PERFORMANCE EVALUATION OF ANTHURIUM (*Anthurium andreanum* Linden) UNDER TWO CLIMATIC REGIMES

By

GAYATHRI.M.N

THESIS

submitted in partial fulfilment of the
requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture

Kerala Agricultural University, Thrissur

DEPARTMENT OF POMOLOGY AND FLORICULTURE
COLLEGE OF HORTICULTURE
KERALA AGRICULTURAL UNIVERSITY
VELLANIKKARA – 680 656
THRISSUR
2008

DECLARATION

I hereby declare that the thesis entitled "**Performance evaluation of Anthurium (*Anthurium andreanum* Linden) under two climatic regimes"** is a bonafide record of research work done by me during the course of research and the 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.

Vellanikkara **GAYATHRI.M.N.**
09-07-2008

Dr. P.K.Rajeevan
Professor and Head,
Dept of Pomology and Floriculture
College of Horticulture

Vellanikkara
09-07-2008

CERTIFICATE

Certified that this thesis entitled **"Performance evaluation of Anthurium (*Anthurium andreanum* Linden) under two climatic regimes"** is a record of research work done independently by **Miss Gayathri.M.N** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associate ship or fellowship to her.

Dr. P.K.Rajeevan
Chair person
Advisory Committee

CERTIFICATE

We, the undersigned members of the advisory committee of Ms**. Gayathri.M.N,** a candidate for the degree of **Master of Science in Horticulture**, with major field in Pomology and Floriculture, agree that the thesis entitled **"Performance evaluation of Anthurium (*Anthurium andreanum* Linden) under two climatic regimes"** may be submitted by Ms. **Gayathri.M.N**, in partial fulfilment of the requirement for the degree.

Dr. P. K, Rajeevan
(Chair person, Advisory Committee)
Professor and Head
Department of Pomology and Floriculture
College of Horticulture
Vellanikkara, Thrissur-680 656

Dr. P. K.Valsalakumari
Professor
(Member, Advisory Committee)
Department of Pomology and Floriculture
College of Horticulture
Vellanikkara, Thrissur-680 656

Dr.C.K. Geetha
Professor
(Member, Advisory Committee)
Department of Pomology and Floriculture
College of Horticulture
Vellanikkara, Thrissur-680 656

Dr. E.K. Lalitha Bai
(Member, Advisory Committee)
Professor
Dept of Agricultural Meteorology
College of Horticulture
Vellanikkara, Thrissur-680 656

EXTERNAL EXAMINER

"Sadashiva Samarambha Sankaracharya Madhyamam
Asmadacharya Paryantham Vande guru paramparam"

Acknowledgement

*I humbly bow my head before the **ALMIGHTY**, who blessed me with will power and courage to complete this endeavour successfully.*

*It is with great respect and devotion, I place on record my deep sense of gratitude and indebtedness to my major advisor **Dr. P.K.Rajeevan,** Professor and Head of the Dept of Pomology and Floriculture and chairperson of my advisory committee for his expert advice, valuable guidance, ever willing help, kind concern, unfailing patience, and constant encouragement throughout the course of study and preparation of the thesis. He in spite of a busy schedule has offered constructive suggestions for the betterment of this manuscript. I really consider it my greatest fortune in having his guidance for the thesis work.*

*I place a deep sense of obligation to **Dr.P.K.Valsalakumari,** Professor, Dept of Pomology and Floriculture, member of my advisory committee for her valuable advice, constant encouragement, goodwill and being kind enough to be available for guidance in spite of her busy schedule for the critical scrutiny of the manuscript, suggestions and support rendered throughout the study. I gratefully remember her knowledge and wisdom which nurtured this research project in right direction without which fulfillment of this endeavor would not have been possible.*

*I express my sincere thanks to **Dr.C.K.Geetha** Associate Professor, Department of Pomology and Floriculture member of my advisory committee for her friendly approach, kind concern, encouragement, whole hearted support and valuable guidance, extended throughout the investigation and various stages of study. Her willingness to help would always be remembered.*

*I also avail this opportunity to pay my sincere obligations and heartfelt thanks to **Dr. E.K.Lalitha Bai,** Professor, Dept of Agricultural Meteorology and member of*

my advisory committee for her cordial support, ever willing help, constructive criticism and suggestions for the improvement of the manuscript to complete the work. I am genuinely indebted to ***Dr. C. Sunanda,*** *Domain expert, VUAT, Kerala Agricultural University for her guidance and valuable assistance in the statistical analysis of the data.*

It is my pleasant privilege to express my gratitude to ***Dr. A.Shobhana, Dr. Jyothi Bhaskar, Dr. Lila Mathew, Dr.N.K.Parameswaran, Dr.Babilatha, Dr.T.Radha****, and* ***Dr.Sarah. T. George*** *and* ***Dr.Jacob John*** *for their encouragement, kind help and moral support offered at different stages of the study.*

I sincerely acknowledge the help and suggestions of each and every member of the Department of Pomology and Floriculture at different periods of my work. I would like to thank ***Liji chechi, Pushpalatha chechi*** *and* ***Sujitha*** *for their encouragement during field work.*

I express my heartfelt gratitude to the labourers of the Department of Pomology and Floriculture, especially ***Chandrika chechi, Leela chechi, John chettan*** *and other field workers for their co-operation and assistance during field work.*

I express my thanks to ***Santha chechi*** *and other workers at the Orange and Vegetable farm, Nelliampathy for their co-operation in carrying out the field works. A special word of thanks to* ***Hari*** *who assisted me in taking the monthly observations at Nelliampathy.*

Let me express my sincere thanks to ***M/s Kumar Florist bio plants, Pune*** *for supplying the planting material required for the study free of cost. I also acknowledge the Dept of Science and Technology (DST) for sponsoring the project.*

I have no words to express my deep sense of gratitude to my department friends ***Meghna, Kaveramma*** *and* ***Smisha*** *for their moral support, encouragement and help throughout the course of my research work.*

I take this opportunity to thank my ever loving friends ***Eliza Lincy, Chithra, Margaret, Nisha*** *and* ***Smitha.*** *They were always with me not only for the thesis preparation but also during my studies.*

I also wish my sincere thanks to my juniors ***Geetha, Jayasri, Hima, Hazmin, Ancy,*** *and* ***Archana*** *and for their help and concern.*

I am extremely thankful to my seniors ***Femina, Mini Sankar, Binisha, Sapheera and Ambily*** *for their kind help and moral support.*

I wish to acknowledge my heartfelt thanks to my friends ***Lina, Shibi , Suja, Grace, Shajna , Sreerekha, Seena, Remya, Dhanya chechi, Renjumol ,Jyothi, Cinu, Sani, Shaneeja ,Sini, Joshi, Santhosh ,Premjith, Smitha Sara*** *and* ***Riya*** *for all their help.*

I thankfully acknowledge Shri. ***Santhosh*** *for his valuable help in computer work.*

I shall be failing in my duty, if I forget to place on record the facilities offered by my Alma-Mater, College of Horticulture, Vellanikkara. The award of KAU Junior Research fellowship is greatly acknowledged.

I am in dearth of words to express my love towards my loving parents (Achan & Amma), grand parents, my dear sister, my parents-in law, brother-in-law, co-sister and sister -in-law for their boundless affection, moral support, eternal love, deep concern, prayers and personal sacrifices which sustains peace and happiness in my life.

Words can't express my soulful gratitude to my loving husband for without his selfless sacrifice, boundless patience, moral support and unflagging interest this study would never have seen the light.

GAYATHRI M.N

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

AFFECTIONATELY DEDICATED

TO MY

LATE GRAND FATHER

Introduction

1. INTRODUCTION

The phenomenal growth of floriculture in India during the last couple of decades has led the world floriculture experts to sit up and take notice. Considering the advantages India has in terms of natural resources, contributing to lower production costs, the export oriented floriculture has also caught up in the recent years. The area devoted to floriculture is estimated to be around 1.17 lakh hectares producing 30,000 tons of loose flowers and 600 million cut flowers (Sengupta and Rajkamal, 2006). Floriculture exports are now showing an annual growth rate of 20-25 per cent. Indian cut flower industry, nearly a decade old, has recorded an export income of Rs.359 crores in 2005-2006(Satyanarayanan, 2006).

Among the cut flowers of the tropics, anthurium has great value. It is cultivated for its colourful long lasting flower and foliage. *Anthurium andreanum* as a cut flower is much valued for the attractive long lasting spikes. It is a semi terrestrial evergreen plant, which can produce flowers all year along. The plant can produce flower from every leaf axil under favorable conditions. Anthurium cultivation is becoming increasingly important in global plant production, both for cut flower and pot plant.

The global trade of anthurium is valued at US $ 50 million and it occupies 9th position among cut flowers in the international market (Evans, 2006).Hawaii, Mauritius, Holland and Germany are the important producers of anthurium and the major importing countries are USA, Canada, Europe and Japan. In India the cultivation of anthurium is confined to Karnataka, Kerala, parts of Maharashtra, Tamil Nadu and North Eastern regions.

Most anthurium species are native to tropical rain forests and are primarily epiphytic in nature. In their natural habitat they receive filtered light, ample aeration and good drainage. Anthuriums grow best with day temperature of 25-32^{O}C and night temperature of 21-24^{O}C. Temperature above 35^{O}C may cause

foliar burning, faded flower colour and reduced flower life. Night temperature between 4-10^{O}C can result in slow growth and yellowing of lower leaves. It will not tolerate frost or freezing conditions. The best relative humidity for growth is 70-80 per cent.

Anthuriums grow under a wide range of light intensities but their actual performance is dependant on the cultivars, elevation, temperature and nutrition. Generally, most anthurium types grow well at light intensities ranging from 11,000 -16,000 lux. Light intensities higher than 27,000 lux may result in faded flower and leaf colour.

Other than the cut flower (CF) varieties of anthurium, pot plant (PP) varieties are also becoming popular among the growers. In view of low requirement of light conditions in anthuriums, such pot plants will also have better demand in future as indoor plants. Since our works in the above areas are meagre it has become necessary to arrive at convincing conclusions before making recommendations.

With this background, investigations on "Performance evalution of anthurium (*Anthurium andreanum* Linden) under two climatic regimes" were taken up with the following objectives:

a) To compare the growth, flower yield and quality of different cut flower and pot plant varieties of anthurium grown in two agro climatic locations and to recommend suitable varieties for the anthurium growing tracts of Kerala.

b) To study the influence of weather parameters on growth, flowering, yield and quality of anthurium cut flowers and pot plants grown under two environmental conditions, viz., in the plains and at high altitude.

Review of literature

2. REVIEW OF LITERATURE

Anthurium is the latest sensation of Indian floriculture scene and is the largest genus of the monocot family Araceae. The popularity of growing anthurium as a cut flower has risen in the past few years and it has now become an export oriented crop. The global market size for floriculture products was estimated at around US $ 10 billion for the year 2004. With an 8 per cent annual growth, this is expected to grow to $ 16 billion by 2010 (Naqvi, 2006). The international anthurium market is estimated at $ 38 billion and growing at 10 to12 per cent per annum. Anthuriums are becoming popular "flowering" foliage plants and their demand is rising annually. In recent years, there has been 38 per cent increase in demand for anthurium as against 18 per cent in rose and carnation (Muthukumaran *et al.*, 2005).

Anthuriums can be divided into four basic groups; *A. andreanum* cultivars, interspecific hybrids between *A. andreanum* cultivars and dwarf species referred to as '*Andreacola*' types, *A. scherzerianum* hybrids and foliage anthuriums. *A. andreanum*, a generally large, some what open structured plant with large flowers, is commonly grown for cut flower production and sometimes adaptable to pot culture. New cultivars, selected specifically for pot culture are more compact. In *A. andreanum* primary flower colours are white, pink, red, orange and green. '*Andreacola*' cultivars are small to intermediate in overall size, more compact and generally produce smaller but more numerous flowers than *andreanum* cultivars. 'Andreacola' cultivars tend to have thicker, dark green leaves and many times show resistance to more aggressive anthurium diseases. Primary flower colours are white, pink and red. Foliage anthuriums come in numerous shapes and size and represent a minor proportion of the total anthurium market.

Pot plants can be classified as a relative novelty in the anthurium sector when compared to the cut flower. The pot plant business is growing in terms of market share and volume, particularly in the high priced segment. In

2005, the anthurium pot plant was ranked fourth in the Dutch auctions listing with 11.1 million supplied; an increase of 1 per cent over the previous year, and the average price was € 3.58 (Vanderleeden, 2006).

Anthurium cultivation is mainly concentrated in Hawaii, Netherlands and Mauritius. USA, Canada, Japan, Germany and other European countries import a lot of these flowers. India is a negligible player in the international trade of fresh cut flowers, which is dominated by the Netherlands, Columbia and Italy, accounting for about 59 per cent, 10 per cent and 6 per cent of the world trade, respectively, followed by African countries, South Korea and Israel. There is tremendous potential for India to exploit the high demand for anthurium both in the domestic and world market (Gutgutia, 2005).

In India, for both the cut and pot anthurium, there is a growing market with consumption growing so fast that production cannot keep up (Evans, 2006). This situation is relatively unique in the world but not surprising considering India has the second faster growing economy.

The floriculture scenario in Kerala is fast improving even without a large-scale organized sector intervention. While analyzing the scope for production of flowers, it has to be reckoned that the state as a whole, with its partially shaded, high humid and high rainfall conditions, is ideally suited for the commercial cultivation of anthurium. It is a dynamic market that needs a production system based on climatic conditions, commercial distribution and post harvest technology. Taking into account the changing scenario of floriculture, Kerala Agricultural University has strengthened research in this area.

In Kerala, the crop is grown largely in the plains and partly in the subtropical situations like those available in Wayanad, Palakkad and Idukki districts. The quality in floriculture crops much dependent on air temperature and humidity just above the ground, which vary from environment to another. In view

of the low requirement of light conditions in anthuriums, pot plants will also have better demand in future as indoor plants and may even replace cut flower arrangements. Since our works in the above areas are meagre, it has become necessary to assure at convincing conclusions before making recommendations so the present study on "Performance evaluation of anthurium (*anthurium andreanum* Linden) under two agro climatic regimes" was taken up with an ultimate objective to recommend suitable varieties for the anthurium growing tracts of Kerala.A brief review of the works relevant to the study is presented in this chapter.

2.1 Performance evaluation under different agro climatic conditions

Evaluation is the comparative testing and recording of useful traits to find the performance in a collection. Jones (1984) states that evaluation "holds highest priority among germplasm functions".

In an experiment carried out on *Anthurium andreanum* grown at a low altitude site and a high altitude site under three shade levels (approximately 40%, 65% and 85%), it was concluded that high altitude produced larger spathes and low altitude produced longer flower stalks. High shade levels at low altitude are best for flower production, while high altitude is more suitable for the production of suckers (Kuruppu and Yogaratnam, 1989).

Eight *Anthurium andreanum* cultivars and two *Anthurium scherzerianum* cultivars were evaluated under a 50 per cent shade net condition in Yercaud. "Lady Jane" and 'AA-43' recorded the highest number of flowers/plant per year (18.2), among *Anthurium andreanum* cultivars while AS-1 had higher values of all the observed parameters among *A. scherzerianum* cultivars (Praneetha *et al.*, 2002).

Nine varieties of *Anthurium andreanum* were evaluated and screened for adaptability in the lowlands of Trinidad. 'RCM 12' yielded the most number of flowers (6.40 flowers per plant). 'RCM 12', 'Anue-nue', 'Sunburst' and ‘De Weese’ were recommended for planting as cut flowers and potted plants (Valdez, 2002).

In a study of fourteen varieties of *Anthurium andreanum* under shade net condition in the Andamans, Singh and Sujatha (2003) observed largest flower stalk length, 2.4 cm for 'Honey'. Honey performed better for most of the important characters.

Talia *et al.* (2003) evaluated six new cultivars of anthurium in soil less culture and under heated glass house conditions. The results revealed that ‘Terra’ was the most productive with 9.4 cut flowers per plant. The longest stem height was observed in variety ‘Queen’.

Srinivasa and Reddy (2005) evaluated five different varieties of *Anthurium andreanum* for cut flower production under hill zone of Coorg. The study revealed that among different varieties, 'Hondura' was found to be most suited to hill zone of Coorg district followed by 'Senator', 'Pasricha' 'Tinora' and 'Tropical'.

2.1.1. Other crops

Eichin and Deisler (1986) studied the performance of eight rose cultivars in a plastic house and reported that the most productive cultivar 'Aalsmeer Gold' produced 200 stems per sq. m.

Out of 97 rose cultivars evaluated Soorianathasundaram *et al.* (1996) found that 'Happiness' has performed exceedingly well with the largest number of flowers (58.5).

Evaluation of seven rose varieties for their quality and yield by Rukmanidevi (1998) revealed that variety 'Tineke' performed well with good flower yield (143 flowers/sq. m).

Gowda (2000) studied the performance of five exotic rose cultivars under naturally ventilated low cost polyhouse and reported that the cultivar 'kiss' produced the highest flower yield (8.096/m^2).

Gaikwad and Patil (2001) studied the performance of nine chrysanthemum varieties in a polyhouse and reported that the most productive cultivar 'Indira' produced more number of sprays per plant (17.97)

Out of five Gerbera varieties evaluated under low cost green house, Mini et *al.* (2003) found that variety 'Essandre' produced maximum number of flowers per plant.

Among 20 chrysanthemum cultivars evaluated for growth and yield, Jayanthi and Vasanthachari (2003) reported that the cultivar 'Red Gold' recorded significantly higher yield (34.40 tons/ha) compared to other cultivars.

Evaluation of nine carnation varieties by Mandal *et al*. (2003) revealed that variety ‘Supermix, Red’ performed well with maximum number of flowers per plant and variety ‘Solamanca’ recorded the largest flower.

Praneetha *et al.* (2003) studied the performance of fourteen carnation genotypes and reported that the cv. 'Sunrise' produced maximum number of flowers per plant (6.31).

Evaluation of six tuberose varieties for various characters by Pratap and Rao (2003) revealed that variety 'Hyderabad Double' performed well with

more number of florets per spike (62.67cm) and variety 'Hyderabad' recorded maximum spike length (84.8cm).

Shahakar and Sable (2003) studied the performance of six standard carnation cultivars under naturally ventilated green houses and reported that the cultivars Cobra, Gaudina and Super green produced maximum yield of flowers over rest of the cultivars.

2.2. Influence of variety

Today, hundreds of varieties are known in different colours in anthurium. So far cultivars have mainly been identified based on the spathe colour (Kobayashi *et al*., 1987). Bright red and bright orange colours have greatest demand all over the world followed by white and pink. Red colour was preferred most in Dutch market and there were nine colour groups like red, pink, green edged, mixed, white, cream, green orange and miscellaneous. Double coloured varieties and varieties with pastel colours are gaining more and more importance now and they are also fetching higher price in the international market (Rajeevan *et al.*, 2002).

An ideal anthurium variety should have compact plants with short internodes, producing suckers profusely; brightly clear coloured, showy, heart shaped spathe with plenty of blisters and symmetrical overlapping of basal lobes; spadix shorter in length than the spathe, reclining to the spathe oriented at an angle less than 30°; an erect, long flower stem, about five times the length of the spathe and resistance to common diseases and pests.

Varietal differences in plant and flower characters, growth, production and post harvest qualities of anthurium have been reported earlier by several scientists. Morphological studies conducted by Christensen (1971) showed that *A. andreanum* had a long juvenile phase followed by a generative phase in which

flower buds are produced. It produces flowers all round the year, one flower from each leaf axil. The sequence of leaf, flower and new leaf is maintained throughout the life of the plant. On comparing the productivity of 120 individual anthurium plants, Steen and Vijverberg (1973) found that their productivity was highly variable ranging between 4 to 16 flowers over two years.

Klapwijk and Spek (1984) recorded the monthly patterns of leaf and inflorescence formation in six Anthurium cultivars and observed that the time required for buds to develop into blooms ready for harvest ranged from about 45 to 53 days from May to October and from about 65 to 75 days from December to March. The average leaf number/m^2 glass house rose from 1.5 in March to 5 in June, thereafter declining until the following March.

Mercy and Dale (1994) observed that anthurium produced only five to eight leaves on a stem axis per year and five to eight spadices per year. Sindhu (1995) has recorded that the number of spadices produced annually by an anthurium plant varied from four to eight. According to Rajeevan *et al.* (2002) the number of leaves and spikes per plant per year varied from 4 to 9 in anthurium.

In a study of five varieties of *A. andreanum*, Bindu and Mercy (1994) observed the largest spathe size for ‘Pink’ (10.4 x 9.7 cm) and the smallest for 'Lady Jane' (6.5 x 3.5 cm). In a similar study, Sindhu (1995) found that varieties 'Pink' and 'Kalimpong Red’ produced super large flowers and the smallest flowers were produced in the variety 'white'. The variety 'Ruth Mort' had spathes larger than those of ‘Lady Jane’, with a mean width and length of 5.01 and 7.68 cm, respectively (Oglesby Plant Laboratory Inc., 1996).

Renu (1999) compared 10 varieties, which showed significant variation in the spathe size, ranging from 17.12 cm in Pompon Red to 30.74 cm in 'Dragon's Tongue Red'.

Henny (1999) recorded that the new variety 'Red Hot' had 6 to 7 cm long and 4 to 5 cm wide spathes. According to Rajeevan *et al.* (2002) the spathe size ranged from 7 cm in 'White Alba' to 17 cm in 'Pink' and 'Kalimpong Red'.

Characterization of six anthurium varieties was done by Ravidas (2003). The results showed significant variation with respect to the morphological characters. The variety 'Hima' was the tallest with long internodes. The shortest varieties were 'Agnihotri' and 'Red Dragon'. The annual productivity of plants ranged from 6 to 9 spikes per plant. Seasonal variation was noticed in the flowering behaviour. Flower production was high during February to March and low during November to January. The magnitude of variation and heritability were estimated. In most of the characters studied, the PCV was slightly higher than GCV indicating the influence of environment.

Performance of fifty morphologically diverse anthurium (*Anthurium andreanum*) cultivars was evaluated by Binodh and Devi (2005). The highest selection index values were observed in genotype LR x DT followed by FR x MW.

In another study by Srinivasa (2005), performance of five anthurium cultivars were evaluated to determine the influence of variety on leaf nutrient content in anthurium.Results revealed that different varieties showed significant influence on both major (N, P, K ,Ca. and Mg) and minor (Fe, Cu, Zn and Mn) nutrient content in the leaves.

2.3. Anthurium cultivars for container production (Pot plants)

In anthurium inflorescence is normally produced by dominant stem initially and later by lateral stems. Cultivars with many lateral shoots are desirable for pot culture, but they tend to flower later than those with strong apical dominance.

Traditionally, anthuriums with colourful inflorescences have been grown for cut flowers. With the introduction of compact interspecific hybrids through breeding and the selection of somaclonal variants, a series of potted anthurium cultivars have been released (Chen *et al*., 2003).

Apart from cut flowers, demand for potted plants is also increasing, mainly for indoor decorations. Potted anthurium has become an important flowering foliage plant because of its long-lasting, colourful flowers and deep green, shiny, arrow-shaped leaves. Export value of anthurium pot plants in Dutch auctions increased by 23 per cent in 2003 (Molfino, 2003).

Anthurium can grow and flower under low light conditions; thus it is becoming more widely used for interior plantscaping (Griffith, 1998). The predominant potted flowering anthurium species are *A. scherzerianum, A. andreanum, A. amnicola* hybrids and *A. antioquiense* hybrids. The most successful cultivar to date is the rosy pink 'Lady Jane' released in 1984 by Oglesby plant Labs Inc.

Performance evaluation of 21 anthurium cultivars for interior use was made by Henley and Robinson (1994). It was observed that light levels and nutrition affect leaf size and number, flower number, colour retention and general plant quality.

2.4. Anthurium for foliage

Foliage plants are used as living plants for interior decoration or interior plantscaping. Foliage plants from the world's tropical or subtropical regions provide the basis for today's foliage plant industry. Foliage plant industry has been enjoying steady growth with a wholesale value of $ 574 billion in 2000 (Chen *et al*., 2001).

Foliage of many attractive tropical ornamental plants like anthurium potentially could be used in the cut foliage industry, although within a species many preharvest factors can have significant effects on post harvest lines of cut foliage of anthurium (Brown, 2000). The major foliage species are *Anthurium clarinervium, A. crystallinum, A. royale, A. pedatoradiatum, A. forgetti, A. pittieri, A. magnificum, A. veitchii* (King anthurium) and *A. warocqueanum* (Queen anthurium). In addition to these, some of the *A. andreanum* varieties like Titicaca, Salasaga, Esmeralda, Emperor, and Flair etc. can also provide attractive foliage.

Chen *et al*. (1999) evaluated two commercial cultivars and three hybrids of anthurium under interior conditions. It was observed that plant quality remained excellent. Leaves were dark green and shiny while flowers were colourful and long lasting, suggesting that potted anthurium is a true interior flowering foliage plant. Some cultivars are able to grow and flower continuously under interior conditions for three years.

2.5. Influence of environment on growth and yield

Most of the *Anthurium* species are native to tropical rain forests and are primarily epiphytic in nature. Thus in their natural habitat, they receive ample, frequent water with good drainage. In cultivation, anthruiums prefer evenly moist media especially when actively growing. Overall it is better to slightly underwater than over water. Drying out may cause tip burn, root damage and reduced growth rates while over watering can also cause root damage and sudden yellowing of older leaves. Anthurium will not tolerate saturated poorly drained growing medium. Soil pH should be maintained between 5.5 and 6.5.

Anthurium andreanum grows best with day temperature of 25-32°C and night temperature of 21-24°C. Temperatures above 35°C may cause foliar burning, faded colour and reduced flower life. Night temperatures between 4 and 10°C can result in slow growth and yellowing of lower leaves. The plant will not

tolerate frost or freezing conditions. The best relative humidity for growth is 70-80 per cent.

Anthuriums grow under a wide range of light intensities but actual performance is dependant on the cultivars, elevation, temperature and nutrition. Generally most of the anthurium types grow well at light intensities ranging from 11,000 to 16,000 lux. Light intensities higher than 27,000 lux may result in faded flower colour and leaf colour.

The development and productivity of a crop is controlled by its surrounding environment, viz., light, temperature, air composition and biotic factors. But natural environment is not always optimum and crop suffers from stresses so that the productivity is significantly reduced. If we know the effect of various weather parameters, on crop growth, we can manipulate such conditions in a green house so that crop productivity is optimized.

2.5.1. Effect of light

Light is the most important environmental factor in the green house culture, as it influences a wide range of processes related to photosynthesis, energy balances including transpiration, phase transitions and morphology. Light is the solar radiation filtered by the atmosphere and reaching the ground.

The visible rays or photosynthetically active radiation (400-700 nm) is necessary for photosynthesis, which is a basic process for the crop production (Mc Cree, 1972) whereas the rest of the solar spectrum is the major factor affecting crop transpiration (Gates, 1976). The UV radiation is further composed by UV-C (200-280 nm); UV-B (280-315 nm) and UV-A (315-400 nm) rays. The UV-C radiation is highly phototoxic and UV-B is detrimental to most of the plants whereas UV-A has formative effects. UV-A has bactericide effects and has a strong effect over the organoleptic qualities of the plant; colour, taste, smell and

turgidity (Zanon, 1990). The relative amount of UV-B plays an important role on the development of some fungi (Kittas and Baille, 1998). The infrared radiation is supposed to have only a heating effect on the plants.

In order to attain good growth of plants inside the green house, there should be sunshine of desired quantity and intensity. Low light intensity is the most important environmental restraint to maximize photosynthesis and growth. Transpiration is also affected by light intensity by the opening and closing stomata (Bakker, 1995).

Light duration plays an important role in photoperiodism, which the response of the organism to the day-night cycle. The relative length of the light and dark periods control a number of responses including flowering, leaf shape, stem elongation, bulb formation and pigmentation. Based on the response of the plants to the light periods, plants are classified into long day plant (requiring 7-10 hr of continuous dark periods), short day plant (requiring 10-14 hr of dark periods) and day neutral plants (photo insensitive). The intensity, quantity as well as duration of light in a day influence many physiological processes in the plants. Flowering is influenced to a great extent by the day length in many plants. In addition to the flowering responses, photoperiod also influences pigmentation, partitioning of photosynthates, quantity and quality of flowers produced (Prasad, 1997). Light control, in addition to other parameters, can be employed for enhancing and delaying the maturity of crops (Bakker, 1995; Suseela, 2002).

Anthurium is a crop, which is highly influenced by light intensity. Various scientists have reported the influence of light intensity on growth, flowering and quality of flowers in anthurium.

2.5.1.1. Influence on morphological characters

In the commercial practice, anthurium is grown under partial shade. The intensity of light affects the morphological characters, flower production and quality of flowers.

Kimball (1986) reported that low light intensity is the most important environmental restraint to maximum photosynthesis and growth. Kaiser (1987) revealed that at extremely high irradiance, leaf photosynthesis can be reduced by photo-inhibition of the light reaction at reduced leaf water content.

Studies in Hawaii with cut flower cultivars of anthurium showed that flower peduncles were longer and spathe size larger at lower light levels, while flower production was slightly higher with increased light. Requirement of fertilizers also depended upon light levels (Henny *et al*., 1991).

At extremely high irradiance green house and leaf temperatures may increase excessively and temperatures above 35°C could irreversibly damage the photosynthetic machinery (Gijzen, 1994). For closed canopies the photosynthesis does not show saturation up to PAR (Photosynthetically Active Radiation) intensities of 2000 µ mol m^{-2} s^{-1} and in green houses where plants are well watered, little limitation of the photosynthesis resulting from high irradiance is likely to occur (Van de Sanden, 1994; Gijzen, 1994).

Singh (1987) and Antoine (1994) observed that shade requirements of anthurium ranges from 60 to 80 per cent of full sunlight. Some growers utilize the shade of coffee, citrus and other trees for growing anthuriums.

Henley and Robinson (1994) have studied the performance of 21 potted anthurium cultivars under shade after 38 weeks of growth. Vonk Noordegraff (1968) has pointed out that at low temperature (< 20°C) associated

with heavy shade, leaf growth was slow, the leaves were smaller in size, dark green in colour with thinner, longer stalks and the plants were more flaccid. It was also necessary to protect the plants from excessive rains.

Based on the study using 27, 43, 57 or 73 per cent shade, Poole and Mc Connel (1971) opined that decrease in shade level did not affect flower production but reduced flower stem length. Leaves of plants kept under 27 per cent shade become chlorotic. In another experiment with 75, 50 or 25 per cent shade of full sunlight, the largest number of flowers was produced with the least shading, but flower quality was better under higher intensity of shade (Poole and Mc Connel, 1971).

Plants from cuttings without the apical bud showed less vegetative growth and did not show a marked response to light intensity (Boula *et al*., 1973). Leffering (1975) reported that the growth rate increased and average flower production rose from 5 to 12 flowers per plant per year when plants received at least 45 per cent of the available light by means of an automatic system outside the greenhouse. Overhead sprinklers were also used to prevent leaf scorch on sunny days. Schmidt and Lauterbach (1985) have presented data on plant height and diameter of 10 cultivars of anthurium under shade.

The response of anthurium ‘Lady Jane” to different light and fertilizer levels was reported by Henny and Fooshee (1988). Klapwijk and Spek (1988) observed that leaf plastochron duration was fairly constant from March until September with an average of 72 days. Around 10th October, the duration was more than double subsequently, it decreased linearly to 72 days again, resulting in high leaf production around April. Leaf plastochron seemed to be related to radiation. Day length is probably not involved, as leaf emergence continued during winter. Klapwijk and Spek (1988) have also reported the influence of light intensity on development rate, flower growth and production of anthurium.

Investigations conducted in Kerala Agricultural University showed that in anthurium height, spread, number of leaves, leaf area and number of suckers were influenced by light intensity. Linear growth rate was consistent and positive under 80 per cent shade. Dry matter production was also significantly superior under this shade level (Salvi, 1997; Rajeevan and Valsalakumari, 2001). Based on another study a model was developed describing the influence of irradiance and temperature in the greenhouses on the size of flowers (Nothuagal *et al*., 2004).

2.5.1.2.Influence on flowering

Light intensity associated with shade and temperature has profound influence on flower production in anthurium. Under low light intensity anthurium plants can maintain attractive foliage but continual blooming may be interrupted. Nakasone and Kamemoto (1962) have reported that increasing shade increases stem and spathe size but reduces flower production.

According to Vonk Noordegraff (1968) when *A. scherzerianum* plants were grown in shade compared to full light, flowers were smaller and less in number. Light had the greatest effect on flower production, followed by temperature. He has also pointed out that while producing *A. scherzerianum* at a temperature above 18°C the number and size of flowers were generally reduced to some extent.

Different flowering responses of *A. scherzerianum* types have been reported by Schaper and Zimmer (1991). Dai and Paull (1991) have reported about the interrelationship of leaf development and flower growth in anthurium. Armitage and Son (1992) stated that plants grown under 67 per cent shade had the longest stems and could be harvested three weeks earlier than field grown plants.

In a study conducted using different shade levels for anthurium (50, 60, 70 and 80 per cent) earliest flowering was observed under 70 per cent shade. But the flower quality in terms of size, colour and length of stalk was highest under 80 percent shade (Salvi, 1997).

In a study conducted to investigate the effects of different light intensities viz., 3.6, 8.5, 10.2 and 14.6 mol of photons/day/m on plant growth, development, yield and flower quality of tissue cultured *Anthurium andreanum* var. Cancan, the largest leaves, flowers and the highest photosynthesis rate were observed under the lowest light intensity (Dufour and Guerin, 2003a).

Spathe colour in anthurium is due to various anthocyanin pigments (Iwata *et al*., 1979). Anthocyanin and chlorophyll contents of plants are, in turn, influenced by light intensity (Kunisaki, 1982). Kamemoto *et al*. (1988) had given a description of the genetics of the major spathe colours in anthuriums.Classification of colours of important anthurium cultivars and new introductions in Hawaii was done by Criley (1989), according to the Royal Horticultural Society colour chart. The histological distribution of anthocyanins in anthurium spathes was studied by Wannakrairoj and Kamemoto (1990).

Plants subjected to low temperature showed a drop in chlorophyll concentration, which seemed to be due to the photo oxidative damage to the membranes of the chloroplast (Levit, 1980). There was a decrease in chlorophyll content of leaf in anthurium with decrease in intensity of shade from 80 per cent to 50 per cent as reported by Salvi (1997).

Leffering (1981) observed more flower production in gerbera plants when grown under long day with a high irradiance level for eight hours with 67 µ mol s^{-1} m^2. In an experiment conducted by Kadmanzahavi and Yahil (1986) it was observed that 40 days for flower bud initiation in aster under field condition was reduced to 21 days when it was grown under green house condition.

Van *et al*. (1989) reported increased flower yield in gerbera with long stemmed heavier flowers at high light intensity. The same effect was also observed by Garala *et al*. (1989).

Neelofar (1992) reported that carnation flowering can be made earlier by manipulating extra light for four hours under polyhouse conditions. Effect of light intensity and CO_2 supplement on growth and flowering of gladiolus was reported by Xiaoping (1995). He observed beneficial effects of improved plant growth and enhanced flowering under supplementary lighting and CO_2 enrichment in gladiolus.

2.5.2. Effect of temperature and relative humidity

Temperature plays an important role in flower initiation and development in numerous greenhouse crops (Hanan, 1998). The maximum activity is obtained at a definite range of temperatures. Below and above this range the activity slows down. Leaf temperatures affect the transpiration rates of the plant. Temperature also affects the quality of the products and maturity rate of the plants and has an important role virtually in all plant responses including photosynthesis, transpiration and respiration. It influences initiation and development of reproductive organs. Temperature influences plant growth from sowing to flowering in three distinct ways. In crops of temperate regions there may be specific cold temperature hastening of flowering known as vernalization. The rate of progress of flowering increases with increase in temperature to an optimum temperature at which flowering is most rapid. At supra-optimal temperature, flowering was progressively delayed as temperature increased (Kachru, 1985; Prasad, 1997).

The climatic conditions desired for the anthurium are very close to tropical condition. Higher temperatures combined with lower humidity stimulate growth since the plant needs more evaporation.

The optimum temperature for growth of anthurium is 18-21°C and the minimum temperature should not be less than 10°C for a short period.

Maatsch and Batchthaler (1964) observed that plant vigour increased with increase in temperature. The unsuitable growing conditions stimulated the development of abnormal spathe and spadix and thereby reduced the productivity of plant (Steen and Vijverberg, 1973). Suda and Fukuda (1998) reported that the decrease in flower number in anthurium was caused by inhibition of flower-bud development in inadequate environment, such as, high temperature in summer.

Temperature influences the incidence of bacterial blight in anthurium as reported by Chase (1988). Severity of blight was greatest for plants maintained at 30°C, whereas no symptom developed at temperature <26°C.

Influence of temperature and light intensity in summer on growth and flowering in anthurium was studied. High temperature in summer hardly influenced vegetative growth, but restrained the growth of flower bud and increased the abortion of it. Effect of light intensity to the flowering was quite different in varieties. Light intensity hardly influenced the rate of vegetative growth (Suda and Fukuda, 1999).

Wang (1999) evaluated six hybrid anthurium cultivars under warm (30°C) and hot (35°C) conditions in greenhouses. He reported that except one cultivar ‘Royal Red’ all other cultivars faded under hot conditions. Growing these cultivars at highest air temperatures of 30°C is recommended for good quality and high flower count.

Misra *et al* (2002) observed poor spathe colour in anthurium when the night temperature was above22^0c.

High temperature developed inside the growing structure coupled with poor aeration is an important problem for growing anthuriums during summer season, more particularly in the plains (Rajeevan *et al*., 2002).

The relative humidity, which also plays an important role in the growth and development of anthuriums, should be around 80 per cent (Ignasse, 1984; Otto, 1967 and Vonk Noordegraff, 1968 and 1969). Higher humidity has, however, marginal effect on the plants (Papenhagen, 1986). Grange and Hand (1987) reported that relative humidity in the range of 60 to 90 % had little influence on the growth and development of the plants normally grown in green houses. Bright, but filtered, light is essential for abundant flowering (Singh, 1987).

2.5.3. Influence of growing environment on post harvest quality of flowers

Post harvest behaviour of cut flower is determined by the pre harvest conditions under which the crop is grown. It may be emphasized that the post harvest behaviour of the flower is determined by the pre harvest growing conditions, which account for 30-70 per cent of vase life of the flower. The pre harvest conditions which have an important bearing on vase life of flowers are selection of variety, environmental factors, viz., light, temperature, relative humidity, fertilization, irrigation, diseases, pests and presence of pollutants (Valsakumari *et al*., 2003; Rajeevan *et al*., 2004).

Mahanta and Paswan (2003) reported that gerbera flowers grown under plastic rain shelter showed better vase life compared to those grown in the open.

Light intensity during the growing period affects the inherent carbohydrate levels. In *Dendrobium nobile* cultivars it was found that carbohydrate accumulates in shoots after the emergence of last leaf and during the

elongation of floral axis. Insufficient light conditions result in flower with low vase life. Too high light intensities cause yellowing of the foliage, discoloration of flower, dropping of leaves and abscission of buds (Hew *et al*., 1987).

Under the different shade levels tried in anthurium, viz., 50, 60, 70 and 80 per cent, post harvest longevity of flowers was maximum when produced under 80 per cent shade (Salvi, 1997).

Flower crops are highly specific in their temperature requirements. Temperature during the growth period influences the size and post harvest quality of flowers. Lower night temperatures are always advantageous because at night, when the plant does not manufacture food due to photosynthesis, the low respiration rates at lower temperatures lower the burning of food.

Paull *et al*. (1992) observed that the mean maximum temperature during the two months before harvest and the duration of post harvest life were positively related. The pre harvest temperature and fertilization significantly influenced the post harvest life of anthurium by 63 to 71 per cent.

Mortensen and Fjeld (1998) observed an increase in shoot length of rose cultivars at higher relative humidity, while there was a reduction in vase life.

High humidity enhanced the plant dry weight of poinsettia and kalanchoe, decreased it in begonia and had significant effect in chrysanthemum. The highest plant quality was generally produced under the lowest humidity, with the development of more compact plants. Keeping quality, when tested under indoor conditions, was the same, irrespective of humidity in begonia, poinsettia and pot chrysanthemum (Mortenson, 2000).

Materials and Methods

3. MATERIALS AND METHODS

Investigations on "Performance evaluation of anthurium (*Anthurium andreanum* Linden) under two climatic regimes" were carried out at the Department of Pomology and Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur and at Orange and Vegetable farm, Nelliampathy during 2005-06.The details of the experiments conducted and the methods followed for analysis of data are presented in this chapter.

Ten, each of the globally important varieties of *Anthurium andreanum* belonging to cut flower (CF) and pot plant (PP) group were grown under two agro climatic conditions, one in the plains (Vellanikkara,Thrissur) and the other at an altitude of 1050m above MSL (Nelliampathy,Palakkad).

Observations were recorded on the vegetative characters, days to flowering, and floral characters at monthly interval, upto a period of fourteen months after planting. Weather parameters, viz., temperature (maximum and minimum), relative humidity and light intensity were recorded daily both inside and outside the growing structures. The effect of weather elements and their diurnal variation on the performance of the crop and varieties were worked out using statistical techniques.

3.1. PLANTING MATERIAL

Two month old tissue culture plants were used as planting material in both the locations. Fifteen plants of each variety in both the groups were used.

3.2. VARIETIES

The varieties used for the study were the following.

3.2.1. Cut flowers

ESMERALDA, CHICHAS, BENICITO, TITICACA, SALASAGA, AYMARA, CAESAR, AKAPANA, JEWEL, LUCIA

3.2.2. Pot plants

DIABLADA, INTI, CORALIS, EXCELLENT, PATINO, MIA, CONDOR, PUMASILLO, TRAMPOLINO, BONINA

3.3. CULTURAL PRACTICES

Planting was done in June 2005. Plants were potted in earthen pots 15cm size. A medium consisting of coarse sand, charcoal, well rotten cow dung, gravel and sterilized coir pith was used for growing plants. The cultivation practices standardized in the department were adopted uniformly (Salvi, 1997). UV stabilized shade nets were used as growing structures so as to provide 75 to 80 per cent shade.

3.4. POST HARVEST STUDIES

Post harvest longevity of anthurium flowers were studied in the laboratory by using 3 flowers, each from all the varieties from both the locations**.**

For this, uniform spikes were harvested when one third of the flowers on the spadix opened (Salvi, 1997). The flowers were harvested in the morning and a fine slanting cut was given to the base of the stalk to expose more surface area and to facilitate easy absorption of water.

3.5. DESIGN OF THE EXPERIMENT

Fifteen plants in a variety were arranged randomly in the growing structures at both the locations. For field experiments a completely randomized design (CRD) with three replications was laid out.

3.6. OBSERVATIONS

In each group three plants were used for recording biometric observations. The parameters recorded during the course of the experiment were the following.

3.6.1. Plant characters

The following plant characters were studied.

3.6.1.1. Plant height

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

3.6.1.2. Plant spread

The spread of the plant in East West and North South directions were measured and recorded in centimeters.

3.6.1.3. Number of leaves

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

3.6.1.4. Length, breadth and area of leaves

The length of the leaf from the basal lobe to the tip and maximum leaf width at the centre of the leaf was measured in centimeters. The area for every newly emerged leaf was computed using the following equation (Salvi, 1995):

Leaf area = 0.72 x (leaf length x leaf breadth)

3.6.1.5. 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 centimeters.

3.6.1.6. Leaf production interval

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

3.6.1.7. Longevity of leaves

Number of days from the opening of the leaf to necrosis on the plant was recorded and expressed as longevity in days.

3.6.1.7. Quality of leaf as cut foliage

Quality of leaf as cut foliage was evaluated based on visual parameters and longevity.

3.6.2. Floral characters

3.6.2.1. Days to flower emergence

Number of days taken for first flower bud to appear after planting was noted and recorded. The number of days required for the emergence of first flower bud after imposing the treatments was recorded and expressed as days to first flowering.

3.6.2.2. Length of peduncle

Length of peduncle from its point of emergence to the point of attachment of the spathe was measured and expressed as the length of peduncle in centimeters.

3.6.2.3. Length and breadth of spathe

The length of the spathe from the joint of the peduncle to the tip and breadth at the centre were measured and recorded in centimeters.

3.6.2.4. Length of spadix

Length of the spadix from the base to tip was measured and recorded in centimeters.

3.6.2.5. Angle of orientation of spadix to spathe

Angle between the spathe and spadix was measured and recorded in degrees.

3.6.2.6. Angle of orientation of spathe to stalk

Angle between the spathe and the stalk was measured and recorded in degrees.

3.6.2.7. Longevity of spike on plant

The number of days from the opening of the spathe to total necrosis of spathe and spadix on the plant was recorded.

3.6.2.8. Interval of flower production

The number of days taken for the emergence of successive spike was recorded.

3.6.2.9. Nature of peduncle (straight / bending)

Nature of peduncle, such as straight or bent was observed and recorded.

3.6.2.10. Colour of spathe and spadix

Colour of spathe and spadix was recorded by visual observation.

3.6.3. Post harvest characters

The following were the post harvest characters studied during the course of experiment.

3.6.3.1. Days to loss of glossiness

Number of days from the date of harvest to the loss of glossiness was recorded.

3.6.3.2. Days to spathe necrosis

Number of days from the date of harvest to the spathe necrosis was recorded.

3.6.3.3. Days to spadix necrosis

Number of days from the date of harvest to the spadix necrosis was recorded.

3.6.4. Weather parameters

Daily readings of temperature (maximum and minimum), relative humidity and light intensity were recorded using maximum and minimum thermometers, hygrothermometer and lux meter respectively. The observations were taken during 11.00 p.m -2.00 p.m, uniformly.

3.6.4.1. Maximum temperature

Maximum temperature was recorded inside and outside the growing structures using maximum thermometer and expressed in degree Celsius.

3.6.4.2. Minimum temperature

Minimum temperature was recorded inside and outside the growing structures using minimum thermometer and expressed in degree Celsius.

3.6.4.3. Relative humidity

Relative humidity was recorded inside and outside the growing structures using hygrothermometer and expressed in percentage.

3.6.4.4. Light intensity

Light intensity was recorded inside and outside the growing structures and expressed in lux.

The meteorological data including the rainfall(mm), rainy days and sunshine hours during the cropping period is presented in Appendix-I.

3.7. STATISTICAL ANALYSIS

The data pertaining to the growth parameters and floral characters were subjected to statistical analysis by applying the technique of analysis of variance (ANOVA) for completely randomized block design (Panse and Sukhatme, 1985).

If the analysis was found significant, Duncan's Multiple Range Test (DMRT) was done to find out the homogenous groups of anthurium species in different characters. The analysis was done separately for each location both for cut flowers and pot plants.

Correlation studies were done between weather parameters and plant growth parameters using the software SPSS. Observations of growth parameters, viz., plant height, plant spread EW, plant spread NS, number of leaves, leaf length, leaf breadth, leaf area, petiole length and weather parameters, viz., temperature (maximum and minimum), relative humidity and light intensity were taken for the analysis (Panse and Sukhatme, 1985).

Results

4. RESULTS

Studies were conducted at the College of Horticulture, Vellanikkara and at Orange and Vegetable farm, Nelliampathy during 2005-06 to examine the performance of ten cut flower and ten pot plant varieties of anthurium.To evaluate the performance various morphological characters like plant height, number of leaves, petiole length, leaf length, leaf breadth, leaf area and floral characters like peduncle length, spathe length, spathe breadth, spadix length were recorded. Observations were recorded monthly starting from July 2005 to August 2006.The results of the experiments are as follows.

4.1. VEGETATIVE CHARACTERS

4.1.1. Plant height

4.1.1.1. *Cut flower varieties*

Data pertaining to the monthly variation in height are presented in Table 1. Significant differences were noticed among the varieties through out the growing period at both the locations.

At Vellanikkara, Aymara recorded a maximum plant height (46.00cm) after 14 months. Minimum plant height was recorded in Benicito (35.50cm).

At Nelliampathy, Salasaga recorded a maximum plant height of 59.50cm, that was on par with Aymara (58.30cm), Caesar (54.30cm) and Esmeralda (51.30cm).Plant height was the lowest (35.70cm) in the variety Akapana.

When the locations were compared, differences were found significant. Plant height was found to be higher at Nelliampathy than at Vellanikkara.

4.1.1.2. *Pot plant varieties*

Significant differences were noticed among the varieties through out the growing period at both the locations.

At Vellanikkara, maximum plant height was recorded for Condor (45.20cm) which was closely followed by Excellent (45.00cm) Plant height was the lowest (27.10) in Diablada (Table 2).

At Nelliampathy, Mia was superior to all other varieties during the entire period of observation. Maximum plant height was recorded for Mia (67.30cm) that was on par with Condor (60.30cm).Minimum plant height was recorded for Inti (18.70).

Difference between locations was not significant for all the varieties except Mia, Condor and Inti. Mia and Condor was always performing better at Nelliampathy where as Inti was found to be good at Vellanikkara.

Table 1.Mean plant height (cm) of anthurium cut flower varieties

Variety		Plant height in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	16.02	17.30	19.0	25.0	25.7	29.2	30.0	30.3	30.3	30.3^{b}	30.3^{b}	30.8^{b}	34.2^{bc}	43.5^{ab}
	Nel	9.12^{a}	15.70^{bc}	20.4	27.7^{abc}	28.3^{abc}	30.6	29.8^{abc}	34.7^{ab}	34.8^{abc}	34.9	43.3^{ab}	44.00^{abc}	44.7^{abc}	51.3^{abcd}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Chichas	Vel	17.13	18.50	19.4	27.3	28.8	27.3	28.2	28.5	29.2	29.7^{b}	29.5^{b}	29.8^{b}	35.8^{ab}	36.2^{bc}
	Nel	8.46^{ab}	16.90^{bc}	19.3	19.5^{cd}	17.0^{de}	23.5	24.9^{bc}	25.5^{abc}	25.2^{bcd}	31.7	32.7^{bc}	33.17^{cde}	36.2^{bc}	43.3^{bcde}
	Sig	*	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	*
Benicito	Vel	18.42	19.70	21.1	26.8	27.2	26.7	27.7	27.8	28.7	27.5^{b}	28.4^{b}	28.7^{b}	30.3^{c}	35.5^{c}
	Nel	6.16^{bcd}	17.70^{bc}	21.8	23.2^{bcd}	24.7^{bcd}	23.0	28.7^{abc}	28.8^{abc}	28.2^{abcd}	38.2	40.0^{abc}	40.50^{abc}	40.7^{abc}	44.3^{bcde}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
Titicaca	Vel	18.28	18.60	19.3	22.4	25.2	27.7	28.7	29.2	30.0	30.0^{b}	31.3^{b}	31.5^{b}	35.5^{ab}	39.5^{bc}
	Nel	7.27^{abcd}	19.40^{abc}	20.3	21.6^{bcd}	22.0^{cde}	23.7	25.3^{abc}	25.5^{abc}	16.8^{d}	30.5	36.7^{abc}	37.00^{bcd}	40.2^{abc}	37.7^{de}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns
Salasaga	Vel	17.44	18.00	18.2	25.8	27.5	26.2	27.2	27.7	28.6	30.2^{b}	30.5^{b}	31.7^{b}	33.7^{bc}	35.7^{bc}
	Nel	7.85^{abc}	20.80^{ab}	26.5	29.3^{ab}	30.7^{ab}	32.3	35.9^{a}	38.5^{a}	37.5^{ab}	43.0	48.3^{a}	50.67^{ab}	52.3^{a}	59.5^{a}
	Sig	*	ns	*	ns	ns	ns	*	*	*	*	*	*	*	*
Aymara	Vel	13.75	15.60	18.4	26.8	28.3	28.3	30.2	30.5	31.5	30.7^{b}	31.7^{b}	32.7^{b}	34.7^{bc}	46.0^{a}
	Nel	5.93^{bcd}	14.70^{c}	18.3	23.5^{bcd}	24.0^{bcde}	29.0	29.5^{abc}	33.5^{ab}	37.2^{abc}	39.3	39.5^{abc}	48.3^{ab}	49.0^{ab}	58.3^{ab}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	*	*	*
Caesar	Vel	19.05	21.20	23.1	28.0	30.8	27.0	28.0	30.0	31.0	30.3^{b}	31.5^{b}	32.5^{b}	34.2^{bc}	41.3^{ab}
	Nel	9.76^{a}	24.00^{a}	25.3	33.2^{a}	33.7^{a}	32.7	35.4^{ab}	38.5^{a}	40.8^{a}	42.5	45.2^{ab}	52.5^{a}	54.5^{a}	54.3^{abc}
	Sig	*	ns	ns	*	ns	*	*	*	*	*	*	*	*	*
Akapana	Vel	17.35	20.10	21.9	30.5	30.7	28.3	30.5	31.3	32.7	37.2^{a}	37.8^{a}	39.2^{a}	39.2^{a}	42.1^{ab}
	Nel	5.11^{d}	17.50^{bc}	17.1	15.6^{d}	16.0^{e}	17.5	19.7^{c}	19.0^{c}	19.6^{d}	28.8	32.0^{bc}	24.8^{de}	31.3^{c}	35.7e
	Sig	*	ns	*	*	*	*	*	*	*	*	ns	*	*	*
Jewel	Vel	17.55	19.50	21.3	28.9	29.3	29.5	30.7	31.1	32.0	37.8^{a}	38.3^{a}	39.3^{a}	39.7^{a}	40.8^{b}
	Nel	5.72^{bcd}	17.50^{bc}	19.0	18.6^{cd}	18.9^{de}	22.2	22.4^{c}	23.1^{bc}	23.5^{cd}	27.8	26.8^{c}	21.3^{e}	33.5^{c}	40.0^{cde}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*	ns	ns
Lucia	Vel	19.62	21.10	22.1	30.7	30.8	31.7	32.7	23.2	33.9	35.6^{a}	36.7^{a}	37.7^{a}	37.7^{ab}	42.3^{ab}
	Nel	5.41^{cd}	17.80^{bc}	18.7	20.5^{bcd}	21.1^{cde}	26.0	26.6^{abc}	28.2^{abc}	34.8^{abc}	34.9	43.3^{ab}	44.00^{abc}	44.7^{abc}	51.3^{abcd}
	Sig	*	ns	ns	*	*	*	*	ns	*	*	ns	*	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 2.Mean plant height (cm) of anthurium pot plant varieties

Variety		Plant height in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	14.1^{d}	15.2^{b}	17.0d^{e}	23.3^{cde}	24.0^{b}	23.5^{cd}	24.5^{b}	24.9^{b}	25.6^{bcde}	24.8^{e}	24.9^{c}	25.4^{e}	25.7^{d}	27.1^{c}
	Nel	7.8^{c}	8.3^{e}	13.7^{c}	14.9^{b}	15.4^{b}	15.6^{c}	15.9^{e}	19.2^{ad}	18.3^{de}	20.8^{d}	21.7^{d}	22.3de	23.2^{ef}	27.5^{cd}
	Sig	*	ns	ns	*	*	*	*	ns	*	ns	ns	ns	*	ns
Inti	Vel	13.2^{d}	14.3^{b}	14.8^{e}	20.7^{e}	21.5^{b}	21.7^{d}	22.0	22.3^{b}	23.0^{e}	25.2^{e}	24.8^{c}	27.3^{de}	28.2^{d}	28.1^{c}
	Nel	7.7^{c}	12.3^{d}	13.6^{c}	14.0^{b}	14.3^{b}	15.0^{c}	15.7^{e}	16.3^{d}	16.0^{e}	18.9^{ee}	14.8^{d}	15.8^{e}	15.3^{f}	18.7^{d}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Coralis	Vel	17.0^{bcd}	17.8^{b}	18.8^{cde}	22.3^{de}	23.0^{b}	25.1^{bcd}	25.0^{b}	25.5^{b}	25.7^{bcde}	31.8^{c}	33.7^{ab}	33.3^{bc}	33.7^{c}	38.7^{ab}
	Nel	7.2^{c}	17.3^{bcd}	17.9^{c}	17.3^{b}	17.5^{b}	20.3^{c}	21.7^{de}	24.0^{cd}	25.2^{cde}	28.7^{cde}	33.0^{bc}	34.0^{bc}	31.3^{de}	34.8^{bc}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Excellent	Vel	23.9a	25.8^{a}	26.7^{a}	32.3^{a}	32.8^{a}	31.9^{a}	32.2^{a}	33.5^{a}	34.2^{a}	32.5^{bc}	34.0^{a}	40.7^{a}	41.5^{ab}	45.0^{a}
	Nel	8.8^{c}	19.3^{bc}	21.7^{b}	23.1	23.7^{b}	24.5^{bc}	29.6^{bc}	32.1^{b}	30.6^{bc}	37.8^{bc}	38.3^{b}	39.7^{b}	44.2^{bc}	46.2^{b}
	Sig	*	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns
Patino	Vel	15.6^{cd}	16.8^{b}	17.2^{de}	21.9^{de}	22.0^{b}	22.6^{d}	23.5^{b}	23.9^{b}	24.9^{de}	29.8^{cd}	27.5^{c}	35.2^{bc}	34.3^{c}	34.8^{b}
	Nel	4.0^{d}	11.7^{d}	13.6^{c}	16.8^{b}	20.7^{b}	17.6^{c}	18.5^{de}	18.5^{d}	19.4^{cde}	22.8^{de}	26.7^{c}	28.7cd	29.0^{de}	30.7^{bcd}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Mia	Vel	19.1^{bc}	21.2^{ab}	21.2^{bcd}	31.3^{ab}	32.0^{a}	31.0^{a}	31.7^{a}	32.3^{a}	33.0^{a}	30.8^{cd}	32.5^{ab}	33.2^{bc}	37.5^{bc}	38.3^{ab}
	Nel	10.1^{c}	27.8^{a}	34.7^{a}	37.5^{a}	39.7^{a}	36.2^{a}	42.5^{a}	45.2	50.3^{a}	51.5^{a}	50.7^{a}	51.8^{a}	68.3^{a}	67.3^{a}
	Sig	*	*	*	*	*	ns	*	*	*	*	*	*	*	*
Condor	Vel	20.7^{ab}	20.2^{ab}	22.9^{ab}	26.7^{bcd}	27.5^{a}	28.0^{abcd}	28.2^{ab}	28.6^{a}	29.0^{abcd}	35.5^{ab}	36.0^{a}	37.0^{ab}	44.2^{a}	45.2^{a}
	Nel	18.9^{a}	26.8^{ab}	28.2^{ab}	32.2^{a}	34.0^{a}	32.2^{ab}	36.0^{b}	35.8^{b}	37.7^{b}	42.3^{ab}	38.5^{b}	39.0^{b}	53.8^{b}	60.3^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	*	*	ns	ns	*	*
Pumasillo	Vel	19.0^{bc}	14.8^{b}	21.6^{bc}	27.7^{abc}	27.9^{a}	29.2^{ab}	29.4^{ab}	26.4^{b}	30.7^{ab}	36.2^{a}	36.8^{a}	37.8^{ab}	43.5^{a}	44.5^{a}
	Nel	8.5^{c}	13.9^{d}	12.4^{c}	17.5	18.4^{b}	18.6^{c}	21.5^{de}	20.5^{cd}	22.5^{cde}	28.0^{cde}	24.7^{c}	25.7cd	34.3^{cd}	43.3^{b}
	Sig	*	ns	ns	*	*	*	*	ns	*	*	*	*	*	ns
Trampolino	Vel	21.4^{ab}	16.2^{b}	17.7^{cde}	28.2^{abc}	29.7^{a}	30.6^{a}	34.1^{a}	32.4^{a}	33.0^{a}	35.7^{ab}	36.5^{a}	37.7^{ab}	43.0^{a}	44.2^{a}
	Nel	8.1^{c}	20.6^{b}	21.3^{bc}	19.8	23.4^{b}	25.0^{b}	24.8^{cd}	28.2^{bc}	28.2^{bc}	29.2^{cde}	32.4^{bc}	33.3^{bc}	40.3^{c}	43.2^{b}
	Sig	*	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	*	ns	ns
Bonina	Vel	15.3^{cd}	21.6^{ab}	24.5^{ab}	22.0^{de}	23.7^{b}	24.3^{bcd}	24.6^{b}	25.8^{b}	26.5^{bcde}	27.8^{de}	29.0^{bc}	30.7^{cd}	34.2^{c}	35.2^{b}
	Nel	13.9^{b}	17.2^{bcd}	18.5^{bc}	19.5^{b}	19.9^{b}	19.1^{c}	24.1^{cd}	23.0^{cd}	25.0^{cde}	31.2^{cd}	30.3^{bc}	31.3bcd	39.5^{cd}	40.7^{bc}
	Sig	ns	*	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

4.1.2. Plant spread (E W)

4.1.2.1. *Cut flower varieties*

Significant differences were noticed among the varieties at both the locations. (Table 3).

At Vellanikkara maximum EW plant spread was recorded in the variety Aymara (37.28. cm).Salasaga recorded lowest plant spread of 28.82cm.

At Nelliampathy, EW plant spread was significantly different among all the varieties. Caesar recorded maximum plant spread (55.30) through out the growth period. It was closely followed by varieties Esmeralda (46.00 cm), Aymara (43.80 cm) and Benicito (41.00 cm).Variety Jewel registered minimum plant spread (23.70 cm).

Difference between locations was significant only for Esmeralda, Benicito and Caesar.EW plant spread was found to be higher at Nelliampathy than Vellanikkara.

4.1.2.2. *Pot plant varieties*

Significant variation is seen in EW plant spread among varieties irrespective of the location (Table 4).

At Vellanikkara, maximum EW plant spread was recorded in the variety Trampolino (38.80 cm).Bonina recorded minimum plant spread (29.28 cm).

At Nelliampathy, maximum EW plant spread was recorded for Mia (49.00 cm).It was closely followed by Condor (43.00cm).Variety Inti had the minimum plant spread of 19.20cm.

Table 3. Mean E W spread (cm) of anthurium cut flower varieties

Variety		Plant spread (E W) in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	10.3	11.3	15.3	17.5	19.3	20.9	21.0	21.8	21.8	26.2^{c}	29.0^{a}	29.3^{ab}	25.2^{cd}	32.5^{ab}
	Nel	8.8^{ab}	10.7	12.5^{b}	20.8^{ab}	21.7^{ab}	23.7	23.7^{ab}	23.7^{a}	29.5	34.9	31.3	43.3^{ab}	49.3^{a}	46.0^{ab}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*
Chichas	Vel	12.0	12.2	14.8	21.3	21.3	24.7	25.3	26.5	27.5	28.5^{ab}	25.0^{b}	26.2^{b}	26.7^{c}	30.2^{b}
	Nel	11.2^{a}	13.2	14.2^{b}	15.2^{abc}	15.5^{abc}	21.8	18.3^{bc}	20.0^{a}	23.0	29.8	29.0	29.7^{b}	32.0^{bc}	32.7^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Benicito	Vel	12.7	12.7	13.7	19.3	22.2	24.3	24.5	26.0	27.0	29.8^{a}	28.8^{a}	29.5^{ab}	30.3^{ab}	30.7^{ab}
	Nel	11.3^{a}	11.2	12.2^{b}	19.3^{abc}	20.3^{ab}	22.2	23.8^{ab}	21.0^{a}	23.2	26.3	30.0	34.8^{ab}	33.0^{bc}	41.0^{abc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*
Titicaca	Vel	17.4	17.5	11.8	15.5	18.0	24.5	24.5	24.9	25.7	29.3^{a}	30.3^{a}	31.2^{a}	29.8^{b}	31.5^{ab}
	Nel	12.8^{a}	13.5	12.5^{b}	17.7^{abc}	17.9^{abc}	20.0	21.0^{abc}	21.7^{a}	25.8	26.8	27.2	32.5^{ab}	31.0^{bc}	36.7^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Salasaga	Vel	12.5	12.3	15.8	19.5	21.3	23.7	24.7	25.2	26.0	29.2^{a}	30.0^{a}	30.0^{a}	27.5^{bc}	28.82^{c}
	Nel	10.8^{a}	14.5	13.2^{b}	23.3^{a}	23.6^{ab}	20.8	22.2^{abc}	25.8^{a}	28.3	31.7	31.3	37.0^{ab}	38.3^{ab}	35.7^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns
Aymara	Vel	10.0	10.1	11.5	19.0	20.0	24.5	24.8	25.3	26.7	28.5^{ab}	29.3^{a}	29.3^{ab}	35.7^{a}	37.28^{a}
	Nel	9.7 ^{a}	13.8	11.3^{b}	18.2^{abc}	18.5^{abc}	18.2	18.7^{bc}	22.8^{a}	27.7	27.7	27.0	37.5^{ab}	37.3^{abc}	43.8^{ab}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*
Caesar	Vel	13.0	13.0	16.8	16.3	20.0	29.5	29.5	28.4	30.1	29.2^{a}	30.2^{a}	31.2^{a}	32.0^{ab}	32.46^{ab}
	Nel	12.5^{a}	18.8	20.2^{a}	23.8^{a}	24.5^{a}	26.5	30.2^{a}	27.5^{a}	27.3	40.0	46.0	48.3^{a}	48.3^{a}	55.3^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
Akapana	Vel	13.0	13.0	10.8	21.7	19.2	26.2	26.5	27.0	28.2	29.2^{a}	30.2^{a}	30.5^{a}	29.3^{b}	29.36^{bc}
	Nel	10.9^{a}	10.3	10.8^{b}	10.2^{c}	10.7^{c}	11.0	13.0^{c}	13.0^{b}	12.0	24.3	24.3	30.7^{b}	22.7^{c}	29.3^{bc}
	Sig	ns	ns	ns	*	ns	*	*	*	*	ns	ns	ns	ns	ns
Jewel	Vel	12.5	12.6	12.7	17.2	20.0	29.2	29.2	29.8	30.7	29.5^{a}	30.8^{a}	31.8^{a}	30.3^{ab}	31.18^{ab}
	Nel	5.0^{b}	14.5	12.5^{b}	13.8^{bc}	14.2^{bc}	17.3	18.7^{bc}	19.8^{ab}	21.3	23.0	21.0	21.8^{b}	23.0^{c}	23.7^{c}
	Sig	*	ns	ns	ns	ns	*	*	ns	ns	ns	*	*	ns	ns
Lucia	Vel	13.8	13.9	15.2	18.7	16.3	23.4	23.7	24.3	25.5	26.5^{bc}	27.2^{ab}	28.2^{ab}	31.0^{ab}	31.28^{ab}
	Nel	9.5^{a}	12.5	12.5^{b}	13.8^{bc}	14.5^{bc}	18.7	17.5^{bc}	21.4^{ab}	19.8	25.2	25.0	24.5^{b}	28.7^{bc}	29.3^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 4. Mean E W spread (cm) of anthurium pot plant varieties

Variety		Plant spread (E W) in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	12.7	12.7	13.3^{cd}	18.4	18.7	23.2	23.5	24.2	25.0	26.0^{bcd}	28.0^{bc}	28.3^{cd}	29.3^{b}	29.5^{b}
	Nel	9.8^{bc}	9.3^{c}	10.8^{c}	17.2^{bc}	17.2^{bc}	15.7^{c}	17.8	20.5^{bcde}	19.8^{bcd}	19.3^{def}	22.3^{cd}	26.2^{cd}	26.5^{b}	30.0^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Inti	Vel	12.8	12.8	13.0^{cd}	19.3	23.0	23.0	23.0	20.9	21.7	24.7^{d}	25.7^{c}	29.3^{bc}	29.8^{b}	30.3^{b}
	Nel	12.2^{b}	11.0^{bc}	11.2^{c}	9.7^{c}	10.8^{c}	14.0^{c}	13.5	13.5^{ef}	12.2^{d}	16.7^{f}	15.0^{d}	17.0^{d}	14.5^{c}	19.2^{c}
	Sig	ns	ns	ns	*	*	ns	ns	ns	*	*	*	*	*	*
Coralis	Vel	14.0	14.5	15.3^{abc}	16.6	17.0	20.5	20.3	21.3	22.2	25.7^{cd}	27.3^{bc}	21.7^{e}	30.0^{b}	30.3^{b}
	Nel	12.6^{b}	12.8^{bc}	14.1^{bc}	16.0^{bc}	16.3^{bc}	18.2^{c}	16.2	16.7^{cdef}	21.0^{bcd}	26.0^{cde}	23.2^{cd}	24.2^{cd}	26.7^{b}	33.0^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns
Excellent	Vel	20.0	20.3	16.2^{ab}	22.0	23.8	27.8	28.7	29.0	29.7	30.7^{ab}	31.0^{ab}	30.3^{bc}	33.5^{ab}	33.8^{ab}
	Nel	11.2^{b}	16.3^{ab}	16.4^{abc}	14.2^{bc}	19.3^{b}	16.5^{c}	21.8	24.2^{b}	25.7^{bc}	27.7^{cd}	27.3^{bc}	28.2^{bc}	29.0^{b}	30.3^{b}
	Sig	*	ns	ns	*	ns	*	ns	ns	ns	ns	ns	ns	*	*
Patino	Vel	12.7	13.0	13.5^{cd}	19.0	19.7	23.8	24.2	24.8	25.7	26.5^{bcd}	26.8^{bc}	29.7^{bc}	31.0^{b}	31.7^{b}
	Nel	7.1^{c}	11.7^{bc}	12.1^{c}	13.3^{bc}	17.7^{bc}	16.0^{c}	17.3	15.5^{def}	18.7^{bcd}	21.0^{def}	20.6^{cd}	21.2^{cd}	25.0^{b}	24.5^{bc}
	Sig	*	ns	ns	*	ns	*	*	*	*	*	ns	*	*	*
Mia	Vel	12.7	14.3	16.6^{ab}	16.6	17.3	22.8	24.0	24.5	23.5	25.2^{d}	26.2^{c}	29.0^{bcd}	29.5^{b}	29.7^{b}
	Nel	13.4^{b}	22.2^{a}	24.4^{a}	26.5^{a}	27.0^{a}	29.5^{a}	24.7	31.8^{a}	17.0^{cd}	40.3^{ab}	38.7^{a}	39.7^{a}	41.0^{a}	49.0^{a}
	Sig	ns	*	*	*	ns	*	ns	ns	ns	ns	*	*	*	*
Condor	Vel	13.8	14.1	14.4^{bcd}	21.3	22.5	21.3	21.8	22.7	24.0	30.3^{abc}	30.8^{ab}	31.3^{b}	34.2^{ab}	34.7^{ab}
	Nel	21.0^{a}	21.0^{a}	21.8^{ab}	27.7^{a}	28.6^{a}	27.0^{ab}	28.2	31.8^{a}	38.3^{a}	42.3^{a}	41.7^{a}	41.7^{a}	38.7^{a}	43.0^{a}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	*	*	ns	*	ns	*
Pumasillo	Vel	13.8	16.5	17.0^{a}	21.9	22.7	26.4	26.5	27.0	27.8	30.3^{abc}	30.7^{ab}	31.7^{ab}	31.2^{b}	31.7^{b}
	Nel	9.9^{bc}	12.2^{bc}	12.7^{bc}	12.8^{bc}	13.3^{bc}	16.2^{c}	13.8	12.0^{f}	16.8^{cd}	17.7^{ef}	29.3^{bc}	30.7^{bc}	27.8^{b}	29.2^{b}
	Sig	ns	*	*	*	*	*	*	*	*	*	ns	ns	ns	ns
Trampolino	Vel	16.3	14.6	14.7^{abcd}	20.5	22.7	29.3	29.5	29.8	30.7	33.3^{a}	33.8^{a}	34.0^{a}	38.5^{a}	38.8^{a}
	Nel	10.9^{bc}	14.2^{bc}	14.6^{bc}	19.3^{b}	16.7^{bc}	20.8^{bc}	21.2	23.3^{bc}	27.3^{b}	32.3^{bc}	27.0^{bc}	28.7^{bc}	27.8^{b}	33.7^{ab}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*
Bonina	Vel	14.8	12.9	12.6^{d}	17.8	18.7	23.3	23.3	24.5	26.2	25.5^{cd}	25.7^{c}	26.5^{d}	28.8^{b}	29.28^{b}
	Nel	12.4^{b}	17.0^{ab}	17.5^{abc}	18.3^{b}	20.1^{b}	20.0^{bc}	21.2	21.8^{bcd}	25.0^{bc}	25.3^{cdef}	35.0^{ab}	36.0^{ab}	31.3^{b}	33.0^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	ns	*

Note: Column headed 'Sig' indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Difference between locations was significant. Performance of varieties Inti, Diablada, Excellent, Patino, Pumasillo and Trampolino were always found to be better at Vellanikkara than Nelliampathy.

4.1.3. Plant spread (N S)

4.1.3.1. *Cut flower varieties*

No significant variation was noticed in the NS plant spread among varieties at Vellanikkara (Table 5).

At Nelliampathy maximum NS plant spread was recorded in the variety Salasaga (39.67cm).Akapana recorded lowest plant spread of 24.20cm.

Difference between locations was significant only for Salasaga.

4.1.3.2. *Pot plant varieties*

Significant variation was seen in NS plant spread among varieties irrespective of the location (Table 6).

At Vellanikkara, maximum NS plant spread was recorded in the variety Condor (41.75 cm).Inti recorded minimum plant spread (25.80 cm) which was on par with Diablada (26.18cm).

At Nelliampathy, maximum NS plant spread was recorded for Mia (49.77 cm).It was closely followed by Condor (42.52 cm).Variety Inti had the minimum plant spread of 18.50cm.

Difference between locations was not significant for all the varieties except Mia and Inti. Performance of varieties Mia and Condor was always found to be better at Nelliampathy than Vellanikkara.

Table 5.Mean N S plant spread (cm) of anthurium cut flower varieties

Variety		Plant spread (N S) in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	14.0	14.3	12.3	17.7	18.3	21.3	21.3	22.3	22.0	22.8^{b}	21.0^{c}	21.8^{b}	27.0	29.7
	Nel	9.8	13.2	14.3	19.0	19.6	22.2	24.8^{ab}	24.3^{ab}	23.0	26.5^{abc}	33.3^{ab}	31.3^{ab}	30.3^{bc}	35.3^{ab}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	ns	ns
Chichas	Vel	13.7	14.0	12.6	20.7	22.0	25.3	25.8	27.0	28.0	31.3^{a}	32.0^{a}	32.5^{a}	32.2	29.8
	Nel	8.6	13.0	14.0	16.5	17.3	16.2	24.2^{abc}	23.5^{ab}	23.7	25.3^{abc}	24.7^{abc}	25.7^{bc}	26.0^{bc}	26.5^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Benicito	Vel	13.2	13.2	13.2	21.0	20.0	23.3	23.2	26.5	30.5	23.8^{b}	24.8^{abc}	29.2^{a}	29.5	30.2
	Nel	10.3	12.0	13.0	16.8	17.5	14.7	20.2^{bc}	27.2^{ab}	22.0	27.7^{ab}	32.8^{ab}	33.2^{ab}	28.2^{bc}	32.7^{abc}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Titicaca	Vel	11.0	11.1	17.7	17.2	15.2	17.3	17.3	23.7	24.5	28.7^{a}	29.5^{ab}	30.0^{a}	27.7	29.0
	Nel	8.9	12.0	14.0	17.8	18.3	16.7	18.5^{bc}	23.5^{ab}	23.2	28.3^{ab}	29.7^{ab}	27.2^{abc}	26.2^{bc}	30.7^{abc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Salasaga	Vel	11.7	15.4	12.5	19.7	21.5	21.3	22.0	22.5	23.2	30.0^{a}	22.2^{bc}	23.0^{b}	28.3	29.0
	Nel	10.9	12.2	15.5	21.2	21.3	21.0	20.7^{bc}	28.7^{a}	25.3	31.5^{ab}	28.3^{ab}	38.0^{a}	37.3^{cb}	39.67^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
Aymara	Vel	11.0	11.0	10.5	19.0	19.8	23.8	23.7	24.2	25.7	30.0^{a}	30.5^{a}	31.0^{a}	29.7	30.0
	Nel	8.9	10.3	14.8	15.3	15.7	21.0	18.7^{bc}	23.7^{ab}	25.8	30.0^{ab}	31.3^{a}	27.7^{abc}	40.0^{a}	35.0^{ab}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns
Caesar	Vel	16.4	16.4	13.1	16.7	16.8	20.8	20.8	30.2	30.5	30.3^{a}	31.0^{a}	32.3^{a}	27.7	28.1
	Nel	14.1	16.8	17.5	25.3	26.3	21.7	30.7^{a}	32.3^{a}	27.9	34.2^{a}	34.0^{ab}	30.0^{ab}	36.7^{ab}	32.3^{abc}
	Sig	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns
Akapana	Vel	10.7	10.8	13.3	18.7	22.0	25.6	26.0	26.7	28.2	30.0^{a}	31.3^{a}	32.3^{a}	29.6	29.8
	Nel	10.6	10.0	10.8	10.7	11.5	12.0	15.2^{c}	12.3^{c}	15.0	17.5^{c}	16.7^{c}	25.3^{bc}	29.7^{bc}	24.20^{c}
	Sig	ns	ns	ns	ns	*	*	*	*	*	*	*	ns	ns	ns
Jewel	Vel	12.1	12.4	13.2	19.0	18.0	24.5	25.0	25.5	26.5	28.6^{a}	29.2^{ab}	29.3^{a}	28.5	28.7
	Nel	10.4	12.2	14.8	13.3	13.7	13.8	18.3^{bc}	21.7^{abc}	21.5	22.2^{bc}	25.0^{abc}	22.7^{bc}	24.0^{c}	26.8^{bc}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	*	ns	*	ns	ns
Lucia	Vel	14.8	14.9	14.1	15.5	19.5	25.5	26.3	26.7	27.7	26.8^{ab}	20.8^{c}	29.0^{a}	27.0	27.3
	Nel	9.1	12.3	12.6	12.8	13.7	16.8	17.5^{bc}	17.0^{bc}	22.0	22.5^{bc}	22.3^{bc}	20.7^{c}	26.7^{bc}	29.5^{bc}
	Sig	ns	ns	ns	ns	ns	*	*	*	ns	ns	ns	ns	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 6. Mean N S plant spread (cm) of anthurium pot plant varieties

Variety		Plant spread (N S) in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	15.0	15.0	16.5^{bc}	19.3	18.7	20.3	20.0	21.0	21.8	26.7^{bc}	26.5^{cd}	27.0^{de}	25.8^{d}	26.18^{d}
	Nel	8.8^{de}	12.5^{bcd}	11.9^{bcd}	15.7^{cd}	17.6^{bcd}	15.5	16.7^{cde}	19.0^{bcd}	19.0^{cde}	27.0^{bcd}	23.7^{cde}	26.2^{bc}	26.8^{abc}	29.2^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Inti	Vel	13.5	13.5	13.9^{e}	21.7	20.3	18.8	18.8	22.7	23.5	23.3^{cd}	23.8^{de}	28.3^{cde}	25.3^{d}	25.80^{d}
	Nel	13.2^{bc}	10.0^{d}	10.7^{d}	10.5^{d}	10.2^{d}	13.2	14.0^{e}	15.3^{d}	15.3^{e}	17.8^{d}	15.7^{e}	14.8^{d}	16.7^{c}	18.5^{c}
	Sig	ns	ns	ns	*	*	ns	ns	ns	ns	ns	*	*	*	*
Coralis	Vel	16.7	17.2	17.6^{b}	18.3	19.3	22.3	22.2	22.8	23.3	22.0^{cd}	23.5^{de}	24.2^{e}	28.2^{cd}	28.0^{cd}
	Nel	9.9^{cde}	14.2^{bcd}	14.0^{bcd}	16.0^{cd}	16.2^{cd}	16.7	18.8^{bcde}	18.3^{bcd}	21.0^{cde}	26.3^{bcd}	21.0^{de}	22.3^{cd}	24.3^{bc}	26.7^{b}
	Sig	*	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns
Excellent	Vel	12.4	12.9	17.3^{b}	22.5	23.8	25.2	29.8	26.8	27.7	28.7^{ab}	29.7^{bc}	32.8^{bc}	30.3^{cd}	30.7^{bcd}
	Nel	14.7^{b}	14.2^{bcd}	14.2^{bcd}	18.8^{bc}	15.0^{cd}	22.2	20.7^{abcde}	22.7^{bcd}	27.3^{abc}	32.7^{ab}	30.3^{bc}	30.3^{bc}	29.3^{abc}	31.5^{b}
	Sig	ns	ns	*	ns	*	ns	ns	ns	ns	ns	ns	*	ns	ns
Patino	Vel	11.7	11.7	12.0^{f}	17.2	18.7	22.0	22.7	23.7	24.3	26.7^{bc}	27.3^{cd}	28.0^{de}	29.5^{cd}	30.2^{bcd}
	Nel	8.3^{e}	11.5^{cd}	12.1^{bcd}	17.0^{bcd}	15.9^{cd}	13.7	17.0^{cde}	17.7^{bcd}	19.0^{cde}	21.5^{d}	24.0^{cd}	24.5^{bc}	25.0^{abc}	27.5^{b}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Mia	Vel	16.6	18.5	19.5^{a}	16.6	17.8	20.0	21.0	21.8	27.3	19.8^{d}	20.5^{e}	29.0^{bcd}	30.2^{cd}	30.7^{bcd}
	Nel	15.8^{b}	19.0^{ab}	18.8^{ab}	30.7^{a}	28.2^{a}	23.8	24.0^{abc}	31.0^{a}	34.3^{a}	38.7^{a}	33.3^{b}	33.3^{b}	37.7^{a}	49.7^{a}
	Sig	ns	ns	ns	*	ns	ns	ns	ns	*	*	*	ns	*	*
Condor	Vel	17.8	13.5	13.9^{e}	19.3	20.3	24.8	25.7	26.5	27.0	31.8^{a}	28.8^{c}	33.7^{b}	41.3^{a}	41.75^{a}
	Nel	22.7^{a}	22.3^{a}	23.4^{a}	24.7^{ab}	25.7^{ab}	25.2	27.8^{a}	26.2^{ab}	32.7^{ab}	38.0^{a}	44.7^{a}	44.7^{a}	33.3^{ab}	42.5^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns
Pumasillo	Vel	13.2	17.9	17.9^{b}	18.8	19.8	25.5	26.2	26.7	27.5	31.7^{a}	37.8^{a}	39.0^{a}	33.0^{bc}	33.7^{bc}
	Nel	10.5^{cde}	10.8^{cd}	11.3^{cd}	13.0^{cd}	13.2^{cd}	13.3	15.7^{de}	16.8^{cd}	17.8^{de}	22.0^{cd}	26.7^{bcd}	27.0^{bc}	22.8^{bc}	28.8^{b}
	Sig	ns	*	*	*	*	*	*	*	*	*	*	*	*	ns
Trampolino	Vel	17.8	15.2	14.2^{de}	16.0	21.3	25.0	25.5	26.3	27.0	33.0^{a}	33.3^{b}	33.0^{bc}	36.7^{ab}	37.3^{ab}
	Nel	10.3^{cde}	17.7^{abc}	18.1^{abc}	16.2^{cd}	20.5^{abc}	20.2	25.0^{ab}	24.3^{abc}	25.2^{bcd}	32.0^{abc}	26.2^{bcd}	27.0^{bc}	19.0^{c}	34.8^{b}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns
Bonina	Vel	14.0	16.7	15.4^{cd}	18.3	19.7	19.8	20.2	21.3	23.5	28.5^{ab}	28.5^{c}	29.7^{bcd}	29.3^{cd}	30.2^{bcd}
	Nel	12.9^{bcd}	14.0^{bcd}	14.5^{bcd}	19.8^{bc}	25.5^{ab}	21.5	23.2^{abcd}	23.8^{abcd}	24.2^{bcde}	26.5^{bcd}	28.0^{bcd}	28.5^{bc}	28.7^{abc}	29.3^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

4.1.4 Number of leaves

4.1.4.1. *Cut flower varieties*

No significant variation was noticed in the number of leaves among varieties at Vellanikkara (Table 7).

At Nelliampathy, maximum number of leaves was recorded for Aymara (15.00).It was closely followed by Lucia (14.25) and Benicito (13.34) .Variety Titicaca had the minimum number of leaves (6.33)

Difference between locations was not significant for all the varieties except Benicito, Aymara and Lucia. Number of leaves was found to be higher at Nelliampathy than Vellanikkara.

4.1.4.2. *Pot plant varieties*

Significant variation is seen among varieties irrespective of the location (Table 8).

At Vellanikkara, maximum number of leaves was recorded in the variety Inti (20.72). Variety Trampolino had the minimum number of leaves (8.36).

At Nelliampathy, maximum number of leaves was recorded in the variety Bonina (72.70).Variety Condor had the minimum number of leaves (11.67) which was statistically on par with Trampolino (12.33).

Difference between locations was significant. Number of leaves was significantly higher at Nelliampathy than Vellanikkara.

Table 7. Mean number of leaves in anthurium cut flower varieties

Variety		Number of leaves.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	3.7^{d}	4.0^{bc}	4.0^{cd}	6.3^{ab}	6.3^{abc}	4.7^{cd}	5.7^{bc}	6.7^{abc}	6.3^{b}	6.3	6.0	6.0	6.7	7.7
	Nel	4.7	5.3^{abc}	4.0^{bc}	5.3^{b}	5.3^{b}	6.0^{bc}	7.7	8.7^{abc}	9.0^{abc}	10.0^{bc}	8.7	11.3^{bc}	11.3a^{bc}	11.0^{abc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	ns
Chichas	Vel	4.0^{c}	4.3^{bc}	4.7^{bc}	5.0^{abcd}	6.3^{abc}	5.3^{bcd}	6.3^{bc}	6.7^{abc}	6.3^{b}	7.7	6.7	7.3	7.0	8.0
	Nel	4.0	3.7^{cd}	4.7^{bc}	5.0^{b}	5.3^{b}	6.3^{bc}	6.7	8.3^{abc}	8.3^{abc}	10.3^{bc}	8.7	10.0^{bc}	11.7^{ab}	11.3^{abc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Benicito	Vel	5.0^{abc}	4.7^{ab}	4.3^{bcd}	4.7^{bcd}	6.0^{abc}	3.3^{d}	5.3^{bc}	6.0^{bc}	5.7^{b}	6.0	6.3	6.3	4.7	5.3
	Nel	5.7	4.0^{cd}	5.0^{b}	6.0^{ab}	6.3^{b}	5.3^{bc}	8.3	12.7^{a}	13.0^{a}	17.3^{a}	15.7	21.7^{a}	16.3^{a}	13.34^{ab}
	Sig	ns	ns	ns	*	ns	*	ns	ns	ns	ns	*	*	*	*
Titicaca	Vel	3.7^{d}	3.3^{c}	3.0^{d}	4.0^{cd}	4.7^{c}	4.3^{cd}	4.3^{c}	5.3^{c}	5.7^{b}	4.3	4.7	5.7	6.0	6.7
	Nel	4.0	4.0^{cd}	5.0^{b}	5.3^{b}	4.7^{b}	5.7^{bc}	6.0	7.3^{bc}	8.3^{abc}	8.0^{bc}	9.0	7.3^{c}	5.7^{cd}	6.33^{c}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Salasaga	Vel	5.7^{a}	5.3^{ab}	4.7^{bc}	6.0^{abc}	7.0^{ab}	7.3^{ab}	7.7^{b}	8.0^{ab}	8.7^{a}	9.0	8.0	8.3	7.7	9.3
	Nel	4.0	4.3^{cd}	4.7^{bc}	4.7^{b}	6.0^{b}	5.0^{bc}	5.7	5.7^{bc}	6.3^{bc}	8.7^{bc}	7.0	7.0^{c}	6.7^{bcd}	6.7^{c}
	Sig	*	ns	ns	ns	ns	ns	ns	*	*	ns	ns	ns	ns	ns
Aymara	Vel	5.3^{ab}	6.0^{a}	6.3^{a}	7.0^{a}	7.7^{a}	5.7^{bcd}	6.7^{bc}	7.3^{abc}	6.7^{b}	7.7	6.3	6.7	6.0	7.0
	Nel	5.0	7.0^{ab}	4.0^{bc}	6.0^{ab}	7.0^{b}	7.0^{bc}	7.3	8.7^{abc}	10.0^{ab}	12.0^{abc}	13.3	15.7^{ab}	15.3^{a}	15.0^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Caesar	Vel	4.7^{abcd}	5.0^{ab}	5.0^{abc}	4.3^{bcd}	5.3^{bc}	6.3^{abc}	5.7^{bc}	6.0^{bc}	6.3^{b}	5.7	5.3	5.7	5.3	5.7
	Nel	4.3	7.3^{a}	8.0^{a}	8.7^{a}	12.7^{a}	10.0^{a}	9.3	8.3^{abc}	6.7^{bc}	8.0^{bc}	7.3	7.7^{c}	6.3^{bcd}	8.0^{bc}
	Sig	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
Akapana	Vel	5.3^{ab}	5.3^{ab}	5.7^{ab}	7.0^{a}	8.0^{a}	8.3^{a}	8.3^{a}	8.3^{a}	8.7^{a}	8.3	6.3	7.0	6.3	7.0
	Nel	3.7	3.0^{d}	3.3^{bc}	3.0^{b}	4.0^{b}	4.3^{c}	4.7	4.3^{c}	5.7^{bc}	6.7^{c}	9.7	8.7^{bc}	9.7^{bcd}	8.0^{bc}
	Sig	*	*	ns	*	*	*	*	ns	ns	ns	ns	ns	ns	ns
Jewel	Vel	4.3^{bcd}	4.7^{ab}	4.7^{bc}	3.3^{d}	4.3^{c}	4.7^{cd}	5.0^{c}	5.3^{c}	5.7^{b}	5.7	5.3	6.0	5.3	6.0
	Nel	3.3	3.7^{cd}	2.3^{c}	3.3^{b}	3.7^{b}	4.3^{c}	3.7	4.7^{c}	4.3^{c}	6.0^{c}	6.7	6.3^{c}	5.3^{d}	8.0^{bc}
	Sig	ns	ns	*	ns	ns	ns	*	ns	*	ns	ns	ns	ns	ns
Lucia	Vel	5.3^{ab}	5.0^{ab}	5.0^{abc}	5.0^{abcd}	6.0^{abc}	6.0^{abc}	6.0^{bc}	6.7^{abc}	7.3^{ab}	6.3	5.7	6.0	6.3	6.7
	Nel	5.7	5.0^{bcd}	3.7^{bc}	4.7^{b}	5.0^{b}	7.3^{b}	8.0	9.7^{ab}	10.3^{ab}	15.0^{ab}	10.0	15.3^{ab}	15.7^{a}	14.25^{a}
	Sig	ns	ns	ns	ns	ns	ns	ns	*	ns	*	ns	*	*	*

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 8. Mean number of leaves in anthurium pot plant varieties

Variety		Number of leaves.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	7.7^{abc}	8.3^{bc}	8.7^{ab}	11.7^{ab}	12.7^{ab}	12.7	13.7	13.3	14.3^{ab}	14.3	14.7	15.3^{a}	14.7^{a}	17.3^{ab}
	Nel	7.3	7.0^{bcd}	8.7^{bc}	12.7^{b}	13.0^{bc}	14.7^{bc}	17.0^{bc}	34.0^{bc}	36.3^{ab}	53.7^{b}	53.3^{bc}	53.7^{bc}	58.3^{b}	57.7^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*	*	*
Inti	Vel	5.3^{cd}	6.7^{bcd}	8.3^{ab}	12.3^{ab}	13.7^{ab}	15.3	15.7	17.3	18.7^{a}	17.3	18.0	15.7^{a}	15.0^{a}	20.72^{a}
	Nel	5.0	5.3^{cd}	7.7^{bcd}	9.0^{bcd}	9.3^{cd}	16.7^{b}	17.7^{b}	23.7^{cd}	23.7^{bc}	34.3^{bcd}	16.0^{de}	16.7^{ef}	17.0^{de}	24.3^{de}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Coralis	Vel	6.0^{cde}	6.3^{cd}	6.7^{bc}	12.7^{a}	13.7^{ab}	12.7	13.3	14.0	15.0^{ab}	14.3	12.7	15.3^{a}	14.7^{a}	17.3^{ab}
	Nel	10.0	16.3^{a}	14.7^{a}	21.3^{a}	21.3^{a}	30.3^{a}	31.3^{a}	41.7^{b}	42.3^{a}	52.3^{b}	61.7^{b}	63.0^{b}	56.0^{b}	51.0^{b}
	Sig	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Excellent	Vel	7.0^{bcd}	7.3^{bcd}	7.7^{bc}	8.3^{bc}	9.3^{bc}	9.0	8.3	10.3	10.7^{ab}	9.0	8.7	8.0^{c}	7.7^{b}	11.3^{bc}
	Nel	6.3	8.0^{bcd}	7.0^{cd}	8.7^{bcd}	9.7^{bcd}	13.7^{bcd}	15.3^{bc}	21.3^{cde}	37.7^{ab}	36.0^{bcd}	37.3^{cd}	39.0^{cd}	44.3^{bc}	32.0^{cd}
	Sig	ns	ns	ns	ns	ns	ns	*	*	*	*	*	*	*	*
Patino	Vel	8.7^{ab}	8.7^{b}	8.7^{ab}	12.0^{ab}	12.7^{ab}	12.7	14.7	14.7	15.7^{ab}	15.3	16.3	13.0^{abc}	12.0^{ab}	13.7^{bc}
	Nel	6.0	9.0^{b}	8.7^{bc}	9.3^{bc}	10.3^{bcd}	14.3^{bcd}	15.3^{bc}	17.7^{def}	24.7^{bc}	40.7^{bc}	50.7^{bc}	52.0^{bc}	51.3^{b}	37.3^{c}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
Mia	Vel	4.7^{d}	5.7^{d}	5.7^{c}	7.0^{c}	7.3^{c}	8.3	9.0	9.7	10.7^{ab}	9.3	9.3	9.0^{c}	8.0^{b}	9.0^{b}
	Nel	6.0	6.3^{bcd}	6.3^{bcd}	7.0^{cd}	8.0^{de}	7.7^{bcd}	8.7^{bcd}	12.3^{def}	13.3^{cd}	18.0^{de}	14.0^{de}	15.0^{ef}	18.7^{de}	16.0^{de}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
Condor	Vel	5.7^{cde}	7.0^{bcd}	7.3^{bc}	6.7^{c}	7.3^{c}	6.3	6.7	7.3	8.0^{b}	8.0	8.7	8.3^{c}	8.0^{b}	9.7^{b}
	Nel	5.0	4.7^{d}	5.3^{cd}	6.7^{cd}	7.7^{de}	6.3^{cd}	7.7^{cd}	8.7^{ef}	10.0^{cd}	9.3^{e}	7.7^{e}	8.0^{f}	10.0^{e}	11.67^{e}
	Sig	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Pumasillo	Vel	7.0^{bcd}	5.3^{d}	5.3^{c}	6.7^{c}	6.7^{c}	8.7	9.0	9.7	9.7^{b}	11.0	12.0	10.0^{bc}	9.0^{b}	10.3^{b}
	Nel	5.7	5.7^{bcd}	5.0^{cd}	6.0^{cd}	7.0^{de}	8.7^{bcd}	9.7^{bcd}	12.3^{def}	18.3^{cd}	19.3^{cde}	28.7^{d}	30.7^{de}	31.3^{cd}	30.7^{cd}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
Trampolino	Vel	5.0^{cd}	10.7^{a}	10.7^{a}	6.3^{c}	6.7^{c}	6.7	7.3	8.0	8.3^{b}	6.3	7.3	8.3^{c}	7.7^{b}	8.36^{c}
	Nel	6.3	4.7^{d}	3.7^{d}	4.3^{d}	5.0^{e}	5.0^{e}	5.3^{d}	6.3^{f}	6.7^{d}	7.7^{e}	8.3d^{e}	9.3^{f}	12.3^{e}	12.33^{e}
	Sig	ns	*	*	ns	ns	ns	ns	*	ns	*	ns	ns	ns	*
Bonina	Vel	9.7^{a}	5.3^{d}	5.7^{c}	14.0^{a}	15.0a	14.3	15.0	17.0	18.3^{a}	17.7	16.3	14.7^{ab}	13.7^{a}	15.0^{b}
	Nel	9.0	8.3^{bc}	10.3^{b}	13.3^{b}	13.7^{b}	27.7^{a}	36.7^{a}	54.3^{a}	51.7^{a}	80.0^{a}	81.7^{a}	83.0^{a}	81.3^{a}	72.70^{a}
	Sig	ns	*	*	ns	ns	*	*	*	*	*	*	*	*	*

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

4.1.5. Leaf length

4.1.5.1. *Cut flower varieties*

Data pertaining to the monthly variation in leaf length are presented in Table 9. Significant differences were noticed among the varieties at both the locations.

At Vellanikkara, Caesar recorded a maximum leaf length (21.26cm).It was on par with varieties Titicaca (21.00cm), Aymara (20.84cm) and Lucia (20.72cm). Minimum leaf length was recorded in Benicito (15.05cm) which was on par with Chichas (15.26cm).

At Nelliampathy, Salasaga recorded a maximum leaf length of 26.47cm. Leaf length was the lowest (16.32cm) in the variety Akapana which was on par with Jewel (17.04cm).

When both the locations were compared, differences between the locations were found significant. Leaf length was found to be higher at Nelliampathy than Vellanikkara.

4.1.5.2. *Pot plant varieties*

Data pertaining to the monthly variation in leaf length are presented in Table 10. Significant differences were noticed among the varieties at both the locations.

At Vellanikkara, Trampolino recorded a maximum leaf length of 21.18cm. Minimum leaf length was recorded in Inti (12.17cm).

At Nelliampathy, Condor was superior to all other varieties during the entire period of observation. Maximum leaf length was recorded for Condor.

Table 9. Mean leaf length (cm) of anthurium cut flower varieties

Variety		Leaf length in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	8.3	8.4	8.8	10.3^{b}	10.5	12.3	12.3	12.4	12.4	14.9^{bc}	13.7^{d}	13.8^{de}	14.2^{c}	16.7^{ab}
	Nel	6.8^{ab}	8.2	8.8^{bc}	15.0^{a}	14.5^{a}	9.7	10.3	15.5^{ab}	15.3^{abc}	20.0^{abcd}	22.0^{abc}	21.4^{ab}	23.8^{ab}	24.3^{ab}
	Sig	ns	ns	ns	*	ns	*	*	*	*	ns	*	*	*	*
Chichas	Vel	7.5	7.5	7.6	6.5^{c}	12.5	13.6	13.7	13.7	14.7	15.2^{b}	13.4^{d}	13.6^{de}	12.5^{c}	15.26^{b}
	Nel	6.9^{ab}	7.8	7.8^{c}	7.8^{b}	8.2^{b}	7.9	7.6	11.4^{bc}	12.7^{cd}	16.2^{bcd}	15.7^{c}	15.5^{c}	18.5^{b}	19.5^{de}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	ns	ns	ns	*	*
Benicito	Vel	8.5	8.7	8.8	10.8^{ab}	10.9	12.4	12.5	12.8	13.2	12.7^{c}	13.0^{d}	13.2^{e}	13.6^{c}	15.05^{b}
	Nel	6.5^{ab}	8.9	10.3^{abc}	10.7^{ab}	11.2^{ab}	12.3	12.0	12.7^{bc}	12.8^{cd}	18.0^{bcd}	20.2^{abc}	20.7^{ab}	19.2^{b}	20.3^{cd}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Titicaca	Vel	9.4	9.4	9.8	11.6^{ab}	12.4	14.7	14.7	14.8	11.7	17.0^{b}	17.7^{ab}	18.2^{ab}	20.6^{ab}	21.0^{a}
	Nel	7.4^{ab}	9.3	11.6^{ab}	8.1^{b}	8.2^{b}	7.8	7.9	11.6^{bc}	11.3^{cd}	21.3^{abcd}	22.3^{abc}	23.3^{a}	20.8^{ab}	19.2^{de}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	ns	ns	*	ns	*
Salasaga	Vel	7.9	8.0	8.1	11.5^{ab}	12.0	13.8	13.8	13.9	14.9	14.6^{bc}	14.2^{d}	14.8^{cde}	16.5^{bc}	16.9^{ab}
	Nel	8.6^{a}	9.6	10.9^{abc}	9.8^{b}	9.9^{b}	9.6	9.6	15.2^{ab}	16.9^{ab}	23.0^{ab}	25.7^{a}	20.2^{ab}	26.3^{a}	26.47^{a}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	ns	*	*	*	*
Aymara	Vel	7.5	7.5	7.7	11.0^{ab}	12.0	12.8	12.9	13.0	13.1	14.7^{bc}	15.0^{cd}	15.7^{cde}	18.7^{ab}	20.84^{a}
	Nel	5.8^{b}	8.2	8.7^{bc}	8.3^{b}	8.5^{b}	8.1	8.1	12.9^{bc}	14.2^{abcd}	21.3^{abcd}	22.0^{abc}	22.8^{a}	23.3^{ab}	24.2^{ab}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	ns	*	*		*
Caesar	Vel	9.5	9.5	9.6	12.2^{ab}	13.0	13.2	13.2	13.3	13.4	16.5^{b}	16.7^{bc}	16.9^{bcd}	21.0^{a}	21.26^{a}
	Nel	8.6^{a}	11.1	13.3^{a}	10.5^{ab}	10.7^{ab}	10.6	10.7	16.2^{a}	18.0^{a}	26.2^{a}	26.3^{a}	24.5^{a}	27.5^{a}	22.8^{bc}
	Sig	ns	*	*	ns	ns	*	*	ns	*	ns	*	*	*	ns
Akapana	Vel	8.9	9.0	9.1	12.0^{ab}	13.0	13.2	13.7	13.7	13.9	16.7^{b}	16.9^{bc}	16.9^{bcd}	16.5^{bc}	16.2^{ab}
	Nel	6.2^{b}	7.5	7.6^{c}	6.5^{b}	6.7^{b}	6.4	6.7	9.8^{c}	11.0^{d}	15.5^{cd}	17.5^{bc}	18.4^{bc}	18.0^{b}	16.32^{e}
	Sig	*	*	*	*	ns	*	*	ns	ns	ns	ns	*	*	ns
Jewel	Vel	8.4	8.4	8.4	12.3^{ab}	13.2	13.5	13.5	13.6	13.7	19.3^{a}	19.4^{a}	19.6^{a}	19.2^{ab}	19.4^{ab}
	Nel	5.4^{b}	9.3	9.4^{bc}	8.0^{b}	8.1^{b}	7.8	7.9	12.8^{bc}	13.0^{bcd}	14.6^{d}	17.7^{bc}	17.9^{bc}	17.3^{b}	17.04^{e}
	Sig	*	ns	ns	*	ns	*	*	ns	ns	ns	ns	ns	ns	*
Lucia	Vel	10.2	10.2	10.3	12.7^{a}	13.7	13.7	13.9	14.2	14.4	16.8^{b}	17.0^{bc}	17.4^{abc}	20.6^{ab}	20.72^{a}
	Nel	7.4^{ab}	9.5	9.6^{bc}	9.5^{b}	9.8^{b}	9.2	9.2	14.5^{ab}	15.3^{abc}	22.1^{abc}	23.5^{ab}	22.8^{a}	18.5^{b}	22.2^{bcd}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	ns	*	*	ns	*

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 10. Mean leaf length (cm) of anthurium pot plant varieties

Variety		Leaf length in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	6.9^{e}	6.9^{e}	7.2^{c}	9.5^{bc}	9.7	10.7	10.8	10.8	10.9	11.1	11.5	12.5	11.9^{c}	11.9^{cd}
	Nel	6.6^{b}	7.0^{c}	7.2^{cd}	6.6^{bc}	7.0^{bc}	6.9^{bc}	6.7^{cd}	7.6^{c}	9.2^{cd}	9.7^{cd}	10.5^{cd}	11.7^{cd}	10.4^{cd}	10.5^{c}
	Sig	ns	ns	ns	ns	*	*	*		ns	ns	ns	ns	ns	ns
Inti	Vel	7.1^{cd}	7.1^{de}	7.3^{c}	8.5^{c}	8.7	10.7	10.7	11.3	11.4	11.4	13.2	13.7	11.9^{c}	12.17^{e}
	Nel	6.2^{b}	6.5^{c}	6.7^{cd}	5.7^{c}	5.8^{c}	5.6^{c}	5.7^{d}	6.9^{c}	7.4^{d}	8.2^{cd}	7.6^{d}	7.8^{d}	7.5^{d}	8.73^{d}
	Sig	ns	ns	ns	ns	ns	*	*	*	*	*	*	*	ns	ns
Coralis	Vel	8.7^{bcd}	8.8^{cde}	9.0^{bc}	10.6^{abc}	10.8	11.0	11.1	11.3	11.4	12.4	11.7	12.1	13.1^{bc}	13.3^{c}
	Nel	6.5^{b}	7.2^{c}	7.3^{cd}	6.9^{bc}	7.0^{bc}	8.4^{bc}	8.5^{bc}	9.8^{bc}	11.1^{cd}	12.3^{cd}	13.8^{c}	14.8^{c}	14.2^{c}	15.2^{bcd}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	ns	ns
Excellent	Vel	10.2^{ab}	10.3^{abc}	10.4^{ab}	10.6^{abc}	11.2	12.0	12.1	12.7	12.9	13.8	14.1	14.2	16.0^{b}	16.2^{bc}
	Nel	7.2^{b}	8.8^{bc}	9.1^{bc}	8.6^{bc}	8.7^{b}	10.5^{b}	10.4^{bc}	11.9^{b}	12.9^{c}	15.4^{bc}	18.0^{bc}	19.1^{b}	17.5^{bc}	18.6^{b}
	Sig	*	*	ns	ns	ns	ns	ns	ns	ns	ns	*	*	ns	ns
Patino	Vel	7.5^{cd}	7.5^{de}	7.9^{c}	9.1^{bc}	10.1	11.3	11.5	11.7	11.8	14.6	14.7	14.8	13.8^{bc}	14.0^{c}
	Nel	4.0^{c}	6.4^{c}	6.1^{cd}	5.6^{c}	5.7^{c}	7.3^{bc}	7.3^{cd}	9.7^{bc}	10.2^{d}	14.0^{bc}	12.9^{c}	13.8^{cd}	14.3^{c}	16.6b^{c}
	Sig	ns	ns	ns	*	*	ns	*	ns	ns	ns	ns	ns	ns	ns
Mia	Vel	9.2^{bc}	10.9^{ab}	9.2^{bc}	10.5^{bc}	12.4	11.7	11.9	12.0	13.0	14.3	14.3	14.3	14.5^{bc}	14.8^{c}
	Nel	8.3^{b}	12.2^{b}	12.5^{ab}	12.0^{b}	12.6^{b}	12.1^{b}	12.2^{b}	14.1^{b}	21.2^{a}	25.4^{a}	21.1^{ab}	22.1^{ab}	25.7^{a}	25.74^{a}
	Sig	ns	ns	*	ns	ns	ns	ns	*	*	*	*	*	*	*
Condor	Vel	10.9^{ab}	8.9^{bcde}	10.3^{ab}	11.4^{a}	12.2	12.1	12.2	12.3	12.4	16.3	16.3	16.4	19.4^{ab}	19.9^{b}
	Nel	13.0^{a}	15.8^{a}	15.3^{a}	14.3^{a}	15.3^{a}	14.9^{a}	14.1^{a}	15.5^{a}	21.5^{a}	25.9^{a}	23.8^{ab}	25.0^{a}	26.8^{a}	25.86^{a}
	Sig	*	*	*	ns	ns	ns	ns	ns	*	*	*	*	*	*
Pumasillo	Vel	8.9^{bcd}	12.1^{a}	10.3^{ab}	10.9^{ab}	11.3	11.0	11.2	11.3	11.4	16.1	14.6	16.5	16.8^{b}	17.3^{b}
	Nel	6.4^{b}	7.2^{c}	4.2^{d}	6.9^{bc}	6.9^{bc}	6.9^{bc}	7.1^{cd}	9.2^{bc}	12.3^{c}	13.3^{c}	15.2^{c}	16.2^{c}	14.2^{c}	20.2^{ab}
	Sig	ns	*	*	*	*	*	*	ns	ns	*	ns	ns	ns	ns
Trampolino	Vel	12.1^{a}	7.6^{de}	11.1^{ab}	12.0^{a}	13.7	13.7	14.0	14.1	14.1	16.5	16.7	16.9	20.9^{a}	21.18^{a}
	Nel	7.5^{b}	10.2^{c}	10.4^{bc}	9.6^{b}	9.7^{b}	11.0^{ab}	10.2^{bc}	11.7^{b}	17.0^{bc}	20.1^{ab}	25.1^{a}	25.1^{a}	21.8^{ab}	25.00^{a}
	Sig	*	*	ns	ns	ns	ns	*	*	ns	*	*	*	ns	ns
Bonina	Vel	7.4^{cd}	9.3^{bcd}	11.3^{a}	8.9^{c}	9.7	9.5	9.6	9.7	9.8	12.3	12.5	12.6	12.9^{bc}	13.2c^{d}
	Nel	6.2^{b}	8.3^{bc}	8.7^{bc}	8.2^{bc}	8.3^{b}	8.2^{bc}	8.3^{bc}	10.1^{b}	10.2^{cd}	11.9^{c}	12.2^{c}	13.2^{c}	14.3^{c}	11.3^{c}
	Sig	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

(25.86cm) that was on par with Mia (25.74cm) and Trampolino (25.00cm). Minimum leaf length was recorded for Inti (5.15cm).

Differences between locations were not significant except for varieties Inti, Mia and Condor. Performance of varieties Mia and Condor was always found to be better at Nelliampathy and Inti at Vellanikkara.

4.1.6. Leaf breadth

4.1.6.1. *Cut flower varieties*

Data pertaining to the monthly variation in leaf breadth are presented in Table 11. Significant differences were noticed among the varieties at both the locations.

At Vellanikkara, Aymara recorded a maximum leaf breadth (12.36cm). Minimum leaf breadth was recorded in Chichas (8.44cm).

At Nelliampathy, Esmeralda recorded a maximum leaf breadth of 14.46cm that was on par with Aymara (14.32cm). Leaf breadth was the lowest (9.10cm) in the variety Benicito.

When both the locations were compared, differences between the locations were found significant. Leaf breadth was found to be significantly higher at Nelliampathy.

4.1.6.2. *Pot plant varieties*

No significant variation was noticed in the leaf breadth among varieties at Vellanikkara (Table 12).

Table 11.Mean leaf breadth (cm) of anthurium cut flower varieties

Variety		Leaf breadth in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	4.4	4.4	4.6	6.4	6.5	7.1	7.1	7.2	7.2	8.9	7.9	8.0bc	8.4^{bc}	9.9^{bc}
	Nel	3.7	4.1	5.9	9.2	9.2	6.5	6.5	9.3	9.2	11.8^{ab}	13.4^{ab}	12.3^{ab}	13.9^{b}	14.4^{a}
	Sig	ns	ns	*	*	*	ns	ns	*	*	ns	*	*	*	*
Chichas	Vel	3.9	3.9	4.1	6.7	6.8	7.2	7.2	7.2	7.6	7.9	7.1	7.2c	7.3^{c}	8.4^{c}
	Nel	3.3	4.3	4.6	4.3	4.3	4.5	4.0	6.7	6.8	8.7^{bc}	8.3^{c}	11.1^{b}	9.6^{bc}	10.5^{bc}
	Sig	ns	ns	ns	*	*	*	*	*	ns	ns	ns	*	ns	*
Benicito	Vel	4.2	4.3	4.4	6.1	6.2	7.4	7.5	7.6	7.8	7.1	7.7	7.8bc	9.0^{bc}	9.4^{bc}
	Nel	3.3	5.0	5.3	6.1	6.1	7.7	7.6	8.3	8.2	11.2^{ab}	12.8^{b}	12.1^{ab}	11.6^{b}	9.1^{c}
	Sig	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*	*	ns	ns
Titicaca	Vel	5.5	5.2	5.3	6.3	6.6	7.7	7.7	7.8	7.9	8.1	8.7	9.2ab	10.1^{ab}	10.5^{ab}
	Nel	4.1	5.9	6.6	4.9	5.0	4.8	4.9	6.7	6.9	11.2^{ab}	11.7^{bc}	13.5^{a}	11.0^{b}	11.9^{b}
	Sig	*	ns	*	ns	ns	ns	ns	ns	ns	ns		*	ns	*
Salasaga	Vel	3.5	3.6	3.7	5.3	5.7	6.5	6.5	6.7	7.4	9.5	7.0	7.4c	8.5^{bc}	8.7^{c}
	Nel	4.0	5.3	6.1	5.8	5.8	5.8	5.8	8.5	8.9	11.0^{ab}	12.5^{b}	10.6^{b}	12.9^{b}	12.9^{ab}
	Sig	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*
Aymara	Vel	4.3	4.4	4.5	7.2	7.7	8.3	8.4	8.5	8.6	9.7	9.9	10.1a	11.8^{a}	12.3^{a}
	Nel	3.4	6.2	6.5	5.6	5.7	5.3	5.4	8.4	9.5	11.8^{ab}	13.2^{ab}	13.2^{a}	14.2^{ab}	14.3^{a}
	Sig	ns	ns	*	ns	ns	*	*	ns	ns	ns	*	*	ns	*
Caesar	Vel	5.2	5.3	5.4	7.7	7.8	8.1	8.1	8.1	8.2	8.5	8.7	9.0ab	11.6^{a}	11.7^{ab}
	Nel	5.6	7.1	7.5	7.1	6.5	7.2	7.4	10.0	11.1	14.3^{a}	15.0^{a}	13.5^{a}	15.7^{a}	12.6^{ab}
	Sig	ns	ns	*	ns	*	ns	ns	*	*	*	ns	*	*	*
Akapana	Vel	4.7	4.6	4.0	7.1	7.3	7.9	8.0	8.0	8.1	9.1	9.2	9.3ab	9.0^{bc}	9.1^{bc}
	Nel	3.3	4.0	4.2	3.6	3.6	4.0	4.0	5.6	6.1	8.0^{bc}	9.6^{bc}	10.3^{c}	10.1^{bc}	9.2^{c}
	Sig	*	ns	ns	*	*	*	*	ns	ns	ns	ns	*	ns	ns
Jewel	Vel	3.9	3.9	4.0	5.9	6.4	6.2	6.9	6.5	6.6	9.0	9.1	9.3ab	9.9^{ab}	10.0^{b}
	Nel	2.7	4.4	4.5	4.2	4.4	4.8	4.7	7.0	6.9	7.5^{c}	8.7^{c}	8.8^{c}	9.0^{c}	8.9^{cd}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
Lucia	Vel	5.3	5.3	5.4	6.7	6.9	6.7	6.8	7.0	7.1	8.6	8.7	8.9a	9.7^{ab}	9.8^{bc}
	Nel	3.7	5.2	5.3	5.1	5.1	5.2	5.5	8.0	8.2	10.5^{b}	11.1^{bc}	12.4^{ab}	9.8^{bc}	10.9^{bc}
	Sig	*	ns	ns	ns	ns	ns	ns	*	ns	*	*	*	ns	*

Note: Column headed 'Sig' indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 12.Mean leaf breadth (cm) of anthurium pot plant varieties

Variety		Leaf breadth in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	1.6	1.6	1.7	3.8	3.8	4.9	5.0	5.1	5.2	5.1	5.9	6.1	5.6	5.7
	Nel	2.6	2.3	2.4	2.4	2.4	2.7	2.6	3.8	4.2	4.3	5.6	6.2^{cd}	5.5^{cd}	5.5^{d}
	Sig	*	*	*	*	*	*	*	*	ns	*	ns	ns	ns	ns
Inti	Vel	3.0	3.0	3.3	4.3	4.5	5.9	6.1	5.5	5.6	6.0	6.2	6.5	6.2	6.4
	Nel	3.1	2.4	2.5	2.3	2.3	2.4	2.4	3.9	5.5	4.1	4.0	4.3^{c}	4.6^{c}	5.1^{d}
	Sig	ns	ns	ns	*	ns	*	*	ns	ns	ns	*	*	*	*
Coralis	Vel	4.1	4.1	4.3	4.8	4.9	5.1	5.5	5.7	5.8	6.7	5.9	6.1	7.1	7.2
	Nel	3.3	3.2	3.3	3.7	3.7	4.5	4.8	5.7	6.6	7.7	7.1	7.8^{bcd}	8.0^{bc}	8.9^{c}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	*
Excellent	Vel	5.1	5.1	5.3	6.4	6.7	7.5	7.9	8.0	8.1	7.5	7.6	7.8	9.7	9.8
	Nel	2.9	5.1	5.3	5.1	5.2	6.9	7.0	8.0	9.3	10.9	12.1	13.4^{ab}	11.2^{cb}	11.5^{bc}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Patino	Vel	2.9	2.9	3.1	4.0	4.7	5.7	5.4	5.4	5.7	6.8	7.0	7.1	6.9	7.0
	Nel	2.0	3.7	3.8	3.2	3.3	4.3	4.3	5.5	6.6	7.5	7.5	8.2^{bc}	8.2^{bc}	11.2^{bc}
	Sig	ns	ns	ns	*	*	ns	ns	ns	ns	ns	ns	ns	ns	*
Mia	Vel	5.6	6.0	6.3	7.5	7.8	7.6	7.7	7.8	7.0	9.4	9.4	9.4	9.7	9.7
	Nel	5.3	7.7	10.2	8.1	8.2	8.2	8.1	9.4	13.5	14.1	12.9	14.0^{a}	14.9^{a}	15.0^{a}
	Sig	ns	*	*	ns	ns	ns	ns	*	*	*	*	*	*	*
Condor	Vel	6.0	4.3	4.4	6.1	7.0	6.7	6.8	6.9	7.0	8.4	8.7	8.7	11.3	11.4
	Nel	6.9	8.4	8.8	8.2	8.9	8.4	8.3	9.3	11.5	13.3	12.3	13.1^{ab}	14.7^{a}	13.5^{ab}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*	ns
Pumasillo	Vel	4.3	6.6	6.7	5.4	5.9	5.3	5.8	5.9	6.0	8.6	8.8	8.7	9.1	9.2
	Nel	2.8	3.9	4.0	3.7	3.8	3.6	3.7	4.4	6.4	7.2	8.2	8.8^{bc}	8.0^{bc}	10.4^{bcd}
	Sig	ns	*	*	*	*	ns	*	ns	ns	*	ns	ns	ns	*
Trampolino	Vel	6.5	2.7	2.9	6.0	7.0	7.0	7.2	7.3	7.4	8.6	8.7	8.9	10.4	10.5
	Nel	3.4	5.3	5.5	5.2	5.2	5.9	5.8	6.7	8.8	10.5	13.8	13.8^{ab}	11.7^{ab}	13.4^{ab}
	Sig	*	ns	ns			ns	ns	ns	ns	ns	*	*	ns	*
Bonina	Vel	2.7	5.6	5.7	4.8	5.0	4.9	5.0	5.4	5.6	6.3	6.4	6.5	6.6	6.7
	Nel	2.5	4.1	4.4	3.1	3.1	3.9	3.9	6.3	6.7	7.5	7.3	8.0^{bc}	8.8^{bc}	6.5^{c}
	Sig	ns	ns	*	*	*	ns	*	ns	ns	*	*	*	ns	ns

Note: Column headed 'Sig' indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

At Nelliampathy, Mia was superior to all other varieties during the entire period of observation. Maximum leaf breadth was recorded for Mia (15.00cm) that was on par with Condor (13.57cm).Minimum leaf breadth was recorded for Inti (5.15cm).

Differences between locations were found significant. Leaf breadth was found to be higher at Nelliampathy than Vellanikkara.

4.1.7. Leaf area

4.1.7.1. *Cut flower varieties*

Data pertaining to the monthly variation in leaf area are presented in Table 13. Significant differences were noticed among the varieties through out the growing period at both the locations.

At Vellanikkara, Aymara recorded a maximum leaf area of 191.82cm^2. Minimum leaf area was recorded in Chichas (92.20cm^2).

At Nelliampathy, Esmeralda recorded a maximum leaf area of 251.70cm^2, that was on par with Salasaga (248.90cm^2) and Aymara (249.70cm^2).Leaf area was the lowest (107.8cm^2) in the variety Akapana.

When the locations were compared, differences were found significant. Leaf area was found to be higher at Nelliampathy than Vellanikkara.

4.1.7.2. *Pot plant varieties*

Significant differences were noticed among the varieties through out the growing period at both the locations.

Table 13. Mean leaf area (cm^2) of anthurium cut flower varieties

Variety		Leaf area in cm^2.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	26.6	27.0	29.4	47.8	49.5	63.5	63.5	64.6	64.7	96.8	78.2^{bcd}	80.3^{bc}	86.2^{cd}	119.3^{bc}
	Nel	19.0^{bc}	24.4^{b}	37.5^{bcd}	99.6^{a}	95.9^{a}	45.4^{abc}	48.8^{abc}	103.8^{ab}	101.1^{bc}	172.2^{ab}	212.9	190.5^{abcd}	238.2^{abc}	251.7^{a}
	Sig	ns	ns	ns	*	*	ns	ns	*	*	*	*	*	*	*
Chichas	Vel	21.1	21.2	22.5	31.3	61.6	70.5	70.6	71.0	80.8	86.8	68.2^{d}	70.1^{c}	66.4^{d}	92.2^{c}
	Nel	16.5^{bc}	24.7^{b}	26.2^{d}	25.1^{bc}	26.6^{bc}	26.7^{c}	22.7^{cd}	60.8^{bc}	63.6^{cd}	106.8^{b}	99.0	122.6^{e}	136.8^{cd}	147.9^{bc}
	Sig	ns	ns	ns	ns	*	*	*	ns	ns	ns	ns	*	*	*
Benicito	Vel	28.2	29.1	30.4	48.1	49.2	67.1	68.7	70.7	74.3	64.7	72.1^{d}	74.0^{c}	90.6^{cd}	105.1^{c}
	Nel	15.3^{bc}	33.0^{b}	40.6^{bcd}	49.8^{b}	52.5^{b}	68.4^{a}	66.3^{a}	76.5^{abc}	76.5^{bcd}	146.8^{b}	187.8	181.3^{bcd}	163.7^{bcd}	136.5^{bc}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
Titicaca	Vel	37.2	35.8	38.1	53.0	59.0	82.1	82.1	83.1	64.7	99.1	111.1^{a}	119.9^{a}	149.8^{ab}	158.5^{abc}
	Nel	22.0^{b}	39.6^{ab}	55.5^{ab}	32.4^{bc}	33.0^{bc}	30.7^{bc}	32.1^{bcd}	57.9^{bc}	58.3^{cd}	178.6^{ab}	198.7	227.0^{ab}	169.8^{bcd}	165.2^{bc}
	Sig	*	ns	*	ns	ns	*	ns	*	ns	*	*	*	*	*
Salasaga	Vel	20.1	20.6	21.7	44.8	50.1	64.9	65.5	67.2	79.8	101.9	74.0^{cd}	81.4^{bc}	103.1^{bcd}	108.7^{c}
	Nel	24.8^{b}	37.6^{ab}	48.4^{bc}	42.3^{bc}	43.2^{bc}	41.7^{bc}	41.7^{abcd}	94.0^{abc}	109.2^{ab}	183.4^{ab}	233.2	155.4^{cde}	247.5^{ab}	248.9^{a}
	Sig	ns	*	*	ns	ns	ns	ns	ns	*	*	*	*	*	*
Aymara	Vel	23.8	24.5	25.6	58.8	69.0	77.2	78.9	80.4	82.0	104.4	109.2^{ab}	115.6^{a}	163.0^{a}	191.0^{a}
	Nel	$14.4b^{c}$	36.4^{ab}	40.6^{bcd}	34.1^{bc}	35.4^{bc}	31.8^{bc}	32.1^{bcd}	79.6^{abc}	97.2^{bc}	183.8^{ab}	208.9	217.1^{ab}	238.9^{abc}	249.7^{a}
	Sig	ns	ns	ns	ns	ns	*	*	ns	ns	*	*	*	*	*
Caesar	Vel	36.0	36.7	37.7	67.2	73.4	76.6	76.6	77.5	78.8	101.4	104.0^{abc}	109.3^{ab}	174.9^{a}	178.4^{ab}
	Nel	34.7^{a}	57.4^{a}	71.7^{a}	54.3^{b}	49.6^{bc}	55.2^{ab}	57.5^{ab}	122.2^{a}	146.0^{a}	277.7^{a}	296.6	238.4^{a}	311.4^{a}	207.4^{ab}
	Sig	ns	*	*	ns	*	ns	ns	*	*	*	*	*	*	ns
Akapana	Vel	30.3	30.3	26.0	61.8	68.7	75.1	79.3	80.1	81.8	108.8	112.1^{a}	113.0^{ab}	106.3^{bcd}	108.8^{c}
	Nel	14.9^{bc}	23.0^{b}	24.2^{d}	18.0^{c}	18.4^{c}	19.2^{c}	20.3^{d}	41.5^{c}	50.9^{d}	91.7^{b}	123.1	136.5^{de}	132.5^{cd}	107.8^{c}
	Sig	ns	ns	ns	*	*	*	*	*	ns	ns	*	*	*	ns
Jewel	Vel	23.8	23.8	24.3	53.5	61.6	61.2	68.2	64.0	65.6	124.6	127.4^{a}	131.5^{a}	137.3^{abc}	140.5^{abc}
	Nel	10.5^{c}	29.8^{b}	30.6^{cd}	24.9^{bc}	26.3^{bc}	27.7^{c}	27.5^{cd}	64.7^{bc}	64.8^{cd}	80.6^{b}	116.4	115.7^{e}	114.6^{d}	111.9^{c}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
Lucia	Vel	38.9	38.9	40.0	61.6	68.2	66.2	68.9	71.7	74.0	103.7	106.5^{ab}	111.5^{ab}	143.8^{ab}	145.7^{abc}
	Nel	20.1^{bc}	37.1ab	$38.2b^{cd}$	36.0^{bc}	37.5^{bc}	35.6^{bc}	37.8bcd	84.5^{abc}	90.4^{bcd}	167.1^{ab}	188.8	204.2^{abc}	134.2^{cd}	174.6^{abc}
	Sig	*	ns	ns	ns	ns	*	ns	ns	*	*	*	*	ns	*

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 14. Mean leaf area (cm^2) of anthurium pot plant varieties

Variety		Leaf area in cm^2.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	7.9^{e}	7.9^{e}	8.8^{g}	26.5^{c}	27.1^{e}	38.2^{bc}	39.0^{de}	39.6^{cd}	40.7^{c}	40.6^{e}	49.6^{c}	55.1^{de}	48.4^{d}	49.1^{d}
	Nel	12.2^{c}	11.6^{c}	12.5^{b}	11.5^{c}	12.1^{c}	13.5^{d}	12.6^{c}	20.7^{d}	27.9^{c}	30.0^{d}	42.7^{ef}	52.7^{de}	42.0^{d}	42.3^{e}
	Sig	*	ns	ns	*	*	*	*	*	ns	*	ns	ns	ns	ns
Inti	Vel	15.9^{de}	16.0^{de}	17.3^{f}	26.2^{c}	28.6^{de}	46.6^{abc}	47.7^{bcde}	45.4^{bcd}	46.1^{bc}	50.2^{de}	58.8^{c}	64.0^{d}	55.6^{d}	58.2^{d}
	Nel	14.1^{c}	11.4^{c}	12.1^{b}	10.1^{c}	10.5^{c}	10.2^{d}	10.4^{c}	19.8^{d}	33.4^{c}	25.6^{d}	21.7^{f}	24.0^{e}	24.9^{d}	32.0^{e}
	Sig	ns	ns	ns	ns	*	*	*	*	ns	ns	*	*	*	*
Coralis	Vel	25.7^{cd}	26.0^{cd}	27.8^{de}	36.5^{bc}	38.2^{cde}	41.3^{bc}	44.7^{cde}	46.9^{bcd}	48.0^{bc}	59.8^{cd}	50.1^{c}	52.7^{e}	67.6^{cd}	69.5^{cd}
	Nel	15.4^{c}	17.2^{c}	17.7^{b}	20.3^{c}	20.4^{c}	28.6^{bcd}	30.4^{bc}	40.8^{cd}	53.4^{bc}	69.5^{cd}	70.7^{de}	83.3^{cd}	82.8^{cd}	97.8^{cd}
	Sig	*	ns	ns	*	ns	ns	ns	ns	ns	ns	*	*	ns	*
Excellent	Vel	37.4^{bc}	37.6^{bc}	40.0^{bc}	49.2^{ab}	53.7^{abc}	64.9^{ab}	69.0^{ab}	73.4^{a}	74.9^{a}	74.8^{b}	76.7^{b}	79.4^{c}	113.8^{b}	116.1^{b}
	Nel	15.5^{c}	32.6^{bc}	35.0^{b}	36.0^{bc}	37.1^{bc}	53.7^{abc}	54.1^{abc}	69.6^{bc}	88.0^{bc}	123.9^{bc}	157.0^{c}	185.6^{b}	143.0^{bc}	155.5^{b}
	Sig	*	ns	ns	ns		ns	ns	ns	ns	*	*	*	*	*
Patino	Vel	15.7^{de}	15.8^{de}	17.6^{f}	26.2^{c}	34.7^{cde}	48.5^{abc}	46.0^{bcde}	47.0^{bcd}	49.3^{bc}	71.7^{bc}	73.8^{b}	76.2^{c}	69.2^{cd}	71.2^{cd}
	Nel	5.9^{c}	17.3^{c}	17.3^{b}	12.9^{c}	13.4^{d}	25.4^{bcd}	25.7^{bc}	39.2^{cd}	49.7^{c}	76.1^{cd}	70.4^{de}	82.1^{cd}	87.0^{cd}	138.1^{bc}
	Sig	*	ns	ns	*	*	ns	ns	ns	ns	ns	ns	ns	ns	*
Mia	Vel	37.6^{bc}	47.7^{ab}	42.0^{ab}	56.4^{a}	69.9^{a}	64.1^{ab}	65.8^{abc}	66.9^{ab}	66.5^{ab}	96.2^{a}	97.0^{a}	97.0^{b}	101.1^{bc}	103.7^{bc}
	Nel	32.4^{b}	67.5^{ab}	91.9^{a}	70.8^{ab}	75.0^{ab}	72.5^{ab}	71.9^{ab}	95.7^{ab}	206.1^{a}	258.4^{a}	195.8^{b}	223.7^{a}	276.3^{a}	278.8^{a}
	Sig	ns	*	*	ns	ns	ns	ns	*	*	*	*	*	*	*
Condor	Vel	47.4^{ab}	28.5^{cd}	32.8^{cd}	51.0^{ab}	62.9^{ab}	59.2^{abc}	60.8^{abcd}	61.6^{abc}	63.4^{abc}	98.9a	101.6^{a}	102.8^{ab}	158.0^{a}	163.6^{a}
	Nel	64.8^{a}	102.5^{a}	105.4^{a}	91.2^{a}	105.8^{a}	97.8^{a}	91.1^{a}	107.7^{a}	181.4^{a}	250.1^{a}	210.7^{b}	236.9^{a}	285.5^{a}	250.5^{a}
	Sig	ns	*	*	ns	*	*	*	*	*	*	*	*	*	*
Pumasillo	Vel	28.2^{cd}	58.0^{a}	49.3^{a}	42.5^{abc}	47.6^{bcd}	42.1^{bc}	46.4^{bcde}	48.0^{bcd}	49.3^{bc}	99.2^{a}	91.7^{a}	103.8^{ab}	110.2^{b}	114.8^{b}
	Nel	13.9^{c}	20.4^{c}	12.1^{b}	18.5^{d}	19.1^{c}	18.3^{d}	19.2^{c}	29.9^{d}	57.6^{bc}	69.2^{cd}	89.8^{d}	102.8^{c}	86.3^{cd}	151.5^{b}
	Sig	ns	*	*	*	*	*	*	*	ns	*	ns	ns	*	*
Trampolino	Vel	57.1^{a}	14.9^{de}	23.4^{ef}	51.7^{ab}	69.2^{a}	69.0^{a}	72.2^{a}	73.7^{a}	75.1^{a}	102.0^{a}	105.2^{a}	108.9^{a}	158.2^{a}	161.1^{a}
	Nel	19.3^{c}	39.9^{bc}	43.3^{b}	38.1^{bc}	39.1^{bc}	50.6^{abc}	45.1^{abc}	57.2^{cd}	112.2^{b}	152.9^{b}	249.1^{a}	249.1^{a}	187.0^{b}	241.4^{a}
	Sig	ns	*	*	*	*	*	*	*	ns	*	ns	ns	*	*
Bonina	Vel	14.5^{de}	38.0^{bc}	46.5^{ab}	30.5^{c}	34.9^{cde}	33.7^{c}	34.8^{e}	37.7^{d}	39.3^{c}	55.7^{d}	57.1^{c}	58.7^{de}	61.8^{cd}	63.5^{cd}
	Nel	11.5^{c}	24.6^{c}	27.6^{b}	18.2^{c}	18.8^{c}	22.8^{bcd}	23.4^{bc}	46.8^{cd}	49.3^{c}	64.6^{d}	64.4^{de}	76.6^{cd}	92.5^{cd}	53.2^{de}
	Sig	ns	ns	*	*	*	*	*	ns	ns	ns	ns	*	*	ns

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

At Vellanikkara, maximum leaf area was recorded for Condor 163.65cm^2 that was on par with Trampolino (161.13cm^2). Leaf area was the lowest (49.10cm^2) in Diablada (Table 14).

At Nelliampathy, Maximum leaf area was recorded for Mia (278.80cm^2) that was on par with Condor (250.50cm^2) and Trampolino (241.40 cm^2).Minimum leaf area was recorded for Inti (32.00cm^2)

Difference between locations was significant for all the varieties except Diablada and Bonina.

4.1.8. Petiole length

4.1.8.1. *Cut flower varieties*

No significant differences were noticed among varieties at Vellanikkara (Table 15). Appreciable differences were seen among varieties at Nelliampathy. Petiole length was the highest (36.34cm) in Esmeralda which was statistically on par with varieties Salasaga (33.15cm), Aymara (32.80cm) and Caesar (29.86cm). Variety Titicaca had the lowest petiole length of 18.70cm.

Differences between the locations were found significant. Petiole length was more at Nelliampathy compared to Vellanikkara among all the varieties except Titicaca.

4.1.8.2. *Pot plant varieties*

Significant differences were noticed among varieties through out the growing period at both the locations.

At Vellanikkara, maximum petiole length was recorded for Pumasillo (24.75cm) with varieties Excellent (24.18cm) and Mia (23.16cm) performing on

Table 15. Mean petiole length (cm) of anthurium cut flower varieties

Variety		Petiole length in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Esmeralda	Vel	9.0	9.2	10.4	11.8	12.5	14.5	14.9	15.2^{abcd}	15.3^{bc}	16.0^{b}	16.0^{c}	16.0^{c}	17.0^{c}	21.0
	Nel	8.4	8.2^{cd}	9.7^{bc}	15.4	15.7	10.3	10.3	16.0^{ab}	15.5^{ab}	19.0^{ab}	25.7^{ab}	27.7^{ab}	27.5^{abc}	36.3^{a}
	Sig	ns	ns	ns	ns	*	*	*	ns	ns	ns	*	*	*	*
Chichas	Vel	10.8	11.2	13.2	14.2	14.8	15.6	16.3	16.4^{abc}	16.8^{abc}	17.9^{ab}	16.5^{bc}	16.8^{c}	17.0^{c}	20.5
	Nel	6.7	9.7^{bcd}	10.6^{bc}	9.3	9.8	9.3	9.2	10.3^{c}	11.3^{b}	16.2^{ab}	17.8^{bc}	18.3^{bc}	21.0^{bcd}	25.3^{bc}
	Sig	ns	ns	ns	*	ns	*	*	ns	*	ns	ns	ns	ns	*
Benicito	Vel	10.4	10.6	10.6	12.4	12.6	15.0	15.7	15.9^{abcd}	16.9^{abc}	15.5^{b}	14.7^{c}	14.8^{c}	15.8^{c}	22.2
	Nel	5.6	9.0^{bcd}	11.8^{abc}	12.0	13.0	11.7	12.8	12.7^{abc}	12.8^{b}	19.3^{ab}	22.0^{abc}	22.5^{abc}	22.7^{abcd}	24.5^{bc}
	Sig	ns	ns	ns	ns	ns	*	*	ns	*	ns	*	*	*	ns
Titicaca	Vel	9.2	9.4	13.0	10.3	11.7	12.5	12.8	13.3^{d}	14.3^{c}	15.9^{b}	16.5^{bc}	16.8^{c}	17.5^{c}	20.2
	Nel	5.7	12.3^{ab}	11.3^{abc}	9.7	10.4	8.8	8.8	11.7^{bc}	11.4^{b}	16.8^{ab}	18.7^{bc}	19.2^{bc}	18.7^{cd}	18.7^{c}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns		*
Salasaga	Vel	8.4	8.6	8.6	11.8	13.3	13.1	13.6	13.8^{cd}	14.6^{c}	17.5^{ab}	17.6^{ab}	18.0^{bc}	18.5^{bc}	19.3
	Nel	7.1	12.3^{ab}	14.0^{ab}	12.1	12.5	12.2	12.7	17.2^{a}	19.2^{a}	24.3^{a}	29.3^{a}	29.3^{a}	29.8^{ab}	33.1^{ab}
	Sig	ns	*	*	ns	ns	ns	ns	ns	*	ns	*	*	*	*
Aymara	Vel	7.3	8.1	8.2	12.3	12.3	13.4	13.7	14.3^{bcd}	15.3^{bc}	15.3^{b}	16.0^{c}	17.0^{c}	17.9^{bc}	23.5
	Nel	4.3	7.2^{d}	8.2^{c}	9.3	9.4	8.7	8.8	11.8^{abc}	14.2^{ab}	22.0^{a}	23.7^{ab}	28.0^{ab}	30.5^{a}	32.8^{ab}
	Sig	*	ns	ns	ns	ns	*	*	ns	ns	*	*	*	*	*
Caesar	Vel	10.2	11.2	11.6	15.5	16.0	16.0	16.2	17.7^{a}	18.5^{a}	15.1^{b}	15.4^{c}	16.3^{c}	16.9^{c}	21.8
	Nel	7.3	14.0^{a}	15.3^{a}	12.7	12.8	12.0	13.0	16.5^{ab}	19.4^{a}	22.8^{a}	24.3^{ab}	27.3^{ab}	30.3^{a}	29.8^{ab}
	Sig	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
Akapana	Vel	9.9	11.9	12.3	15.2	15.7	16.3	16.3	17.0^{ab}	17.9^{ab}	20.2^{a}	20.5^{a}	21.5^{a}	21.8^{a}	20.6
	Nel	5.2	11.3^{abc}	11.9^{abc}	7.8	8.2	6.3	6.9	9.7^{c}	11.5^{b}	12.5^{b}	15.0^{c}	18.7^{bc}	20.2^{cd}	20.0^{c}
	Sig	*	ns	ns	*	*	*	*	*	*	*	*	ns	ns	ns
Jewel	Vel	10.1	11.8	12.2	13.8	14.3	14.4	14.6	15.0^{abcd}	15.5^{bc}	19.8^{a}	19.5^{ab}	20.5^{ab}	20.8^{ab}	21.0
	Nel	5.2	9.5^{bcd}	10.5^{bc}	8.5	8.6	8.9	9.0	12.5^{abc}	16.2^{ab}	12.8b	17.3^{bc}	16.7^{c}	17.2^{d}	20.0^{c}
	Sig	*	ns	ns	*	*	ns	ns	ns	ns	*	ns	ns	ns	ns
Lucia	Vel	10.6	10.9	11.3	13.7	13.5	14.4	14.5	15.0^{abcd}	15.5^{bc}	19.3^{a}	20.3^{a}	21.3^{a}	22.1^{a}	21.4
	Nel	5.1	9.2^{bcd}	9.6^{bc}	9.3	9.5	9.3	9.2	12.2^{abc}	13.2^{b}	18.2^{ab}	20.3^{bc}	23.0^{abc}	22.7^{abc}	24.0^{bc}
	Sig	*	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	*

Note: Column headed ‘Sig’ indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel: Vellanikkara Nel: Nelliampathy

Table 16. Mean petiole length (cm) of anthurium pot plant varieties

Variety		Petiole length in cm.(months after planting)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Diablada	Vel	6.8^{c}	7.4^{d}	7.9^{e}	10.2^{de}	11.2^{de}	11.7^{d}	11.8^{d}	12.1^{b}	12.2^{c}	13.9^{d}	11.4^{e}	11.8^{f}	14.4^{c}	14.5^{c}
	Nel	5.4^{bc}	5.1^{ef}	6.1^{d}	5.0^{c}	5.1^{c}	4.7^{d}	6.2^{cd}	7.2^{e}	9.9^{c}	13.0^{cd}	12.8^{de}	12.8^{c}	13.2^{e}	13.2^{cd}
	Sig	ns	*	ns	*	*	*	*	*	ns	ns	ns	ns	ns	ns
Inti	Vel	6.5^{c}	6.8^{d}	7.1^{e}	9.2^{e}	9.7^{e}	12.1^{d}	12.3^{d}	12.6^{b}	12.7^{c}	13.8^{d}	13.5^{de}	15.2^{de}	15.3^{c}	15.5^{c}
	Nel	6.2^{bc}	6.2^{def}	6.5^{d}	6.6^{bc}	6.3^{bc}	6.5^{cd}	5.7^{d}	8.3^{de}	9.3^{c}	11.7^{d}	8.8^{e}	9.8^{c}	8.3^{f}	9.8^{d}
	Sig	ns	ns	ns	ns	ns	ns	*	*	ns	ns	*	*	*	*
Coralis	Vel	9.2^{bc}	9.6^{bcd}	9.7^{cde}	12.8^{cd}	13.3^{bcd}	12.3^{d}	12.7^{cd}	12.9^{b}	13.1^{c}	17.8^{bc}	20.8^{a}	14.8^{e}	20.7^{ab}	21.6^{ab}
	Nel	6.3^{bc}	8.5^{bcd}	8.9^{bcd}	11.0^{bc}	11.2^{b}	11.5^{bc}	11.3^{bc}	12.7^{cd}	12.0^{c}	17.2^{bcd}	22.0^{abc}	23.0^{ab}	21.8^{bcd}	21.3^{bc}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns
Excellent	Vel	14.4^{a}	14.7^{a}	15.7^{a}	13.5^{abcd}	14.0^{abcd}	19.3^{a}	19.3^{a}	19.9^{a}	20.3^{a}	14.8^{d}	15.5^{cd}	20.0^{b}	23.6^{a}	24.1^{a}
	Nel	6.6^{bc}	9.5^{bc}	10.9^{bc}	11.6^{b}	11.7^{b}	12.7^{b}	12.7^{b}	15.8^{bc}	18.1^{b}	20.2^{b}	24.5^{abc}	25.7^{ab}	27.3^{bc}	26.5^{b}
	Sig	*	*	ns	ns	ns	*	*	ns	ns	*	ns	ns	ns	ns
Patino	Vel	7.8^{c}	8.8^{cd}	8.6^{de}	10.8^{de}	11.2^{de}	12.0^{d}	12.1^{d}	12.5^{b}	13.1^{c}	14.1^{d}	14.8^{cd}	16.3^{cde}	17.1^{bc}	17.4^{c}
	Nel	3.2^{c}	4.8^{f}	5.2^{d}	5.7^{bc}	5.9^{bc}	7.2^{bcd}	7.2^{cd}	9.7^{cde}	10.1^{c}	11.7^{d}	16.6^{cde}	18.2^{bc}	16.5^{de}	20.6^{bc}
	Sig	*	*	ns	*	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
Mia	Vel	11.1^{b}	11.8^{abc}	12.3^{bc}	16.8^{a}	17.2^{a}	17.0^{ab}	17.9^{ab}	18.7^{a}	19.3^{a}	18.7^{b}	19.7^{ab}	20.3^{b}	22.6^{a}	23.1^{a}
	Nel	7.4^{b}	16.3^{a}	19.5^{a}	20.4^{a}	20.8^{a}	18.5^{a}	18.9^{a}	22.7^{a}	27.2^{a}	29.2^{a}	29.0^{a}	30.3^{a}	46.2^{a}	46.7^{a}
	Sig	ns	*	*	ns	*	ns	ns	ns	ns	*	*	*	*	*
Condor	Vel	11.3^{ab}	11.9^{abc}	12.0^{bcd}	13.3^{bcd}	13.7^{bcd}	12.9^{cd}	13.0^{cd}	13.2^{b}	13.4^{bc}	16.2^{bcd}	16.5^{cd}	17.5^{cd}	21.3^{ab}	21.8^{ab}
	Nel	14.7^{a}	11.0^{b}	12.1^{b}	11.7^{b}	11.7^{b}	12.3^{b}	12.8^{b}	13.5^{bc}	19.6^{b}	21.2^{b}	27.6^{ab}	28.7^{a}	28.7^{b}	25.8^{b}
	Sig	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
Pumasillo	Vel	11.2^{ab}	11.3^{bc}	11.4^{bcd}	16.4^{ab}	16.7^{ab}	16.9^{ab}	17.0^{ab}	17.5^{a}	13.8^{bc}	22.1^{a}	22.6^{a}	23.6^{a}	24.3^{a}	24.7^{a}
	Nel	7.6^{b}	7.3^{cdef}	7.9^{cd}	8.8^{bc}	8.9^{bc}	9.4^{bcd}	9.3^{bcd}	9.5^{cde}	9.6^{c}	12.8^{cd}	19.3^{bcd}	13.5^{c}	19.9^{cde}	20.2^{bc}
	Sig	ns	*	*	*	*	*	*	*	ns	*	ns	*	*	*
Trampolino	Vel	11.3^{ab}	8.7^{cd}	9.3^{cde}	14.6^{abc}	15.2^{abc}	15.3^{bc}	15.7^{bc}	16.6^{a}	17.2^{ab}	15.5^{cd}	16.3^{cd}	16.1^{cde}	21.3^{ab}	21.5^{ab}
	Nel	6.4^{bc}	8.9^{bc}	7.5^{cd}	9.3^{bc}	9.6^{bc}	11.4^{bc}	10.9^{bcd}	11.2^{cde}	14.4^{bc}	18.2^{bc}	11.6^{de}	17.3^{bc}	20.3^{cde}	20.3^{bc}
	Sig	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Bonina	Vel	7.9^{c}	12.5^{ab}	13.9^{ab}	12.0^{cde}	12.3^{cde}	11.3^{d}	11.4^{d}	12.5^{b}	12.9^{c}	16.5^{bcd}	17.5^{bc}	18.4^{bc}	17.5^{bc}	18.2^{bc}
	Nel	8.3^{b}	7.7^{cde}	8.0^{cd}	7.1^{bc}	7.2^{bc}	8.0^{bcd}	8.3^{bcd}	13.5^{bc}	13.8^{bc}	17.6^{bcd}	23.8^{abc}	24.8^{ab}	26.9^{bc}	16.9^{cd}
	Sig	ns	*	*	*	**	*	*	ns	ns	ns	*	*	*	ns

Note: Column headed 'Sig' indicate location wise significance; ns-non significant at 5 % level and * significant at 5 % level
Vel:Vellanikkara Nel:Nelliampathy

par with it. Minimum petiole length (14.55cm) was recorded in the variety Diablada (Table 16).

At Nelliampathy, Mia was superior to all other varieties during the entire period of observation. Maximum petiole length was recorded for Mia (46.70cm). Shortest petiole length was recorded for Inti (9.83cm).

When the locations were compared, differences were found significant only for Inti, Patino, Mia Condor and Pumasillo.However petiole length was found to be higher at Nelliampathy.

4.1.9. Leaf longevity

4.1.9.1 Cut flower varieties

Leaf longevity was observed for one year for all the ten varieties. Noticeable differences in the leaf longevity were recorded among varieties both at Vellanikkara and Nelliampathy. (Table 17 and Fig.1).

At Vellanikkara, among the varieties, the highest longevity was recorded for Chichas (183.75 days) which was on par with Salasaga (183.28 days) and Esmeralda (176.37 days). The lowest (108.72 days) was in the variety Benicito.

At Nelliampathy, among the varieties the highest longevity was recorded in Aymara (202.56 days) which was significantly superior to all other varieties and the lowest (119.25days) was recorded in Titicaca.

Difference between locations was found significant for all other varieties except Akapana. Varieties Esmeralda, Chichas, Titicaca and Salasaga had more leaf longevity at Vellanikkara.

4.1.9.2 Pot plant varieties

Leaf longevity differed significantly among varieties both at Vellanikkara and Nelliampathy (Table 17 and Fig.1).

At Vellanikkara among the varieties, the highest longevity was recorded for the variety Inti (204.75 days) which was on par with Diablada (200.72days). The lowest (94.33 days) was in the variety Condor.

At Nelliampathy among the varieties, the highest longevity was recorded for the variety Bonina (205.67days) which was on par with Diablada (201.34 days). The lowest (98.32) was in the variety Condor.

Varieties Inti, Patino, Mia and Pumasillo differed significantly between the locations. Leaf longevity was significantly high at Nelliampathy except for the variety Inti.

4.1.10. Leaf production interval

4.1.10.1 Cut flower varieties

Leaf production interval differed significantly among varieties at both the locations (Table 18 and Fig.2).

At Vellanikkara, among the varieties, mean leaf production interval was lowest for the variety Lucia (31.72days).The longest leaf production interval was recorded for the variety Chichas (39.80days).

At Nelliampathy, among the varieties, the lowest leaf production interval was recorded in Titicaca (33.73days) which was closely followed by variety Caesar (33.70days).Highest leaf production interval was recorded in Lucia (39.35days).

No significant differences were observed between the locations, except for variety Lucia which showed significantly lower leaf production interval at Vellanikkara.

4.1.10.2 Pot plant varieties

Leaf production interval differed significantly among varieties at both the locations (Table 18 and Fig.2).

At Vellanikkara, among the varieties, mean leaf production interval was lowest for the variety Mia (31.08days) which is closely followed by Bonina (31.22days).The longest leaf production interval was recorded for the variety Inti (36.67days).

At Nelliampathy, among the varieties the lowest leaf production interval was recorded in the variety Condor (33.12days). Highest leaf production interval was recorded in Bonina (36.63days).It was closely followed by the variety Inti (36.20days).

No significant differences were observed between the locations except for variety Bonina which showed significantly lower leaf production interval at Vellanikkara.

4.1.10. Quality of leaf as cut foliage

Data pertaining to the quality of leaf as cut foliage are presented in Table 19

Table.17 .Longevity of the leaf (days)

Cut flowers				Pot plants			
Varieties	Vellanikkara	Nelliampathy	Sig	Varieties	Vellanikkara	Nelliampathy	Sig
Esmeralda	176.37^{a}	152.34^{d}	**	*Diablada*	200.72^{ab}	201.34^{a}	ns
Chichas	183.75^{a}	153.64^{d}	*	*Inti*	204.75^{a}	150.62^{d}	**
Benicito	108.72^{d}	171.32^{c}	**	*Coralis*	176.56^{c}	183.77^{b}	ns
Titicaca	152.33^{b}	119.25^{e}	**	*Excellent*	154.72^{d}	171.35^{bc}	ns
Salasaga	183.28^{a}	125.42^{e}	**	*Patino*	112.33^{f}	179.32^{b}	**
Aymara	152.25^{b}	202.56^{a}	**	*Mia*	94.75^{g}	126.45^{e}	**
Caesar	119.34^{d}	157.35^{d}	**	*Condor*	94.33^{g}	98.32^{g}	ns
Akapana	153.35^{b}	157.72^{d}	ns	*Pumasillo*	131.52^{e}	158.71^{cd}	**
Jewel	134.34^{c}	163.34^{cd}	**	*Trampolino*	100.75^{fg}	112.33^{f}	ns
Lucia	151.36^{b}	187.24^{b}	**	*Bonina*	192.55^{b}	205.67^{a}	ns

** Significant between location at 1% level; * significant between location at 5% level; ns- non significant between location at 5 % level

Table.18 .Leaf production interval (days)

Cut flowers				Pot plants			
Varieties	Vellanikkara	Nelliampathy	Sig	Varieties	Vellanikkara	Nelliampathy	Sig
Esmeralda	35.55^{bc}	34.28^{bcd}	ns	*Diablada*	33.33^{cd}	33.33^{c}	ns
Chichas	39.45^{a}	34.64^{bcd}	ns	*Inti*	36.67^{a}	34.34^{abc}	ns
Benicito	33.72^{cd}	36.33^{ab}	ns	*Coralis*	35.74^{ab}	36.20^{ab}	ns
Titicaca	34.22^{bcd}	33.73^{cd}	ns	*Excellent*	34.45^{abc}	33.48^{c}	ns
Salasaga	37.45^{ab}	34.85^{bcd}	ns	*Patino*	33.32^{bcd}	33.72^{c}	ns
Aymara	34.56^{bcd}	36.44^{ab}	ns	*Mia*	31.08^{d}	32.30^{c}	ns
Caesar	34.34^{bcd}	33.45^{cd}	ns	*Condor*	32.34^{cd}	33.12^{c}	ns
Akapana	34.72^{bcd}	34.38^{bcd}	ns	*Pumasillo*	32.74^{cd}	34.08^{bc}	ns
Jewel	33.34^{cd}	35.76^{bc}	ns	*Trampolino*	33.34^{bcd}	33.67^{c}	ns
Lucia	31.77^{d}	39.35^{a}	*	*Bonina*	31.22^{d}	36.63^{a}	*

** Significant between location at 1% level; * significant between location at 5% level; ns- non significant between location at 5 % level

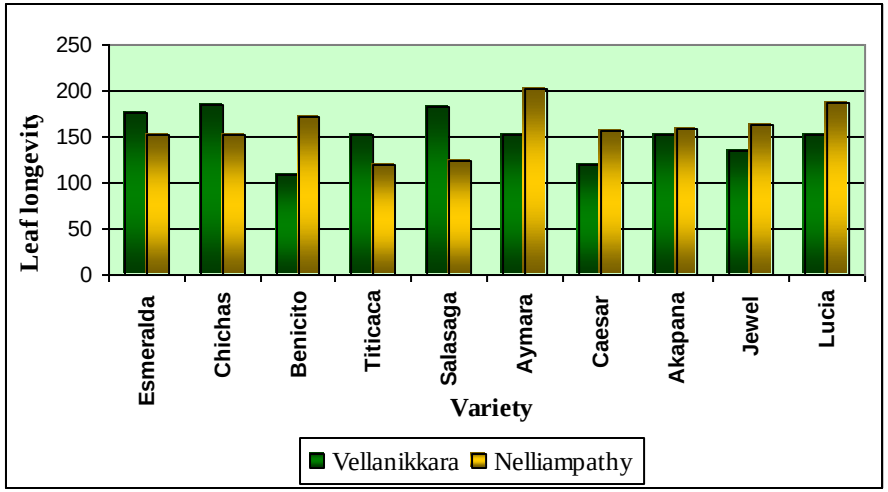


Fig.1-1.Longevity of the leaf in cut flowers

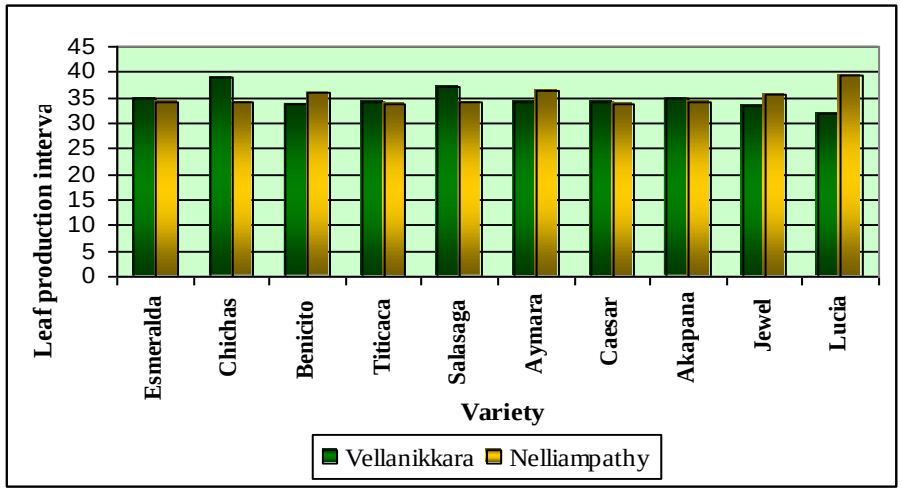


Fig.2-1.Leaf production interval in cut flowers

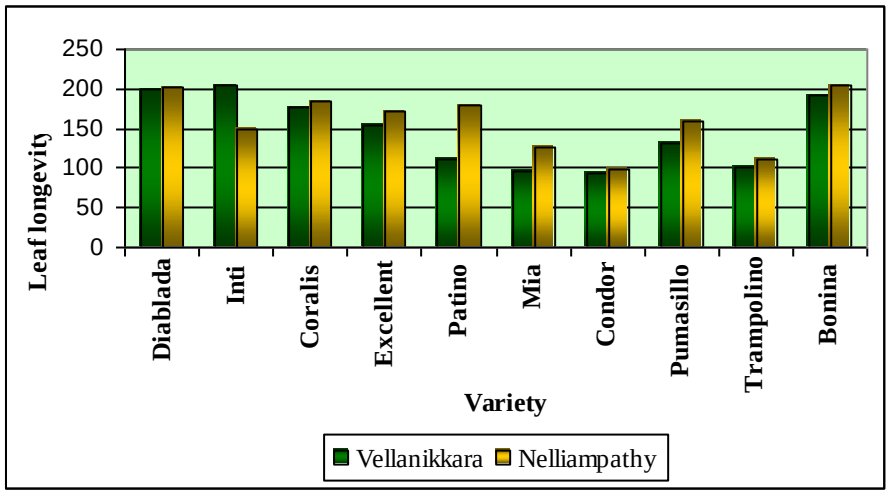


Fig.1-2. Longevity of the leaf in pot plants

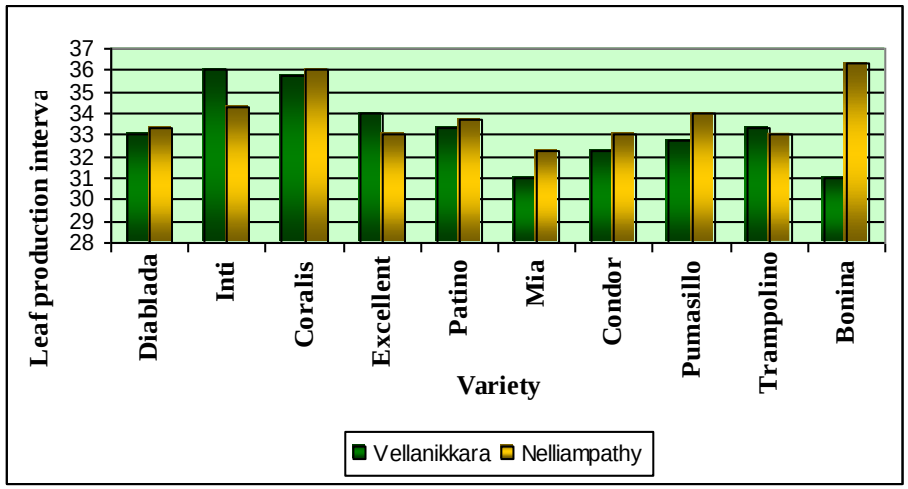


Fig.2-2. Leaf production interval in pot plants

4.2. FLORAL CHARACTERS

Data pertaining to the monthly variations in days to flowering and floral characters of anthurium are presented in Tables 20 to 32.

4.2.1. Days to flower emergence

4.2.1.1. *Cut flower varieties*

Days taken for first flowering differed significantly among varieties both at Vellanikkara and Nelliampathy (Table 20 and Fig.3).

At Vellanikkara, variety Lucia was the earliest (116.00days).It was on par with varieties Esmeralda (118.00days), Benicito (121.00days) and Jewel (121.67days).Variety Caesar (157.00days) was the last to flower.

At Nelliampathy, earliest flowering (196.00days) was recorded for the variety Caesar. It was significantly lower than all other varieties. The variety Titicaca (250.00days) was the last to flower.

Significant differences were found between the locations. Time taken for flowering was significantly less at Vellanikkara.

4.2.1.2 Pot plant varieties

Days taken for first flowering differed significantly among varieties both at Vellanikkara and Nelliampathy.

At Vellanikkara, variety Condor was the earliest (100.00days). Variety Inti (130.00days) was the last to flower (Table 20 and Fig.4).

At Nelliampathy, earliest flowering (141.33days) was recorded for the variety Condor which was found to be on par with variety Patino (150.67days). Variety Inti (249.00days) was the last to flower.

Significant differences were found between the locations. Time taken for flowering was significantly less at Vellanikkara.

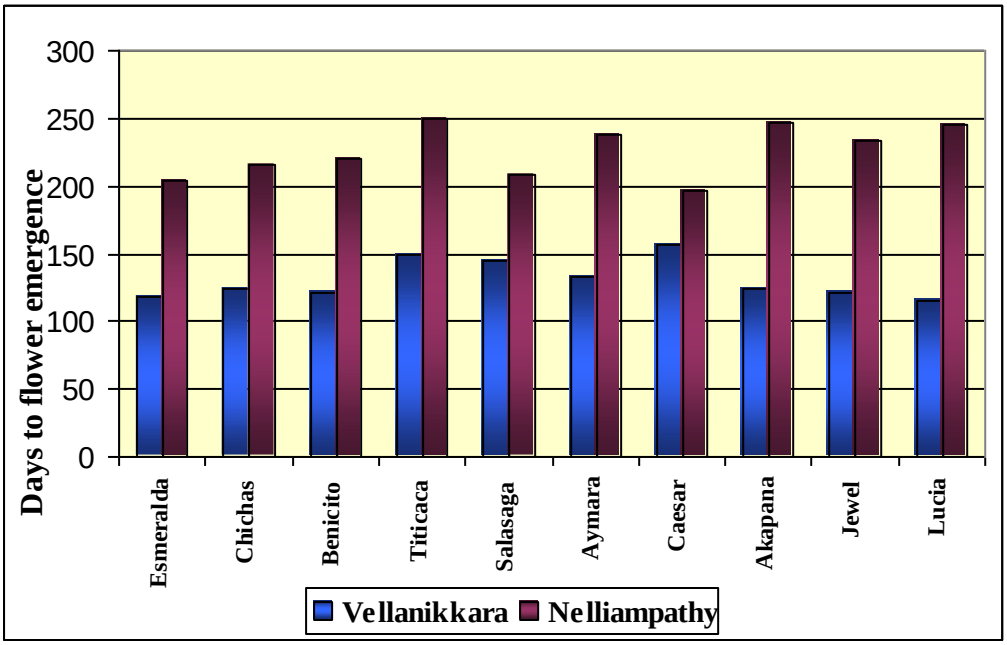
Table 19. Quality of leaf as cut foliage

Cut flowers		**Pot plants**	
Varieties	Quality of leaf as cut foliage	Varieties	Quality of leaf as cut foliage
Esmeralda	Acceptable	*Diablada*	Not acceptable
Chichas	Not acceptable	*Inti*	Not acceptable
Benicito	Not acceptable	*Coralis*	Not acceptable
Titicaca	Acceptable	*Excellent*	Not acceptable
Salasaga	Acceptable	*Patino*	Acceptable
Aymara	Acceptable	*Mia*	Not acceptable
Caesar	Not acceptable	*Condor*	Not acceptable
Akapana	Acceptable	*Pumasillo*	Acceptable
Jewel	Acceptable	*Trampolino*	Acceptable
Lucia	Not acceptable	*Bonina*	Not acceptable

Table 20 .Days to flower emergence

Cut flowers				**Pot plants**			
Varieties	Nelliampathy	Vellanikkara	Sig	Varieties	Nelliampathy	Vellanikkara	Sig
Esmeralda	204.00^{b}	118.00^{ab}	**	*Diablada*	242.00^{b}	114.33^{b}	**
Chichas	216.00^{c}	124.00^{bc}	**	*Inti*	249.00^{b}	130.00^{d}	**
Benicito	220.33^{c}	121.00^{abc}	**	*Coralis*	243.33^{b}	120.00^{bc}	**
Titicaca	250.00^{e}	149.67^{e}	**	*Excellent*	244.67^{b}	114.67^{b}	**
Salasaga	208.67^{b}	145.67^{e}	**	*Patino*	150.67^{a}	117.67^{bc}	*
Aymara	238.33^{d}	133.67^{d}	**	*Mia*	221.00^{b}	121.00^{c}	**
Caesar	196.00^{a}	157.00^{f}	*	*Condor*	141.33^{a}	100.00^{a}	*
Akapana	247.67^{e}	124.33^{c}	**	*Pumasillo*	238.67^{b}	119.67^{b}	**
Jewel	233.67^{d}	121.67^{abc}	**	*Trampolino*	214.00^{b}	114.00^{bc}	**
Lucia	246.67^{e}	116.00^{a}	**	*Bonina*	217.00^{b}	115.33^{bc}	**

Fig.3. Days to flower emergence in cut flowers



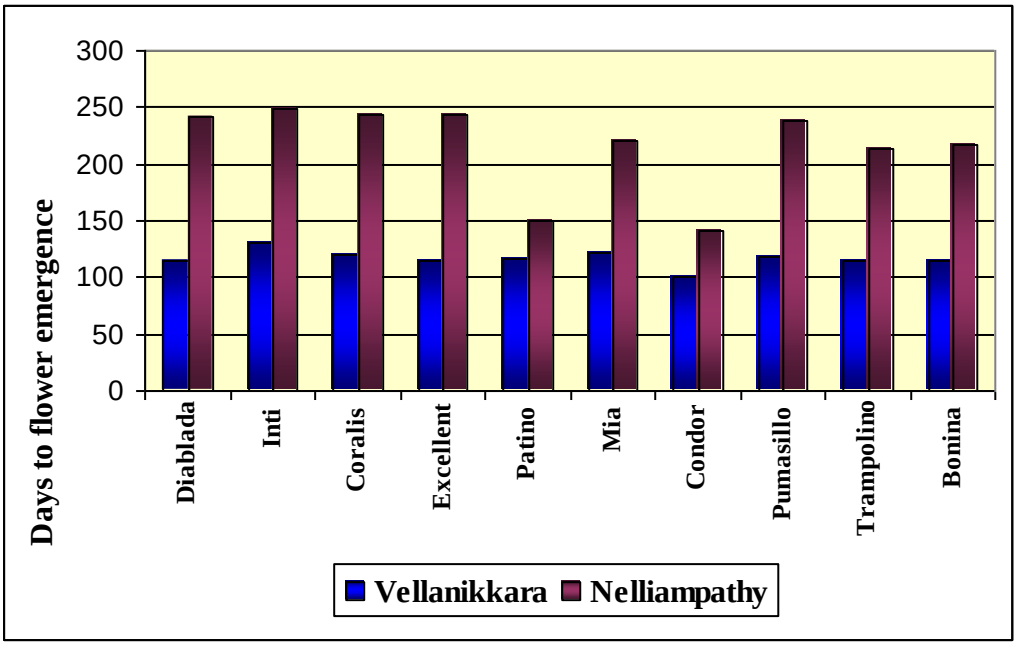


Fig.4. Days to flower emergence in pot plants

** Significant between locations at 1% level; * sig. between locations at 5% level

4.2.2. Peduncle length

4.2.2.1. *Cut flower varieties*

Noticeable differences in the peduncle length were recorded among the varieties through out the growing period at both the locations (Table 21).

At Vellanikkara, Titicaca recorded a maximum peduncle length of 40.85cm. Minimum length was recorded in Aymara (28.20cm) which was on par with Benicito (28.78cm).

At Nelliampathy, Caesar recorded a maximum peduncle length of 49.87cm Lowest was recorded in the variety Akapana (27.25cm).

When the locations were compared, differences were found significant. Peduncle length was found to be higher at Nelliampathy than Vellanikkara except for varieties Chichas, Akapana and Jewel.

4.2.2.2. *Pot plant varieties*

Noticeable differences in the peduncle length were recorded among the varieties through out the growing period at both the locations (Table 22).

At Vellanikkara, Mia recorded a maximum peduncle length of 38.46cm. Minimum length was recorded in Bonina (22.25cm) which was on par with Diablada (22.56cm)

At Nelliampathy, Mia recorded a maximum peduncle length of 60.15cm. Lowest was recorded in the variety Inti (13.82cm).

Table 21.Mean peduncle length of anthurium cut flower varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	21.0^{b}	33.0^{abc}	*	21.3^{d}	33.0	*	32.0^{bcd}	40.7^{ab}	*	32.2^{bcd}	43.0^{ab}	*
Chichas	28.1^{a}	27.0^{cd}	ns	28.6^{bc}	30.5	ns	35.4^{ab}	27.8^{cd}	*	36.3^{ab}	34.3^{cde}	ns
Benicito	20.0^{b}	30.7^{abc}	*	20.4^{d}	34.5	*	28.5^{d}	33.3^{bc}	ns	28.7^{d}	36.2^{bcd}	*
Titicaca	27.2^{a}	37.3^{a}	ns	27.8^{bc}	37.0	*	39.7^{a}	39.3^{ab}	ns	40.8^{a}	40.5^{bc}	ns
Salasaga	nil	36.8^{a}	ns	29.7^{bc}	35.7	ns	29.8^{cd}	44.8^{a}	*	30.2^{cd}	40.3^{bc}	*
Aymara	25.3^{a}	27.8^{bcd}	ns	27.2^{c}	31.9	ns	28.1^{d}	37.2^{ab}	*	28.0^{d}	40.8^{bc}	*
Caesar	27.4^{a}	35.3^{ab}	ns	29.2^{bc}	39.2	*	33.8^{bc}	45.6^{a}	*	34.7^{bc}	49.8^{a}	*
Akapana	27.5^{a}	nil	ns	31.0^{b}	27.3	ns	31.8^{bcd}	24.5^{d}	ns	32.3^{bcd}	27.0^{e}	ns
Jewel	25.7^{a}	20.2^{d}	ns	36.3^{a}	23.3	ns	31.7^{bcd}	26.6^{cd}	ns	32.0^{bcd}	30.7^{de}	ns
Lucia	27.4^{a}	19.8^{d}	*	29.9^{bc}	28.7	ns	32.2^{bcd}	33.5^{bc}	ns	33.2^{bcd}	39.0^{bc}	*

Table22. .Mean peduncle length of anthurium pot plant varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	19.2^{d}	15.3^{d}	*	21.0^{f}	19.5^{d}	ns	21.8^{ef}	20.8^{d}	ns	22.2^{d}	21.5^{d}	ns
Chichas	19.0^{d}	nil	ns	23.1^{e}	nil	ns	23.9^{def}	11.3^{e}	*	24.7^{cd}	13.8^{e}	*
Benicito	21.3^{cd}	24.7^{c}	ns	26.6^{d}	28.2^{c}	ns	25.5^{de}	32.0^{c}	*	26.2^{bcd}	32.0^{b}	*
Titicaca	23.4^{bcd}	26.3^{c}	ns	27.6^{d}	27.1^{c}	ns	29.3^{c}	31.0^{c}	ns	29.5^{b}	32.2^{b}	ns
Salasaga	23.3^{bcd}	23.5^{c}	ns	25.8^{d}	23.7^{cd}	ns	27.7^{cd}	28.0^{c}	ns	27.8^{bc}	27.0^{bcd}	
Aymara	27.0^{b}	51.9^{a}	*	41.5^{a}	52.4^{a}	ns	38.5^{a}	47.9^{a}	ns	38.0^{a}	60.1^{a}	*
Caesar	25.0^{bc}	35.2^{b}	ns	29.7^{c}	35.7^{b}	ns	27.2^{cd}	37.9^{b}	*	28.0^{bc}	31.0^{b}	ns
Akapana	33.2^{a}	27.3^{c}	ns	36.4^{b}	29.2^{bc}	*	34.2^{b}	28.6^{c}	*	35.3^{a}	29.2^{bc}	*
Jewel	20.5^{d}	27.0^{c}	*	26.4^{d}	27.8^{c}	ns	25.3^{de}	28.5^{c}	ns	26.0^{bcd}	30.1^{b}	ns
Lucia	19.5^{d}	26.5^{c}	*	19.3^{f}	27.9^{c}	*	21.5^{f}	27.7^{c}	*	22.2^{d}	23.5^{cd}	ns

Significant at 5 % level; ** significant at 1% level; ns non-significant**;** nil-not flowered

When the locations were compared, differences were found significant. Peduncle length was found to be higher at Nelliampathy than Vellanikkara except for varieties Diablada, Inti and Pumasillo.

4.2.3. Spathe length

4.2.3.1. *Cut flower varieties*

Appreciable differences were noted in the spathe length among varieties through out the growing period at both the locations (Table 23).

At Vellanikkara, Titicaca recorded a maximum spathe length of 12.96cm. Minimum length was recorded in Benicito (6.03cm).

At Nelliampathy, Esmeralda recorded a maximum spathe length of 15.27cm which was on par with Titicaca (14.53cm). Lowest was recorded in the variety Aymara (9.18cm) which was on par with Jewel (9.25cm).

When the locations were compared, differences were found significant only for varieties Esmeralda, Benicito, Caesar and Akapana. Spathe length was found to be higher at Nelliampathy than Vellanikkara.

4.2.3.2. *Pot plant varieties*

Appreciable differences were noted in the spathe length among varieties through out the growing period at both the locations (Table 24).

At Vellanikkara, Trampolino recorded a maximum spathe length of 10.88cm which was on par with Condor (10.52cm). Minimum length was recorded in Bonina (6.27cm) which was on par with Coralis (6.36cm).

Table 23. Mean spathe length of anthurium cut flower varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	7.1^{b}	12.5^{a}	*	7.1^{d}	12.7^{a}	*	11.6^{ab}	13.4^{ab}	ns	11.8^{ab}	15.2^{a}	*
Chichas	7.7^{b}	9.2^{bcd}	ns	7.7^{cd}	10.8^{ab}	ns	10.6^{bc}	8.7^{d}	*	10.8^{bc}	10.7^{cd}	ns
Benicito	5.0^{c}	9.4^{bc}	*	5.0^{e}	10.2^{ab}	*	6.0^{f}	10.8^{c}	*	6.0^{f}	11.9^{bc}	*
Titicaca	9.1^{a}	10.8^{ab}	ns	9.1^{a}	12.5^{a}	*	12.5^{a}	14.0^{a}	ns	12.9^{a}	14.5^{a}	ns
Salasaga	nil	10.5^{ab}	ns	7.3^{cd}	10.3^{ab}	ns	8.3^{e}	11.6^{bc}	*	8.6^{e}	10.9^{cd}	ns
Aymara	7.6^{b}	7.1^{d}	ns	8.8^{ab}	8.0^{b}	ns	8.2^{e}	8.3^{d}	ns	8.4^{e}	9.1^{d}	ns
Caesar	7.4^{b}	10.3^{b}	*	8.1^{bc}	11.8^{a}	*	9.7^{cde}	13.3^{ab}	*	9.8^{cde}	13.7^{ab}	*
Akapana	8.1^{ab}	nil	ns	8.9^{ab}	7.7^{b}	ns	8.8^{de}	8.6^{d}	ns	8.9^{de}	13.4^{ab}	*
Jewel	8.2^{ab}	7.5^{cd}	ns	8.8^{ab}	8.4^{b}	ns	9.1^{cde}	8.8^{d}	ns	9.4^{cde}	9.1^{d}	ns
Lucia	7.8^{b}	7.6^{cd}	ns	9.4^{a}	10.3^{ab}	ns	10.4^{bcd}	10.3^{cd}	ns	10.5^{bcd}	11.0^{c}	ns

Table 24. Mean spathe length of anthurium pot plant varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	6.8^{bc}	5.9^{e}	ns	7.9^{de}	6.3^{d}	*	9.1^{abc}	nil	ns	9.2^{ab}	7.1e	ns
Chichas	6.3^{bc}	nil	ns	8.0^{de}	nil	ns	8.7^{bc}	3.6^{g}	*	8.9^{ab}	3.8^{f}	*
Benicito	5.9^{c}	6.3^{e}	ns	6.5^{f}	6.2^{d}	ns	6.2^{d}	6.8^{ef}	ns	6.3^{c}	6.9^{e}	ns
Titicaca	9.3^{a}	9.8^{bc}	ns	8.9^{c}	9.5^{c}	ns	8.7^{bc}	10.6^{c}	*	9.0^{ab}	11.3^{c}	*
Salasaga	7.0^{b}	6.8^{e}	ns	7.8^{e}	6.8^{d}	ns	9.1^{abc}	8.6^{de}	ns	9.3^{ab}	9.0d	ns
Aymara	7.0^{b}	9.5^{cd}	*	8.0^{d}	10.5^{bc}	*	8.2^{c}	9.1^{cd}	ns	8.5^{b}	10.4^{cd}	ns
Caesar	9.7^{a}	14.4^{a}	*	10.1^{b}	14.6^{a}	*	10.4^{ab}	16.9^{a}	*	10.5^{a}	16.2^{a}	*
Akapana	9.4^{a}	7.7^{de}	ns	10.2^{b}	9.0^{c}	ns	9.6^{abc}	8.6^{de}	*	9.7^{ab}	9.2^{d}	ns
Jewel	9.5^{a}	11.5^{b}	ns	11.0^{a}	11.7^{b}	ns	10.7^{a}	13.0^{b}	*	10.8^{a}	13.1^{b}	*
Lucia	6.1^{bc}	5.6^{e}	ns	6.4^{f}	5.3^{d}	*	6.1^{d}	5.9^{f}	ns	6.2^{c}	5.4^{ef}	ns

Significant at 5 % level; ** significant at 1% level; ns non-significant**;** nil-not flowered

At Nelliampathy, Condor recorded a maximum spathe length of 16.57cm. Lowest was recorded in the variety Inti (3.83cm).

When the locations were compared, differences were found significant. For the varieties Diablada, Inti, Patino, Pumasillo and Bonina, spathe length was higher at Vellanikkara.

4.2.4 Spathe breadth

4.2.4.1. *Cut flower varieties*

Detectable differences could be seen in the spathe breadth among the varieties through out the growing period at both the locations (Table 25).

At Vellanikkara, Titicaca recorded a maximum spathe breadth of 10.77cm. Minimum breadth was recorded in Benicito (5.22cm) which was on par with Esmeralda (7.04cm) and Salasaga (7.12cm).

At Nelliampathy, Caesar recorded a maximum spathe breadth of 13.28cm which was on par with Esmeralda (12.25cm). Lowest was recorded in the variety Jewel (7.83cm) which was closely followed by Aymara (8.00cm).

When the locations were compared, differences were found significant except for the varieties Titicaca, Aymara, Jewel and Lucia. Spathe breadth was found to be higher at Nelliampathy than Vellanikkara.

4.2.4.2. *Pot plant varieties*

Detectable differences could be seen in the spathe breadth among the varieties through out the growing period at both the locations (Table 26).

Table 25. Mean spathe breadth of anthurium cut flower varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	5.6^{d}	9.9^{a}	*	5.6^{e}	9.9^{ab}	*	6.9^{e}	10.7^{ab}	*	7.0^{e}	12.2^{a}	*
Chichas	6.4^{bc}	8.3^{ab}	ns	6.4^{d}	9.0^{abc}	*	7.5^{bcd}	8.5^{c}	ns	7.7^{bcd}	10.0^{bc}	*
Benicito	4.9^{e}	8.1^{ab}	*	4.8^{f}	8.4^{bcd}	*	4.9^{e}	9.4^{bc}	*	5.0^{e}	10.1^{b}	*
Titicaca	8.0^{a}	9.0^{ab}	ns	8.1^{a}	10.6^{a}	*	10.5^{a}	12.0^{a}	ns	10.7^{a}	13.2^{a}	ns
Salasaga	nil	8.8^{ab}	ns	6.4^{d}	8.2^{bcd}	*	6.9^{e}	9.2^{bc}	*	7.1^{e}	8.8^{bcd}	ns
Aymara	6.2^{bcd}	6.2^{c}	ns	7.0^{c}	6.6^{d}	ns	7.0^{e}	7.8^{c}	ns	7.3^{cd}	8.0^{d}	ns
Caesar	6.0^{cd}	9.1^{ab}	*	6.4^{d}	9.9^{ab}	*	6.9^{e}	11.6^{a}	*	7.0^{e}	11.8^{a}	*
Akapana	7.8^{a}	nil	ns	8.0^{ab}	7.9^{bcd}	ns	8.7^{b}	8.3^{c}	ns	8.8^{b}	11.6^{a}	*
Jewel	6.8^{b}	7.4^{bc}	ns	7.0^{c}	7.2^{cd}	ns	7.2^{cd}	7.7^{c}	ns	7.3^{cd}	7.8^{d}	ns
Lucia	6.7^{bc}	7.5^{bc}	*	7.5^{bc}	8.8^{abc}	ns	8.4^{bc}	8.1^{c}	ns	8.6^{bc}	8.3^{cd}	ns

Table 26. Mean spathe breadth of anthurium cut flower varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	6.9^{bc}	4.6^{e}	*	7.2^{c}	5.9^{c}	ns	7.9^{b}	5.6^{cd}	*	7.8^{b}	6.1^{de}	ns
Chichas	5.8^{cd}	nil	ns	8.1^{c}	nil	ns	8.0^{b}	4.2^{d}	*	8.1^{b}	4.2^{f}	*
Benicito	5.6^{d}	6.2^{de}	ns	5.3^{d}	6.0^{c}	*	6.1^{cd}	6.6^{c}	ns	6.2^{cd}	7.0^{cd}	ns
Titicaca	8.6^{a}	9.5^{b}	ns	10.0^{a}	8.6^{b}	ns	10.7^{a}	11.1^{b}	ns	10.8^{a}	11.3^{b}	ns
Salasaga	6.3^{cd}	7.1^{cd}	ns	8.0^{c}	8.5^{b}	ns	10.1^{a}	9.5^{b}	ns	10.3^{a}	11.4^{b}	ns
Aymara	5.7^{cd}	8.1^{bc}	*	7.2^{c}	8.1^{bc}	ns	7.2^{bc}	7.1^{c}	ns	7.4^{bc}	8.1^{c}	ns
Caesar	7.8^{ab}	11.8^{a}	*	9.0^{b}	12.7^{a}	*	10.2^{a}	15.0^{a}	*	10.3^{a}	15.3^{a}	*
Akapana	6.2^{cd}	7.8^{bcd}	*	9.3^{ab}	8.5^{b}	ns	10.0^{a}	7.5^{c}	*	10.1^{a}	8.4^{c}	*
Jewel	7.8^{ab}	9.3^{b}	*	10.1^{a}	10.0^{b}	ns	10.1^{a}	11.0^{b}	*	10.2^{a}	10.9^{b}	*
Lucia	5.6^{d}	5.1^{e}	ns	4.7^{d}	5.7^{c}	ns	5.7^{d}	5.6^{cd}	ns	5.8^{d}	5.0^{ef}	ns

Significant at 5 % level; ** significant at 1% level; ns non-significant**;** nil-not flowered

At Vellanikkara, Excellent recorded a maximum spathe breadth of 10.82cm. It was statistically on par with Patino (10.33cm), Condor (10.30cm), Trampolino (10.23cm) and Pumasillo (10.14cm). Minimum breadth was recorded in Bonina (5.84cm).

At Nelliampathy, Condor recorded a maximum spathe breadth of 15.35cm. Lowest was recorded in the variety Inti (4.21cm) which was performing on par with Bonina (5.18cm).

When the locations were compared, differences were found significant. Spathe breadth was found to be higher at Nelliampathy than Vellanikkara except for varieties Coralis, Pumasillo and Bonina.

4.2.5. Spadix length

4.2.5.1. *Cut flower varieties*

Noticeable differences in the spadix length were recorded among the varieties through out the growing period at both the locations (Table 27).

At Vellanikkara, Titicaca recorded a maximum spadix length of 5.35cm. Minimum length was recorded in Salasaga (3.33cm) which was on par with Benicito (3.45cm).

At Nelliampathy, Esmeralda recorded a maximum spadix length of 8.96cm which was on par with Caesar (8.67cm) and Benicito (8.44cm). Lowest was recorded in the variety Jewel (4.37cm).

When the locations were compared, differences were found significant. Spadix length was found to be higher at Nelliampathy than Vellanikkara in all the varieties.

Table 27. Mean spadix length of anthurium cut flower varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	3.7^{bc}	6.4^{a}	*	3.7^{bc}	7.5^{ab}	*	4.2^{bc}	7.2^{ab}	*	4.3^{abc}	8.9^{a}	*
Chichas	3.3^{bcd}	5.0^{bc}	*	3.2^{bc}	5.5^{cde}	*	3.9^{c}	5.4^{cd}	*	3.9^{c}	6.1^{bc}	*
Benicito	2.7^{cde}	5.0^{bc}	*	2.8^{c}	4.8^{def}	*	3.4^{c}	6.5^{bc}	*	3.4^{c}	8.4^{a}	*
Titicaca	3.9^{b}	5.0^{bc}	ns	3.9^{b}	6.7^{abc}	*	5.2^{a}	7.2^{ab}	*	5.3^{a}	7.4^{ab}	*
Salasaga	nil	4.4^{cd}	ns	3.0^{bc}	4.2^{ef}	ns	3.6^{c}	5.3^{cd}	*	3.3^{c}	5.1^{cd}	ns
Aymara	5.0^{a}	5.0^{bc}	ns	6.0^{a}	6.1^{bcd}	ns	4.8^{ab}	6.2^{bc}	ns	4.9^{ab}	6.8^{b}	*
Caesar	2.9^{cde}	5.7^{ab}	*	3.4b^{c}	7.7^{a}	*	3.9^{c}	8.1^{a}	*	4.0^{bc}	8.6^{a}	*
Akapana	2.1^{e}	nil	ns	2.9^{c}	5.3^{cdef}	*	3.7^{c}	5.7^{c}	ns	3.8^{c}	5.8^{bcd}	ns
Jewel	2.5^{e}	3.3^{e}	ns	3.2^{bc}	3.8^{f}	ns	3.6^{c}	4.2^{d}	ns	3.7^{c}	4.4^{d}	ns
Lucia	2.9^{cde}	3.8^{de}	*	3.0^{bc}	5.1^{def}	*	3.8^{c}	5.3^{cd}	*	3.7^{c}	5.9^{bcd}	*

Table 28. Mean spadix length of anthurium pot plant varieties

Variety	May 2006			June 2006			July 2006			August 2006		
	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig	Vel	Nel	Sig
Esmeralda	2.8d^{e}	2.2^{c}	ns	2.3^{e}	3.1^{d}	*	3.0^{cd}	3.0^{cd}	ns	3.0^{cd}	3.6^{de}	ns
Chichas	4.0b^{c}	nil	ns	4.4^{b}	nil	ns	3.8^{abc}	1.7^{d}	*	3.7^{bcd}	2.1^{e}	*
Benicito	3.8^{bcd}	3.4^{c}	ns	2.3^{d}	3.4^{d}	*	3.2^{cd}	3.7^{bc}	ns	3.2^{cd}	4.3^{bcd}	*
Titicaca	7.0^{a}	4.9^{b}	*	3.1^{d}	5.1^{bc}	*	3.9^{abc}	4.9^{ab}	ns	4.0^{abc}	5.6^{abc}	ns
Salasaga	4.4^{b}	2.4^{c}	*	2.9^{e}	2.9^{d}	ns	2.7^{d}	3.0^{cd}	ns	2.7^{d}	3.6^{de}	ns
Aymara	4.4^{b}	6.1^{ab}	*	5.1^{a}	7.0^{a}	*	4.9^{a}	6.1^{a}	ns	5.1^{a}	7.0^{a}	*
Caesar	3.0^{cde}	6.3^{a}	*	3.1^{d}	5.8^{ab}	*	3.9^{abc}	6.3^{a}	*	3.9^{abcd}	6.0^{ab}	ns
Akapana	2.7^{e}	3.5^{c}	*	3.4^{c}	3.9^{cd}	ns	4.3^{ab}	3.6^{bc}	ns	4.4^{ab}	3.9^{cde}	ns
Jewel	2.4^{e}	5.2^{ab}	*	3.7^{c}	5.2^{bc}	ns	3.3^{bcd}	5.5^{a}	*	3.4^{bcd}	6.4^{a}	ns
Lucia	3.2^{cde}	3.2^{c}	ns	4.5^{b}	3.2^{d}	*	2.9^{cd}	3.1^{cd}	ns	2.9^{cd}	3.0^{de}	ns

Significant at 5 % level; ** significant at 1% level; ns non-significant**;** nil-not flowered

4.2.5.2. *Pot plant varieties*

Noticeable differences in the spadix length were recorded among the varieties through out the growing period at both the locations (Table 28).

At Vellanikkara, Mia recorded a maximum spadix length of 5.18cm. Minimum length was recorded in Patino (2.71cm).

At Nelliampathy, Mia recorded a maximum spadix length of 7.05cm. Lowest was recorded in the variety Inti (2.12cm).

When the locations were compared, differences were found significant. Spadix length was found to be higher at Nelliampathy than Vellanikkara except for varieties Inti and Pumasillo.

4.2.6. Angle of orientation of spathe to the stalk

4.2.6.1. Cut flower varieties

Angle of orientation of spathe to the stalk was recorded for a period of four months (from May to August).

At Vellanikkara, highest angle of orientation was recorded in variety Titicaca (160^{O}) in the month of August. The lowest (60^{O}) was recorded in variety Lucia in the month of July (Fig 5).

At Nelliampathy, highest angle of orientation was recorded in variety Esmeralda (140^{O}) in the month of July. The lowest (55^{O}) was recorded in variety Akapana in the month of June (Fig 5).

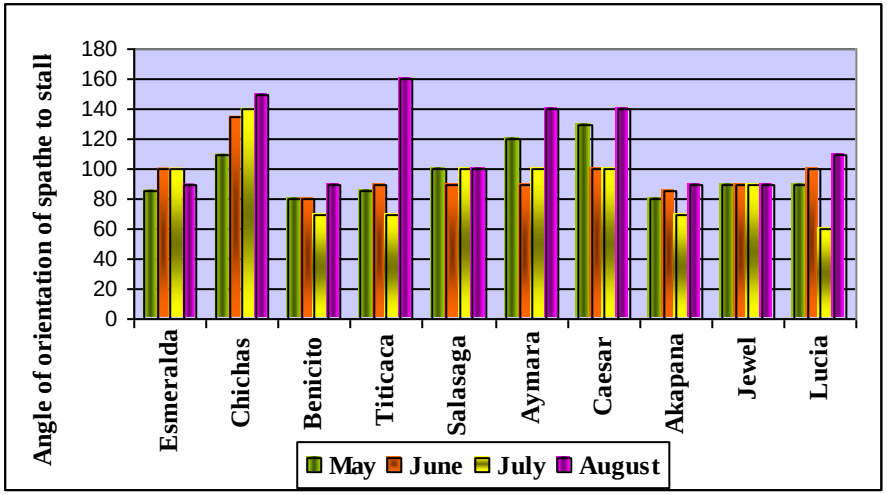


Fig.5-1. Angle of orientation of spathe in cut flowers at Vellanikkara

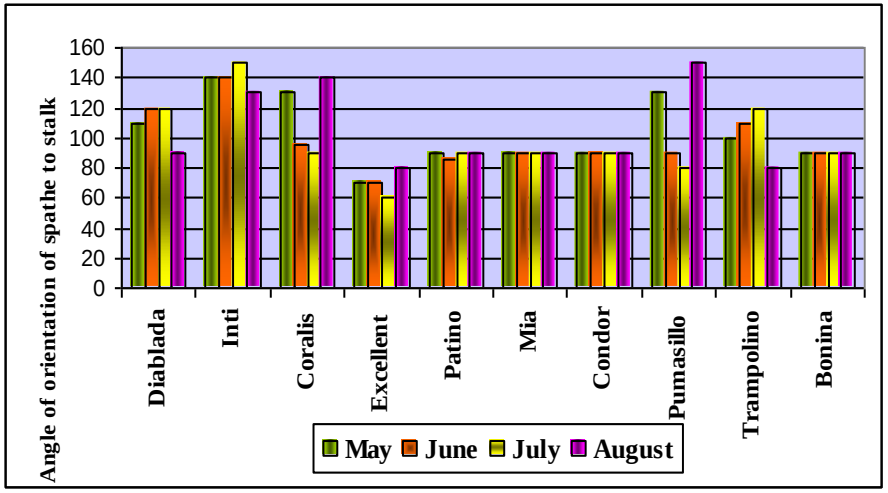


Fig.6-1. Angle of orientation of spathe in pot plants at Vellanikkara

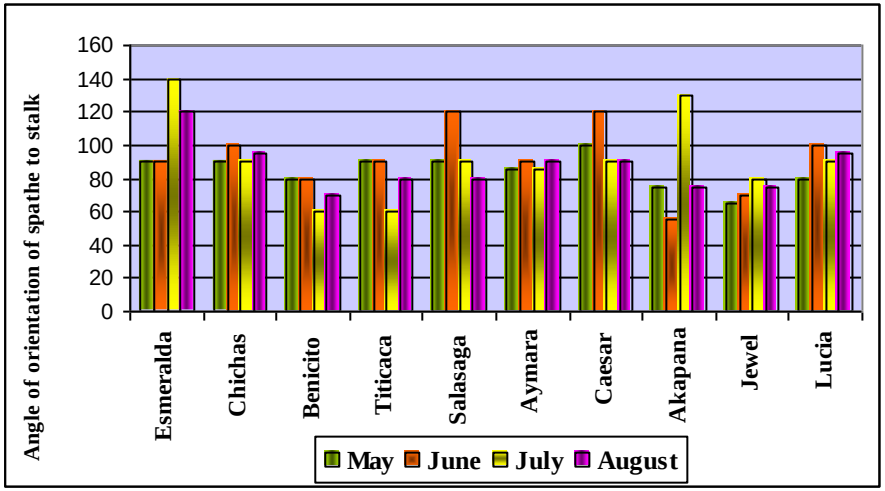


Fig.5-2. Angle of orientation of spathe in cut flowers at Nelliampathy

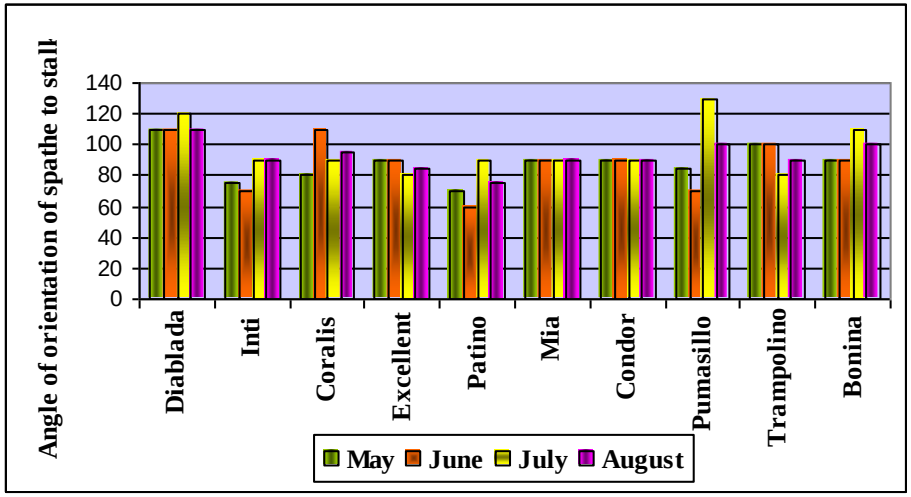


Fig.6-2. Angle of orientation of spathe in pot plants at Nelliampathy

4.2.6.2 Pot plant varieties

At Vellanikkara, highest angle of orientation was recorded in variety Inti (150^{O}) in the month of July. The lowest (60^{O}) was recorded in variety Excellent in the month of July (Fig 6).

At Nelliampathy, highest angle of orientation was recorded in variety Pumasillo (130^{O}) in the month of July. The lowest (60^{O}) was recorded in variety Patino in the month of June (Fig 6).

4.2.7. Angle of orientation of spadix

4.2.7.1. Cut flower varieties

Angle of orientation of spadix to the spathe was recorded for a period of four months (from May to August).

At Vellanikkara, the lowest angle of orientation (20^{O}) was recorded in variety Titicaca in the month of August. The highest angle was recorded in variety Chichas (60^{O}) in the month of August (Fig 7).

At Nelliampathy, lowest angle of orientation was recorded in variety Aymara (20^{O}) in the month of June. The highest (70^{O}) was recorded in variety Esmeralda in the months of May and June (Fig 8).

4.2.7.2 Pot plant varieties

At Vellanikkara, the lowest angle of orientation (20^{O}) was recorded in variety Inti in the month of July .The highest angle was recorded in variety Diablada (100^{O}) in the months of June and August. (Fig 9).

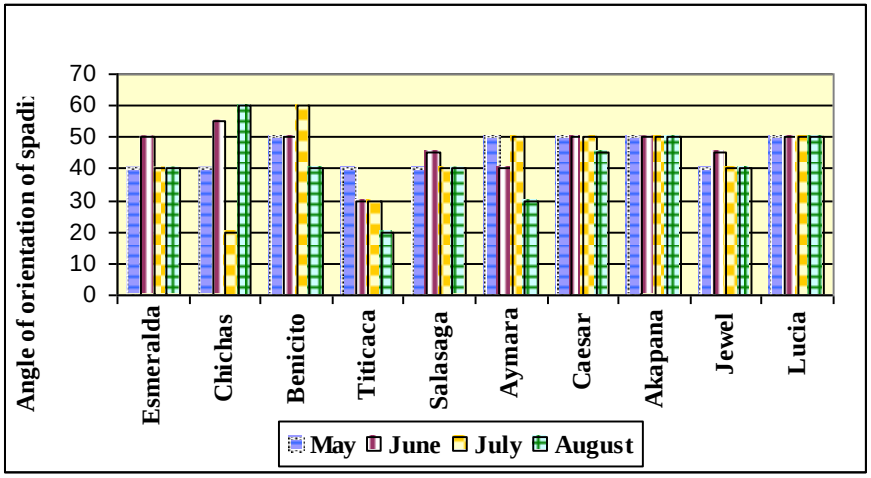


Fig.7-1. Angle of orientation of spadix in cut flowers at Vellanikkara

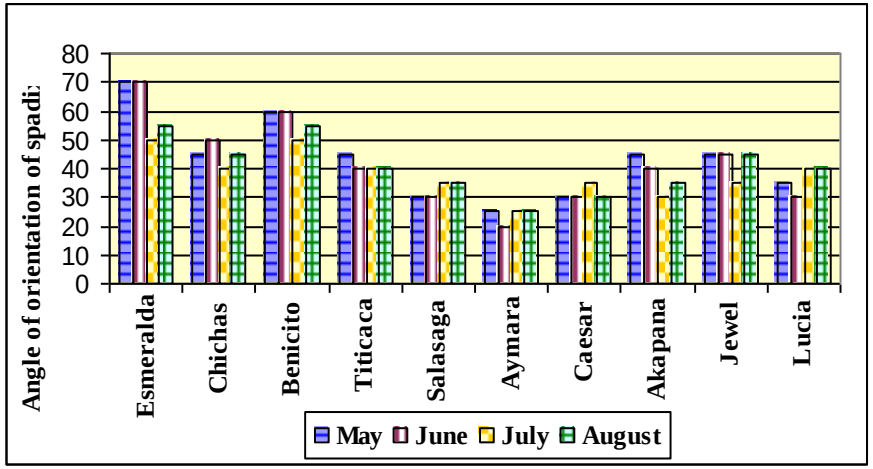


Fig.8-1. Angle of orientation of spadix in pot plants at Vellanikkara

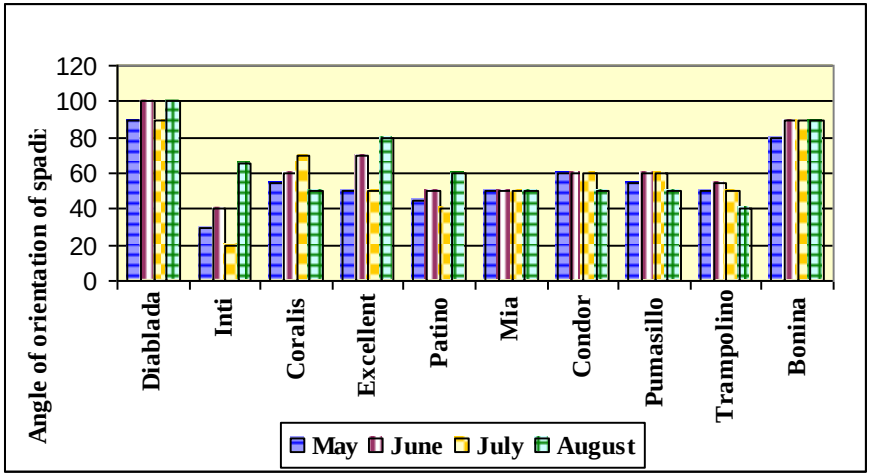


Fig.7-2. Angle of orientation of spadix in pot plants at Nelliampathy

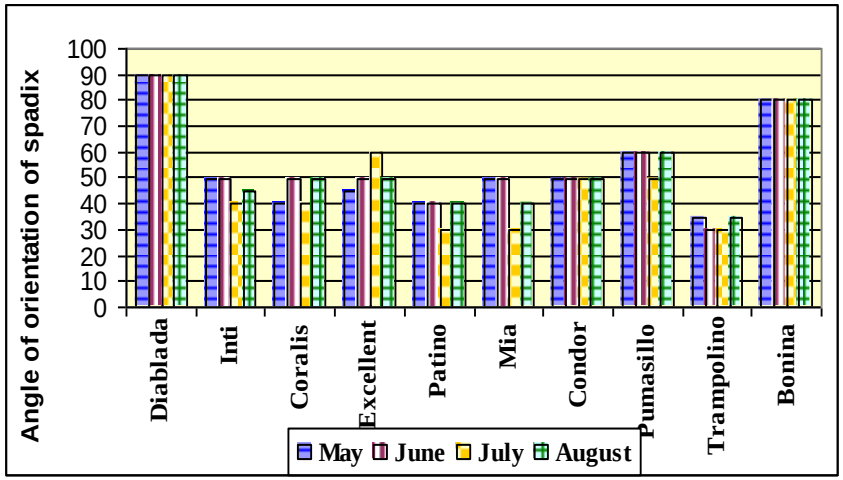


Fig.8-2. Angle of orientation of spadix in pot plants at Nelliampathy

At Nelliampathy, the lowest (30^{O}) was recorded in variety Patino in the month of July .The highest angle was recorded in variety Diablada (90^{O}) in all the four months. (Fig 10).

4.2.8. Longevity of spike

4.2.8.1. Cut flower varieties

Noticeable differences in the spike longevity were recorded among varieties both at Vellanikkara and Nelliampathy. (Table 29 and Fig.9).

At Vellanikkara, among the varieties, the highest longevity was recorded for Esmeralda (125.24 days) which was on par with Caesar (120.53days) and Chichas (120.20days). The lowest (60.24 days) was in the variety Benicito.

At Nelliampathy, among the varieties the highest longevity was recorded in Caesar (135.47days) which was on par with Esmeralda (133.23days) and Chichas (125.30days).The lowest (55.25days) was recorded in Jewel.

Difference between locations was not significant for all varieties except Aymara, Caesar and Jewel.

4.2.8.2 Pot plant varieties

Spike longevity differed significantly among varieties both at Vellanikkara and Nelliampathy (Table 29 and Fig.9).

At Vellanikkara among the varieties, the highest longevity was recorded for the variety Bonina (160.78days).The lowest (75.23days) was in the variety Coralis.

At Nelliampathy among the varieties, the highest longevity was recorded for the variety Bonina (180.45days). The lowest (65.79days) was in the variety Patino.

Difference between locations was not significant for all varieties except Condor, Pumasillo, Trampolino and Bonina.

4.2.9. Interval of flower production

4.2.9.1 Cut flower varieties

Interval of flower production differed significantly among varieties at both the locations (Table 30 and Fig.10).

At Vellanikkara, among the varieties, mean flower production interval was lowest for the variety Chichas (31.25days).The longest flower production interval was recorded for the variety Benicito (45.67days).

At Nelliampathy, among the varieties the lowest flower production interval was recorded in Esmeralda (31.23days) which was closely followed by variety Chichas (31.45days).Highest flower production interval was recorded in Benicito (44.56days).

No significant differences were observed between the locations.

4.2.9.2 Pot plant varieties

Interval of flower production differed significantly among varieties at both the locations (Table 30 and Fig.10).

At Vellanikkara, among the varieties, mean flower production interval was lowest for the variety Diablada (30.56days).The longest flower production interval was recorded for the variety Mia (42.45days).

Table 29 .Interval of flower production (in days)

Cut flowers				Pot plants			
Varieties	Vellanikkara	Nelliampathy	Sig	Varieties	Vellanikkara	Nelliampathy	Sig
Esmeralda	31.66^{cd}	31.23^{cd}	ns	*Diablada*	30.56^{c}	31.25^{c}	ns
Chichas	31.25^{cd}	31.45^{cd}	ns	*Inti*	31.28^{cd}	32.00^{cd}	ns
Benicito	45.67^{a}	44.56^{ab}	ns	*Coralis*	33.66^{cd}	34.56^{cd}	ns
Titicaca	37.23^{b}	36.75^{bc}	ns	*Excellent*	36.76^{bcd}	37.45^{bc}	ns
Salasaga	31.33^{cd}	32.24^{c}	ns	*Patino*	39.70^{bc}	38.45^{b}	ns
Aymara	35.45^{bc}	37.56^{bc}	ns	*Mia*	42.45^{a}	41.23^{b}	ns
Caesar	32.28^{cd}	33.45^{c}	ns	*Condor*	41.65^{ab}	42.45^{b}	ns
Akapana	44.45^{ab}	45.33^{a}	ns	*Pumasillo*	40.42^{ab}	44.25^{ab}	ns
Jewel	42.36^{ab}	41.04^{ab}	ns	*Trampolino*	38.33^{bc}	43.76^{ab}	ns
Lucia	36.78^{bc}	35.23^{bc}	ns	*Bonina*	32.85^{bc}	45.66^{a}	**

ns non significant between location at 5 % level; ** significant between location at 1% level; * significant between location at 5% level

Table 30 .Longevity of flower on the plant (days)

Cut flowers				Pot plants			
Varieties	Vellanikkara	Nelliampathy	Sig	Varieties	Vellanikkara	Nelliampathy	Sig
Esmeralda	125.24^{a}	133.23^{a}	ns	*Diablada*	135.52^{bc}	142.50^{ab}	ns
Chichas	120.20^{ab}	125.30^{ab}	ns	*Inti*	94.56^{bcd}	96.24^{cd}	ns
Benicito	60.24^{c}	58.55^{c}	ns	*Coralis*	75.23^{c}	78.63^{cd}	ns
Titicaca	98.80^{bc}	100.65^{b}	ns	*Excellent*	94.12^{bcd}	103.13^{bcd}	ns
Salasaga	105.23^{b}	103.78^{b}	ns	*Patino*	78.48^{c}	65.79^{c}	ns
Aymara	85.24^{bcd}	94.90^{bc}	*	*Mia*	120.89^{bc}	116.53^{bc}	ns
Caesar	120.53^{a}	133.45^{a}	*	*Condor*	114.75^{bc}	125.84^{bc}	**
Akapana	70.50^{bcd}	78.63^{bc}	ns	*Pumasillo*	120.42^{bc}	153.43^{ab}	**
Jewel	78.65^{bcd}	55.25^{c}	**	*Trampolino*	100.56^{bc}	133.90^{bc}	**
Lucia	90.67^{bc}	96.70^{bc}	ns	*Bonina*	160.78^{a}	180.45^{a}	**

ns non significant between location at 5 % level; ** significant between location at 1% level; * significant between location at 5% level

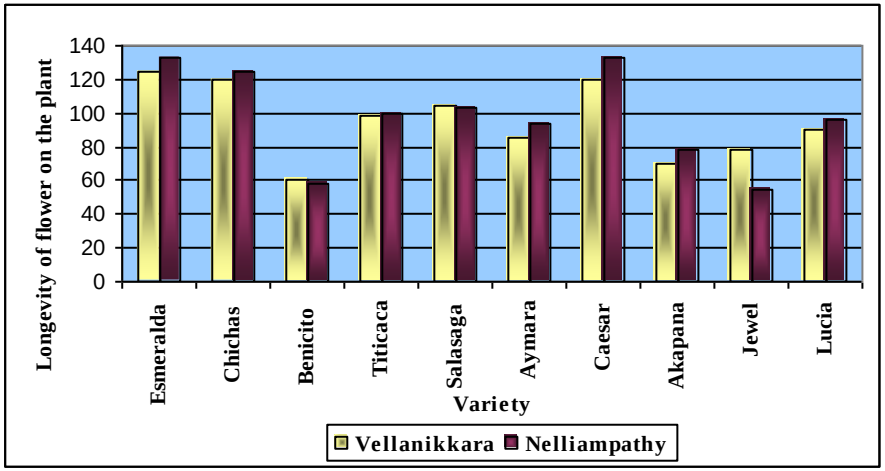


Fig.9-1.Longevity of flower on the plant in cut flowers

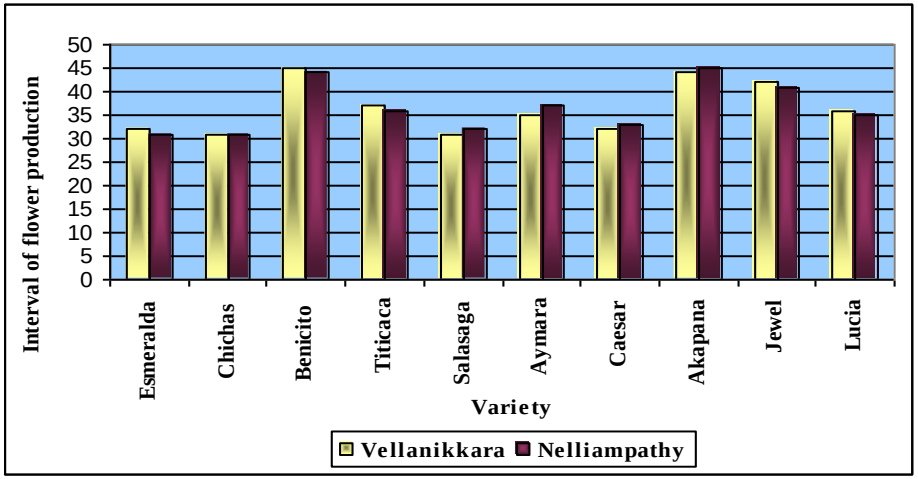


Fig.10-1.Interval of flower production in cut flowers

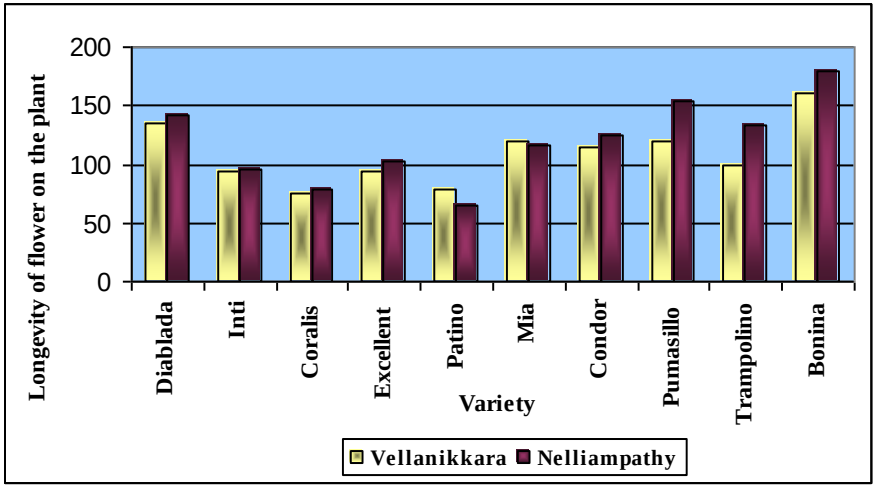


Fig.9-2.Longevity of flower on the plant in pot plants

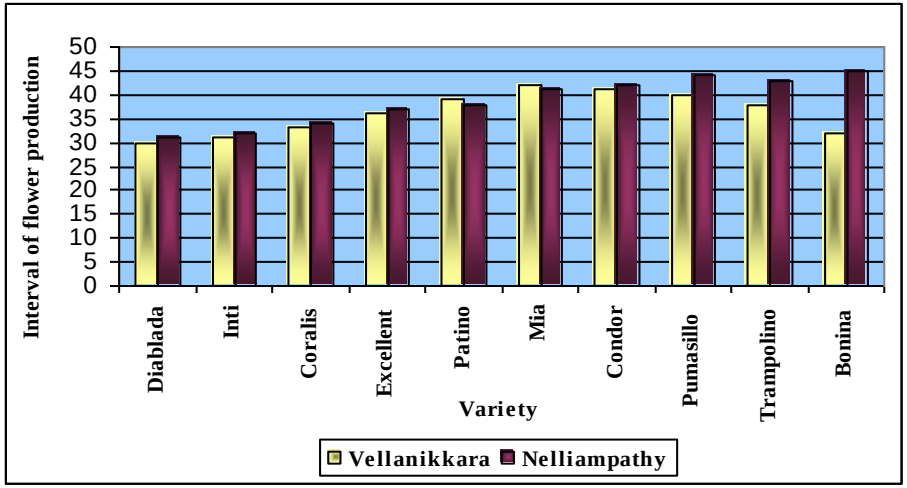


Fig.10-2. Interval of flower production in pot plants

At Nelliampathy, among the varieties the lowest flower production interval was recorded in the variety Diablada (31.25days).Highest flower production interval was recorded in Bonina (45.66days).It was closely followed by the variety Pumasillo (44.25days).

No significant differences were observed between the locations except for variety Bonina which showed significantly lower flower production interval at Vellanikkara.

4.2.9. Nature of peduncle

Among cut flowers, nature of peduncle of all the varieties was straight except that of Akapana, Jewel and Lucia which was slightly bending towards the ground.

Among pot plants, nature of peduncle of all the varieties was straight except that of Inti, Pumasillo and Trampolino which was slightly bending towards the ground.

4.2.10. Colour of spathe and spadix

Colour of spathe and spadix differed from variety to variety (Table 31 and Plates1 to 2).

4.3. POST HARVEST CHARACTERS

Data pertaining to the monthly variations in the post harvest characters of anthurium are presented in Figures 11 to 22.

4.3.1. Days to loss of glossiness

4.3.1.1. *Cut flower varieties*

Table 31. Colour of spathe and spadix

Cut flowers			Pot plants		
Varieties	Spathe colour	Spadix colour	Varieties	Spathe colour	Spadix colour
Esmeralda	Green	White base with spadix tip green	*Diablada*	Red	Light red base with spadix tip dark red
Chichas	Bordeaux Brown	White base with spadix tip green	*Inti*	Dark red	Cream base with spadix tip yellow
Benicito	Green/ White	White base with spadix tip green	*Coralis*	Red with green shoulders	Cream base with spadix tip yellow
Titicaca	White/Obake	Tricolour spadix (pink, yellow & green)	*Excellent*	Yellow/Green	Cream base with spadix tip yellow
Salasaga	Pink	Cream base with spadix tip green	*Patino*	Orange	Cream base with spadix tip yellow
Aymara	Pink	White base with spadix tip green	*Mia*	Red	White base with spadix tip yellow
Caesar	Dark lilac/Purple	Dark purple spadix	*Condor*	Orange	Cream base with spadix tip yellow
Akapana	Cream/Green	Light pink base with spadix tip green	*Pumasillo*	Red	Cream base with spadix tip yellow
Jewel	Bright red/Obake	Cream base with spadix tip light yellow	*Trampolino*	Apricot/Peach	Light peach with spadix tip green
Lucia	Soft white/Pink	Light pink base with spadix tip dark pink	*Bonina*	Light pink	Light pink

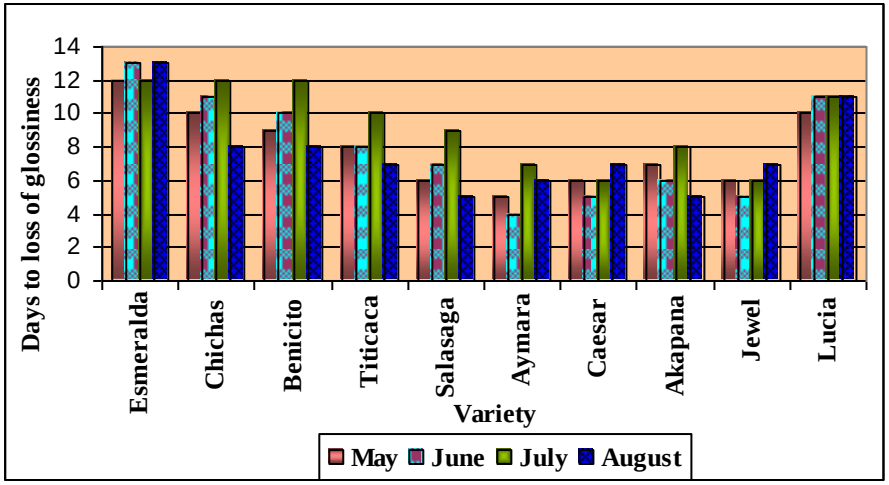


Fig.11-1. Days to loss of glossiness in cut flowers at Vellanikkara

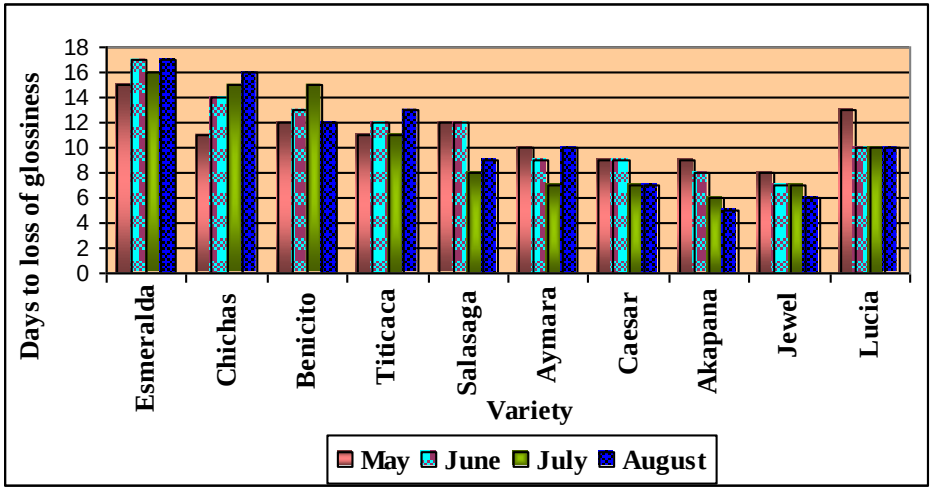


Fig.11-2. Days to loss of glossiness in cut flowers at Nelliampathy

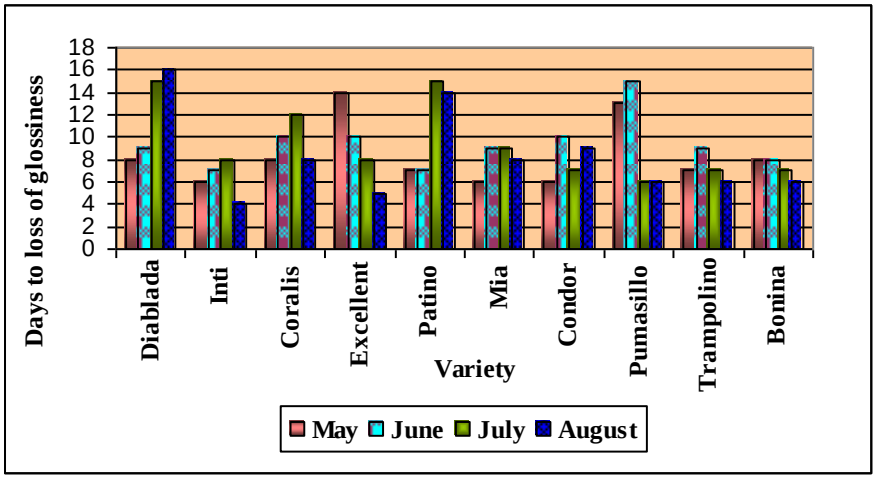


Fig.12-1. Days to loss of glossiness in pot plants at Vellanikkara

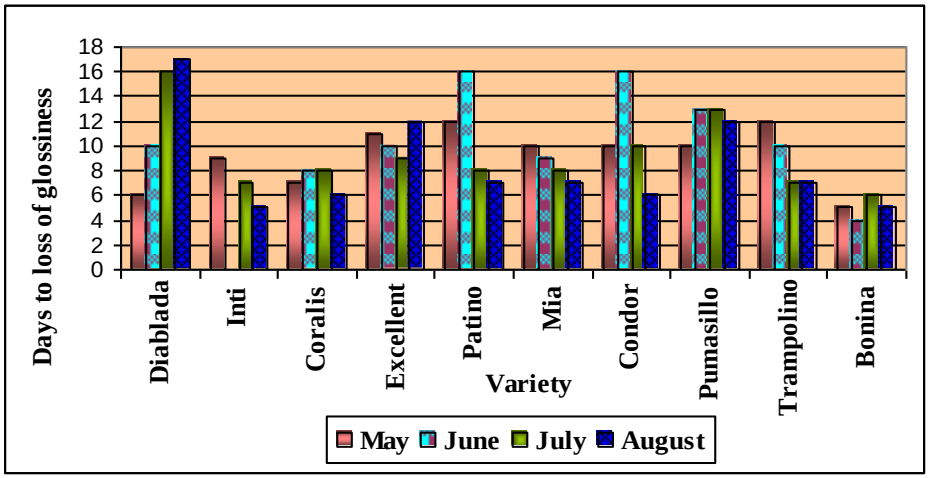


Fig.12-2. Days to loss of glossiness in pot plants at Nelliampathy

Days taken for the loss of glossiness of the spathe were recorded for a period of four months (from May to August).

At Vellanikkara, maximum number of days for loss of glossiness was recorded for variety Esmeralda (13.0days) in the months of June and August. The lowest was recorded in variety Aymara (4.0days) in the month of June (Fig.11).

At Nelliampathy, maximum number of days for loss of glossiness was recorded in variety Esmeralda (17.0days) in the months of June and August. The lowest (5.0days) was recorded in variety Akapana in the month of August (Fig.11).

4.3.1.2 Pot plant varieties

At Vellanikkara, maximum number of days for loss of glossiness was recorded in variety Diablada (16.0days) in the month of August. The lowest (4.0days) was recorded in variety Inti in the month of August (Fig.12).

At Nelliampathy, maximum number of days for loss of glossiness was recorded in variety Diablada (17.0days) in the month of August. The lowest (4.0days) was recorded in variety Bonina in the month of June (Fig.12).

4.3.2. Days to necrosis of spathe

4.3.2.1. *Cut flower varieties*

Days taken for the necrosis of spathe were recorded for a period of four months (from May to August).

At Vellanikkara, maximum number of days for spathe necrosis was recorded for variety Benicito (33.0days) in the month of May. The lowest was recorded in variety Caesar (10.0days) in the months of May and June (Fig.13).

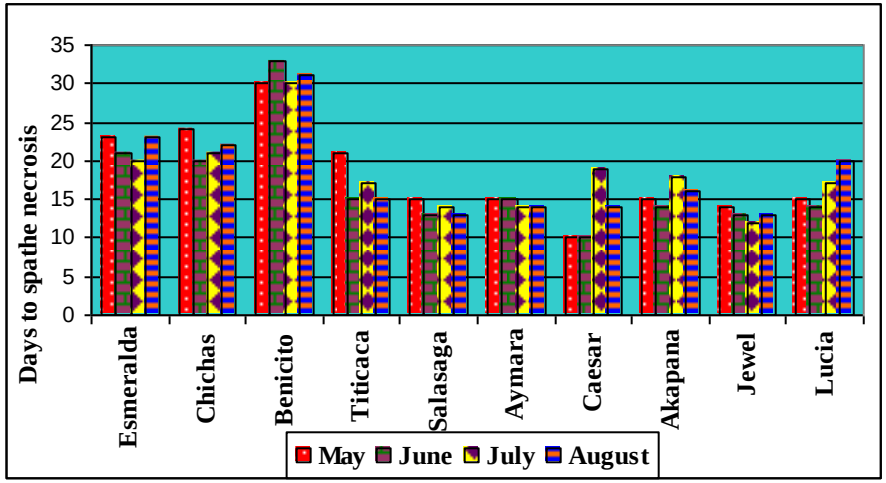


Fig.13-1.Days to necrosis of spathe in cut flowers at Vellanikkara

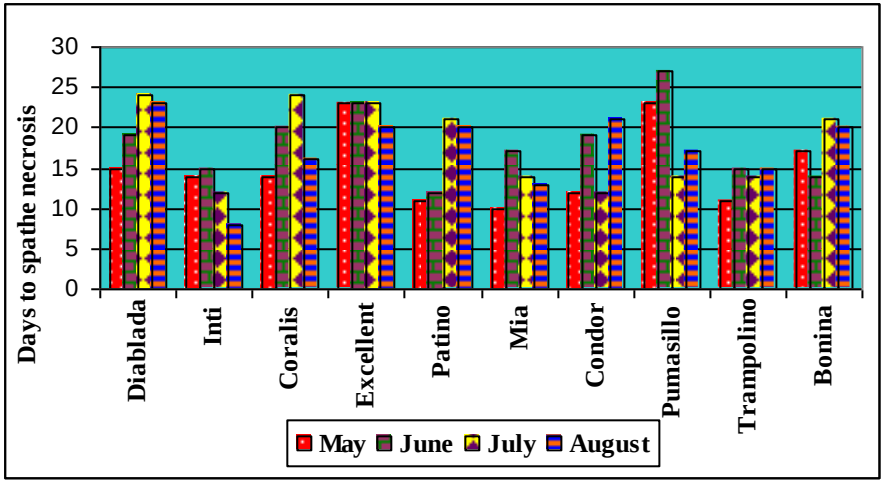


Fig.14-1. Days to necrosis of spathe in pot plants at Vellanikkara

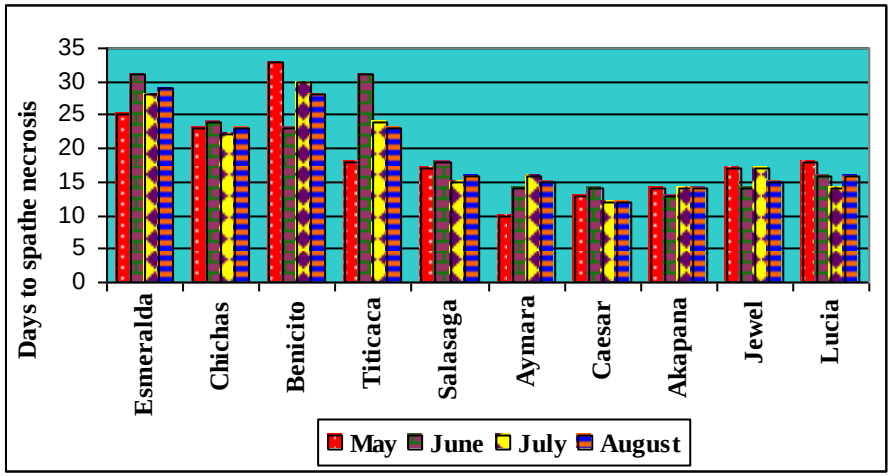


Fig.13-2.Days to necrosis of spathe in cut flowers at Nelliampathy

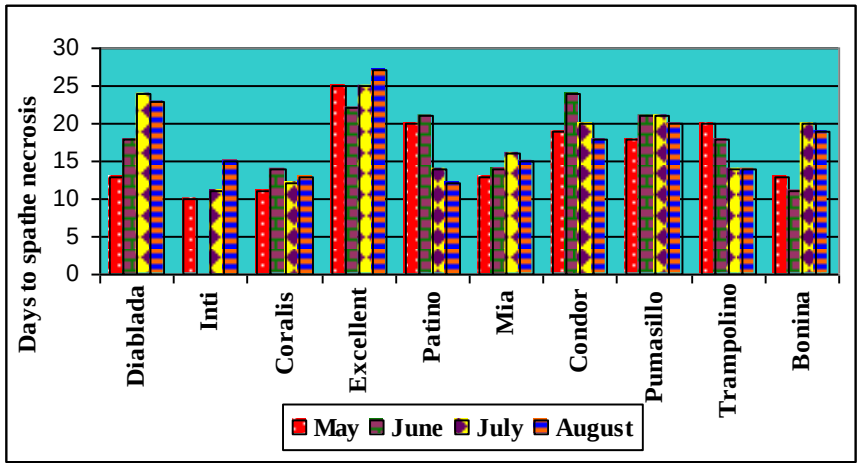


Fig.14-2.Days to necrosis of spathe in pot plants at Nelliampathy

At Nelliampathy, maximum number of days for spathe necrosis was recorded in variety Benicito (33.0days) in the month of May. The lowest (10.0days) was recorded in variety Aymara in the month of May (Fig.13).

4.3.2.2 Pot plant varieties

At Vellanikkara, maximum number of days to spathe necrosis was recorded in variety Pumasillo (27.0days) in the month of June. The lowest (8.0 days) was recorded in variety Inti in the month of August (Fig.14).

At Nelliampathy, maximum number of days to spathe necrosis was recorded in variety Excellent (27.0days) in the month of August. The lowest (10.0days) was recorded in variety Inti in the month of May (Fig.14).

4.3.3. Days to necrosis of spadix

4.3.3.1. *Cut flower varieties*

Days taken for the necrosis of spadix were recorded for a period of four months (from May to August).

At Vellanikkara, maximum number of days for spadix necrosis was recorded for variety Benicito (30.0days) in the month of June. The lowest was recorded in variety Caesar (8.0days) in the month of May (Fig.15).

At Nelliampathy, maximum number of days for spadix necrosis was recorded in variety Benicito (32.0days) in the month of May. The lowest (8.0days) was recorded in variety Salasaga in the month of July (Fig.15).

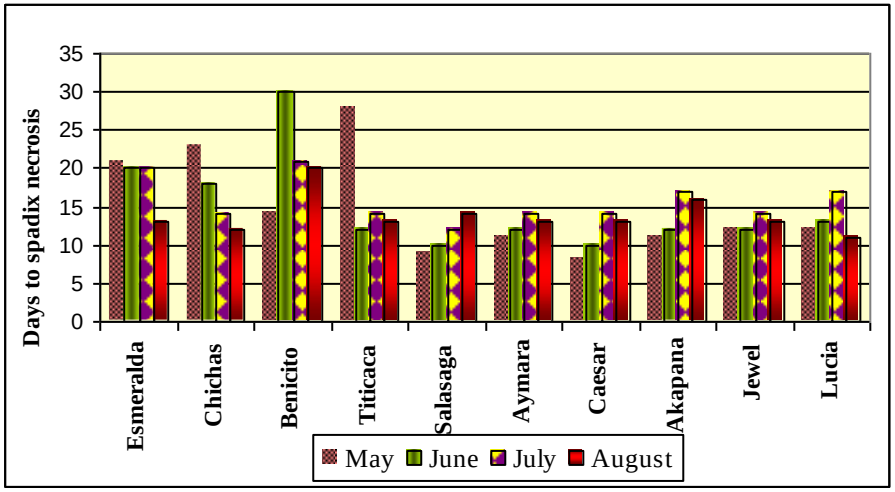


Fig.15-1. Days to necrosis of spadix in cut flowers at Vellanikkara

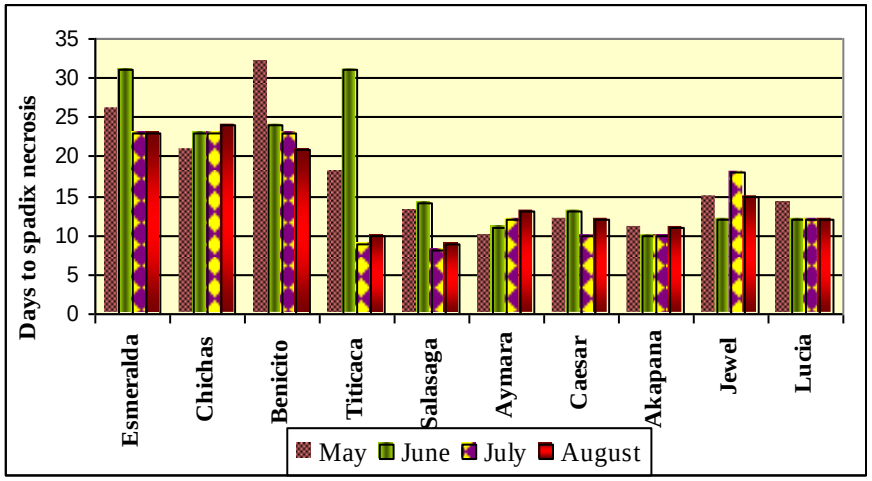


Fig.15-2. Days to necrosis of spadix in cut flowers at Nelliampathy

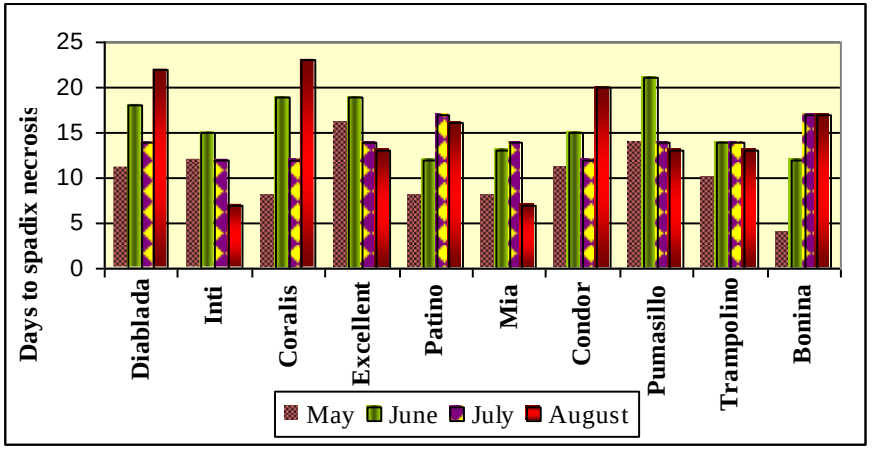


Fig.16-1. Days to necrosis of spadix in pot plants at Vellanikkara

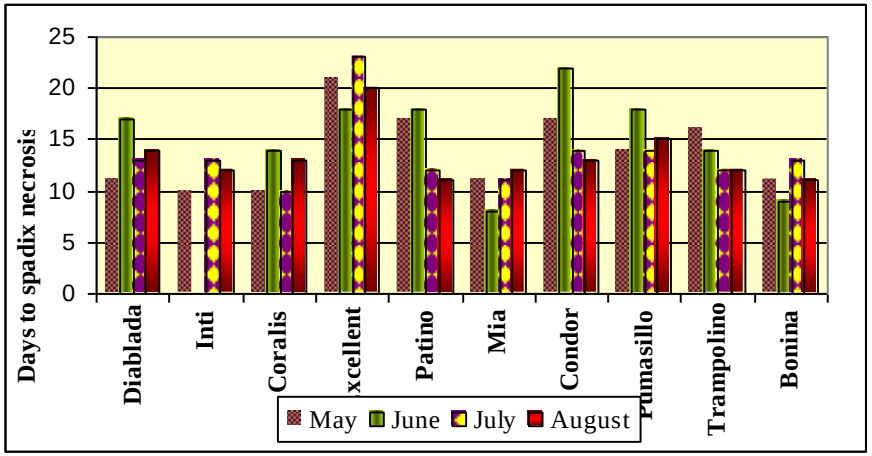


Fig.16-2.Days to necrosis of spadix in pot plants at Nelliampathy

4.3.3.2 Pot plant varieties

At Vellanikkara, maximum number of days to spathe necrosis was recorded in variety Coralis (23.0days) in the month of August. The lowest (4.0days) was recorded in variety Bonina in the month of May (Fig.16).

At Nelliampathy, maximum number of days to spadix necrosis was recorded in variety Excellent (23.0days) in the month of July. The lowest (8.0days) was recorded in variety Mia in the month of June (Fig.16).

4.4. CORRELATION STUDIES

To understand the effect of climatic characters on plant growth, temperature, humidity and light intensity inside the growing structures were correlated with the growth parameters of anthurium varieties.

4.4.1. Weather parameters

The temperature (maximum and minimum), relative humidity and light intensity recorded inside and outside the growing structures for a period of one year are presented in tables 32-33.

4.4.1.1. Vellanikkara

The monthly average of temperature, relative humidity and light intensity inside and outside growing structure at Vellanikkara are presented in Table 32.

4.4.1.1.1. Maximum temperature

At Vellanikkara the lowest maximum temperature was recorded in July ($30.18^{O}C$) and the highest in the month of March ($36.00^{O}C$).

4.4.1.1.2. Minimum temperature

At Vellanikkara the lowest minimum temperature was recorded in January (16.59^{O}C) and the highest was in the month of April (25.32^{O}C).

4.5.1.1.3. Relative humidity

There was variation in relative humidity and the recorded lowest was in the month of February (36%) and the highest in the month of August (92%).

4.5.1.1.4. Light intensity

Variation in light intensity was measured and the lowest light intensity was recorded in the month of September (2016.66lux).The highest light intensity was recorded in the month of February (15233.00lux).

4.4.1.2. Nelliampathy

The monthly average of temperature, relative humidity and light intensity inside and outside growing structure at Nelliampathy are presented in Table 33.

4.4.1.2.1. Maximum temperature

At Nelliampathy the lowest maximum temperature was recorded in August (22.00^{O}C) and the highest in the month of May (31.56^{O}C).

4.4.1.2.2. Minimum temperature

At Nelliampathy the lowest minimum temperature was recorded in March (15.11^{O}C) and the highest in the month of May (19.20^{O}C).

Table 32. Mean Monthly weather data at Vellanikkara

Month	Inside the structure				Outside the structure				
	Max. temp (°C)	Min. temp (°C)	Light intensity(lux)	RH (%)	Max. temp (°C)	Min. temp (°C)	Light intensity (lux)	RH (%)	% Shade
July-05	30.18	23.42	5061.67	85	31.44	22.93	29670.0	85	82.94
Aug - 05	31.16	23.42	10133.33	92	31.46	22.79	46066.66	78	78.00
Sept - 05	30.02	24.80	2016.66	70	30.72	22.74	13461.0	83	85.02
Oct - 05	32.25	23.38	5415.58	78	32.81	23.03	30490.4	71	82.24
Nov - 05	32.53	20.88	6985.65	64	31.22	20.86	44677.7	76	84.36
Dec - 05	32.80	21.85	7835.00	63	32.48	20.54	45520.0	53	82.79
Jan - 06	33.38	16.59	7637.00	47	33.80	21.38	46275.0	46	83.50
Feb - 06	35.12	21.42	15233.00	36	36.08	20.62	53533.0	28	71.54
Mar - 06	36.00	24.42	6093.00	48	37.08	23.81	56639.0	39	89.24
Apr - 06	34.70	25.32	11617.00	74	35.28	24.56	31800.0	49	63.47
May - 06	34.27	24.68	4090.00	68	34.85	23.02	53930.0	35	92.42
June - 06	31.50	25.28	6935.00	83	31.95	23.06	43535.0	64	84.07
July-06	30.95	23.80	5516.00	76	31.65	22.85	31620.00	77	82.56
Aug - 06	31.30	23.40	6087.50	74	31.80	30.30	32247.50	73	81.12

Table 33. Mean Monthly weather data at Nelliampathy

Month	Inside the structure				Outside the structure				
	Max. temp (°C)	Min. temp (°C)	RH (%)	Light intensity(lux)	Max. temp (°c)	Min. temp (°c)	RH (%)	Light intensity (lux)	% shade
July-05	23.88	18.70	97		24.16	18.54	85		
Aug - 05	22.40	18.06	98		22.39	18.04	81		
Sept - 05	23.34	17.49	91		23.13	17.20	89		
Oct - 05	24.27	17.87	94		23.25	17.13	96		
Nov - 05	25.67	17.69	88		25.59	17.00	89		
Dec - 05	27.52	17.10	87	**	24.36	16.21	93	**	**
Jan - 06	27.93	18.74	98	4842.00	24.48	15.58	96	37430.0	87.06
Feb - 06	29.13	16.59	88	6137.00	25.46	15.31	93	45500.0	86.51
Mar - 06	29.82	15.11	86	10275.00	29.78	15.08	75	73483.0	86.02
Apr - 06	29.80	16.00	82	24643.00	30.99	16.20	93	83343.0	70.43
May - 06	31.56	19.20	86	11661.67	28.25	17.50	96	91700.0	87.28
June - 06	27.84	18.20	91	6926.00	27.80	17.90	98	42220.0	83.60
July-06	22.90	17.85	92	2014.00	21.90	15.67	94	11000	81.69
Aug - 06	22.00	15.82	96	3743.00	21.55	15.24	91	22560	83.41

** Instruments were installed in January

4.5.1.2.3. Relative humidity

There was variation in relative humidity and the recorded lowest was in the month of April (82%) and the highest in the months of August and January (98%).

4.5.1.2.4. Light intensity

Variation in light intensity was measured and the lowest light intensity was recorded in the month of July (2014.00lux).The highest light intensity was recorded in the month of April (24643.00lux).

4.4.2. Correlation studies on growth parameters of Anthurium andreanum

Data pertaining to the correlation effects of maximum temperature, minimum temperature, relative humidity and light intensity on growth parameters of ten cut flower and ten pot plant varieties of anthurium for one year period are presented in Tables 35 to 41.

4.4.2.1. Maximum temperature on growth parameters

The results of the correlation studies of maximum temperature on growth parameters of anthurium varieties grown are presented in Table 34-40.

4.4.2.1.1. Cut flowers

Data pertaining to the effect of maximum temperature on growth parameters of anthurium cut flower varieties are presented in Table 34.

In the varieties Esmeralda, Benicito, Titicaca, Aymara and Caesar all the characters showed non significant correlation with maximum temperature.

In the variety Chichas NS plant spread showed significant and positive correlation with maximum temperature.

In the variety Salasaga number of leaves showed significant and positive correlation with maximum temperature. All other characters were not significant.

In the variety Akapana, Plant height, number of leaves, NS plant spread and EW plant spread showed significant and positive correlation with maximum temperature.

In the variety Jewel, Plant height, NS plant spread and EW plant spread showed significant and positive correlation with maximum temperature.

In the variety Lucia, NS plant spread showed significant and positive correlation with maximum temperature.

4.4.2.1.2. Pot plants

Data pertaining to the effect of maximum temperature on growth parameters of anthurium pot plant varieties are presented in Table 35.

In the variety Diablada, plant height, petiole length and leaf length showed significant and positive correlation with maximum temperature.

In the variety Inti, all the characters except number of leaves showed significant and positive correlation with maximum temperature.

In the variety Coralis, all the characters showed non significant correlation with maximum temperature except number of leaves. Number of leaves were significantly and negatively correlated with maximum temperature.

Table 34.Correlation between plant characters of cut flowers and maximum temperature

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Esmeralda	-0 .045	-0 .251	-0 .238	-0.212	-0.212	-0.044	-0.157	-0.321
Chichas	0 .186	0 .158	-0 .119	0.125	0.095	0.504(**)	0.236	-0.010
Benicito	0 .021	-0 .008	-0 .327	-0.128	-0.008	0.237	0.113	-0.163
Titicaca	0 .141	0 .078	-0 .102	0.088	-0.019	0.212	0.167	-0.060
Salasaga	-0 .238	-0 .263	0.650(**)	-0.155	-0.179	-0.063	0.053	-0.264
Aymara	-0 .022	-0 .122	-0.349	-0.039	-0.019	0.150	0.046	-0.143
Caesar	-0 .213	-0 .193	-0.353	-0.131	-0.174	0.082	-0.185	-0.212
Akapana	0 .506(**)	0 .347	0.383(*)	0.294	0.308	0.459(*)	0.432(*)	0.219
Jewel	0 .460(*)	0 .358	0.155	0.300	0.236	0.457(*)	0.605(**)	0.213
Lucia	0 .342	0 .152	-0.293	0.103	0.055	0.413(*)	0.333	-0.023

*Significant at 5 % level; ** significant at 1% level; ns non-significant

Table 35. Correlation between plant characters of pot flowers and maximum temperature

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Diablada	0.536(**)	0.406(*)	-0.338	0.436(*)	0.276	0.281	0.336	0.320
Inti	0.693(**)	0.620(**)	0.269	.654(**)	.565(**)	0.648(**)	0.593(**)	0.620(**)
Coralis	0.264	0.050	-0.416(*)	0.187	0.079	0.393(*)	0.154	0.013
Excellent	0.237	0.090	-0.348	0.035	0.006	0.320	0.486(**)	-0.105
Patino	0.348	0.212	-0.282	0.310	0.000	0.356	0.490(**)	0.010
Mia	-0.316	-0.374(*)	-0.168	-0.293	-0.331	-0.328	-0.320	-0.359
Condor	-0.257	-0.288	0.063	-.412(*)	-.411(*)	-0.140	-0.231	-0.440(*)
Pumasillo	0.361	0.397(*)	-0.337	0.210	0.183	0.490(**)	0.393(*)	0.081
Trampolino	0.277	0.312	-0.031	-0.045	-0.083	0.380(*)	0.435(*)	-0.178
Bonina	0.041	0.008	-0.333	0.152	0.120	0.156	0.008	0.051

* Significant at 5 % level; ** significant at 1% level; ns non-significant

In the variety Excellent, EW spread showed significant and positive correlation with maximum temperature.

In the variety Patino, EW spread showed significant and positive correlation with maximum temperature.

In the variety Mia, petiole length showed significant and negative correlation with maximum temperature.

In the variety Condor, leaf length, leaf breadth and leaf area showed significant and negative correlation with maximum temperature.

In the variety Pumasillo, petiole length, NS plant spread and EW plant spread showed significant and positive correlation with maximum temperature.

In the variety Trampolino, NS plant spread and EW plant spread showed significant and positive correlation with maximum temperature.

In the variety Bonina, all the characters showed non significant correlation with maximum temperature.

4.4.2.2. Minimum temperature on growth parameters

The results of the correlation studies of minimum temperature on growth parameters of anthurium varieties grown are presented in Table 36-37.

4.4.2.2.1. Cut flowers

Data pertaining to the effect of minimum temperature on growth parameters of anthurium cut flower varieties are presented in Table 36.

In the varieties Esmeralda, Chichas, Titicaca and Aymara all the characters showed non significant correlation with minimum temperature.

In the variety Benicito number of leaves showed significant and negative correlation with minimum temperature.

In the variety Salasaga number of leaves showed significant and positive correlation with minimum temperature.

In the variety Caesar number of leaves showed significant and negative correlation with minimum temperature.

In the variety Akapana, Plant height, petiole length, NS plant spread and EW plant spread showed significant and positive correlation with minimum temperature.

In the variety Jewel, Plant height, petiole length and EW plant spread showed significant and positive correlation with minimum temperature.

In the variety Lucia, number of leaves showed significant and negative correlation with minimum temperature.

4.4.2.2.2. Pot plants

Data pertaining to the effect of minimum temperature on growth parameters of anthurium pot plant varieties are presented in Table 37.

In the variety Diablada, plant height, petiole length and leaf length showed significant and positive correlation with minimum temperature. Number of leaves was significantly and negatively correlated.

Table 36. Correlation between plant characters of cut flowers and minimum temperature

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Esmeralda	-0.107^{ns}	-0.155 ^{ns}	-0.338 ^{ns}	-0.208 ^{ns}	-0.238	-0.117	-0.124	-0.262
Chichas	0.161 ^{ns}	0.300 ^{ns}	-0.198 ^{ns}	0.052 ^{ns}	0.052	0.314	0.147	-0.015
Benicito	-0.059 ^{ns}	0.052 ^{ns}	-0.451(*)	-0.161 ^{ns}	-0.127	0.114	0.068	-0.170
Titicaca	0.208 ^{ns}	0.289 ^{ns}	-0.314 ^{ns}	0.224 ^{ns}	0.096	0.203	0.154	0.097
Salasaga	-0.316 ^{ns}	-0.210 ^{ns}	0.504(**)	-0.165 ^{ns}	-0.203	-0.135	-0.058	-0.217
Aymara	-0.066 ^{ns}	0.012 ^{ns}	-0.372 ^{ns}	0.047 ^{ns}	0.033	0.085	0.024	0.014
Caesar	-0.258 ^{ns}	-0.153 ^{ns}	-0.579(**)	-0.050 ^{ns}	-0.160	-0.104	-0.219	-0.132
Akapana	0.560(**)	0.507(**)	0.260 ^{ns}	0.351 ^{ns}	0.307	0.485(**)	0.439(*)	0.296
Jewel	0.476(*)	0.459(*)	0.206 ^{ns}	0.371 ^{ns}	0.283	0.332	0.408(*)	0.358
Lucia	0.326 ^{ns}	0.304 ^{ns}	-0.375(*)	0.150 ^{ns}	0.086	0.295	0.334	0.068

*Significant at 5 % level; ** significant at 1% level; ns non-significant

Table 37. Correlation between plant characters of pot flowers and minimum temperature

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Diablada	0.404(*)	0.405(*)	-0.405(*)	0.427(*)	0.218	0.290	0.296	0.328
Inti	0.636(**)	0.590(**)	-0.089	.665(**)	0.473(*)	0.663(**)	0.656(**)	0.597(**)
Coralis	0.323	0.194	-0.540(**)	0.215	0.063	0.356	0.259	0.074
Excellent	0.253	0.139	-0.452(*)	0.121	-0.075	0.164	0.365	-0.049
Patino	0.431(*)	0.310	-0.321	0.306	-0.006	0.338	0.469(*)	0.079
Mia	-0.429(*)	-0.336	-0.341	-0.311	-0.336	-0.318	-0.282	-0.343
Condor	-0.146	-0.068	0.023	-0.276	-0.305	-0.051	-0.256	-0.305
Pumasillo	0.473(*)	0.575(**)	-0.324	0.381(*)	.413(*)	0.543(**)	0.481(**)	0.351(*)
Trampolino	0.275	0.330	0.193	0.076	-0.035	0.311	0.352	-0.037
Bonina	0.179	0.180	-0.473(*)	0.337	0.133	0.143	-0.023	0.191

* Significant at 5 % level; ** significant at 1% level; ns non-significant

In the variety Inti, all the characters except number of leaves showed significant and positive correlation with minimum temperature.

In the variety Coralis, number of leaves was significantly and negatively correlated with minimum temperature.

In the variety Excellent, number of leaves showed significant and negative correlation with minimum temperature.

In the variety Patino, plant height and EW spread showed significant and positive correlation with minimum temperature.

In the variety Mia, plant height showed significant and negative correlation with minimum temperature.

In the variety Pumasillo, all the characters except number of leaves showed significant and positive correlation with minimum temperature.

In the varieties Condor and Trampolino, all the characters showed non significant correlation with minimum temperature.

In the variety Bonina, number of leaves was significantly and negatively correlated with minimum temperature.

4.4.2.3. Relative humidity on growth parameters

The results of the correlation studies of relative humidity on growth parameters of anthurium varieties grown are presented in Table 38-39.

4.4.2.3.1. Cut flowers

Data pertaining to the effect of relative humidity on growth parameters of anthurium varieties are presented in Table 38.

In the varieties Esmeralda, Chichas, Benicito, Titicaca and Aymara all the characters showed non significant correlation with relative humidity.

In the variety Salasaga number of leaves showed significant and negative correlation with relative humidity. All other characters were not significant.

In the variety Caesar number of leaves showed significant and positive correlation with relative humidity.

In the variety Akapana, Plant height, petiole length, number of leaves, NS plant spread and EW plant spread showed significant and negative correlation with relative humidity.

In the variety Jewel, Plant height, NS plant spread and EW plant spread showed significant and negative correlation with relative humidity.

In the variety Lucia, NS plant spread showed significant and negative correlation with relative humidity.

4.4.2.3.2. Pot plants

Data pertaining to the effect of relative humidity on growth parameters of anthurium pot plant varieties are presented in Table 39.

In the variety Diablada, plant height, petiole length and leaf length showed significant and negative correlation with relative humidity.

Table 38. Correlation between plant characters of cut flowers and Relative humidity

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Esmeralda	0.079	0.137	0.238	0.202	0.220	0.102	0.166	0.272
Chichas	-0.161	-0.266	0.138	-0.237	-0.163	-0.375	-0.280	-0.101
Benicito	0.067	-0.040	0.346	0.120	0.057	-0.215	-0.113	0.148
Titicaca	-0.131	-0.082	0.212	-0.097	-0.024	-0.094	-0.104	0.035
Salasaga	0.317	0.239	-0.557(**)	0.075	0.159	0.104	-0.019	0.191
Aymara	0.047	0.056	0.299	0.015	-0.007	-0.119	-0.081	0.090
Caesar	0.299	0.095	0.438(*)	0.147	0.166	0.054	0.117	0.203
Akapana	-0.447(*)	-0.386(*)	-0.495(**)	-0.294	-0.330	-0.514(**)	-.464(*)	-0.237
Jewel	-0.391(*)	-0.273	-0.155	-0.218	-0.146	-0.423(*)	-.591(**)	-0.130
Lucia	-0.188	-0.108	0.258	-0.049	0.030	-0.458(*)	-0.298	0.067

Significant at 5 % level; ** significant at 1% level; ns non-significant

Table 39. Correlation between plant characters of pot flowers and Relative humidity

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Diablada	-0.54(**)	-0.43(*)	0.318	-.476(*)	-0.347	-0.164	-0.321	-0.373
Inti	-0.57(**)	-0.58(**)	-0.122	-.63(**)	-.58(**)	-0.56(**)	-0.54(**)	-0.60(**)
Coralis	-0.138	0.011	0.431(*)	-0.185	-0.041	-0.329	-0.152	-0.024
Excellent	-0.143	-0.158	0.344	-0.010	0.017	-0.316	-0.414(*)	0.089
Patino	-0.228	-0.199	0.239	-0.260	0.006	-0.327	-0.456(*)	-0.024
Mia	0.365	0.310	0.135	0.310	0.355	0.334	0.275	0.341
Condor	0.295	0.223	0.071	.388(*)	.388(*)	0.140	0.300	0.406(*)
Pumasillo	-0.306	-0.364	0.264	-0.113	-0.094	-.418(*)	-0.438(*)	-0.013
Trampolino	-0.264	-0.340	-0.090	0.022	0.077	-0.217	-0.372	0.141
Bonina	-0.036	0.019	0.345	-0.046	-0.031	0.031	-0.030	0.019

* Significant at 5 % level; ** significant at 1% level; ns non-significant

In the variety Inti, all the characters except number of leaves showed significant and negative correlation with relative humidity.

In the variety Coralis, number of leaves was significantly and positively correlated with relative humidity.

In the variety Excellent, EW spread showed significant and negative correlation with relative humidity.

In the variety Patino, EW spread showed significant and negative correlation with relative humidity.

In the variety Condor, leaf length, leaf breadth and leaf area showed significant and positive correlation with relative humidity.

In the variety Pumasillo, NS plant spread and EW plant spread showed significant and negative correlation with relative humidity.

In the varieties, Mia, Trampolino and Bonina, all the characters showed non significant correlation with relative humidity.

4.4.2.4. Light intensity on growth parameters

The results of the correlation studies of light intensity on growth parameters of anthurium varieties grown are presented in Table 40.

4.4.2.4.1. Cut flowers

All the cut flower varieties showed non significant correlation with light intensity.

4.4.2.3.2. Pot plants

Data pertaining to the effect of light intensity on growth parameters of anthurium pot plant varieties are presented in Table 40.

All the pot plant varieties showed non significant correlation with light intensity except Inti. In the variety Inti, number of leaves showed significant and positive correlation with light intensity.

Table 40. Correlation between plant characters of pot flowers and Light intensity

Variety	Plant height	Petiole length	Number of leaf	Length	breadth	Spread NS	Spread EW	Leaf area
Diablada	-0.028	0.228	0.209	0.080	0.058	0.132	-0.109	0.026
Inti	0.028	0.193	0.508(*)	0.015	0.021	0.014	-0.052	0.009
Coralis	0.027	-0.014	0.206	0.062	0.175	0.171	0.068	0.097
Excellent	-0.029	-0.002	0.217	0.076	0.200	0.245	0.132	0.125
Patino	-0.079	-0.101	0.204	0.137	0.082	0.032	0.000	0.051
Mia	0.051	-0.026	0.299	0.264	0.206	0.121	0.134	0.225
Condor	-0.051	0.044	0.006	0.192	0.154	0.192	0.225	0.171
Pumasillo	-0.173	-0.117	0.061	0.018	-0.026	-0.012	-0.096	-0.058
Trampolino	-0.112	0.030	-0.199	0.096	0.121	0.212	0.181	0.085
Bonina	-0.056	0.018	0.240	-0.014	0.176	0.074	0.077	0.061

* Significant at 5 % level

Plate 1. Growing structure at Vellanikkara

Plate 2. Growing structure at Nelliampathy

Plate 3. Cut flower varieties used for the experiment

ESMERALDA

BENICITO

CHICHAS

SALASAGA

AYMARA

AKAPANA

JEWEL

TITICACA

CAESAR

LUCIA

Plate 4. Pot plant varieties used for the experiment

DIABLADA

INTI

PATINO

CORALIS

MIA

CONDOR

EXCELLENT

TRAMPOLINO

PUMASILLO

BONINA

Plate 5. Comparison of some cut flower varieties

I. ESMERALDA

II.CHICHAS

III.TITICACA

At Vellanikkara

At Nelliampathy

Plate 6. Comparison of some pot plant varieties

I.EXCELLENT

II.DIABLADA

III.PATINO

At Vellanikkara

At Nelliampathy

Discussion

5. DISCUSSION

Results of the investigations on the “Performance evaluation of anthurium (*Anthurium andreanum* Lind) under two climate regimes” are discussed below.

Anthurium is a unique beautiful flowering and foliage plant having high demand in the domestic and international flower markets. The brilliantly coloured spathes, bold effects and versatile usage in floral arrangements and long vase life make anthuriums one of the highly cherished cut flowers by the florists. In the global market the anthurium is second only to orchids among tropical cut flowers (Galinsky and Laws, 1996).

Anthurium is sensitive to high light intensity, temperature, rainfall and aeration. It can be easily grown provided the plants are given right greenhouse conditions. Location specific growing system is very important in anthurium which determines the yield and quality of flowers.

The performance of any plant depends upon its inherent genetic character as influenced by the growing environment. Each plant has its inherent genetic characters, which ultimately make it suitable for commercial exploitation. How ever the environment under which it is grown largely determines the realization of its genetic potential. Thus it becomes imperative to evaluate the plant types based on their performance and as influenced by the environment.

Potted anthuriums are also becoming popular among the growers. They are true interior flowering plants and have advantage over other potted plants due to their unique appearance, long lasting flowers, continuous growth and flowering under very low light conditions. It is anticipated that more potted anthurium cultivars will be introduced to the interior plantscape industries and that anthurium will continue to increase in value as a flowering foliage plant.

5.1. VARIETY

An ideal cut flower anthurium variety should have compact plants with short internodes; producing suckers profusely; bright clear coloured, showy, heart shaped spathe with plenty of blisters and symmetrical overlapping of basal lobes; spadix shorter in length than the spathe, reclining to the spathe oriented at an angle less than 30^0; erect, long flower stem, about five times the length of the spathe and resistance to common diseases and pests (Rajeevan *et al*. 2002). A pot plant variety, on the other hand, should be compact, profusely suckering and bearing more number of flowers at a time.

Cut flower and pot plant varieties used in the present study differed significantly with respect to vegetative and floral characters. Among cut flowers, at Vellanikkara, plant height, EW spread, leaf length, leaf breadth, leaf area, leaf longevity, leaf production interval, days to flower initiation peduncle length, spadix length, spathe length and spathe breadth differed significantly among varieties. At Nelliampathy, other than these characters, petiole length, spread and number of leaves were also significantly different.

Among pot plants, at Vellanikkara, plant height, EW spread, NS spread number of leaves, leaf length, leaf area, leaf longevity, leaf production interval, days to flower initiation, petiole length, peduncle length, spadix length, spathe length and spathe breadth differed significantly among varieties. At Nelliampathy, other than these characters, leaf breadth was also significant.

As a prelude to introduction and commercialization of a crop, varietal evaluation has significant role to play. The differences make the growers select a particular variety according to the suitability to a growing tract and market demand. Varietal differences in plant and flower characters, growth, production and post harvest qualities of anthurium have already been reported in various studies. In a study Renu (1999) compared 10 varieties, which showed significant

variation in height, ranging from 29.70 cm in ‘Midori’ to 70.90 cm in ‘Pompon Red'.

In a study using five varieties of *Anthurium andreanum,* Bindu and Mercy (1994) observed the largest spathe size for the variety ‘Pink’ and the smallest for 'Lady Jane'. In a similar study, Sindhu (1995) found that varieties 'Pink' and 'Kalimpong Red’ produced super large flowers and the smallest flowers were produced in the variety 'White'.

Henny (1999) reported that the new variety 'Red Hot' had 6 to 7 cm long and 4 to 5 cm wide spathes. According to Rajeevan *et al.* (2002) the spathe size ranged from 7 cm in 'White Alba' to 17 cm in 'Pink’ and 'Kalimpong Red'. Srinivasa (2006) evaluated the performance of five anthurium varieties for cut flower production. The results revealed that even physiological parameters such as chlorophyll, carotenoids, anthocyanins and wax content significantly differed among varieties.

The assortment of cut flower varieties is annually expanding. Red colour was preferred most in Dutch market and there were nine colour groups like red, pink, green edged, mixed, white, cream, green orange and miscellaneous (Rajeevan *et al.* 2002). Among the cut flower varieties included under the study, Esmeralda, Benicito and Akapana comes under the green group. Among pot plants, varieties Mia, Condor and Pumasillo is preferred because of its bright red colour.Variety Excellent comes under the green group.

The colour preference for anthurium varies through out Europe. Since the flowers satisfy an aesthetic need rather than a physical need the demand for certain colours may change drastically. Light colours and novelty colours are slowly gaining importance in place of bright colours. In the case of cut flowers, Salasaga, Aymara, Lucia, and Titicaca and among pot plants, Trampolino and Bonina can be considered good for commercial cultivation.

5.3 VEGETATIVE CHARACTERS

Vegetative characters have a direct bearing on the floral characters. It is reported that, in anthurium, primarily, the shoot/root ratio increases slightly when the plant begins to produce flowers (Dufour and Guerin, 2003b). The extent of difference is also contributed by genetic variation. From the experiment, it was found that varieties differed significantly with respect to vegetative characters.

5.3.1. Plant size

Plant size is generally regarded as an index of plant growth. Tisdale *et al.* (1985) reported that plant height can be used as an important plant growth index. Though height is a varietal character, it is also significantly influenced by shade level, nutrient supply, growth regulators, as well as potting media.

In the present studies, among cut flower varieties tried, Aymara exhibited maximum plant height, EW plant spread, leaf breadth and leaf area at Vellanikkara. At Nelliampathy, plant height, NS plant spread, leaf length and leaf area were the highest in Salasaga.

Among pot plants, at Vellanikkara, variety Condor exhibited maximum plant height, NS plant spread and increased leaf size. At Nelliampathy, almost all the characters were the highest in variety Mia which was significantly superior to all other varieties.

Difference between the locations was also significant for almost all the characters. The values were higher at Nelliampathy compared to Vellanikkara owing to the low temperature prevailing in the high altitude.

The primary differences in the vegetative characters of varieties could be attributed to their genetic make up (Srinivasa, 2006). At Nelliampathy, initially

there was a decline in the growth characters. But very soon recovery was observed. The decrease in vegetative parameters during the initial months may be due to increase in relative humidity due to high rainfall and relatively low temperature. This is in accordance with the findings of Mortensen (1986) who reported a negative response in the dry weight of some plant species under increased humidity.

5.3.2. Leaf characters and flowering

Anthurium andreanum had a long juvenile phase followed by a generative phase in which flower buds are produced. *A.andreanum* produces flowers all round the year, one flower from each leaf axil.The sequence of leaf, flower and new leaf is maintained through out the life of the plant. In order to improve flowering, Dai and Paull (1990) suggested removing the young leaf, i.e. the main sink, as soon as it emerges. This accelerates flower emergence but decreases the source for the next flowers by reducing the leaf area. The conclusion of morphological studies conducted by Christensen (1971) is also on similar lines.

In the present study, among cut flowers at Nelliampathy, variety Aymara exhibited highest leaf number and longevity. At Vellanikkara, it was not significant. Among pot plants at Vellanikkara, variety Inti recorded maximum number of leaves and leaf longevity. They were the highest for variety Bonina at Nelliampathy.

The monthly pattern of leaf formation in anthurium cultivars was analysed for four years by Klapwijk and Spek(1984) and they found that the average leaf number/m^2 glass house rose from 1.5 in March to 5 in June, there after declining until the following March. Mercy and Dale (1994) observed that anthurium produced only five to eight leaves on a stem axis per year and five to eight spadices per year. Sindhu (1995) has recorded that the number of spadices produced annually by an anthurium plant varied from four to eight. According to

Rajeevan *et al.* (2002) the number of leaves and spikes per plant per year varied from 4 to 9 in anthurium.

Leaf area was highest in Aymara and Salasaga among cut flowers, at Vellanikkara and Nelliampathy, respectively. At both the locations, Lucia had the lowest leaf production interval. Among pot plants, leaf area was highest in Condor and Mia, at Vellanikkara and Nelliampathy, respectively. Lowest leaf production interval was noticed in Mia and Condor, at Vellanikkara and Nelliampathy respectively. Thus, among the pot plant varieties, Mia and Condor produced the maximum cumulative leaf area.

Leaf size and number of leaves per plant decides the efficiency of photosynthetic activity, which contributes towards better growth and yield. In the present study among cut flowers, Aymara and Salasaga and among pot plants, Condor and Mia were far ahead of other varieties in vegetatative growth and floral characters. These findings are in agreement with the works of Betonio (1996), Nirmala (1996), Aswath *et al*. (1998) and Henny and Norman (2001).and Chandrappa (2003).

Anthurium has a monopodial juvenile phase without any flower production, then a sympodial generative phase during which it produces a flower for each leaf. The duration of monopodial phase is variety dependant. Dufour (2001) observed a hybrid with prolonged monopodial phase in the same growing conditions. In tropical conditions, there is no flower bud abortion, contrary to what generally happens in a temperate climate (Klapwijk and Spek, 1998).

In the present study, uniform flowering was initiated after a period of nearly ten months after planting. Among cut flowers, Lucia and Caesar were the earliest to flower at Vellanikkara and Nelliampathy, respectively. Condor was the earliest among pot plants at both the locations .In both the groups, time taken for flowering was significantly less at Vellanikkara, i.e., 116 days in Lucia to 157

days in Caesar compared to 196 days in Caesar to 250 days in Titicaca among cut flowers at Nelliampathy. The fact that the variety Caesar, which was the last to flower at Vellanikkara was the first to flower at Nelliampathy, also indicates the varietal response to climatic conditions. Even that variety flowered 39 days earlier at Vellanikkara further suggests that the tropical plains favour earliness in flowering, which is significantly different.

In the case of pot plants, the pre-blooming duration at Vellanikkara ranged from 100 days in Condor to 120 days in Inti, compared to 141 days in Condor to 249 days in Inti at Nelliampathy. The fact it took more than double the time for the same variety (Inti) to flower at Nelliampathy also indicates the relative response of pot plant varieties to climatic conditions.

In general, the increase in pre-blooming duration was more than 40 per cent at Nelliampathy, compared to Vellanikkara. This can be attributed to higher mean temperature at Vellanikkara which promoted early growth. This advantage of tropical locations suggests the possibility of raising nurseries for growing plants during pre blooming period in the plains and later on taking up commercial planting at higher altitudes.

5.4. FLORAL CHARACTERS

In a crop like anthurium where flowers form the major consumable product, floral characters assume high importance. The desirable characters of spike are given under 5.1. In the Anthurium flowers exhibit wide variability in colour, size, shape and texture of the spathe. The plant flowers round the year producing 5 to 7 spikes per year on an average in the cut flower varieties, which may be more in pot plant varieties. The first flowers to be produced are small and their value is less than half that of large flowers (Galinsky and Laws, 1996).

Significant differences were observed among the varieties and between the locations with regard to various floral characters like days taken for flower initiation, peduncle (stalk) length, spadix length, spathe length and spathe breadth. Peduncle length is a factor that determines the attractiveness and market acceptability of the flower. Maximum peduncle length was observed in Titicaca and Caesar (40.85 cm and 49.87 cm, respectively) among cut flowers, at Vellanikkara and Nelliampathy, respectively. Among pot plants, Mia recorded longest peduncles at both the locations (38.46 cm and 60.15 cm, at Vellanikkara and Nelliampathy, respectively).

The size of spathe is a commercially important trait of anthurium flowers. Market price is largely based on the spathe size. From the studies, it was seen that, among cut flowers, Titicaca and Esmeralda had maximum spathe length and spadix length, at Vellanikkara (12.96cm and 5.35cm) and Nelliampathy (15.27cm and 8.96cm), respectively. Spathe breadth was the highest in Titicaca (10.77cm) and Caesar (13.28cm).

Among pot plants, Trampolino and Condor exhibited maximum spathe length at Vellanikkara (10.88cm) and Nelliampathy (16.57cm) respectively. Excellent (10.82cm) and Condor (15.35cm) recorded highest spathe breadth. Mia recorded maximum spadix length at both the locations (5.18cm and 7.05cm respectively).

Varieties differed in spathe size among themselves and between locations. Spathe size and other floral characters were significantly larger at Nelliampathy, showing 30 per cent increase at Nelliampathy, compared to Vellanikkara. Lower temperature at Nelliampathy significantly influenced the quality of flower and hence Nelliampathy excelled Vellanikkara. Covering the sides of the polyhouse with UV stabilized polyethylene film (120 gsm) during night in the months of November to February was necessary to raise the temperature at Nelliampathy.

An increasing trend in peduncle length and other floral characters with the age of varieties was observed during the growth period. Higaki and Poole (1978) also reported an increase in flower size with ageing. Perhaps these floral traits are highly controlled by the genetic make up of the varieties.

5.5. POST HARVEST CHARACTERS

Varieties differ in vase life as well as the longevity in packing. Several pre harvest and post harvest factors also influence the longevity of cut flowers (Abdussamad, 1997). Senescence of flowers is associated with the plugging of stem vascular tissues accompanied by the loss in weight, visible changes including spathe gloss loss, necrosis of spathe and spadix, stem collapse and abscission of the spathe and spadix from the stem (Akamine, 1976).

Maximum time to loss of glossiness, in the present study, was recorded for Esmeralda among cut flowers and for Diablada among pot plants, at both the locations. Time taken to spathe and spadix necrosis was the highest in Benicito among cut flowers. Among pot plants, Pumasillo and Excellent at Vellanikkara and Nelliampathy, respectively took the maximum time. Coralis and Excellent recorded maximum days for spadix necrosis at Vellanikkara and Nelliampathy, respectively.

The differences in the post harvest life of different cultivars were reported earlier by Kalkaman (1983) and Salvi *et al.* (1997). From the present study, it was also noted that large and medium sized flowers kept better than small and miniature ones.

5.6. WEATHER PARAMETERS

The differences or variations present among the varieties between the seasons in the same location or the difference in performance of plants at the two

locations can be largely attributed to environment. Genotype or the genotype environment interaction could also bring in such changes. In the present study, weather parameters, viz., temperature (maximum and minimum), relative humidity and light intensity outside and inside growing structures were correlated with plant characters of all the twenty varieties. Simple correlation coefficients between plant characters and weather parameters inside the growing structures were worked out to assess the influence of weather parameters.

5.6.1. Maximum Temperature

Maximum temperature showed positive correlation with plant characters in cut flowers. Increase in plant height, number of leaves, and plant spread (NS and EW) was observed with increase in temperature.

In pot plants also, maximum temperature showed positive correlation with plant characters like plant height, petiole length, leaf length and breadth, spread (NS and EW) and leaf area but in varieties, Mia and Condor a decrease in petiole length, leaf length and breadth was observed with increase in maximum temperature. In variety Coralis, number of leaves decreased when maximum temperature increased.

5.6.2. Minimum Temperature

Temperature is one of the most important weather elements that control growth, differentiation, flowering and all such important characters of plants. Each plant has an optimum temperature beyond which the performance will be impaired. Within a crop itself varietal differences are known to exist in most of the crops which makes us to utilize the crop in a wide range of agro-climatic situations.

In the present study temperature was found to be positively correlated with plant height, petiole length and spread (EW and NS) in cut flowers. Negative correlation was observed in leaf number which indicates that, beyond a level, it is the number of leaves that is more affected by temperature than any other leaf characters. In pot plants also, a decrease in the leaf number is observed with increase in minimum temperature. All other characters were positively correlated. These results are in conformity with that of Moe & Heins (1990) who also reported that lateral branching and stem elongation could be controlled by temperature. Increase in temperature increases juvenile growth rate and vigour of plants (Schenk and Brundert *et al.*, 1981; Dufour and Guerin, 2003b).

Results of the experiment conducted by Chen *et al.* (2003) on effect of temperature on the flower quality of Oncidium showed that high temperature had significant positive effect on stem length. Low temperature controlled the floret number. The required growth days from harvesting to next shoot initiation was determined using high temperature studies.

Anthurium grows according to a leaf-flower-leaf-flower cycle. Inflorescence is formed at the axil of each leaf. This will cause flower production to equal leaf production. Earlier reports showed that the leaf plastochron duration varied during the different months of a year and flower production fluctuated strongly. This means that maximum flower production is related to high leaf production (Klapwijk and Spek, 1988).

With high temperature and low light intensity the need for assimilates in the plant is much higher and the flower bud may find competition from leaves and roots. Suda and Fukuda (1998) reported that high temperature caused reduction in number of flowers in anthurium. After flowering, low light intensity and associated low temperature is favourable for better leaf and flower production (Dufour and Guerin 2003 b).

5.6.3. Relative Humidity (RH)

Anthurium is a crop the growth and development of which is known to be favoured by high relative humidity. A level above 70 per cent is the generally recommended relative humidity for anthuriums. This is found to favour the number of leaves rather than any other vegetative characters.

In the present study too, plant height, petiole length, leaf number and plant spread showed negative correlation or non significant correlations with relative humidity, in cut flower varieties. In the case of pot plants also, except in leaf number, negative correlations were obtained with all the vegetative characters.. In variety Condor, leaf length, breadth and area increased as relative humidity increased.

Reports of Mortensen (2000) are in line with the present findings that low relative humidity is associated with the development of more compact plants. High relative humidity is reported to enhance the plant dry weight as well as quantity and quality of flowers.

Anthurium requires high relative humidity and low temperature for flower production. In the present study, growth parameters like height spread and leaf area increased with increase in air temperature. As the temperature increased, there was a corresponding decrease in relative humidity, resulting in a negative correlation of relative humidity with growth parameters like height and spread.

These results emphasize the advantages of temperature integration and process based relative humidity control in green houses which was tried in Chrysanthemum by Korner and Challa (2004). The commonly applied fixed set point RH of 80-85 per cent reduced the potential for growth. The availability of assimilates will be more under high RH combined with more dry weight of plants. The competition for flower buds from leaves is lesser and the plant is able to

develop more number of flower buds. This explains the reduction in flower yield in anthurium consequent of high temperature in tropical areas. When the temperature increases and relative humidity decreases, the availability of assimilates for plants is less.

Plant height being negatively correlated with relative humidity indicates that high relative humidity may reduce plant height in anthurium. When the internodal length and plant height increase in anthurium after flowering, the plant shows a tendency to creep and hence taller plants are not preferred. The negative relationship of plant height with relative humidity obtained in the present study shows that increase in relative humidity in the growing structure favours the production of compact plants with better flower yield in tropical areas.

5.6.4. Light intensity

Anthurium is a semi shade plant, which under natural conditions, is protected by the leaf covering of trees and bushes. During the entire cultivation, the plant must be protected against excess sunlight. In commercial practice anthurium is grown under partial shade. The intensity of light affects the morphological characters, flower production and quality of flowers. Shade threshold varies with variety.

Singh (1987) and Antoine (1994) observed that shade requirement of anthurium ranges from 60 to 80 percent. In the previous studies conducted at the Kerala Agricultural University, Thrissur, Kerala, it was proven that among the four levels of shade tried for the variety ‘Hawaiian Red’, 80 per cent shade was the best with respect to growth, production and quality of flowers (Salvi, 1997; Valsalakumari, *et al*. 2001).

In the present study, no significant correlation was obtained with light intensity among cut flowers. In pot plants variety Inti exhibited a positive

correlation of leaf number with light intensity. In other varieties significant correlations were not obtained. It is observed that light intensity on flowering was different in different varieties of anthurium (Suda and Fukuda, 1999)

5. 7. CONCLUSION

The following conclusions could be drawn from the present studies conducted in cut flower and pot plant anthurium varieties at two locations.

Importance of the selection of varieties is emphasized by the fact that the varieties differed significantly with respect to growth parameters, time taken for flowering, flower qualities, post harvest characters and their response to climatic factors.

Based on the evaluation conducted on ten cut flower varieties of anthurium, Aymara, Titicaca, Benicito, and Chichas are recommended for the plains (Vellanikkara) and Salasaga, Caesar, Esmeralda, Titicaca and Benicito for higher altitude (Nelliampathy) of Kerala. Similarly, among the pot plant varieties, Trampolino, Mia, Condor, Coralis and Pumasillo are recommended for the plains (Vellanikkara) and Mia, Condor, Excellent and Bonina for higher altitudes (Nelliampathy) of Kerala.

This clearly shows that some varieties have specific response to temperature (or, rather altitude) differences. It may also be noted that certain varieties (Titicaca and Benicito among cut flowers and Mia and Condor among pot plants) performed equally well at both the locations, compared to other varieties.

Pre harvest growing conditions influenced the post harvest quality of flowers. If more light is available for the plant as in tropical conditions, the temperature may be high. The rate of photosynthesis increases with increase in

availability of light. The rate of increase is directly proportional to temperature up to the optimum temperature for the crop. It has been reported that the temperature should remain below 30°C and the relative humidity, at least 50 per cent for anthurium. Pre-blooming period was significantly reduced when the plants were grown in the plains.

Anthurium is crop suitable for higher elevations in Kerala where the ambient temperature is low. The crop may receive the required light, which need not be associated with an increase in temperature. On the contrary, in plains, an attempt to increase light availability in shade houses may result in an increase in temperature, which is not favourable for the crop. Anthurium growers in the plains are often confronted with high temperatures, especially during summer months. A height between 600 and 1000 meters above sea level is often preferred for commercial production of anthurium, if the temperature could not be controlled by other less expensive means.

The studies also underline the need for resource-based development of floriculture and introduction and evaluation of all the varieties available in a crop so as to have specific recommendation of varieties for each growing track for enhanced yield and quality.

Summary

6. SUMMARY

Results of the investigations on the "Performance evaluation of anthurium (*Anthurium andreanum* Lind) under two climate regimes" are summarized below.

In anthurium, varietal performance differed significantly among themselves and between the two locations with respect to growth parameters at both locations.

- Among cut flowers at Vellanikkara, mean plant height (46.00cm), EW plant spread (37.28 cm), leaf breadth (12.36 cm) and leaf area (191.82 cm^2), were the highest in the variety Aymara. Leaf length was the highest in Caesar. Highest leaf longevity (21.26 cm) was recorded for the variety Chichas (183.75 days) and lowest leaf production interval for the variety Lucia (31.72 days).NS plant spread and numbers of leaves were not significant at Vellanikkara.

- At Nelliampathy, mean plant height (59.50 cm), NS plant spread (39.67 cm), leaf length (26.47cm), leaf area (251.70 cm2) were the highest in the variety Salasaga. Leaf breadth (14.46 cm) and petiole length (36.34 cm) were the highest in the variety Esmeralda. Caesar recorded maximum EW plant spread (55.30). Highest leaf number (15.00) and longevity (202.56 days) was recorded in Aymara.Lowest leaf production interval (31.72 days) was noticed in variety Lucia.

- When both the locations are compared, differences between the locations were found significant for the characters, plant height, leaf length, leaf breadth, leaf area, petiole length and leaf longevity. All these values were higher at Nelliampathy compared to Vellanikkara.

- Among pot plants at Vellanikkara the mean plant height (45.20 cm), NS plant spread (47.15 cm), leaf area (163.65 cm^2) were highest in the variety

Condor. Mean EW plant spread (38.80 cm) and leaf length (21.18) were highest in the variety Trampolino.Inti recorded maximum number of leaves (20.72) and highest leaf longevity (204.75 days). Highest petiole length was recorded in variety Pumasillo. Lowest leaf production interval was noticed in variety Mia (31.08 days).

- At Nelliampathy, the mean plant height (67.30 cm), EW plant spread (49.00 cm), NS plant spread (49.77 cm), leaf length (25.86 cm), leaf breadth (15.00 cm), leaf area (278.80 cm^2), petiole length (46.70 cm) were the highest in variety Mia. Lowest leaf production interval was noticed in variety Condor (33.12 days). Variety Bonina recorded maximum number of leaves (72.70) and highest leaf longevity (205.67 days).

- Difference between the locations were found significant for the characters, E W plant spread, number of leaves, leaf breadth, leaf area and petiole length. All these values were higher at Nelliampathy than Vellanikkara.

- Number of days for first flowering was lowest (116.00 days) in the variety Lucia among cut flowers at Vellanikkara. Ceasar was the earliest (196.00 days) to flower at Nelliampathy.Time taken for flowering was significantly less at Vellanikkara.

- Among pot plants at Vellanikkara, Condor was the earliest (100.00 days). Condor recorded first flowering (141.33 days) at Nelliampathy also. Time taken for first flowering was significantly less at Vellanikkara.

- When quality of leaf for cut foliage was considered, among cut flower varieties, Esmeralda, Titicaca, Salasaga, Aymara, Akapana and Jewel were found acceptable. Among pot plant varieties Patino, Pumasillo and Trampolino were found to be acceptable.

In anthurium, varietal performance differed significantly among themselves and between the two locations with respect to floral parameters also at both locations.

- Among cut flowers at Vellanikkara, mean peduncle length (40.85cm), spathe length (12.96cm), spathe breadth (10.77 cm) and spadix length (5.35 cm), were the highest in the variety Titicaca. Spike longevity was the highest in Esmeralda (125.24 days). Lowest flower production interval was noted in the variety Chichas (31.75 days).

- At Nelliampathy, mean peduncle length (48.87cm), spathe breadth (13.28 cm) and spike longevity (135.47 days), were the highest in the variety Caesar. Spathe length (15.27cm), spadix length (8.96cm) and lowest flower production interval (31.23days) were noted in the variety Esmeralda.

- When both the locations are compared, differences between the locations were found significant for the characters, peduncle length, spathe breadth and spadix length. All these values were higher at Nelliampathy compared to that in Vellanikkara.

- Among pot plants at Vellanikkara, mean peduncle length (38.46cm) and spadix length (5.18) were the highest in the variety Mia. Spike longevity was the highest in Bonina (60.78 days). Spathe length was higher in Trampolino (10.88cm) and breadth in Excellent (10.82cm). Lowest flower production interval was noted in the variety Diablada (30.56 days).

- At Nelliampathy, mean peduncle length (60.15cm), and spadix length (7.05), were the highest in the variety Mia. Highest spathe length (16.57cm) and spathe breadth (15.35cm) were noted in the variety Condor.

Spike longevity was the highest in Bonina (180.45 days). Lowest flower production interval was noted in the variety Diablada (31.25 days).

- When both the locations are compared, differences between the locations were found significant for the characters, peduncle length, spathe length, spathe breadth and spadix length. All these values were higher at Nelliampathy compared to that in Vellanikkara.

- Among cut flowers, nature of peduncle of all the varieties was straight except that of Akapana, Jewel and Lucia which was slightly bending towards the ground. Among pot plants, nature of peduncle of all the varieties was straight except that of Inti, Pumasillo and Trampolino which was slightly bending towards the ground.

- Angle of orientation of spathe was highest in variety Titicaca (160^{O}) among cut flowers at Vellanikkara. At Nelliampathy, variety Esmeralda was the highest (140^{O}). Among pot plants, the highest angle was recorded in Inti (150^{O}) and Pumasillo (130^{O}) at Vellanikkara and Nelliampathy, respectively.

- Angle of orientation of spadix was lowest in variety Titicaca (20^{O}) among cut flowers at Vellanikkara. At Nelliampathy, variety Aymara was the lowest (20^{O}). Among pot plants the lowest angle was recorded in Inti at Vellanikkara (20^{O}) and in Patino at Nelliampathy (30^{O}).

- With respect to post harvest longevity, At Vellanikkara,among cut flowers maximum number of days for loss of glossiness was recorded in Esmeralda(13.0days).Number of days for spathe necrosis(33.0days) and spadix necrosis(30.0days) were the highest in Benicito

- At Nelliampathy, maximum number of days for loss of glossiness was recorded in Esmeralda (17.0days).Number of days for spathe necrosis(33.0) and spadix necrosis(32.0)were the highest in Benicito

- Among pot plants at Vellanikkara, maximum number of days for loss of glossiness was recorded in Diablada (16.0days).Number of days for spathe necrosis (27.0) and spadix necrosis(23.0)were the highest in Pumasillo and Coralis respectively

- At Nelliampathy, maximum number of days for loss of glossiness was recorded in Diablada (17.0days).Number of days for spathe necrosis (27.0) and spadix necrosis (23.0) were the highest in Excellent.

- The availability of light intensity inside the growing structure, on an average, ranged from 2,016.66 lux in September to 15,233.00 lux in February; maximum temperature from 30.18^0c in July to 36.00^0c in March; minimum temperature from 16.59^0c in January to 30.40^0c in August and humidity from 36% in February to 92% in August during 14 month period at Vellanikkara.

- At Nelliampathy, availability of light intensity ranged from 2,014.00 lux in July to 26,643.00 lux in April; maximum temperature from 22.00^0c in August to 31.56^0c in March; minimum temperature from 15.11^0c in March to 19.20^0c in May and humidity from 82% in April to 98% in August.

- Among cut flowers ,maximum temperature was significantly and positively correlated with plant height in Akapana and jewel; with number of leaves in Salsaga and Akapana, NS spread in Benicito,Akapana,Jewel and Lucia with EW spread in Akapana and Jewel .In all other cases, correlation was not significant.

- Among pot plants, maximum temperature was significantly and positively correlated with plant height, petiole length and leaf length in Diablada and Inti;leaf breadth and NS spread in Inti ,Pumasillo and Trampolino; EW spread in Inti,Excellent,Patino,Pumasillo and Trampolino;leaf area in Inti .Petiole length was negatively correlated with Mia; number of leaves with Coralis ,leaf area, leaf length and breadth were negatively correlated with condor. In all other cases, correlation was not significant.

- Among cut flowers, minimum temperature was significantly and positively correlated with plant height, petiole length and EW spread in Akapana and jewel; with number of leaves in Salsaga; NS spread in Akapana. Number of leaves was negatively correlated in Benicito, Caesar and Lucia. In all other cases, correlation was not significant.

- Among pot plants, maximum temperature was significantly and positively correlated with plant height in Diablada,Inti,Patino and Trampolino;petiole length and leaf length in Diablada,Inti and Pumasillo;leaf breadth and NS spread in Inti and Pumasillo; EW spread in Inti, Patino and Pumasillo;leaf area in Inti and Pumasillo.Plant height was negatively correlated in Mia; number of leaves was negatively correlated Diablada,Coralis,Excellent and Bonina. In all other cases, correlation was not significant.

- Among cut flowers, relative humidity was significantly and negatively correlated with plant height and EW spread in Akapana and jewel; with petiole length in Akapana; with number of leaves in Salsaga, Caesar and Akapana; NS spread in Akapana, Jewel and Lucia. In all other cases, correlation was not significant.

- Among pot plants, maximum temperature was significantly and negatively correlated with plant height, petiole length and leaf length in Diablada and Inti; leaf breadth in Inti; NS spread in Inti and Pumasillo; EW spread in

Inti, Excellent, Patino and Pumasillo;leaf area in Inti. Number of leaves was positively correlated in Coralis; leaf length, breadth and area in Condor. In all other cases, correlation was not significant.

- Light intensity did not affect the performance of cut flower varieties of anthurium.

- Among pot plants, number of leaves showed significant and positive correlation with light intensity only in the variety Inti.

References

REFERENCES

Abdussamad, K.P. 1999. Regulation of flower and post harvest behavior of *Anthurium andreanum* Lind. M.Sc (Ag) .Thesis, Kerala Agricultural University, 135p

Akamine, E.K. 1976. Post harvest handling of tropical ornamental cut crops in Hawaii. *Florida Agricultural Experiment Stations Journal Series*. No.6096

Antoine, R. 1994. Commercial production of Anthurium cut flowers in Mauritius. *Floriculture-Technology, Traders and Trends* (ed.) Bhandary, K. and Prakash, J. 1994. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, p.21-23

Armitage, A.M. and Son, K.C. 1992. Shade and photoperiod influence *Caryopteris incana* use as cut flowers. *Hort. Sci*. 27(12): 1275-1276

Aswath, C., Prakash. D., Prasad, K.V. and Choudhary, M.L. 1998. Evaluation of anthurium under green house conditions. *Paper National seminar on anthurium production* organized by IIHR, Bangalore, 2-3 June, 1998, Chettalli, Coorg, Karnataka

Bakker, J.C. 1995. Greenhouse climate control: Constraints and limitations. *Acta Hort.* 399: 25-33

Betonio, G.L, 1996. Germplasm collection and evaluation of different anthurium cultivars. *J.Crop.Sci*. 20:12.

Bindu, M. R. and Mercy, S.T. 1994. Cytological studies in *Anthurium andreanum* L. 1st National Seminar on Anthurium 6-9 May, 1994, Trivandrum, India Abstract: 14

Binodh, A.K. and Devi, P. M. 2005. Selection indices and per se performance of morphologically diverse anthurium genotypes. *Indian. J. Gen and Pl. Brdg* . 65(1): 65-66

*Boula, R., Fougerouze, J., Bonhomme, K. and Schoch, P.G. 1973. *Pepinierstes Horticultures Maraichers.* No.134, p.13-16

*Brown, D. 2000. Aroid plants of the Arum family.Timber Press, Portland, OR.

Chandrappa. 2003. Evaluation and effect of media, bio-fertilizer and growth regulators on growth and flowering in anthuriums .Ph.D.Thesis, University of Agricultural Sciences, Bangalore.

Chase, A.R. 1988. Effect of temperature and Preino culation light level of severity of syngonium blight caused by *Xanthomonas Campestris*. *J. environ. Hort.* 6(2): 61-63

Chen, J., Henny, R.J., Robinson, C.A., Mellich, T. and Caldwell, R.D. 1999. Potted Anthurium: An interior flowering foliage plant. *Proc. Fla. State. Hort. Soc*. 112: 280-281

Chen, J., Henny, R.J., Mc Connell, D.B., and Nell, T.A. 2001. Cultivar differences in interior performances of acclimatized foliage plants. *Acta Hort.* 543: 135-140

Chen, J., Henny, R.J., Mc Connell, D.B., and Everitt, K.C. 2003. Cultural guidelines for commercial production of interiorscape anthurium. *http://edis.ifas.ufl.edu.*

Chen, C.C., Hsu, Y.M., and Hsu, Y.M. 2003. Effect of accumulation temperature on the flower quality of oncidium.*J.agric. For*. 52(1): 33-48

*Christensen, O.V. 1971. Morphological studies on the growth and flower formation of *Anthurium scherzerianum* Schott. and *A. andreanum* Lind. *Tistsskrift for plant eavl*. 75(6): 793-798

Criley, R. A. 1989. Culture and cultivar selection for anthurium in Hawaii. *Acta Hort.* 246: 227-236

Dai, J. and Paull, R.E. 1990. The role of leaf development in *Anthurium andreanum* inflorescence growth. *J. Am. Soc. Hort.Sci*.115: 901-905.

Dai, J. and Paull, R.E. 1991. Leaf development and anthurium flower growth. *The Service. RESTAHRUHCES.* Dec. 1991. (124) p.109-113

Dufour, L. 2001. Elaboration du rendement en enfleur coupee' de l' *Anthurium andreanum* cultive' hors sol et sous abri en milleu tropical.*Thesis de Doctorat.* Ecole Doctorale de l'Universite'd'Angers, 153pp.

Dufour, L. and Guerin, V. 2003a. Low light intensity Promotes growth, photosynthesis and yield of *Anthurium andreanum* Lind. In tropical condition. *Adv. Hort. Sci.* 17(1): 9-19

Dufour, L. and Guerin, V. 2003b. Growth, developmental features and flower production of *Anthurium andreanum* Lind in tropical condition. *Sci. Hort.* 98(1): 25-35.

Eichin, R. and Deiser, E. 1986. Roses for cutting in an unheated plastic house. *Deutscher Gartenbau*.40 (32): 1478-1480

Evans, A. 2006. Anthurium around the world. *Flower Tech*.9 (2): 6-8

Gaikwad, A. M. and Patil, S.S. 2001. Evaluation of Chrysanthemum varieties under open and poly house conditions. *J. ornamental Hort. New. Ser.* 4(2): 95-97

Galinsky, R. and Laws, N. 1996. Anthurium market. *RAP market information bulletin* .No.11.

Garala, M.P.F., Former, C.M.R., Ananda, R.R. and Ferver, S.M.S. 1989. Root zone heating of Gerbera. *Acta Hort*. 246: 45-52

*Gates, D.M. 1976. Energy exchange and transpirations. In: *water plant life* (Eds. Lange, O.L., Kappen, L., Schulze, E.) Springer-Verlag: 137-147

Gijzen, H. 1994. Interaction between CO_2 uptake and water loss. In: *Green house climate and control; an integrated approach.* Eds: Bakker, J.C., Bot, G.P.A., Challa, H. and Van de Braak, N. Wageningen Pers, Wageningen

Gowda, J. V.N. 2000. Studies on evaluation of exotic rose cultivars under low cost polyhouse. *Proceedings of the National Seminar on Hi-tech Horticulture*. Bangalore. 26-28 June 2000. pp.118

Grange, R. I. and Hand, D.W. 1987. A review of the effects of atmospheric humidity on the growth of horticultural crops. *J. Hort. Sci.*, 52 : 125-134

*Griffith, L.P. 1998. *Tropical Foliage Plants: A Grower's Guide*. Ball Publishing. Batavia, IL

Gutgutia, S.K. 2005. Giving a boost for growth. *Floric. Today*. Vol.6. p.33

Hanan, J.J. 1998. Greenhouse-Advanced Technology for protected Horticulture. CRC Press, New York.: 31-41

Henley, R.W. and Robinson, C.A. 1994. Evaluation of twenty-one potted anthurium cultivars grown for interior use. *Proc. Flor. St. Hortic. Soc., Florida, USA*

Henny, R.J. 1999. 'Red Hot' Anthurium. *Hort Sci*. 34(1): 153-154

Henny, R.J. and Fooshee, W.C. 1988. Response of 'Lady Jane' liners to different light and fertilizer levels. *Proc. Ann. Meet. Flor. St. Hort. Soc.* USA. 101: 304-305

Henny, R.J. Chase, A.R. and Osborne, L.S. 1991. *CFREC-Apopka Foliage Plant Research Note RH-91-3.*

Henny, R.J and Norman, D, J. 2001. Anthurium "Show Bit". *Hort.sci*. 36: 1140-1441

Hew C.S., Wee, K.H. and Lee, F.Y. 1987. Factors affecting the longevity of cut Aranda flowers. *Acta Hort*. 205: 195-202

Higaki, T. and Poole, R.T. 1978. A media and fertilizer study in anthurium. *J.Amer.Soc.Hort.Sci*.103: 98-100

Ignasse, J.F.1984. Climate influences on anthurium. *Hort. Francies* 160: 10

Iwata, R.Y., Tang, C.S. and Kamemoto, H. 1979. Anthocyanins of *Anthurium andreanum* Lind. *J. Amer. Soc. Hort. Sci*. 104(4): 464-466

Jayanthi, R. and Vasanthachari, L.H. 2003. Varietal evaluation of chrysanthemum for better growth and yield in open conditions. In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 79

Jones, Q. 1984. A national plant germplasm system. In: *Conservation of crop germplasm an international perspective* (Eds. Brown, W.L., Chang, T.T., Goodman, M.M and Jones, Q) Am.Soc.Agron, Madison: 27-34

*Kachru, R.P. 1985. Greenhouse temperature control techniques. Hand out delivered during summer training on Greenhouse Design and Environmental Control held at Central Institute of Agricultural Engineering, Bhopal, India: G36-G46

Kadmanzahavi, A. and Yahil, H. 1986. *Aster pilosus*. *Hand book of Flowering* (ed. Haley, A.H.) CRS Press, Boca Raton, Florida. pp.42-46

Kaiser, W. M. 1987. Effects of water deficits on photosynthetic capacity. *Physiologica Plantarum*. 71: 142-149

Kalkaman, E. C. 1983. Anthurium. *Vakblad voor de Bloemisteri.* 38: 69-71

Kamemoto, H., Iwata, R.Y. and Marutani, M. 1988. Genetics of the major spathe colours in anthuriums. *Research Series, College of Trop. Agric. Hum. Reso*. Univ. Hawaii 56: 11

Kimball, E.1986. Influence of high light intensity on flower formation. *Gartenbau*. 25(8): 379-384

Kittas, C. and Baille, A. 1998. Determination of spectral properties of several greenhouse cover materials and evaluation of specific parameters related to plant response. *J. Agric. Engng. Res*., 71: 193-202

Klapwijk, D. and Spek, H.J.J. Van der. 1984. Leaf formation and flower production in *Anthurium andreanum*. *Vakblad voor de Bloemisterij*.39 (48): 54-59

Klapwijk, D. and Spek, H.J.J.Van der. 1988. Development rate, flower growth and production of anthurium. *Netherlands J. Agric. Sci*. 36: 219-224

Kobayashi, R. S., Brewbaker, J. L. and Kamemoto, H. 1987. Identification of Anthurium andreanum cultivars by gel electrophoresis. *J. Amer. Soc. Hort. Sci*. 112(1):164-167

Korner, O and Challa, H. 2004. Temperature integration and process based humidity control in chrysanthemum. *Computers Electronics Agric*.43 (1):1-21.

Kunisaki, J. T. 1982. The effect of shade levels on spathe colour of Anthurium andreanum 'Marian Seefurth' and 'Anuenue'. *Hort. Digest*. 64:1-3

Kuruppu, N .P. U. and Yogaratnam, V. 1989. Response of *Anthurium andreanum* Lind. to different shade levels in Sri Lanka. *Trop. Agricst.* 145: 13-23

Leffring, L. 1975. Influence of climatical conditions on growth and flower yield of *Anthurium andreanum*. *Acta. Hort*. 51:63-68

*Leffring, L. 1981. Light is the main limiting factor in Gerbera growing in winter. *Vakblad Voor de Bloemisterij*. 36: 108-109

Levit, J. 1980. Response of plant to environmental stresses. *Pl. Physiology* (ed.) Levitt, J.Vol.1 Academic Press, New York, 1:23-64

Maatsch, R. and Batchthaler, E. 1964. Anthurium. In *Commercial Flowers* (ed.) Bose, T.K. and Yadav, L.P. (1989), Naya Prakash Publishers, Calcutta, 623-641

Mahanta, P and Paswan, L. 2003. Assessment of comparative performance of some gerbera (*Gerbera jamesonii* Bolus) cultivars under open cultivation and plastic rain shelter in Assam condition. In: Rajeevan, P.K., Valsalakumari, P. K. and Misra, R. L. (ed.). *One hundred papers in Floriculture.* Indian Society of Ornamental Horticulture, New Delhi. p 154-156.

Mandal, T. Biswas, B. and Biswas, J. 2003. Performance of carnation (*Dianthus caryophyllus L.*)varieties under polyshades in the plains of West Bengal. In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 51.

Mc Cree, K.J. 1972. The action spectrum, absorbance and quantum yield of photosynthesis in crop plants. *Agric. Met*., 9:191-216

Mercy, S.T. and Dale, B. 1994. *Anthurium.* St. Joseph's press, Thiruvananthapuram, India. 64p.

Mini, S., Sreelatha, U.,Rajeevan P.K., Jyothi, B. and Krishnan, S. 2003. Varietal evaluation of gerbera (*Gerbera jamesonii bolus*) under low cost green

house. In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 52.

Misra, R.L., Kumar and Misra, S.2002. Greenhouse management of ornamental plants-an overview. In: Misra, R.L and Misra, S. (ed.). *Floriculture Research Trend in India.* Isted. Indian Society of Ornamental Horticulture, IARI, New Delhi.p.13-18

Moe, R. and Heins, R. 1990. Control of plant morphogenesis and flowering by light quality and temperature. (ed.) Heins, R.D. *Proceedings of the International Symposium on Bedding and pot plant culture*.29 Apr-4 May.1989. 81-89. *Acta Horticulturae*.

Molfino, M. 2003. Downturn of Dutch flowers and plants in the USA. *Colture-Protette*. 32(10): 55-60

Mortenson, L.M. 1986. Effect of relative humidity on growth and flowering of some green house plants. *Sci Hort*. 29: 301-307

Mortensen, L.M. 2000. Effect of air humidity on growth, flowering, keeping quality and water relations of four short day green house species. *Sci. Hort*. 86(4): 299-310

Mortensen, L.M. and Fjeld, T. 1998. Effects of air humidity, lighting period and lamp type on growth and vase life of roses. *Sci. Hort*. 73:229-237

Muthukumaran, K., Sankade, L., Makkar, G.K., Pawan, K., Hegde, N.T. and Hegde, K.S. 2005. Opportunity for Indian fresh cut flowers. *Floric. Today*. 10(5): 18-21

Nakasone, H.Y. and Kamemoto, H. 1962. Anthurium culture, with emphasis on the effects of some induced environments on growth and flowering. *Univ. Hawaii. Hawaiian Agril. Ext. Serv*. 62:19

Naqvi, S.J. 2006. Opening window of opportunity. *Floric. Today*. 11(3): 10-12

Neelofar, S. 1992. Response of Carnation (*Dianthus caryophyllous* L.) to extended day length and gibberellins. M.Sc. (Ag.) thesis, P.A.U., Ludhiana. p.125

Nirmala, K., 1996. Micro propagation and genotypic conformity in *Anthurium andreanum* L. Ph.D Thesis. University of Agricultural Sciences, Bangalore

Nothuagal, M., Kosiba, A. and Larsen, R.U. 2004. Predicting the effect of irradiance and temperature on the flower diameter of green house grown chrysanthemum. *Sci. Hort*. 99:3-4

Oglesby Plant Laboratory Inc. (Corporate author). 1996. 'Ruth Mort' Syn Lady Ruth. *Pl. Varieties J*. 9(3): 17

*Otto, A. 1967. The influence of temperature on the flowering of *Anthurium scherzerianum* hybrids. *Deutscher Gartenbau*. 1986. 67:283-286

Panse, V.G. and Sukhatme, P.V.1985. Statistical Methods for Agricultural Workers.I.C.A.R, New Delhi, 4:97-123

*Papenhagen, A. 1986. High humidity has a marginal effect on plants. *Gartenbau*. 86(36): 1343-1346

Paull, R.E., Higaki, T. and Imamura, J.S. 1992. Season and fertilization affect the post harvest flower life of anthurium. *Scientia Horticulturae*. 49:125-134.

Poole, R.T. and Mc Connel, D.B. 1971. Effects of shade levels and fertilization on flowering of *Anthurium andreanum* 'Nitta' and 'Kaumana'. *Proc. Trop. Reg. Am. Soc. Hort. Sci*. 15:189-195

Praneetha, S., Jawarlal, M. Vijaykumar, M. Misra, R.L. and Sanyat Misra. 2002. Performance of anthurium under shade net conditions at Yercaud. *Proceedings of the National symposium on Indian floriculture in the new millennium 25*-27 February 2002. Lal-Bagh, Bangalore. pp.328-329

Praneetha, S., Jeeva Jothi, L., and Narayanan, R. 2003. Performance of carnation cultivars at Yercaud. . In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 84.

Prasad, T.G. 1997. Environment and Plant Growth Relations in Greenhouse. *Proceedings of International seminar on protected cultivation in India*, Bangalore, India: P.51-54

Pratap, A. and Rao, M. 2003. Assessment of tuberose varieties for commercial cultivation under Andhra Pradesh conditions. In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 86.

Rajeevan, P.K. and Valsalakumari, P.K. 2001. Anthurium. In: Chadha, K.L. (ed). *Hand book of Horticulture*. ICAR, New Delhi.p 544-548.

Rajeevan, P.K., Valsalakumari, P.K., Geetha, C.K., Leena Ravidas, Vinod Kumar and Bhattacharjee, S.K. 2002. Anthurium. *Tech. Bull*. IARI, New Delhi, p.42.

Rajeevan, P.K., Valsalakumari, P.K. and Geetha, C.K. 2004. *Post harvest handling of Orchids*. Britto, S.J. (eds.). Orchids Biodiversity and conservation-a tissue culture approach. Indian Institute of Natural resources, Tiruchirappalli, India, 336-355

Ravidas, L. 2003. Improvement of *Anthurium andreanum* Lind *in vivo* and *in vitro* methods. Ph.D. thesis, Kerala Agricultural University, Thrissur, India

Renu, R.S. 1999. Inter varietal hybridization in *Anthurium andreanum* Lind. M.Sc. thesis, Kerala Agricultural University, Thrissur, India. 131p.

Rukmanidevi, S. 1998. Evaluation of rose varieties under green house conditions. M.Sc. thesis. Tamil Nadu Agricultural University, Coimbatore, India

Salvi, B.R.1995., Valsalakumari, P.K., Rajeevan, P.K. and Geetha, C.K. 1997. Effect of holding solutions on cut anthurium flowers.*Hort. J*.10 (2): 14-17

Salvi, B.R. 1997. Optimization of shade, nutrients and growth regulators for cut flower production in *Anthurium andreanum* Lind. Ph.D. thesis, Kerala Agricultural University, Thrissur, p.278

Salvi, B.R.1995., Prabhakaran, P.V., Valsalakumari, P.K. and Geetha, C.K. (Unpublished). Estimation of Leaf area in Anthurium. *Anthurium andreanum*. Kerala Agricultural University, Thrissur, India

Satyanarayanan, T.V. 2006. Indian floriculture on fast track. *Floric. Today*. 10 (8): 15-19

*Schaper, D. and Zimmer, K. 1991. Different flowering responses in *Anthurium scherzerianum* Schott. *Garten bauer issen schajt*. 56(4): 163-169

Schenk, M. and Brundert, W. 1981. Temperature effect on *Anthurium andreanum* hybrids *Deutscher Gartenbau*.36 (49): 2064-2065

*Schmidt, K. and Lauterbach, D. 1985. Correct cultivar selection in *Anthurium scherzerianum. Gartenbau*. 85(30:1136-1137

Sengupta, D and Rajkamal. 2006. Floriculture production –The grower's perspective. *Floric.Today*.10 (8): 15-19

Shahakar, A. W. and Sable, A.S. 2003. Evaluation of carnation cultivars under naturally ventilated green house. In: *Abstract of National Symposium on Recent Advances in Indian Floriculture*. 12-14 November, 2003. held at Kerala Agricultural University, Thrissur, India, abstr. No.VII-31, p. 43

Sindhu, K. 1995. Cross compatibility in *Anthurium andreanum* Lind. M.Sc. thesis, Kerala Agricultural University, Thrissur, India, 111p

Singh, F. 1987. Anthurium viewing for a place among commercial flower crops. *Ind. Hort*. 4: 14-16

Singh, D.R., and Sujatha, N. 2003. Anthurium under shade net condition at Andaman. In the compendium of *National Symposium on Recent Advances in Indian Floriculture* held at KAU, Trichur during 12-14 November, and 2003. pp: 315-316

Soorianathasundaram, K., Rajamani, K., Rengasami, K and Azhakiamanavalan, R.S. 1996. Studies on the performance of hybrid tea rose cultivars. *S.Ind.Hort*. 44 (3 & 4): 83-84

Srinivasa, V. 2005. Influence of varieties on leaf nutrient content in Anthurium. *Crop Res*. 30 (2): 288-290

Srinivasa, V. 2006. Studies on the performance of some varieties of anthurium.*Crop Res.* 31(1): 75-77.

Srinivasa, V.and Reddy, T.V. 2005. Evaluation of different varieties of Anthurium under hill zone of Coorg district, Karnataka.*Mysore J.Agric.Sci.*, 39(1): 70-73

*Steen, J.V.D. and Vijverberg, A.J. 1973. Yield difference in the culture of *Anthurium andreanum*. *Vakblad voor de Bloemisterij* 28(7): 10-11

*Suda, A. and Fukuda, M. 1998. Growth habits and influence of photo period on flowering in anthurium and spathiphyllum. *Res. Bull. Aichi-Ken agric. Res. Center* 30: 195-200

*Suda, A. and Fukuda, M. 1999. Influences of temperature and light intensity in summer on growth and flowering in anthurium. *Res. Bull. Aichi-Ken-Agric. Res. Center* (Japan) No.31: 173-177

Suseela, P. 2002. Effect of height and ventilation of green house on micro climate under tropical condition and its impact on crop growth. Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore, India. 165p.

Talia, M.A.C., Cristiano,G. and Forleo, L.R. 2003. Evaluation of new anthurium cultivars in soil less culture. *Acta. Hort*. 614(1): 223-226\

Tisdale, S.L., Nelson, W.L and Beaton, J.D. 1985. *Soil fertility and fertilizers*. Macmillan Pub.Co.Inc.New York.p.733

Valdez, L. M. 2002. Promising Anthurium varieties for the low lands.*PCARRD-Highlights-2001* (Philippines).P.102-103.

Valsalakumari, P.K., Abdussamed, K.P., Rajeevan, P.K. and Geetha, C.K. 2001. Shade and nutrient management in *Anthurium andreanum* changing scenario in the production systems of horticultural crops. *Proceedings of National Seminar*, 28-30 August 2001. Coimbatore, Tamil Nadu, India. P.326-331

Valsalakumari, P.K. and Rajeevan, P.K., Juliemol, T., Pushpalatha, V.B. and Geetha, C.K. 2003. Improvement of Post harvest quality of Dendrobium 'Sonia 17'. *National symposium on Recent Advances in Indian Floriculture.* 12-14 November 2003. Kerala Agricultural University, Thrissur, India

Vanderleeden. 2006. Anthurium sets sails to conquer all continents. *Flower Tech*. 9 (2): 6-8

Van de Sanden, P.A.C.M. 1994. Water balance. In: *Green house climate and control; an integrated approach*. Eds: Bakker, J.C., Bot, G.P.A., Challa, H. and Van de Braak, N. Wageningen Pers, Wageningen

Van-os-Pc., De-Koster, R. and Van-der-Wurff-AAM. 1989. Day/night temperature affect production and quality of Gerbera. *Vakblad Voor de Bloemisterij*. 44:56-57

*Vonk Noordegraff, C. 1968. Growth and flowering of *Anthurium scherzerianum*. *Vakblad Bloemist*. 23:637

*Vonk Noordegraff, C. 1969. *Anthurium scherzerianum* in flower at the required time. *Vakblad Bloemist*. 24:133

Wang, Y.T. 1999. Green house performance of six potted anthurium cultivars in a subtropical area. *Hort. Tech*. 9(3): 409-412.

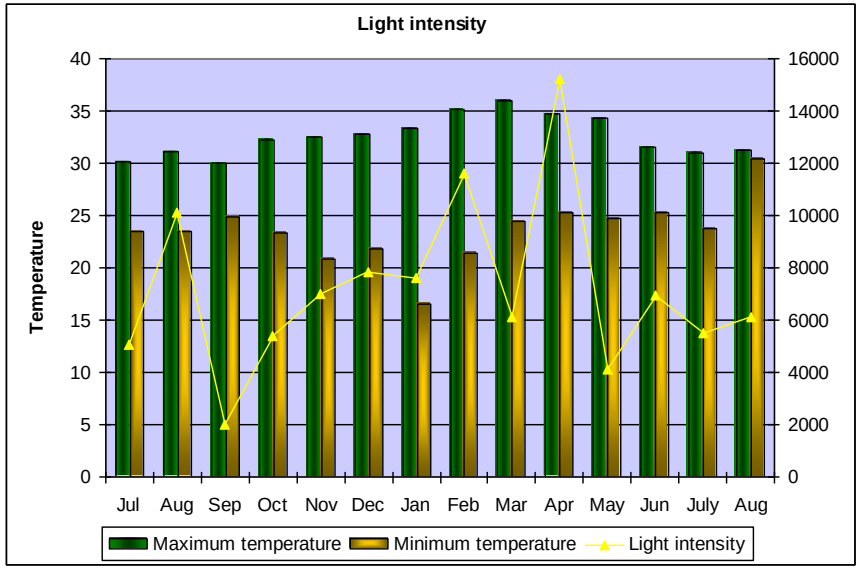
Wannakrairoj, S. and Kamemoto. H. 1990. Histological distribution of anthocyanins in Anthurium spathes. *Hort.Sci*. 25(7): 809

Xiaoping, Z. 1995. Effect of light intensity and CO2 supplement on growth and flowering of gladiolus. *Acta Hort*. 22:73-76

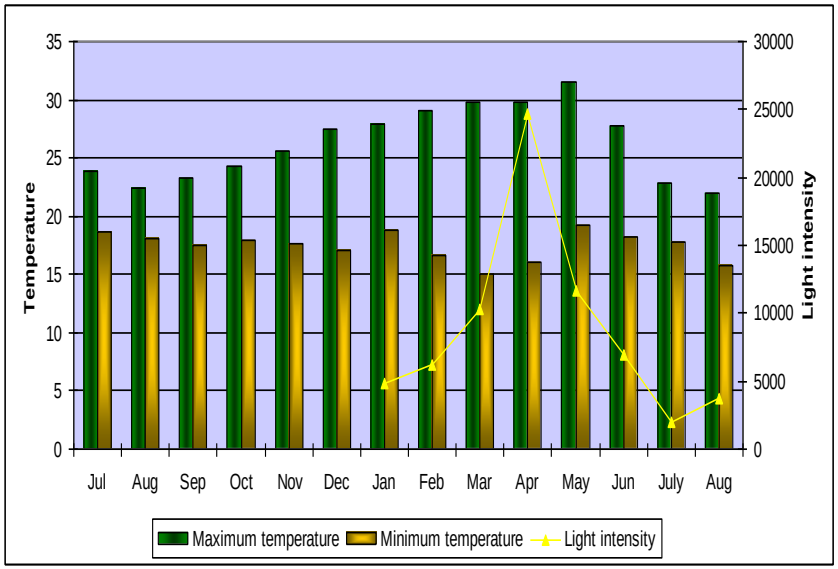
Zanon, I.M. 1990. Synergy between plastics research and protected agriculture. *Proceedings of XI International Congress on the Use of Plastics in Agriculture,* New Delhi, India. 34-39

* Originals not seen

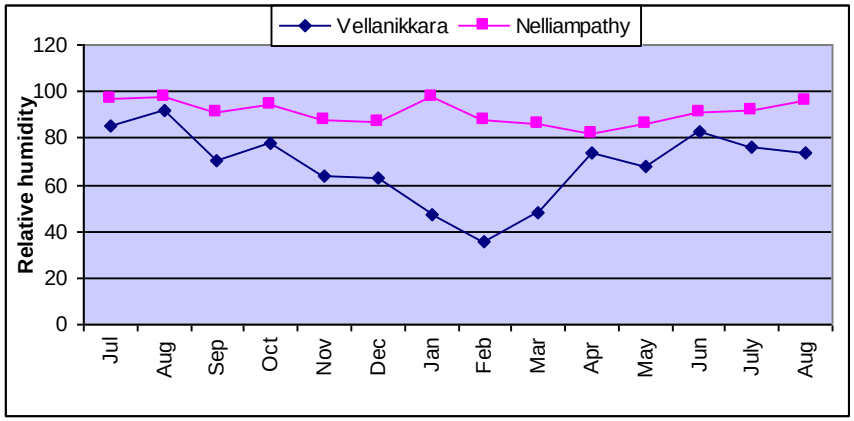
Appendix



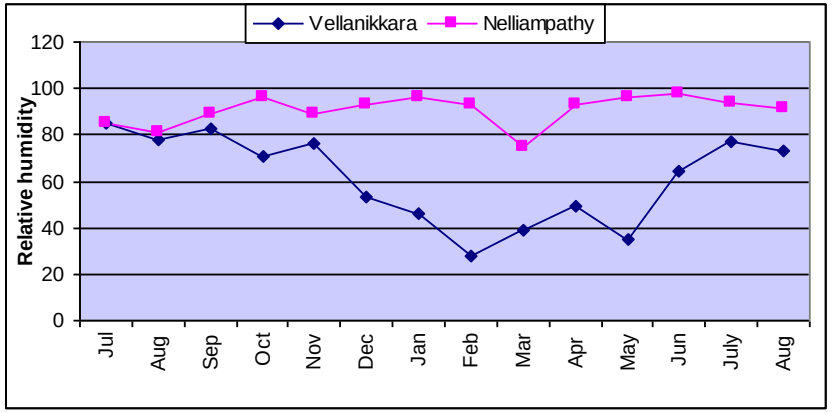
Temperature (Maximum & Minimum), Light intensity at Vellanikkara



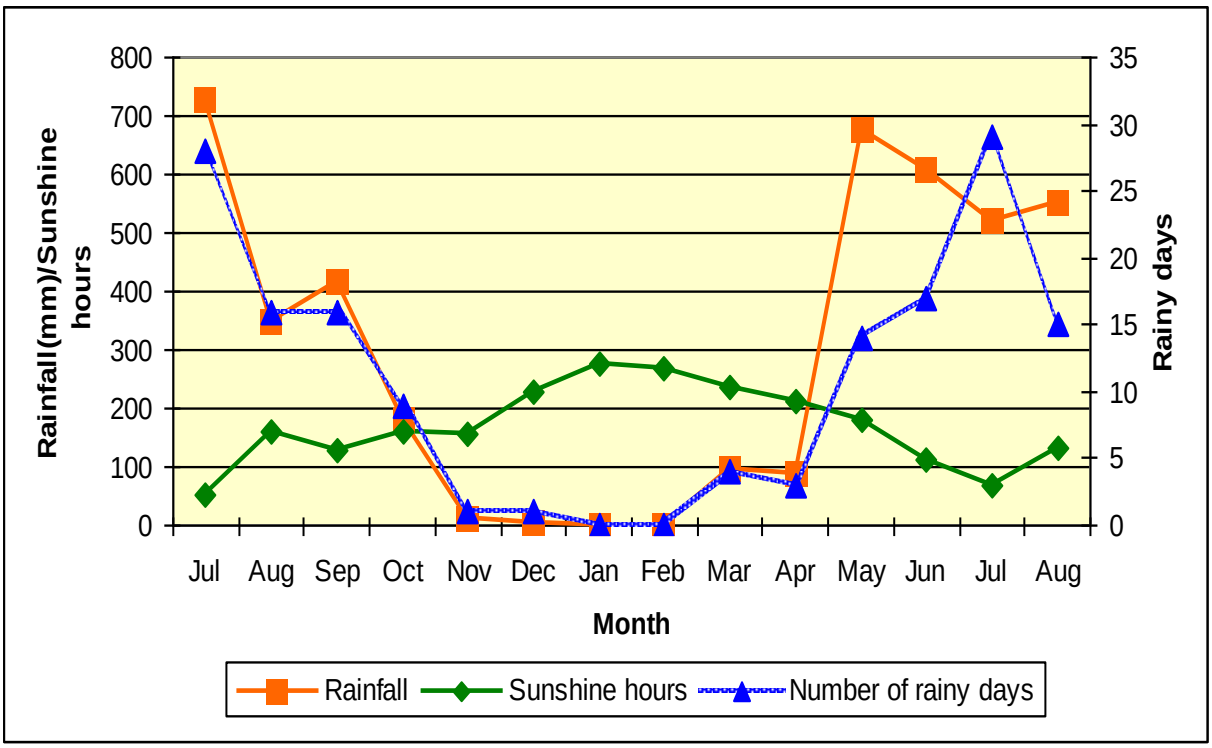
Temperature (Maximum & Minimum), Light intensity at Nelliampathy



Relative humidity inside the structure



Relative humidity outside the structure



Number of rainy days, Sunshine hours and Rainfall at Vellanikkara from July-2005 to August 2006

PERFORMANCE EVALUATION OF ANTHURIUM (*Anthurium andreanum* Linden) UNDER TWO CLIMATIC REGIMES

By

GAYATHRI.M.N

ABSTRACT OF THE THESIS

submitted in partial fulfilment of the
requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture

Kerala Agricultural University, Thrissur

DEPARTMENT OF POMOLOGY AND FLORICULTURE
COLLEGE OF HORTICULTURE
KERALA AGRICULTURAL UNIVERSITY
VELLANIKKARA – 680 656
THRISSUR
2008

ABSTRACT

Investigations on the “Performance evaluation of anthurium (*Anthurium andreanum* Lind) under two climate regimes” were conducted at the Department of Pomology and Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur district and at the Orange and Vegetable Farm, Department of Agriculture, Nelliampathy, Palakkad district. The objectives of the experiment were to compare the growth, flower yield and quality of selected cut flower and pot plant varieties at two agro climatic locations and to recommend suitable varieties for the anthurium growing tracts of Kerala.

Ten, each, of the globally important cut flower and pot plant varieties of anthurium were chosen. They were grown under suitably designed greenhouses at both the locations. Observations were recorded on the vegetative and floral characters as well as post harvest behaviour of the flowers and foliage. Weather parameters were recorded daily, both inside and outside the growing structures.

Results of the studies showed that, among cut flowers, at Vellanikkara, plant height, leaf breadth and leaf area were the highest in the variety Aymara. Leaf length was the highest in Caesar. Highest leaf longevity was recorded for Chichas and lowest leaf production interval for Lucia. At Nelliampathy, plant height, leaf length and leaf area were the highest in Salasaga. Leaf breadth and petiole length were the highest in Esmeralda. Highest leaf number and longevity were in Aymara and lowest leaf production interval was in Lucia. Differences between the locations were significant for plant height, leaf length, leaf breadth, leaf area, petiole length and leaf longevity. All these values were higher at Nelliampathy.

Among pot plants, at Vellanikkara, plant height and leaf area were the highest in variety Condor. Leaf length was highest in Trampolino. Inti recorded maximum number of leaves and leaf longevity. Highest petiole length was recorded in Pumasillo. Lowest leaf production interval was in Mia. At Nelliampathy, plant height, leaf length, leaf breadth, leaf area and petiole length were the highest in Mia. Lowest leaf production interval was in Condor. Bonina recorded maximum number of leaves and leaf longevity. Difference between the locations was significant for number of leaves, leaf breadth, leaf area and petiole length. All these values were higher at Nelliampathy. Among cut flower varieties, Esmeralda, Titicaca, Salasaga, Aymara, Akapana and Jewel produced cut foliage of acceptable quality. Among pot plant varieties Patino, Pumasillo and Trampolino were superior.

Time taken for flowering was significantly lesser at Vellanikkara. It was the lowest in the cut flower variety Lucia, at Vellanikkara. Caesar was the earliest to flower at Nelliampathy. Among pot plants, Condor was the earliest to flower at Vellanikkara as well as at Nelliampathy. The duration was significantly lesser at Vellanikkara.

Varieties and locations differed significantly with respect to floral parameters also. Among cut flowers, at Vellanikkara, peduncle length, spathe length and spathe breadth were the highest in Titicaca. Spike longevity was the highest in Esmeralda. Lowest flower production interval was in Chichas. At Nelliampathy, peduncle length, spathe breadth and spike longevity were the highest in Caesar. Maximum spathe length and lowest flower production interval were in Esmeralda. Differences between the locations were significant for peduncle length and spathe breadth. These values were higher at Nelliampathy.

Among pot plants, at Vellanikkara, peduncle length was the highest in Mia. Spike longevity was the highest in Bonina. Spathe length was the highest in Trampolino and breadth in Excellent. Lowest flower production interval was in Diablada. At Nelliampathy, peduncle length was the highest in Mia. Highest spathe length and spathe breadth were in Condor. Spike longevity was the highest in Bonina and lowest flower production interval was in Diablada. Differences between the locations were significant for peduncle length, spathe length, spathe breadth and spadix length. These values were higher at Nelliampathy.

Angle of orientation of spathe was highest in Titicaca among cut flowers, at Vellanikkara. At Nelliampathy, Esmeralda was the topper. Among pot plants, the highest angle was recorded in Inti and Pumasillo, at Vellanikkara and Nelliampathy, respectively. Angle of orientation of spadix was lowest in Titicaca among cut flowers at Vellanikkara. At Nelliampathy, variety Aymara was the lowest. Among pot plants the lowest angle was recorded in Inti and Patino at Vellanikkara and Nelliampathy respectively.

At Vellanikkara, among cut flowers, maximum number of days for loss of glossiness was recorded in Esmeralda. Days for spathe necrosis and spadix necrosis were the highest in Benicito. At Nelliampathy, maximum number of days for loss of glossiness was in Esmeralda. Days for spathe necrosis and spadix necrosis were the highest in Benicito. Among pot plants, at Vellanikkara, maximum number of days for loss of glossiness was in Diablada. Days for spathe necrosis and spadix necrosis were the highest in Pumasillo and Coralis, respectively. At Nelliampathy, maximum number of days for loss of glossiness was recorded in Diablada. Number of days for spathe necrosis and spadix necrosis were the highest in Excellent.

Among cut flowers, maximum temperature was significantly and positively correlated with plant height in Akapana and Jewel and with number of leaves in Salsaga and Akapana. Among pot plants, maximum temperature was significantly and positively correlated with plant height, petiole length and leaf length in Diablada and Inti; with leaf breadth in Inti, Pumasillo and Trampolino and with leaf area in Inti. Among cut flowers, relative humidity was significantly and negatively correlated with plant height in Akapana and Jewel; with petiole length in Akapana and with number of leaves in Salsaga, Caesar and Akapana. In all other cases, correlation was not significant.