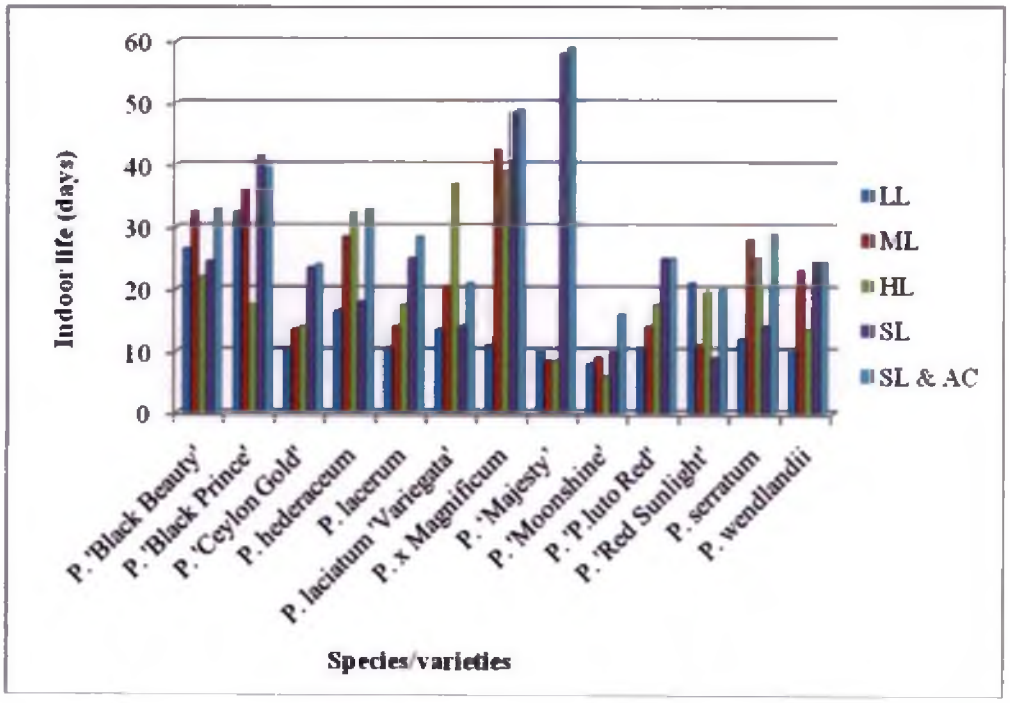


Fig 13.Indoor life of selected philodendrons under different light intensities

. 4.3. Air Pollution Tolerance Index (APTI) of philodendrons

The Air Pollution Tolerance Index was computed from four parameters, total chlorophyll content, leaf extract pH, relative water content and ascorbic acid content. Twenty-five *Philodendron* species/varieties selected for the study were analyzed for the above parameters.

4.3.1. Total chlorophyll content

To determine the air pollution tolerance index of plants, total chlorophyll content is an important parameter. The chlorophyll content was analyzed and the values are presented in Table. 18 fig 14.

The total chlorophyll content of the Philodendrons differed significantly. *Philodendron* 'Red Dutches' recorded the maximum chlorophyll content (2.85 mg /g) and it was closely followed by *Philodendron lacerum* and *Philodendron bipinnatifidum* with contents of 2.763 and 2.683 mg/g respectively and they were on par. The lowest content was recorded in *Philodendron scandens oxycardium* (0.11 mg/g) which is followed by *Philodendron* 'Moonshine' (0.49 mg/g), and *Philodendron'* Red Sunlight' (1.16 mg/g).

4.3.2. Leaf extract pH

Leaf extract pH also plays a vital role in evaluating the air pollution tolerance of philodendrons, as the plants depend on pH levels to carry out their various physiological and biochemical functions. So they were analyzed for their leaf extract pH and data are presented in Table 18 and fig 15.

The highest pH value recorded was 5.54 in *Philodendron lacerum* and it was closely followed by *Philodendron superbum* and *Philodendron* 'Majesty' with pH of 5.51 and 5.45 respectively which were on par. The lowest pH values were in *Philodendron scandens oxycardium* (3.82), *Philodendron williamsii* (4.44) and *Philodendron pertusum* (4.68).

4.3.3. Relative Water Content (RWC)

The most important factor to keep the plants live is turgidity RWC represents turgidity and determines the ability of plants to resist air pollutants. The RWC of *Philodendron* is presented in Table 18 and fig 16.

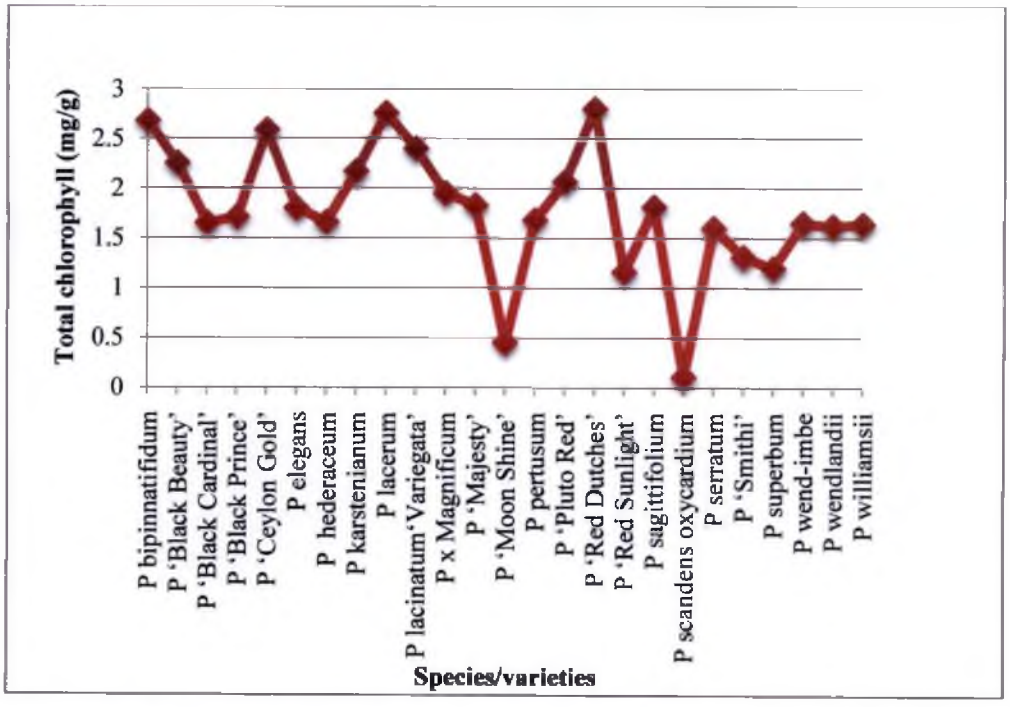


Fig 14.Total chlorophyll content of species/varieties of *Philodendron*

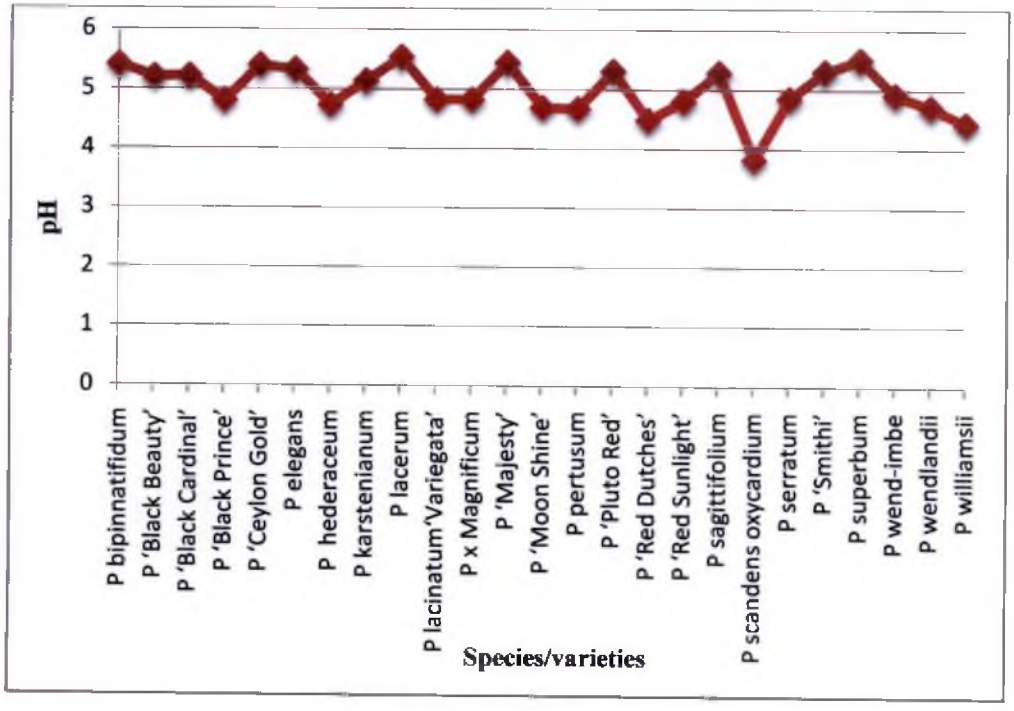


Fig 15 pH value of species/varieties of *Philodendron*

Philodendron 'Black Prince' had the highest RWC of 97.02 per cent followed by *Philodendron lacerum* and *Philodendron* 'Black Beauty' with contents of 90.44 per cent 89.82 per cent respectively, which were on par. *Philodendron wend-imbe* recorded the lowest value (78.30 %) followed by *Philodendron superbum* (79.511 %) and they were on par.

4.3.4. Ascorbic acid content

Ascorbic acid is the main deciding factor of the tolerance of plants to air pollutants rather than any other. The ascorbic acid content of different *Philodendron* species/varieties is presented in Table 18 and fig 17.

Philodendron 'Majesty' recorded 29.16 mg/g of ascorbic acid content which was the highest value recorded among the philodendrons under study and is followed by *Philodendron serratum* (20.40 mg/g) and *Philodendron* 'Black Cardinal' (13.50 mg/g). The lowest value (0.45 mg/g) was in *Philodendron bipinnatifidum* and it was on par with *Philodendron superbum* (0.97 mg/g), *Philodendron karstenianum* (1.89 mg/g), *Philodendron* x *Magnificum* (2.01 mg/g), and *Philodendron* 'Smithi' (2.01 mg/g).

4.3.5. Air Pollution Tolerance Index (APTI)

The Air Pollution Tolerance Index was computed from the above parameters. The susceptibility level of Philodendrons to air pollution was also assessed Table.18,19 and fig 18.

The species were significantly different in their pollution tolerance index. The APTI values calculated ranged from the maximum of 30.27 in *Philodendron* 'Majesty' to the minimum of 8.56 in *Philodendron superbum*. The next highest level of APTI was in *Philodendron serratum* (22.32) and *Philodendron* 'Black Cardinal' (17.53). Rest of the species had APTI in the range of 9.0 to 16.0

4.3.6. Susceptibility levels

The susceptibility of the *Philodendron* to air pollution was determined based on the APTI values. The species which scored APTI values more than 18 were categorized as tolerant, 15-18 as medium tolerant, 11-14 as intermediately tolerant and species that scored below or equal to 10 were categorized as susceptible to air pollution. The philodendrons varied in their susceptibility

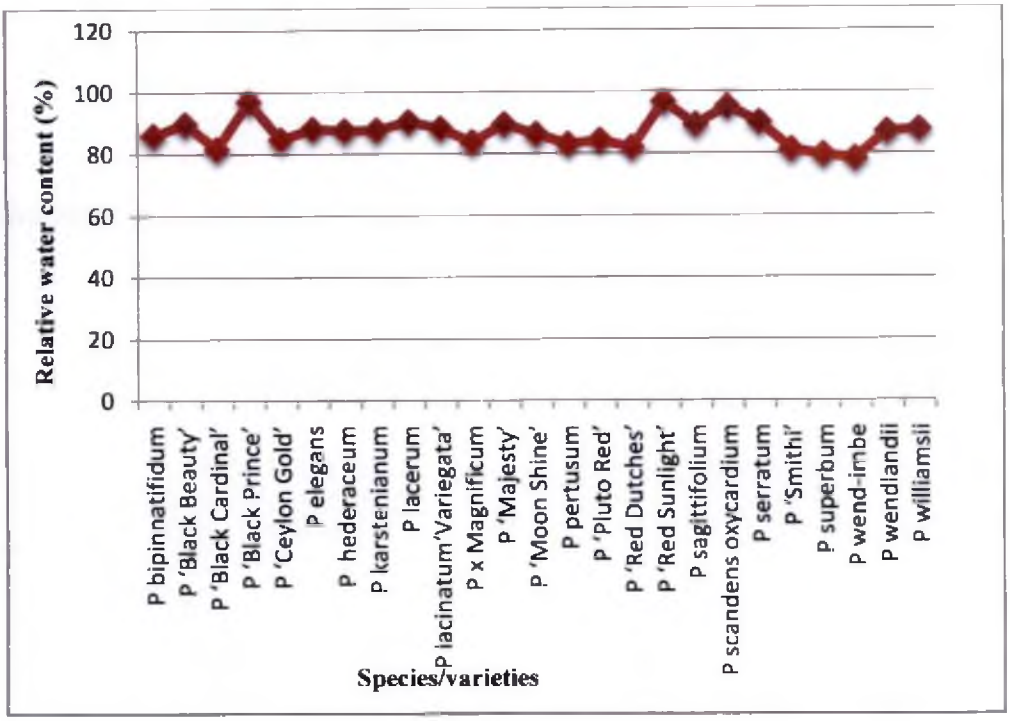


Fig 16. Relative water content of species/varieties of *Philodendron*

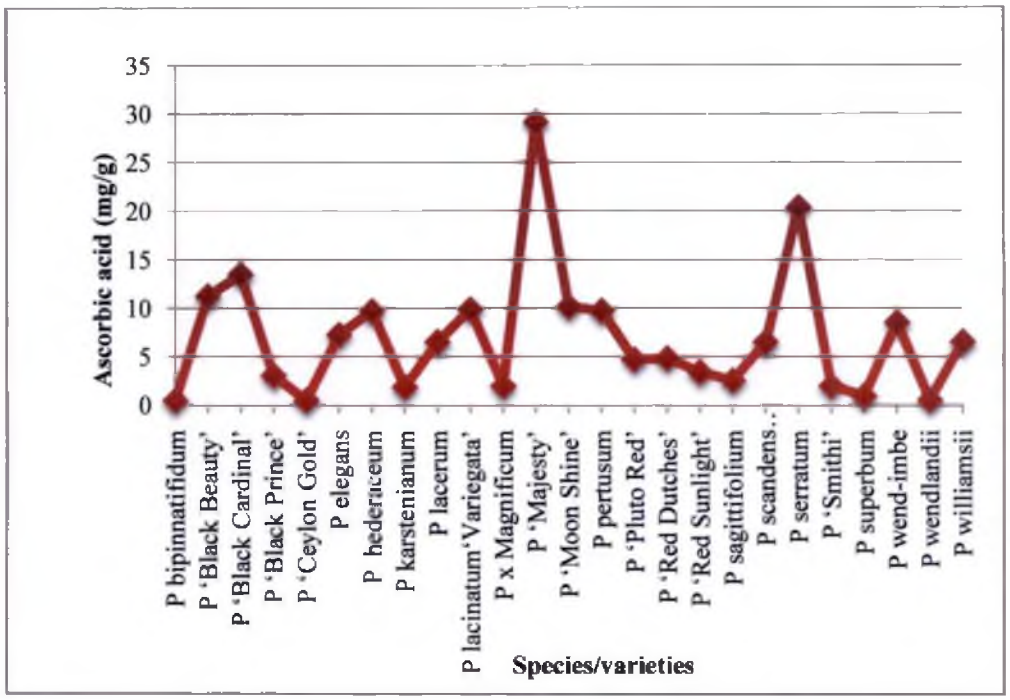


Fig 17.Ascorbic acid content of species/varieties of *Philodendron*

Table 18. Air Pollution Tolerance Index (APTI) of philodendrons

S.no	Plant species	Total chlorophyll (mg/g)	pH	Ascorbic acid (mg/g)	RWC (%)	APTI
1	*Philodendron bipinnatifidum*	2.68^{ab}	5.41^{abc}	0.48^{l}	86.09^{efgh}	9.01^{j}
2	*Philodendron* 'Black Beauty'	2.25^{d}	5.21^{de}	11.3^{d}	89.82^{bc}	17.45^{c}
3	*Philodendron* 'Black Cardinal'	1.65^{hi}	5.22^{de}	13.5^{c}	81.72^{jkl}	17.53^{c}
4	*Philodendron* 'Black Prince'	1.71^{hi}	4.81^{fg}	3.09^{ij}	97.02^{a}	11.84^{ghi}
5	*Philodendron* 'Ceylon Gold'	2.59^{bc}	5.4^{abc}	0.51^{l}	84.68^{ghij}	8.74^{j}
6	*Philodendron elegans*	1.8^{gh}	5.33^{bcd}	7.28^{fg}	88.12^{bcde}	14.08^{defg}
7	*Philodendron hederaceum*	1.66^{hi}	4.74^{fg}	9.73^{de}	87.55^{bcdef}	15.01^{de}
8	*Philodendron karstenianum*	2.17^{de}	5.14^{e}	1.89^{jkl}	87.7^{bcde}	10.25^{hij}
9	*Philodendron lacerum*	2.76^{ab}	5.54^{a}	6.56^{gh}	90.44^{b}	14.47^{def}
10	*Philodendron lacinatum*'Variegata'	2.4^{c}	4.83^{fg}	9.91^{de}	88.26^{bcde}	16.02^{cd}
11	*Philodendron* x *Magnificum*	1.95^{fg}	4.83^{fg}	2.01^{jkl}	83.75^{hijk}	9.87^{ij}
12	*Philodendron* 'Majesty'	1.83^{ghi}	5.45^{abc}	29.16^{a}	89.58^{bc}	30.27^{a}
13	*Philodendron* 'Moon Shine'	$.45^{k}$	4.7^{g}	10.2^{de}	86.36^{defgh}	13.93^{defg}
14	*Philodendron pertusum*	1.68^{hi}	4.68^{g}	9.76^{de}	83.11^{ijk}	14.46^{def}
15	*Philodendron* 'Pluto Red'	2.06^{ef}	5.31^{cde}	4.71^{hi}	84.27^{ghij}	12.03^{ghi}
16	*Philodendron* 'Red Dutches'	2.8^{a}	4.49^{h}	4.85^{hi}	81.92^{ijkl}	11.86^{ghi}
17	*Philodendron* 'Red Sunlight'	1.16^{j}	4.81^{fg}	3.43^{ij}	96.80^{a}	11.71^{ghi}
18	*Philodendron sagittifolium*	1.81^{ghi}	5.29^{cde}	2.56^{jk}	89.33^{bcd}	10.77^{hij}
19	*Philodendron scandensoxycardium*	$.11^{l}$	3.82^{i}	6.51^{gh}	95.17^{a}	12.03^{ghi}
20	*Phildendron serratum*	1.6^{hi}	4.86^{fg}	20.4^{b}	90.09^{b}	22.32^{b}
21	*Phiodendron* 'Smithi'	1.31^{j}	5.31^{cde}	2.01^{jkl}	81.22^{kl}	6.43^{k}
22	*Phlodendron superbum*	1.20^{j}	5.51^{ab}	$.96^{kl}$	79.51^{lm}	8.56^{jk}
23	*Philodendron wend-imbe*	1.65^{hi}	4.92^{f}	8.56^{ef}	78.29^{m}	13.47^{efg}
24	*Philodendron wendlandii*	1.62^{i}	4.72^{g}	$.56^{l}$	86.92^{cdefg}	9.07^{j}
25	*Philodendron williamsii*	1.64^{hi}	4.44^{h}	6.56^{gh}	87.69^{bcde}	12.78^{efgh}

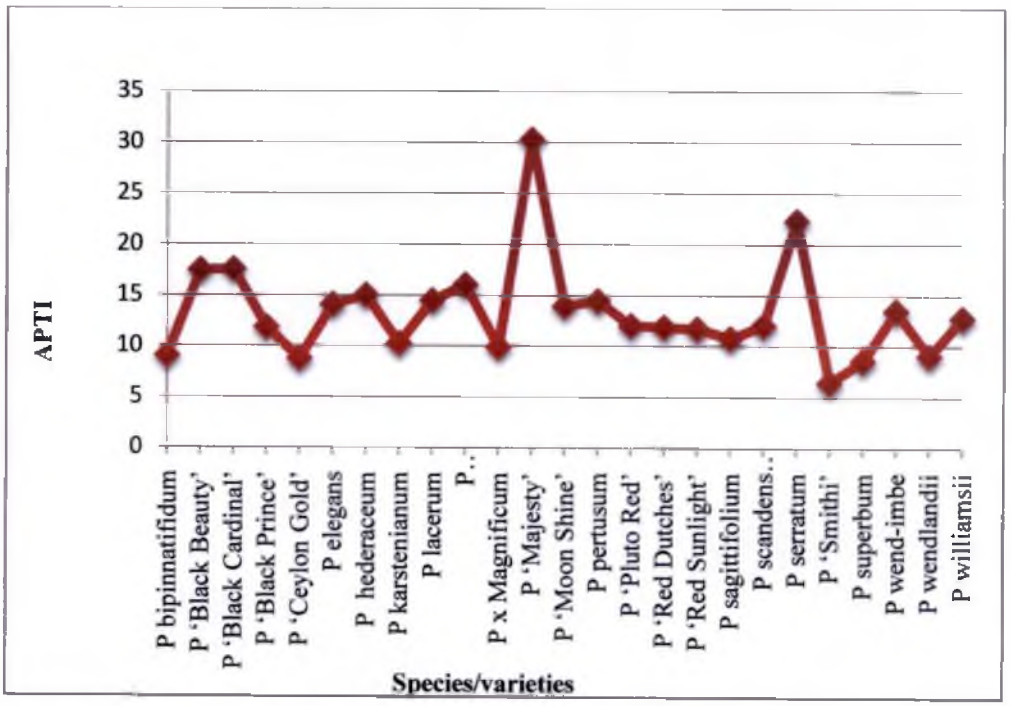


Fig 18. Air Pollution Tolerance Index of species/varieties of *Philodendron*

levels. Based on their susceptibility levels philodendrons under the study were categorized into tolerant, medium tolerant, intermediately tolerant and susceptible (Table 19).

Table 19. Classification of philodendrons based on air pollution tolerance

Susceptibility levels	Plant names
Tolerant (APTI value>18)	*Philodendron serratum*
	Philodendron 'Majesty'
Medium tolerant (15 to 18)	*Philodendron hederaceum*
	Philodendron lacinatum 'Variegata'
	Philodendron 'Black Beauty'
	Philodendron 'Black Cardinal'
Intermediately tolerant (11 to 14)	*Philodendron* 'Red Sunlight'
	Philodendron 'Black Prince'
	Philodendron 'Red Dutches'
	Philodendron 'Pluto Red'
	Philodendron scandens oxycardium
	Philodendron williamsii
	Philodendron wend-imbe
	Philodendron 'Moonshine'
	Philodendron elegans
	Philodendron pertusum
	Philodendron lacerum
Susceptible (≤10)	*Philodendron sagittifolium*
	Philodendron karstenianum
	Philodendron x *Magnificum*
	Philodendron wendlandii
	Philodendron bifinattifidum
	Philodendron 'Ceylon Gold'
	Philodendron superbum
	Philodendron 'Smithi'

It was observed that *Philodendron serratum* and *Philodendron* 'Majesty' had the highest APTI values and was tolerant to air pollution. Of all the species/varieties, *Philodendron sagittifolium, Philodendron karstenianum, Philodendron* x *Magnificum, Philodendron wendlandii, Philodendron bifinattifidum, Philodendron* 'Ceylon Gold', *Philodendron superbum* and *Philodendron* 'Smithi' were found to be the most susceptible.

4.4. Evaluation of Philodendron species/varieties for use as cut foliage

Leaves of all the species/ varieties selected for the study were evaluated for their suitability for use as Cut foliage

4.4.1. Fresh weight of leaf

Fresh weight is an important factor for a leaf to use as cut foliage. The fresh weight of leaf of philodendrons is presented in (Table.20 and fig 19).

Philodendron bipinnatifidum recorded 62.7 g of fresh weight which was the highest value recorded among the philodendrons under the study. This is followed by *Philodendron lacerum* (52.16 g) and *Philodendron lacinatum* 'Variegata' (49.63 g). The lowest value was recorded in *Philodendron superbum* (2.93g) followed by *Philodendron scandens oxycardium* (4.86 g) and it was on par with *Philodendron karstenianum* (4.93 g).

4.4.2. Water uptake by leaf

The water uptake by leaves are presented in Table 20 and fig 20.

The species/varieties were significantly different in their water uptake. The highest and lowest values observed were 31.33 ml and 4.00 ml in *Philodendron* 'Red Sunlight' and *Philodendron lacinatum* 'Variegata' respectively. Relatively high value was observed in *Philodendron* 'Moonshine' (20.66 ml), *Philodendron* 'Pluto Red' (18 ml) and they were at par. The species on par with the lowest values were *Philodendron lacinatum* 'Variegata' (4.00 ml), *Philodendron sagittifolium* (4.66 ml), *Philodendron williamsii* (4.33 ml), *Philodendron* 'Smithi' (9.85ml), *Philodendron* 'Black Cardinal' (5.00 ml), *Philodendron* 'Black Beauty' (5.00 ml), *Philodendron bipinnatifidum* (5.00 ml) and *Philodendron* 'Majesty' (6.00 ml), and *Philodendron lacerum* (7.00 ml).

4.4.3. Physiological loss in weight (g)

The same kind of pattern as that of water uptake was observed in physiological loss in weight also.

The highest value recorded was 2.1g in *Philodendron* 'Red Sunlight' and it was closely followed by *Philodendron* 'Moon Shine' (2.05 g) and *Philodendron* 'Pluto Red' (18 g). The

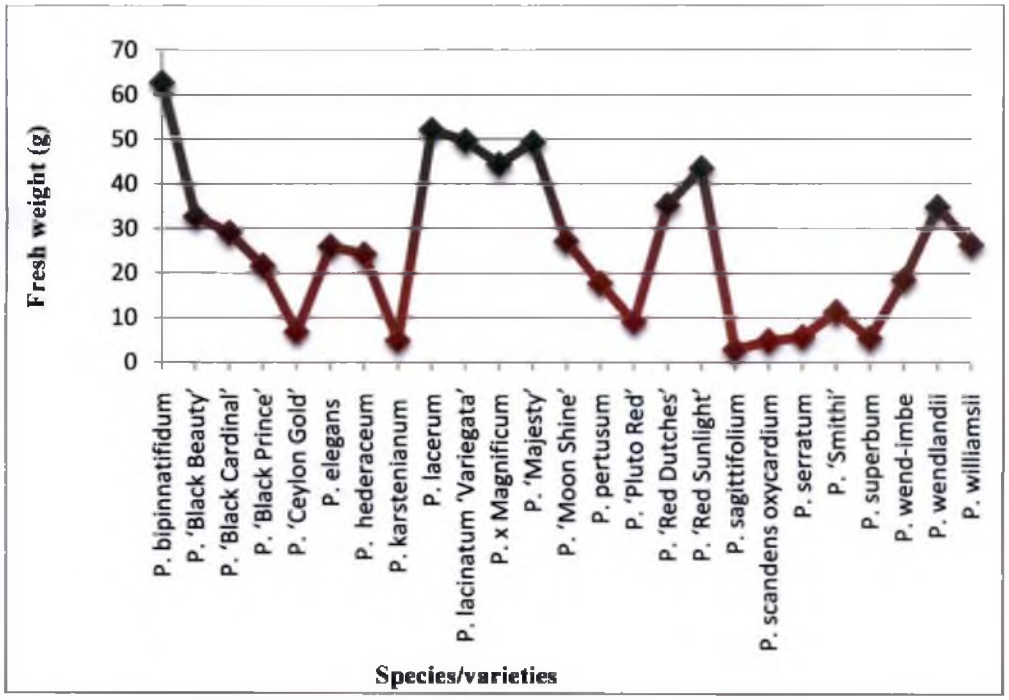


Fig 19. Fresh weight of leaf species/varieties of *Philodendron*

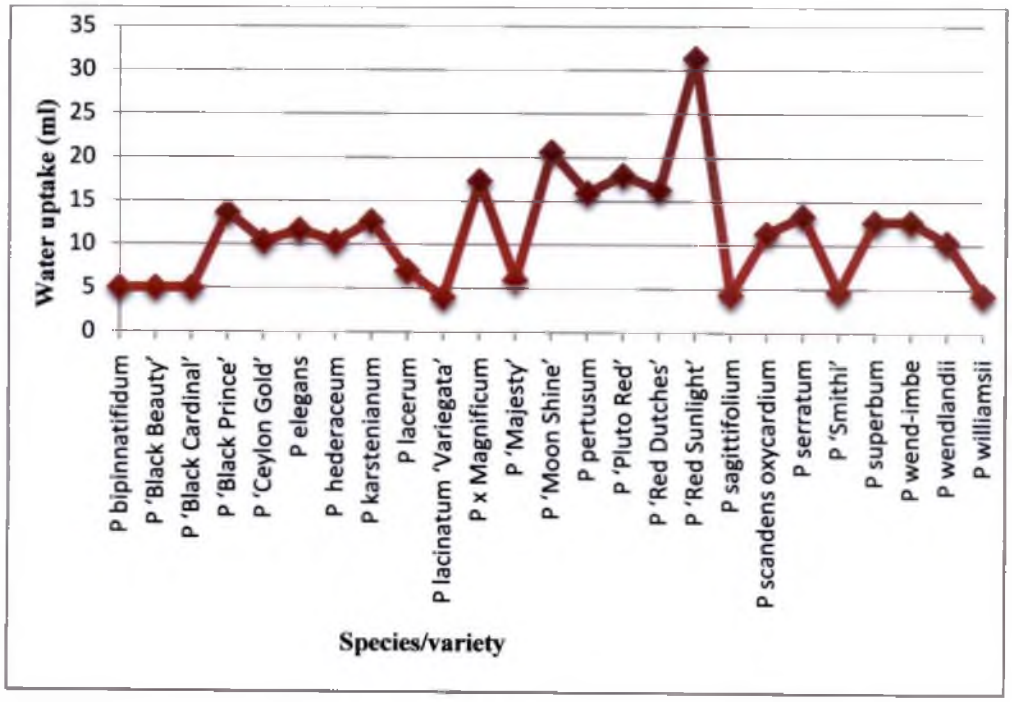


Fig 20 . Water uptake by leaf of species/varieties of *Philodendron*

Table 20. Evaluation of Philodendron species/varieties for use as cut foliage

S. No.	Species/Variety	Fresh Wt. of leaf (g)	water uptake (ml)	Physiological loss in wt (g)	Vase life (days)
1	*Philodendron bipinnatifidum*	62.7^{a}	5^{h}	1.24^{m}	26.33^{de}
2	*Philodendron* 'Black Beauty'	32.7^{f}	5^{h}	1.25^{lm}	24.33^{def}
3	*Philodendron* 'Black Cardinal'	29.06^{g}	5^{h}	1.26^{lm}	20.33^{fghi}
4	*Philodendron* 'Black Prince'	21.63^{j}	13.66^{def}	1.76^{g}	37.33^{ab}
5	*Philodendron* 'Ceylon Gold'	6.86^{mn}	10.33^{fg}	1.42^{j}	17.33^{hij}
6	*Philodendron elegans*	26^{hi}	11.66^{f}	1.55^{i}	20.66^{fghi}
7	*Philodendron hederaceum*	24.26^{i}	10.33^{fg}	1.42^{j}	35.66^{bc}
8	*Philodendron karstenianum*	4.93^{no}	12.66^{ef}	1.64^{h}	28.33^{d}
9	*Philodendron lacerum*	52.16^{b}	7^{gh}	1.34^{k}	21.66^{fgh}
10	*Philodendron lacinatum* 'Variegata'	49.63^{c}	4^{h}	1.0^{p}	23^{efg}
11	*Philodendron* x *Magnificum*	44.36^{d}	17.33^{e}	1.93^{d}	32.66^{c}
12	*Philodendron* 'Majesty'	49.23^{c}	6^{h}	1.29^{l}	23^{efg}
13	*Philodendron* 'Moon Shine'	27.16^{gh}	20.66^{b}	2.05^{b}	11.33^{k}
14	*Philodendron pertusum*	17.76^{k}	16^{cde}	1.80^{f}	41^{a}
15	*Philodendron* 'Pluto Red'	9.1^{lm}	18^{bc}	1.99^{c}	39.33^{ab}
16	*Philodendron* 'Red Dutches'	35.26^{e}	16.33^{cd}	1.85^{e}	23^{efg}
17	*Philodendron* 'Red Sunlight'	43.46^{d}	31.33^{a}	2.1^{a}	17.33^{hij}
18	*Philodendron sagittifolium*	2.93^{o}	4.33^{h}	1.1^{o}	19.66^{ghi}
19	*Philodendron scandens oxycardium*	4.86^{no}	11.33^{f}	1.51^{i}	23.33^{efg}
20	*Phildendron serratum*	5.76^{n}	13.33^{def}	1.74^{g}	21.33^{fgh}
21	*Philodendron* 'Smithi'	11.3^{l}	4.66^{h}	1.16^{n}	20.33^{fghi}
22	*Philodendron superbum*	5.46^{no}	12.66^{fe}	1.64^{h}	10.66^{k}
23	*Philodendron wend-imbe*	18.5^{k}	12.66^{ef}	1.64^{h}	18.33^{hi}
24	*Philodendron wendlandii*	34.8^{ef}	10.33^{fg}	1.42^{j}	16.33^{ij}
25	*Philodendron williamsii*	26.33^{hi}	4.33^{h}	1.1^{o}	14^{jk}
	C.D (0.05)	1.37	1.76	0.029	2.19

lowest physiological loss in weight was in *Philodendron lacinatum* 'Variegata' (1.0 g) followed by *Philodendron sagittifolium* (1.1 g) and *Philodendron williamsii* (1.1g) which were on par with each other. (Fig. 21)

4.4.4. Days taken to develop symptoms like leaf drop, yellowing, blackening and wilting (Vase life)

The key factor of a leaf for use of cut foliage is vase life. A significant difference was observed among different philodendron species/varietie for the no. of days taken to develop symptoms like leaf drop, yellowing, blackening and wilting. *Philodendron pertusum* (41 Days) and *Philodendron superbum* (10.67 Days) had shown highest and lowest values respectively. Relatively high value was observed in *Philodendron* 'Pluto Red' (39.33 Days), *Philodendron* 'Black Prince' (37.33 Days) and they were at par. *Philodendron* 'Moon Shine' (11.33 Days) and *Philodendron williamsii* (14 Days) are the species on par with the inferior values. Relatively low values were observed in *Philodendron wendlandii* (16.33 Days), *Philodendron* 'Ceylon Gold' (17.33 Days), *Philodendron* 'Red Sunlight' (17.33 Days) and they were at par. In rest of the species/varieties, the vase life ranged from 11 to 16.(Fig. 22)

4.4.5. Quality rating of leaf of philodendrons by visual scoring

Quality rating of leaf was done by evaluating four parameters viz., texture, colour and pigmentation, shape and pattern, size by 15 individuals. Selected persons were briefed with required information about the philodendrons and allowed to observe them for a period of one week before the rating. The grades ranged from 1-10 for each character and the total for each species/variety are presented in the table 21. In texture, *Philodendron* 'Majesty' rated the highest with 9.3 out of 10, *Philodendron* 'Black Beauty' scored maximum (9.3) against Colour & Pigmentation, *Philodendron* 'Majesty' (8.4) against shape and pattern and *Philodendron* 'Red Dutches' scored the highest (8.5) against size. In total, *Philodendron* 'Majesty' was rated as the best among all the philodendrons which scored 35.1 out of 40 with regard to all the concerned characters and *Philodendron* 'Pluto Red' the poorest with 26.9 points.

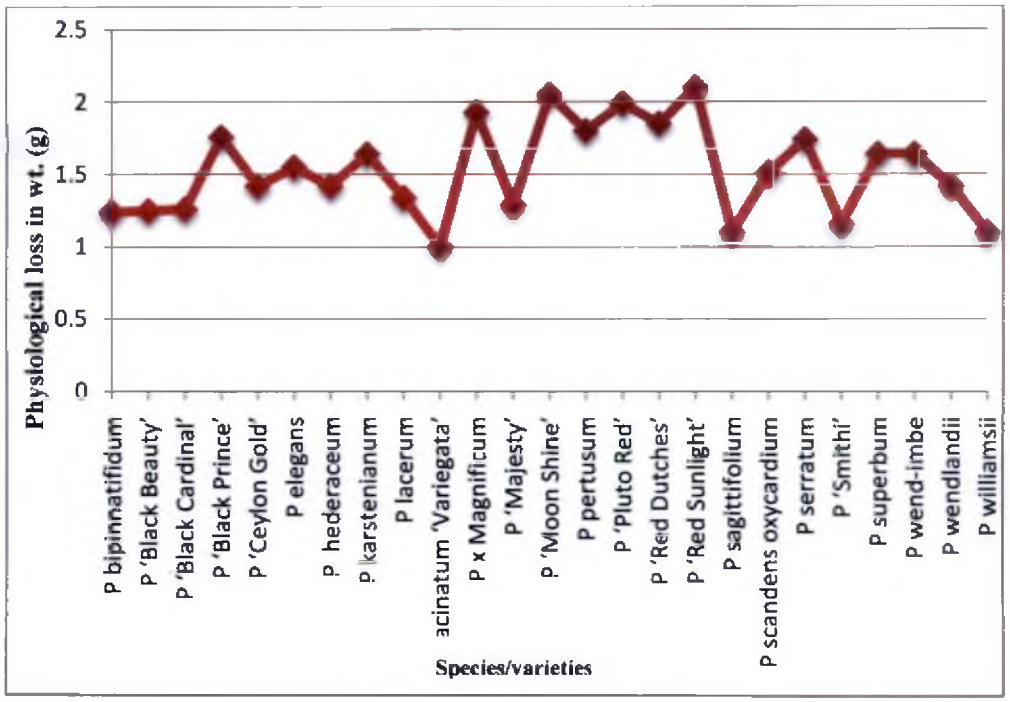


Fig 21 . Physiological loss in weight (g) of leaves of species/varieties of *Philodendron*

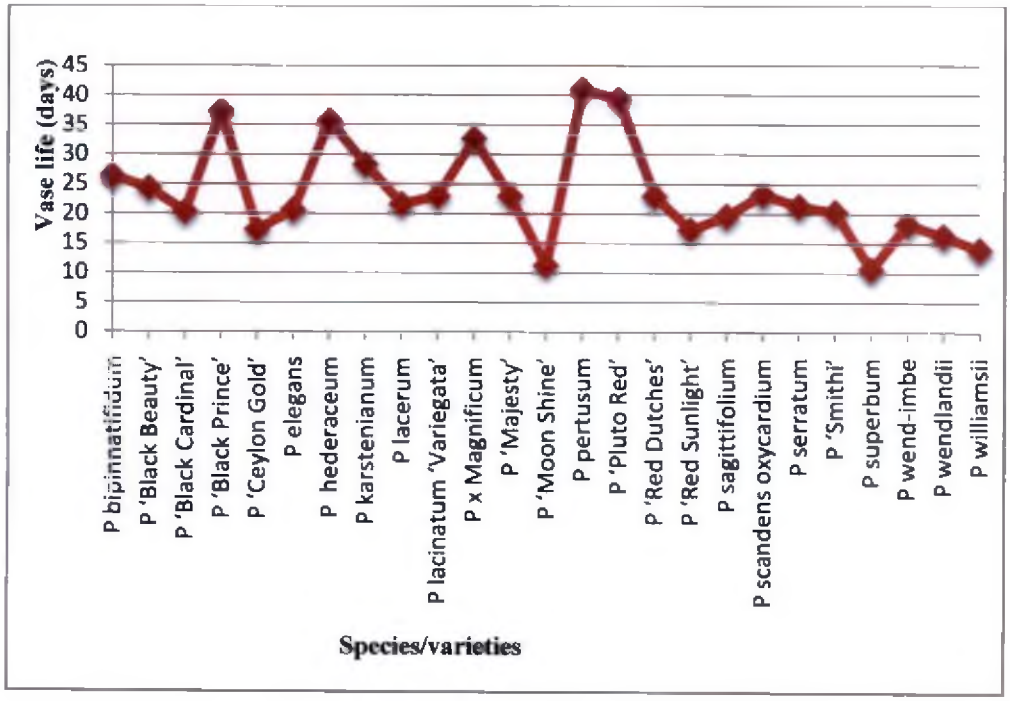


Fig 22 . Vase life of leaves of species/varieties of *Philodendron*

Table 21. Quality rating of philodendrons by visual scoring

S. No.	Species/Variety	Texture (Out of 10)	Colour & Pigmenta -tion (Out of 10)	Shape and pattern (Out of 10)	Size (Out of 10)	Total (out of 40)
1	*Philodendron bipinnatifidum*	8.4	8.5	8.0	6.8	31.7
2	*Philodendron* 'Black Beauty'	8.6	9.3	7.9	7.6	33.4
3	*Philodendron* 'Black Cardinal	8.7	8.6	8.0	8.1	33.4
4	*Philodendron* 'Black Prince'	8.1	8.5	7.4	7.7	31.7
5	*Philodendron* 'Ceylon Gold'	8.8	7.4	7.8	7.6	31.6
6	*Philodendron elegans*	8.6	7.6	8.1	8.1	32.4
7	*Philodendron hederaceum*	8.9	8.9	8.3	8.2	34.3
8	*Philodendron karstenianum*	8.4	8.6	7.6	7.3	31.9
9	*Philodendron lacerum*	7.8	8.1	8.0	6.9	30.8
10	*Philodendron lacinatum*'Variegata'	8.8	8.2	7.7	7.9	32.6
11	*Philodendron* x *Magnificum*	7.6	8.3	8.2	7.8	31.9
12	*Philodendron* 'Majesty'	9.3	9.1	8.4	8.3	35.1
13	*Philodendron* 'Moon Shine'	7.2	7.6	8.3	7.6	30.7

Table 21. Quality rating of philodendrons by visual scoring (contd..)

S. No.	Species/Variety	Texture (Out of 10)	Colour & Pigmenta -tion (Out of 10)	Shape and pattern (Out of 10)	Size (Out of 10)	Total (out of 40)
14	*Philodendron pertusum*	9.1	8.4	7.3	6.7	31.5
15	*Philodendron* 'Pluto Red'	6.4	8.1	6.2	6.2	26.9
16	*Philodendron* 'Red Dutches'	8.6	8.3	8.0	8.5	33.4
17	*Philodendron* 'Red Sunlight'	7.9	8.6	7.9	7.8	32.2
18	*Philodendron sagittifolium*	8.8	8.6	8.3	8.1	33.8
19	*Philodendron scandensoxycardium*	8.7	7.8	8.1	7.2	31.8
20	*Philodendron serratum*	7.8	7.6	8.0	6.8	30.2
21	*Philodendron* 'Smithi'	8.3	8.5	7.8	7.3	31.9
22	*Philodendron superbum*	8.6	8.3	7.9	7.6	32.4
23	*Philodendron wend-imbe*	8.4	7.1	7.4	7.5	30.4
24	*Philodendron wendlandii*	8.1	7.6	7.4	7.6	30.7
25	*Philodendron williamsii*	9.4	7.8	8.4	8.4	34

Discussion

5. DISCUSSION

5.1. Performance of philodendrons under rain shelter

The salient results obtained for the different growth parameters like plant height, spread, number of leaves, leaf length and breadth, leaf area, internodal length, leaf producing interval, etc. of twenty-five *Philodendron* species/varieties were observed in rain shelter.

5.1.1. Quantitative characters

The economic importance of plant height is manifested together with the number of branches and internodal length (Eapen, 2003). In the present study also, the tallest plants had more internodes and branches. The length of vines was taken as height for climbing and trailing plants and so they seem to possess more height than others. The findings of Aasha (1986) were also supporting the results. The plants with lesser height could be utilized for decorating places like small rooms as the space required by are minimum. The plants with more height could provide great appeal when used in places like indoor stadiums, big marriage halls etc.

Plant spread is an important character considering the philodendrons for interior plantscaping. The minimum the spread, more compact will be the plants and this makes them suitable for indoors. The plants with maximum spread could also be desirable as it helps to decorate (cover) a large interior with few number of plants. The species/varieties with more spread were *Philodendron williamsii, Philodendron lacerum* and *Philodendron* x *Magnificum, Philodendron lacinatum*'Variegata' among climbing and heading type philodendrons respectively. The plants with more branches/laterals were found to have more spread and plants with vertical growth rather than lateral were having lesser spread. Such differences in plant spread were also observed by Russ and Pertuit (2001) in different foliage plant species like *Dracaena, Philodendron and Schefflera.*

As we deal with philodendrons, it would be meaningless, if we are not considering the leaf characters. Length, breadth, area and number of leaves are the main parameters that were observed to understand the variation among the philodendrons. As the plants possess attractive foliages, the number of leaves and its size will give great impact in decorating the indoors. Among the philodendrons, the species/variety with the lengthiest leaves was *Philodendron bipinnatifidum* and *Philodendron williamsii.* The species with the shortest leaves were

Philodendron scandens oxycardium, Philodendron karstenianum, Philodendron 'Pluto Red' *Philodendron* 'Red Sunlight', *Philodendron serratum* and *Philodendron* 'Smithi'.

The factor which decides crop productivity is the leaf area, because the light incidence depends on the size of leaf. So it has to be considered as a very important character. In the present study, among climbing type philodendrons the species/variety with the maximum leaf area where as *Philodendron bipinnatifidum. Philodendron* 'Majesty' and *Philodendron lacinatum*'Variegata' were observed with maximum leaf area among heading type. The plants having more leaf area will have a faster growth and there will be more crop productivity (Benedetto *et al.*, 2006). Wang and Chen (2003) also described the importance of leaf area from the study conducted in *Spathiphyllum* in which they observed more CO_2 fixation in leaves having more area.

Another important leaf character is the number of leaves. More the number of leaves in a plant, more will be the physiological activities and so will be the benefits for the plant. It differs from species to species and depends on many factors like tiller production and leaf production intervals (Eapen, 2003). In the present study also it differed significantly between the species/varieties of *Philodendron.* Among climbing type, the species/variety with more leaves was *Philodendron karstenianum* while *Philodendron wendlandii* and *Philodendron serratum* was species/variety with more leaves among heading type. Basically the species with larger leaves tend to produce only less number of leaves whereas the species with smaller leaves have more number. This is because of many factors like genetic makeup, partition of photosynthates, production of more number of branches and tillers etc. So both the cases are desirable as they compensate each other with their size and number of leaves.

When the internodal length of philodendrons was concerned, few species/varieties had no internodes as they were short and compact which are the very first qualities needed for interior plantscaping. However, the internodal length is important because of its contribution to plant height. If a plant could withstand low light conditions, it can be well identified by its long internodes. In the present study, the plants which had the maximum internodal length were *Philodendron williamsii, Philodendron* 'Red Dutches', *Philodendron pertusum, Philodendron* 'Black Cardinal' among climbing type while *Philodendron* 'Majesty', *Philodendron lacinatum*'Variegata' and *Philodendron* x *Magnificum* among heading type.

Length and girth of petiole are important for their physical support rendered to the leaves. Also the length of the petiole contributes to spread of the plant. More the petiole length, more will be the spread and higher will be the compactness, if it is short. The plants with lengthiest petioles were *Philodendron bipinnatifidum, Philodendron lacerum. Philodendron* 'Moon Shine', *Philodendron* 'Pluto Red' and *Philodendron karstenianum, Philodendron wend-imbe, Philodendron hederaceum* and *Philodendron* 'Black Beauty' were the plants with shortest petiole.

Likewise, the species with thickest petioles were *Philodendron bipinnatifidum Philodendron lacerum* and *Philodendron wendlandii*; the species/varieties with thinnest petiole were *Philodendron* 'Pluto Red', *Philodendron scandens oxycardium.*

Regarding the leaf producing interval, it varied according to the species/varieties. The species/varieties which produced leaves at shorter intervals were *Philodendron scandens oxycardium.* It is found that the plants with shorter leaf producing intervals were having high growth rate and they can establish itself easily within a short period of time, whereas plants with long leaf producing interval will take time to establish.

The leaf longevity on the plant is linked with the leaf producing intervals. If a plant produces leaves at longer intervals, longevity of the leaf is found to be more. In the present study, the species with more leaf longevity was *Philodendron pertusum* and *Philodendron* 'Moon Shine' was the variety having low leaf longevity.

5.1.2. Qualitative characters

Texture, type, shape, margin, tip, base, pigmentation, venation and arrangement, branching habit, pest and diseases and other damaging symptoms were taken as qualitative characters as it helped to identify the aesthetic value of the plants. The plants like *Philodendron* 'Black Cardinal', *Philodendron* 'Ceylon Gold', *Philodendron elegans, Philodendron karstenianum, Philodendron pertusum, Philodendron* 'Red Dutches' *Philodendron sagittifolium, Philodendron scandens oxycardium, Phiodendron* 'Smithi', *Phlodendron superbum* required proper staking as they were bending.

The plants were also rated according to their quality characters like colour and texture, pigmentation, tolerance capacity, pests and disease occurrence etc. The species having a high rating among philodendrons were *Philodendron* 'Majesty', *Philodendron scandens oxycardium,*

Philodendron pertusum, Philodendron sagittifolium, Philodendron wendlandii, Philodendron bipinnatifidum, Philodendron hederaceum and *Philodendron lacinatum* 'Variegata'. These plants could be well recommended as best philodendrons which possess all the qualities to be grown in any type of growing systems and they are well suited for indoors also. This kind of visual quality grading was also done by Alex (2012) in different foliage plants.

5.2. Evaluation under indoor conditions

Based on the growth habit, thirteen *Philodendron* species/varieties were selected for indoor studies under five different light levels, viz., low (<800 lux), medium (800-2000 lux), high (>2000 lux), supplementary (800-2000 lux) and air conditioned with supplementary light (800-2000 lux). Observations relevant to indoor conditions were taken and the results are discussed here.

Because of the tolerance to low light (Haynes, 2006) philodendrons are preferred as indoor plants and most of them are well adapted to home growing (Davison, 1998; Trinklein, 1999).

Philodendron species/varieties are finest, very attractive and are suitable for indoors. Plants lasted for a longer period in air conditioned zone with supplementary light and the zone having supplementary light without air-condition. Irrespective of light intensity *Philodendron* x *Magnificum, Philodendron* 'Black Prince' and *Philodendron* 'Majesty' recorded maximum indoor life.

5.3. Air pollution tolerance index of Philodendrons

Increasing population, rapid urbanization, increase in industrialization, alarming increase in vehicles fleet and underestimated future plan of city development are the major triggers for the increases in the air pollution level in the city (Jayanthi and Krishnamoorthy, 2006). Air pollutants, both in the outdoor and indoor environments are associated with acute adverse effects on health of man and plants (Tripathi *et al.,* 2009). Plants are our resource and weapon to fight against this. The air pollution tolerance index of plants can be used to select those suitable to maintain the quality of air. As suggested by Singh *et al.* (1991), APTI can be calculated by estimating four parameters *viz.*, total chlorophyll content, leaf extract pH, relative water content

and ascorbic acid content. The index was developed based on the fact that ascorbic acid being a strong reductant, protects chlorophyll functions from pollutants through its pH dependent reducing power (Tanaka *et al.*, 1982) and RWC shows the capacity of cell membrane to maintain its permeability under polluted conditions (Singh *et al.*, 1991).

As far as philodendrons are concerned in the present study, the parameters were determined carefully and their susceptibility/tolerance to air pollution was assessed accordingly and the results obtained are discussed here.

5.3.1. Total chlorophyll content

Among the different parameters that determine the tolerance level of plants to pollution, chlorophyll content plays an important role as it indicates the photosynthetic activity as well as the growth and development of biomass (Bell and Mudd, 1976; Jyothi and Jaya, 2010). Tolerance of plants to SO_2 is reported to be linked with synthesis or degradation of chlorophyll (Bell and Mudd, 1976; Ninave *et al.*, 2001). Thus, plants having high chlorophyll content are generally found tolerant to air pollutants (Singh *et al.*, 1991). Further, the total chlorophyll content is also related to ascorbic acid productivity (Aberg, 1958) which is having a strong reductant action against the pollutants and ascorbic acid is concentrated mainly in chloroplast (Franke and Heber, 1964). In the present study variations were observed in the chlorophyll content of philodendrons. *Philodendron* 'Red Dutches' was having the highest chlorophyll content. Lowest chlorophyll content was found in *Philodendron scandens oxycardium.*

5.3.2. Leaf Extract pH

Determining leaf extract pH also plays a vital role in evaluating the air pollution tolerance of philodendrons. Photosynthetic efficiency strongly depends on leaf extract pH (Liu and Ding, 2008). Türk and Wirth (1975) reported that photosynthetic efficiency was found to be low in plants when the leaf pH was low. It has been reported that, in the presence of an acidic pollutants the leaf pH is lowered and the decline is greater in plants which are sensitive to pollution compared to tolerant ones (Scholz and Reck, 1977). Thus, a higher level of leaf-extract pH in plants under polluted conditions may increase their tolerance level (Singh *et al.*, 1991). Further, the presence of an acidic pollutant may turn the cell sap acidic and decrease the efficiency of conversion of hexose sugar to ascorbic acid. However, the reducing activity of ascorbic acid is pH dependent being more at higher and less at lower pH (Jyothi and Jaya, 2010). In the present

study, maximum pH content was in *Philodendron lacerum* and the minimum in *Philodendron scandens oxycardium.*

5.3.3. Relative Water Content (RWC)

The RWC of leaves is an indicator of plant water status in relation to its physiological activities of cell water and it is associated with protoplasmic permeability (Oleinikova, 1969). The air pollutants increase cell permeability (Keller, 1986) in the case of sensitive species (Farooq and Beg, 1980). Pollutant induced increased permeability in cells cause loss of water and dissolved nutrients, resulting in early senescence of leaves (Masuch *et al.*, 1988). Therefore it is likely that plants with high RWC under polluted conditions may be tolerant to pollutants (Singh *et al.*, 1991). More water content will also dilute acidity. Further, high water content within a plant body will help to maintain its physiological balance under stress condition such as exposure to air pollution when the transpiration rates are usually high, and also serves as an indicator of drought tolerance in plants (Swami *et al.*, 2004; Dedio, 1975). If transpiration rate is reduced due to air pollution, plants cannot sustain due to loss of capacity to pull water up with roots for photosynthesis. Then, the plants neither bring minerals from the roots to leaves where biosynthesis occurs, nor reduce the leaf temperature (Liu and Ding, 2008). Current investigation shows that RWC values ranged from 97.02 to 78.29 per cent between different species/varieties of *Philodendron* among which *Philodendron* 'Black Prince' possessed maximum RWC and *Philodendron wend-imbe,* the minimum.

5.3.4. Ascorbic acid

To determine the susceptibility level of philodendrons most important parameter considered is ascorbic acid. Though a plant possesses relatively low pH, chlorophyll content, and RWC, there is a great chance for the plant to have a higher APTI as the low values can be counter-balanced by the ascorbic acid multiplier effect in the APTI formula (Wood and Burchett, 1995). Studies showed that higher ascorbic acid content favours pollution tolerance in plants (Keller and Schwager, 1977; Lee *et al.,* 1984). The level of this acid declines on exposure to pollutants. Plants maintaining high ascorbic acid level even under polluted conditions are considered to be tolerant to air pollutants, as the level of this acid declines on exposure to pollutants (Singh *et al.*, 1991). Chaudhary and Rao (1977) and Varshney and Varshney (1984)

explains that higher ascorbic acid content in plants is a sign of its tolerance against sulphur dioxide pollution. In the current study, *Philodendron* 'Majesty' was found to contain more ascorbic acid and have the highest APTI value also. *Philodendron bipinnatifidum* was found to have the lowest ascorbic acid content.

5.3.5. APTI and susceptibility levels

The APTI values were computed for each *Philodendron* species/variety using the above four parameters. No species/variety had the maximum value for all the four parameters and each parameter plays a distinctive role in the determination of susceptibility of plants. *Philodendron* 'Majesty' had the highest APTI and *Philodendron superbum* had the lowest value. The philodendrons with high APTI value could be identified as tolerant and, low as sensitive to pollution and possibly pollution indicators.

Along with leaf extract pH, APTI plays a significant role in determining the SO_2-sensitivity of plants (Chaudhary and Rao, 1977). Its reducing power is more at higher and lower at low pH values. Among all different parameters taken, wide variation was seen only in ascorbic acid and it increased its impact by its multiplier effect in the APTI formula. Studies reveal that ascorbic acid through its reducing power protects chloroplasts against SO_2-induced H_2O_2, O_2- and OH accumulation, and thus protects the enzyme of the CO_2 fixation cycle and chlorophyll from inactivation (Tanaka *et al.*, 1982). Thus, it may be possible that ascorbic acid protects chloroplasts and chlorophyll functions from pollutants through its pH-dependent reducing power. One of the parameters to compute APTI, Relative Water Content shows the capacity of the cell membrane to maintain its permeability under polluted condition. Thus, the combination of four parameters is suggested as representing the best index of the susceptibility levels of plants under any condition.

5.4. Evaluation of *Philodendron* species/varieties for use as cut foliage

Keeping quality is the prime aspect of commercial importance in the trade of philodendrons. Besides the aesthetic aspects, pre-harvest factors, post harvest factors together with stage and time of harvest determine the keeping quality of philodendrons in the vase life. If harvested immature or over mature they will not keep well and the desired cut foliage qualities

will not be manifested. Generally foliage is cut when they are mature and have fully attained the shape, colour and size. According to Nowak and Rudnicki (1990) foliage of *Asparagus setaceus, Cordyline terminalis, Coediaeum variegatum, Dracaena* Sp., *Juniperus* Sp. and *Nephrolepsis* Sp. are harvested when mature. Kumar and Bhattacharjee(2003) reported that foliage of *Calathea ornata, Codiaeum variegatum, Dracaena* and *Nephrolepsis* kept longer in vase only when they are harvested at mature and fully developed stage. In the present study fully matured physiologically active leaf is collected in early morning for the study. *Philodendron* 'Red Sunlight' had the highest water uptake. Among *Philodendron* species/varieties no. of days to develop symptoms like leaf drop, yellowing, blackening and wilting was observed. *Philodendron pertusum* (41 Days) and *Philodendron superbum* (10.67 Days) had shown the highest and the lowest values respectively. Relatively high value was observed in *Philodendron* 'Pluto Red' (39.33 Days).

Senescence of philodendrons is usually exhibited as yellowing, discoloration, drooping, wilting, loss of turgidity etc. that makes the termination of vase life. According to Nooh *et. al.,* (1986), the end of vase life of cut *Ruscus hypoglossum* and *Nephrolepsis exaltata* was recorded when the cut green parts lost their turgidity. According to Broschat and Donselman (1987), signs of wilting, yellowing or other discoloration, abscission or necrosis were used for determining the vase life of cut foliage species. Senescence of *Eucalyptus gunni* was determined visually by Forrest (1991) and symptoms of wilting of young foliage, discoloration of older leaves and leaf drop was observed. According to Wirthensohn *et al.,* (1996) vase life of cut stems of eucalyptus foliage was completed when 50 per cent of the leaves commenced browning or wilting. In the present study of philodendron species/varieties, no. of days to develop symptoms like leaf drop, yellowing, blackening and wilting *Philodendron pertusum* and *Philodendron* 'Pluto Red' were delayed.

Summary and Conclusion

Summary and Conclusion

6. SUMMARY

The present investigation on "Evaluation of Philodendrons for landscaping and interior plantscaping" was undertaken in the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 2011- 2013 with the objectives of evaluating the performance of different *Philodendron* species/varieties, so as to assess their suitability for landscaping, interior plantscaping and as cut foliage.

The study comprised of four experiments involving evaluation of the performance of different species/ varieties of philodendrons, assessing their Air Pollution Tolerance Index (APTI) and assessing their potential for interior plantscaping and finding their use as cut foliage.

The salient findings of the study could be summarised as follows:

1. The species with more spread were *Philodendron williamsii* and *Philodendron lacerum* among climbing types. The species with the lengthiest leaves and larger leaf area were *Philodendron bipinnatifidum* and *Philodendron williamsii* among the climbing types. The plants with lengthiest petioles were *Philodendron bipinnatifidum, Philodendron lacerum* among climbing type. These species/varieties could be recommended for landscaping larger areas.
2. Among heading type philodendrons the species with more spread were *Philodendron* x *Magnificum* and *Philodendron lacinatum*'Variegata'. The species with larger leaf area were *Philodendron* 'Majesty' and *Philodendron lacinatum* 'Variegata'. These species/varieties were recommended for decorating bigger indoor places like big halls, indoor stadiums etc
3. Based on the growth habit, thirteen Philodendron species/varieties were selected and evaluated under various indoor light conditions. All the species performed well in air conditioned zone with supplementary light and supplementary light without air-condition (800-2000 lux).
4. However, it is recommended that every plant should be shifted to outdoor conditions after a maximum period of two months for reclamation. So two sets of plants should be maintained for regular recycling.

5. Among the Philodendrons, with regard to interior plantscaping. *Philodendron x Magnificum*, *Philodendron* 'Black Prince' and *Philodendron* 'Majesty' were found to be good for keeping under various indoor conditions.
6. When the APTI was concerned, it was found that the philodendrons significantly differed in their tolerance levels to air pollution. The highest and the lowest APTI values were recorded in *Philodendron* 'Majesty' and *Philodendron superbum* respectively.
7. *Philodendron* 'Majesty' and *Philodendron* serratum had the highest APTI values and were tolerant to air pollution. *Philodendron sagittifolium, Philodendron karstenianum, Philodendron* x *Magnificum, Philodendron wendlandii, Philodendron bipinattifidum, Philodendron* 'Ceylon Gold', *Philodendron superbum, Philodendron* 'Smithi' were found to be the most susceptible and they could be well utilized as indicator plants.
8. In the experiment conducted for use of philodendrons as cut foliage *Philodendron pertusum*, *Philodendron* 'Pluto Red' has shown longest vase life while *Philodendron superbum* has shown shortest vase life.
9. Hence, among all the philodendrons selected for the study *Philodendron* 'Majesty' is recommended for indoor conditions, as it was found to have good indoor life and APTI value recorded was the highest. Cut foliage of *Philodendron* 'Majesty' also have good vase life.

ABBREVIATIONS

^0C	-	Degree Celsius
AD	-	After Christ
BC	-	Before Christ
CD (0.05)	-	Critical Difference at 5 per cent level
APTI	-	Air Pollution Tolerance Index
LL	-	Low light intensity (<800 lux)
ML	-	Medium light intensity (800-2000 lux)
HL	-	High light intensity (>2000 lux)
SL	-	Supplementary light (800-2000 lux)
A/C	-	Air conditioned with supplementary light (800-2000 lux)
NS	-	Non-significant
cm	-	centimeters
cm^2	-	square centimeter
et al.	-	and others
Fig.	-	Figure
FYM	-	Farm Yard Manure
g	-	gram
i.e.	-	that is
nos.	-	Numbers
pH	-	Power of hydrogen ion
ppm	-	parts per million
RH	-	Relative Humidity
viz.,	-	namely

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Appendix

APPENDIX I

Weather data of the Rain Shelter

Months (Aug '12 to July '13)	Temperature (°C)		RH (%)	Light (Lux)
	Max.	Min.		
1	33.04	25.4	78.6	6356.30
2	33.00	25.6	79.41	5434.21
3	34.85	25.6	72.75	6398.17
4	38.28	26.5	64.6	10946.92
5	34.57	26.4	58.4	10828.98
6	34.67	25.2	54.55	9524.42
7	35.83	24.3	52.63	10891.31
8	38.02	26.4	46.86	10951.36
9	41.95	27.35	57.9	7658.16
10	41.31	27.31	64.9	7175.31
11	39.17	28.32	65.97	8259.33
12	33.59	25.60	78.64	6363.67

APPENDIX II
Weather data of the indoor experiment site

Fortnight	Non air conditioned zone								Air conditioned zone				
	Temperature (°C)		RH (%)		Light intensity (Lux)				Temperature (°C)		RH (%)		Light intensity (Lux)
	Max.	Min.	Max.	Min.	LL	ML	HL	SL	Max.	Min.	Max.	Min.	
1	26.54	25.41	98.56	96.26	55.90	904.41	2528.71	831.08	25.46	23.65	94.05	78.34	845.30
2	27.55	26.19	98.61	91.20	37.58	967.88	2880.76	851.66	26.14	24.07	88.60	72.50	923.40
3	28.37	25.99	97.69	87.41	64.15	1026.91	2466.87	882.25	26.06	22.76	85.83	63.25	1098.29
4	27.36	25.47	98.56	93.06	94.19	789.65	2559.88	846.38	25.81	23.64	89.38	72.88	1018.25
Monthly mean													
1	27.28	25.56	98.37	92.87	92.39	944.33	2669.17	840.57	25.63	23.45	91.59	75.26	863.00
2	28.53	26.23	98.00	87.78	63.04	1057.87	2366.38	871.13	26.34	22.43	87.44	63.67	1161.11

LL-Low light (<800 lux), ML- Medium light (800-2000 lux), HL- High light (>2000 lux), SL- Supplementary light without a/c (800-2000 lux), A/C- Supplementary light with a/c (800-2000 lux)

APPENDIX III

Weather data of Vellanikkara

Months	Temperature (°C)		Relative Humidity (%)		Sun-shine (hrs)	Rainfall (mm)	Number of rainy days
	Max.	Min.	Max.	Min.			
Aug. '12	29.2	23	95	77	90.7	616.5	18
Sep. '12	30.4	23.3	94	71	137.4	191.8	14
Oct. '12	32.1	23.5	90	64	192	145.6	10
Nov. '12	32.5	22.7	85	53	224.9	46.7	3
Dec. '12	33	23.2	73	43	252.4	19.8	2
Jan. '13	34.1	22.3	70	34	270.9	0	2
Feb. '13	34.7	23.3	76	37	241.4	84.4	2
Mar. '13	35.4	24.4	82	46	221.2	14.6	0
Apr. '13	34.9	25.1	88	55	181.7	0	5
May. '13	33.6	25.2	92	61	124.1	99.1	28
June '13	28.5	22.7	97	83	29.4	1031.8	30
July '13	28.4	22.7	97	84	23.8	932.3	30

EVALUATION OF PHILODENDRONS FOR LANDSCAPING AND INTERIOR PLANTSCAPING

By

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ABSTRACT OF THE THESIS
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ABSTRACT

Studies were undertaken in Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 2011-2013 to evaluate the philodendrons for landscaping and interior plantscaping. The study comprised of four experiments in which twenty-five species/varieties were selected for evaluation. Based on the growth habit, thirteen species/varieties were selected and their performance under different indoor light conditions was studied. Air Pollution Tolerance Index of all the species /varieties was computed and they were evaluated for their use as cut foliage.

Twenty-five selected species/varieties of philodendrons were classified into two categories namely heading and climbing types based on their growth habit. Wide variation was observed in their growth characters. Among the heading types, *Philodendron lacinatum*'Variegata', *Philodendron x Magnificum* and *Philodendron* 'Majesty' were found to have maximum growth. In climbing types of philodendrons, *Philodendron bipinnatifidum*, *Philodendron lacerum* and *Philodendron williamsii* recorded maximum growth.

Based on the growth habit, thirteen species/varieties of philodendrons were selected for evaluating their performance under five different indoor light zones viz., low (<800 lux), medium (800-2000 lux), high (>2000 lux), supplementary light without air condition (800-2000 lux) and supplementary light with air condition. It was found that most of the philodendrons could thrive well under supplementary light zone with and without air condition. Species/varieties like *Philodendron x Magnificum*, *Philodendron* 'Black Prince' and *Philodendron* 'Majesty' could be recommended for all the light intensities tried. *Philodendron* 'Red Sunlight' and *Philodendron* 'Black Beauty' could be recommended for areas with low light intensity. Plant quality rating of the philodendrons was done by visual scoring based on growth and fullness, color and pigmentation, suitability to indoor conditions and pest and diseases incidence. Based on this the selected philodendrons were classified into excellent, good, medium, low and not acceptable. It was observed that *Philodendron* 'Majesty' had the highest score and *Philodendron* 'Moonshine', the lowest.

The Air Pollution Tolerance Index (APTI) of philodendron species/varieties under the study was computed. Based on this, they were categorized into sensitive, intermediately tolerant, moderately tolerant and tolerant. It was observed that *Philodendron* 'Majesty' and *Philodendron serratum* had the highest APTI values and were tolerant to air pollution.

Philodendron sagittifolium, Philodendron karstenianum, Philodendron x *Magnificum, Philodendron wendlandii, Philodendron bipinnatifidum, Philodendron* 'Ceylon Gold', *Philodendron superbum* and *Philodendron* 'Smithi' were found to be the most susceptible and they could be recommended as pollution indicator plants.

Vase life and leaf characters are important for use of any foliage as cut foliage. *Philodendron pertusum, Philodendron* 'Pluto Red' and *Philodendron* 'Black Prince' are the species/varieties with longest vase life while *Philodendron superbum, Philodendron* 'Moon Shine', *Philodendron williamsii* are the species/varieties that had the shortest vase life. Based on the leaf characters like texture, color and pigmentation, shape and pattern and size, the leaves were visually scored for use as cut foliage and were classified into excellent, good, medium, low and not acceptable. *Philodendron* 'Majesty' *and Philodendron* 'Pluto Red' were found to possess the highest and lowest scores, respectively.