EVALUATION OF FRAGRANT VANDACEOUS ORCHIDS FOR ORNAMENTAL TRAITS

By

DEEPA T

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THESIS

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DECLARATION

I hereby declare that the thesis entitled "**Evaluation of fragrant vandaceous orchids for ornamental traits**" 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, associate ship, fellowship or other similar title, of any other university or society.

Vellanikkara,

Date: 22.08.2017

Deepa T

(2015-12-006)

CERTIFICATE

Certified that this thesis entitled **"Evaluation of fragrant vandaceous orchids for ornamental traits"** is a record of research work done independently by Deepa. T (2015-12-006) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Vellanikkara
21-10-2017

Dr. C. K. Geetha
Professor and Head
Department Floriculture and Landscaping
College of Horticulture, Vellanikkara

CERTIFICATE

We, the undersigned members of the advisory committee, **Deepa T** a candidate for the degree of **Master of Science in Horticulture**, with major field in **Floriculture and Landscaping**, agree that the thesis entitled **"Evaluation of fragrant vandaceous orchids for ornamental traits"** may be submitted by **Deepa T**, in partial fulfilment of the requirement for the degree.

21.10.2017

Dr. C. K. Geetha
(Chairman, Advisory Committee)
Professor and Head
Department Floriculture and Landscaping,
College of Horticulture, Vellanikkara

21/10/17

Dr. P. K. Sudhadevi
(Member, Advisory committee)
Professor and Head of AFCFIP
Department of Floriculture and Landscaping
College of Horticulture, Vellanikkara

21.10.2017

Dr. A. Sobhana
(Member, Advisory committee)
Professor
Horticulture
Cashew Research Station, Madakkathara

21.10.17

Dr. Jayasree Sankar. S.
(Member, Advisory Committee)
Professor and Head
Department of Soil Science and
Agricultural Chemistry
College of Horticulture, Vellanikkara

21/10/17

EXTERNAL EXAMINER
Dr. M. Ganga
Associate Professor (Horticulture)
Horticultural Research Station (TNAU)
Ooty – 643001,the Nilgiris Dt.,
TamilNadu

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Introduction

1. INTRODUCTION

Orchids have become one of the most important segments in world floriculture market. These are grown for cut flowers, pot plant, extraction of biomolecules, herbal medicines, etc. The flowers and pot plants command highest price in market due to their incredible range of diversity in size, colour, shape, forms, appearance and long lasting flowers. The world export/import trade of orchid cut flowers and plants exceeds $150 million dollars. Of these, about 80 per cent are cut orchids, and the remaining 20 per cent is composed of pot plants. In European Union, the import of orchids accounts for 3 per cent of total fresh cut flower import with a wholesale value of 21 million Euros. The Netherlands is the largest exporter (39. 67%) of orchids in the world, followed by Thailand (28.41%), Taiwan (10%), Singapore (10%) and New Zealand (6%). The major importing countries include Japan (30%), UK (12%), Italy (10%), France (7%) and the USA (6%).

The orchids with 25000-35000 species in nearly 700-800 genera constitute the largest family among flowering plants (De *et al*., 2014). They are unique with their versatility in form, flower colour, size, shape and longer life span of flower. Nearly two lakh registered hybrids are available in the world. *Ascocentrum, Cattleya, Cymbidium, Dendrobium, Neofentia, Oncidium, Phalaenopsis, Paphiopedilum, Rhyncostylis* and *Vanda* are top in the list.

The family of orchids constitutes both monopodial and sympodial genera. Monopodials have recently gained popularity due to the availability of large number of varieties and hybrids, including intergeneric ones that show a wide range of variability in floral characters. *Phalaenopsis, Vanda* and the intergenerics like *Aranda,* and *Mokara* are the most popular monopodial orchids in the world market. Intermediate vandas have become extremely popular and they are now amongst the foremost in orchids cultivated outdoors or in greenhouse in the warmer regions of the world.

India is a late entrant in orchid business. However India has a great potential to emerge as a major orchid producing country in the world due to its suitable climate, availability of manpower and lesser cost of cultivation in comparison to the orchid growing countries. Several units have come up for production of tropical orchids in the states of Kerala, Karnataka, Tamil Nadu, Maharashtra and Assam. The units producing temperate orchids are located in the North Eastern states namely Sikkim and Manipur.

Orchids in view of the vast number of genera and cross pollinating nature have several species that produce fragrant flowers to attract pollinators. However, the hybrids rarely express the attributes, barring a few genera, viz, *Aerides, Ascocentrum, Neofenetia, Renanthera, Rhyncostylis, Vanda* etc., generally referred to as vandaceous orchids. The range of odours produced by these plants is enormous, providing thereby an exhaustive basis for specificity. Some smell like other flowers (carnation, jasmine, gardenia, rose), while others have the scents of spices and foods (vanilla, citrus, cloves, licorice, honey, cinnamon, grapes). This feature also makes orchids a novelty in sensory/fragrant gardens. Orchid fragrance is due to the presence of volatile aromatic oils produced in minute quantities in floral parts like sepals, petals, calluses, basal spurs or petioles in specialized glands called 'osmophores'. Besides their exotic beauty and amazing colour, these orchids add incomparable fragrance to landscapes. They are also suitable for interiorscasping to create a peaceful relaxing and inviting environment, the fragrance being an added advantage.

In view of the unique mix of longevity and fragrance, these intermediate monopodials (vandaceous) can be grown in hanging baskets, in addition to their use as cut flowers, whereas some of the fragrant species like *Dendrobium cruminatum, Cattleya intermedia, Epidendrum radicans,* etc. hardly last for a day.

The potential of epiphytic vandaceous orchids (basket vandas and relatives) has not been systematically exploited so far in the country. Better vase life and unique fragrance are considered as a rare combination. Therefore there is an imperative need

to evaluate the performance of fragrant vandaceous orchids for ornamental traits as value added plants. With this background, the present study has been undertaken in the Department of Floriculture and Landscaping, College of Horticulture, Kerala Agricultural University with the following objectives:

1. To evaluate the performance of fragrant vandaceous orchids grown in hanging baskets
2. To classify them based on economic and aesthetic parameters for commercial exploitation as value added plants.

Review of literature

2. REVIEW OF LITERATURE

Flamboyant, intriguing, bewitchingly beautiful exotic orchids have evolved to become the largest family of plants in the world. In a billion-dollar international industry, orchids are prized for their spectacular beauty and longevity. Orchid flowers are known for their high magnitude of diversity in form, colour, size, shape, attractiveness, longer life span and response to the environment. This manifold and perplexing range of floral structures arouse our highest admiration (Bose *et al,* 1999). The world export/import trade of orchid cut flowers and plants exceeds $150 million. Of these, about 80% are cut orchids, and the remaining 20 per cent is composed of pot plans. Attractiveness, diversity in forms, shape and colour, high productivity, right season of bloom and easy packing and transportation made this flower important in the world floriculture trade.

Orchids are classified according to the way they live and survive, whether they are supported by trees or rocks or grow in the ground, ie, epiphytes, lithophytes and terrestrials. The mosaic of geo-climatic conditions occurring in India had resulted in a great range of habitats for rich diversity of orchid flora (Arora, 1983). In North Western India and Western Ghats, Indian terrestrial orchids were seen in humus rich moist earth under tree shades. North eastern region was recognized as the mega diversity area for orchids (Kumariya and Tandon, 2010). In these area epiphytic orchids grows upto an elevation of 2000m from msl (De *et al.*, 2014).Western ghat harbour small flowered orchids. While considering these fascinating plants there exists an endless scope for genetic improvement and industrial development. Nearly two lakh registered hybrids are available in the world. *Ascocentrum, Cattelya, Cymbidium, Dendrobium, Neofenetia, Oncidium, Phalenopsis, Paphiopedilum, Rhynchostylis* and *Vanda* are top in the list. Production of several excellent hybrids contributed by the parent plants which was

originated in India. Vandas and ascocendas and their combinations were used to produce new hybrids (Grove, 1995).

Vandaceous orchids are a special group of tropical orchids, characterized by a monopodial growth habit. They are coming under the sub tribe Sarcanthinae which is classified into some 86 genera consisting of 1000 species. Over the past few decades, thousands of vandaceous orchids were produced trough interspecific and intergeneric hybridization. Among those cultivars, some have become particularly important for cut flower production in Singapore. *Aranda* hybrids, which are derived from crosses between *Arachnis* and *Vanda* rank first and trigeneric Mokara hybrids (*Arachnis* x *Vanda* x *Ascocentrum*) (Chen *et al.*, 1999).

Intermediate vandas are extremely popular in warmer region of the world because of their large dimension and unusually shaped attractive flowers and long lasting nature. From India, China, The Himalayas, Sri Lanka, Philippines and most part of the South East Asia, more than 70 species of Vandas were identified. They are commercially exploited in Thailand, Singapore, Malaysia and Hawaii (De and Debnath, 2011). *Vanda coerulea* leaf juice is used against diarrhoea, dysentery and skin diseases. The whole plant of *Vanda tessellata* is used against fever, arthritis, rheumatism, bronchitis and they are also potential aphrodisiac and fertility booster. Leaf paste of *Vanda teres* is used to reduce temperature in fever. Orchids are used in the treatments against spasms, flatulence, rheumatism and epilepsy (Kong *et al.*, 2003).

2.1 Distribution of orchids in India and Kerala

Orchids are well known since vedic period. Rajeevan *et al.*, (2002) stated that nearly 200 species of orchids are distributed in North Western Himalayas, 800 species in North Eastern India, 200 species in Western Ghats and 100 species in other regions. While comparing to other parts of the country, North East India

harbours maximum number of orchid species. There are about 960 species of orchids belonging to 170 genera reported so far from N.E.India. Out of them, about 625 are epiphytes, about 300 terrestrial and about 35 are mycotrophs. More than 100 species are endemic to this area (Rao, 2013).

Orchids are about nine per cent of our flora. Medicinally important orchids were identified in forests of Kerala. *Nervilia aragoana* Gaud. is a delicate ground orchid found in the ground vegetation forests especially in Peechi, Parambikulam, Thekkady and sacred grooves of Western Ghats. Sudhadevi, (1992) listed the plants including *Habaneria latilabris* in the forest areas of Thrissur. Climatic conditions prevailing in Kerala have an important role in the rich biodiversity of orchids in Kerala (Rajeevan, 1995). Niyamgiri a rich area of orchids, was accounted for 31 species (Mishra, 2005. Chowdhery, 2001). Among orchids collected from this region, some of them showed therapeutic properties (Dash *et al.*, 2008). *Habaneria latilabris* is a terrestrial orchid, also known as *Jeevakam*. Economic part of this is the sphere and its decoction is used for the preparation of health tonic. Hilly districts of Assam, Meghalaya. Arunachal Pradesh, Darjeeling, Western Ghats, Garhwali and Andaman and Nicobar Islands harbour different species of vandas (Bose and Bhattacharjee, 1980). Because of the agro climatic diversity, high humidity and rainfall forms, North East India is the richest orchid belt in the country. Kumar *et al.* (2012) conducted a study on forty orchid species belonging to 16 genera for vegetative and flowering characters at subtropical mid hills of Meghalaya and made appreciable findings. *Dendrobium nobile, Phaius tankervillae, Calanthe masuca, Rennthera imshootiana, Thunia marshalliana, Cymbidium Giganteum* and *Vanda Coerulea* were found promising as cut flowers.

In India, Northern Himalayas, Western Ghats and Andaman Nicobar Islands are the major diversity rich regions and our country is considered as one of the primary/ secondary centre of orchid biodiversity.

2.2 Conservation of orchids

Orchids are highly vulnerable to loss or erosion in their natural habitat. Jalal (2012) listed 58 orchid species threatened in India. *Paphiopedilum wardii, Anoectochilus rotundifolius and Vanda wightiana* have probably been vanished from Indian Islands. In 1984, under the banner of IUCN, the Orchid Specialist Group (OSG) was established for orchid conservation. It has many regional groups; ISROSG - Indian Subcontinent Regional Orchid Specialist Group of which covers the Indian sub continental region. The Orchid Society of India (TOSI) was established in 1984 with a view to promote awareness about disseminating knowledge, projecting the importance of conservation, improvement propagation and commercialization of Indian orchids. For the biodiversity conservation, India has implemented Indian Forest Act, 1927; the Wildlife(Protection) Act, 1972; the Forest (Conservation) Act, 1980; the Environment(Protection) Act, 1986; the Biodiversity Act, 2002; and the Biodiversity Rule, 2004 (De and Medhi, 2015). TBGRI, Kerala, NRC for orchids, Sikkim and several other organizations are also engaged in the mission. Priority sites were identified by using Satellite Remote Sensing and Geographic Information System by the Indian Institute of Remote Sensing and Department of Space (IIRS) and with respect to that conservation strategies have been taken up. Institutions like IISR and IIHR are also actively involved in using DIVA-GIS for preparing biological richness maps of commercial orchid species. Medhi *et al.,* (2012) stated that networking of institutions engaged in conservation of orchids coupled with strong orchid breeding programme would enhance judicious utilization of orchids.

2.3 Tissue culture and breeding

Vandaceous orchid breeding has been carried out by private breeders and botanists in the Singapore Botanical Gardens since 1930s. The registration of new

orchid hybrids has been undertaken by the Royal Horticultural Society in UK. As some of the private breeders are amateurs, parental materials used for hybridization might not be properly identified. It is, therefore, possible that the taxonomic status of parental material stated in the registration of new hybrids may not be accurate in some cases. Thus, a reliable test system, which can be used to establish the taxonomic status of breeding material and to verify orchid hybrids with doubtful parentage, is desirable. DNA fingerprinting techniques have been demonstrated to be powerful techniques for molecular typing in both eukaryotes and prokaryotes for the study of classification, evolution and phylogenetic relationships.

Recently, a novel PCR based DNA fingerprinting technique, the amplified fragment length polymorphism (AFLP), has been described as a powerful technique to identify molecular markers for both plant and bacterial DNA (Johnson, 2007) The AFLP method has become an attractive method for genomic analysis of plants and microorganisms because of its reproducibility, the requirement for small amounts of genomic DNA and the ability to resolve multiple polymorphic bands per reaction. In this study, the AFLP method was used to detect genomic differences between siblings that were derived from the same parental cross (two cultivars of *Aranda Christine*, five cultivars of *Mokara* Willie How) and between variants of the same clone originating from somatic mutations during massive propagation by meristem culture (two cultivars of *Ar. Christine*, and four cultivars of *M. Chark Kuan*). (Chen *et al.,* 1998)

2.4 Status of exotic hybrids and species

Exotic hybrids and species listed above have added to our germplasm collection and to our agro biodiversity. However, the list is only representative and not exhaustive. In the major commercial hybrid genera like *Aranda, Aranthera, Mokara, Vanda, Cymbidium, Dendrobium, Oncidium, Phalaenopsis* and *Cattleya*,

several cultivars have been imported and introduced for growing in India. Some initiatives have been taken to assess and enlist the performance of *Cymbidium* hybrids in Sikkim (NRC Orchids, 2000) and in Arunachal Pradesh. APEDA has brought out a Production manual of Cymbidiums suitable to our country in 2006. In fact, a systematic cataloguing would yield more numbers of exotic hybrids and species that have been introduced under cultivation in India.

Critical observation of the origin of some of these hybrids reveals that they are primary hybrids of yester years. For example, *Arachnis* Maggie Oei (*A. hookeriana* x *A. Flos-aeris*) is an old hybrid produced in Singapore in 1941 cultivated now in India. However, this particular hybrid has been responsible to give rise to large number of modern complex hybrids of commerce. Similarly, *Aranda* (*Arachnis hookeriana* x *Vanda lamellata)* – Debora (1945) and *Aranthera* (*Arachnis hookeriana* x *Renanthera cocinia*) – Mohamed Haniff(1937) are the other examples which have been grown in India and could be utilized for the production of newer hybrids utilizing our own native species like *Arachnis cathcartii, A. clarkei, Vanda whitii, V. thwaitesii*, etc.

2.5 Classification of Tribe Vandae

Classification of the vandaceous orchids has proven difficult and has led to conflicting taxonomic visions of the group (Arditti and Ernst, 1992). Dressler (1981; 1993) placed Vanda and closely allied species into the largest of the Orchidaceae subfamilies, Epidendroideae, which includes *Calypso, Coelogyne, Cymbidium*, *Dendrobium, Epidendrum*, and *Maxillaria*. The common characteristics of this highly variable subfamily include, pseudobulbs or corms, fleshy leaves with distichous arrangement (often caduceus), lateral inflorescence, hard pollinia with caduceus anthers and epiphytic habitat(Dressler, 1993).Such a broad description of this subfamily warrants further taxonomic splitting, and so

Dressler (1993) placed *Vanda* into the phylad Epidendroid (eight pollinia, often reduced to six, four, or two), and the subclad Dendrobiod. Tribes of the Dendrobiod subclad (including Dendrobieae, Podochileae, and Vandae) have distinctive "spherical silica" bodies, or stegmata, present in their cells and typically lack pseudobulbs (Dressler, 1993). Interestingly, this subclad contains both sympodial and monopodial genera. Dressler (1993) wrote that these differences are minor, as "only continued apical growth and rooting at the nodes is needed to convert sympodial growth to monopodial growth". Among the more recognized genera of the tribe Vandae are *Aerides, Phalaenopsis*, and *Vanda*. The Vandae can be further divided into the sub tribes Aeridinae, Angraecinae and Aerangidinae (Dressler, 1993). The Aeridinae consists of 103 genera of monopodial orchids with a vanda-type velamen (multilayered with larger epivelamen cells marked by helical Thickenings), two or four pollinia, one or more stipes and a viscidium (Arditti and Ernst, 1992; Dressler, 1993). Flower structures in the sub tribe are variable in both size and shape.

2.6 Performance evaluation

2.6.1 Vegetative characters

Two types of growth is identified depending on plant structure as 'monopodial' and 'sympodial'. Monopodials grow with single non-branching stem and are mostly climbers. Leaves, roots and inflorescences are produced from the nodes, along the entire length of the stem. The roots absorb moisture and nutrients from the air.*Vanda*, *Arachnis, Aerides, Ascocentrum, Rhynchostylis, Phalaenopsis* belong to this group (Mercy and Dale, 1997)

Sympodials have rhizomes or modified bulbs which grow horizontally, producing new growths. Thus, a well-developed sympodial plant contains a clump of shoots of varying age and size. Some examples of this group are *Catteya,*

Dendrobium, *Oncidium* etc. The new growth originating from the base of a sympodial orchid is called a 'lead', which indicates the direction of growth of the plant.

In general, the monopodial (single footed, by meaning) have a vertical growth, whereas, the sympodial (united feet) have a horizontal growth. (Rajeevan *et al.*, 2002). The stem of both monopodials and sympodials is usually thick and green, storing food and water.

2.6.2 Leaves

The leaves of vandaceous orchids are simple, arising from the main stem. They are generally green in colour. Three distinct groups are there based on the shape of the leaves. In strap –leaf vanda, flat, broad leaves are there. Terete vanda has cylindrical leaves and semi- terete vanda is a hybrid between the others and leaves are somewhat in between. Leaf tips are serrated and these enable the plant to dispose of any excess moisture taken up through the roots.

2.6.3 Roots

The aerial roots of orchids are unique to plant kingdom. They are thick and mostly white. Roots consist of a thick inner core, with an absorbent outer covering made up of layers of dead cells, that help for absorption of water which is called velamen and it progresses behind the green growing tips. Roots are extremely vulnerable and can be easily broken when it is outside the pots. They provide the plant with essential water and nutrients from the atmosphere.

2.6.4 Floral characters

For a successful hybridization programme, selection of parents with good ornamental traits especially floral characters are very important.so a study is needed

to understand the diversity of monopodial orchid genotypes. Amin *et al* (2004) observed significant differences on both quantitative and qualitative characters among varieties of indigenous monopodial orchid genotypes belonging to genera *Aerides, Rhynchostylis* and *Vanda*. Thomas and Rani (2008) evaluated 15 monopodial orchid genotypes belonging to the genera *Aranda, Aranthera, Kagawara, Mokara, Renanthera, and Vanda* and found wide range of variability among genotypes, enabling them to be suitable as parents in hybridization.

2.6.5 Colour and Fragrance

Chlorophyll (green), carotene (yellow and orange) anthocyanidins (red, blue, purple) and flavones (pale yellow) are the four pigments which are the potential genetic colour palette. Unique colour combinations or shades are created by several pigments which are present within the plant. It is predetermined at cellular level. Vandaceous orchids vary in colour from red, yellow, pink, green, and brown, violet, purple and its different shades. *Vanda coerulea* is one of the few botanical orchids which can produce varieties with blue coloured flowers. Among vanda hybrids, *Vanda dearie* is one of the source of yellow colour.

Colour and scent are the major pollinator attractants to flowers, and their production may be linked by shared biosynthetic pathways. Delle-Vedove *et al.,* (2011) conducted a study to know about the relation between colour and scent. In that study varieties of *C. sylvatica*, which displays three colours, but two scents, was proved that colour is not always a good indicator of odour and that colour-scent associations may be complex, depending on pollination ecology of the populations concerned.

Raguso (2008), stated that fragrance is a highly complex component of floral phenotype for its dynamic patterns of emission and chemical composition. Floral volatiles have anti- microbial or anti- herbivore properties which could be

used by the plants to protect their vital floral reproductive parts from potential predators. In almost all major civilizations people have been using flowers with vibrant colours and scents to enhance their beauty. According to Baudino *et al.,* (2007) in most of the plants economic importance relies on petals which are found to be the main site of natural fragrances and flavourings.

Tatzuzawa *et al.*, (2004), isolated eight major acylated anthocyanins from vanda hybrid cultivars and more than 11 anthocyanins were observed in these hybrids. Alkaline floral pH determines the blue colour in many orchid flowers. (Griesbach, 2005; Yokoi, 1975 and Arditti, 1992), reported the occurrence of delphinidin and cayanidins as anthocyanidins in the flowers of *Vanda coerulea.*

Frowine, (2005) discovered that more than 400 orchids emit fragrance. Only 2% fragrant orchids were studied for their fragrance. Fragrance study of orchids were not well established as in other flowers such as rose, petunia, etc.

2.6.6 Longevity

Opening of florets in vase, changes in the fresh weight, diameter and length of florets, diameter or length of stem or pedicel, senescence pattern, colour of petal, total longevity and foliage burning are the attributes which determines the vase life or longevity of cut flowers (De *et al.*, 2014).

AgNO3 (10-30 ppm) and HQS (50-100 ppm) extends vase life and bud opening of cut flowers, especially in tropical orchids like *Dendrobium* and. In *Cymbidium*, 1-MCP and AVG are superior to STS in prolonging the vase life of cut flowers. In Cymbidium 'PCMV', highest per cent of fully opened buds (75%) and maximum vase life (45 days) were recorded with the chemical combination of sugar 4% + salicylic acid 200 ppm. Emasculation accelerate coloration of labellum and senescence whereas amino-oxyacetic acid retards these process. With higher concentration of AOA and ethylene coloration of the labellum can be delayed

(Harkma and Struijlaart, 1989). Tatzusawa *et al.* (2004) analyzed and enlisted the flower colour and pigments in Disa hybrids. Pollination of flowers leads to the acceleration of senescence and shows symptoms like discoloration, wilting. Anthocyanin production and abscission.

According to Valsalakumari *et al.* (2007) pulsing with BA improved the post-harvest longevity in Dendrobium varieties viz., Sonia 17, Renappa and fairy white harvested at different stages of maturity.

2.7 Production technology

2.7.1 Growing environment

Orchids are wonderfully accommodating plants that will succeed in almost any situation with comparative ease. These plants are hardy and they can withstand in almost all conditions except extreme cold and heat. Though, critical factors like light, temperature, humidity, photoperiod, watering, pots, potting media, repotting, fertilizer application and plant protection (Sheela, 2008). Light loving, cool growing orchid genera such as *Cymbidium, Odontoglossum, Coelogynes, Encyclia and Dendrobium* can thrive well in such conditions (Brian and Rittershausen, 2014).

2.7.2 Media

2.7.2.1 Growing media

Vanda, Rhynchostylis and *Arachnis* are having dangling roots and pendent flowers and they prefer more light and are used to grown in hanging baskets. Tall growing monopodials are grown in clay pots, where terrestrials and semi-terrestrials are better to be grown in deep pots. For epiphytic orchids, plastic pots are suitable. Small growing epiphytic orchids are ideal to be mounted on tree barks. Orchids are need to be grown in as small a pot as possible. Terrestrial orchids

always prefer well drained sub soils, whereas tropical epiphytes are growing upon the branches and trunks of trees.

2.7.2.2 Potting media

Commercially prepared orchid potting mixes are the combination of charcoal, fiber and coarse peat moss. Mixture of coconut husk pieces, charcoal, dry fern roots, broken pieces of bricks, perlite pieces and sphagnum moss is the most common potting mixture for orchids. It should ensure drainage along with the retention of moisture. Fresh, clean and suitably sized media are required for the better growth of plant as well as proper distribution of roots. Replacement of decomposed old media or repotting is essential in every two or three year. Orchids can be transferred from an organic growing media to an inorganic or vice versa. But mixing of these two are not recommended because they require different watering technique. When the plants attain new growth or just after flowering, repotting can be done (Sheela, 2008).

Vandas mostly thrive under bright, humid, warm and intermediate conditions with coarse pine bark as potting medium in wooden baskets. Commercially vandas are grown in slotted baskets in a compost of coarse bark chips to which a few pieces of horticultural charcoal or pumice have been added.

Media selection is mainly based on the availability of quality materials as well as on the water requirement of orchids. Growing medium should be well aerated for the successful cultivation of orchids.

2.7.3 Nutrition

Orchids are very similar to other plants in their nutritional requirements except that they generally take long duration to exhibit the mineral deficiency. Number of studies were conducted from very early time to know about the

nutritional aspects of orchids. For the rapid proliferation of protocorm, MS media is better and Nitsch medium for differentiation and growth into plantlets (Nagaraju *et al.,* 2003). Nair *et al.* (2002) conducted a study in *Dendrobium* "Sonia 28" using 32P to assess the translocation of nutrients from back bulb to the young shoots. As a result they confirmed that translocation occurs from the back bulb to young shoots of *Dendrobium* during the course of development. Sheehan (1960), studied the effects of nutrition and potting media on growth and flowering of certain epiphytes mainly on *Cattelya and Phalaenopsis* and they found that levels of potassium and phosphorus had no effect on flowering and growth. In *Vanda cristata* N content varies from 1.1 to 2.8 g/Kg dry weight and P content varies from 1.1 to 1.6 g/kg dry weight during flowering stage (Naik *et al.*, 2006). Higaki and Imamura (1987), observed that increasing the level of Nitrogen generally increases the flower size of Vanda 'Miss Joaquim'. Rajeevan and Swapna (2003) studied the regulation of flower yield and quality in Dendrobium "Sonia 17" through the use of different combinations of nutrients and growth regulators. The balance between N and K is, however important and for best results it should be 1: 1, unless media requiring high nitrogen are used for growing the plants.

Like any other plants, orchids require nitrogen, phosphorous, potassium and trace elements for their healthy growth. Fertilizers are applied in liquid form as very dilute solution for easy absorption by roots. Bi – weekly feedings of water-soluble fertilizers are best for flower production in orchids. Orchids require nitrogen from beginning to two third of their life cycle and they are light feeders. They did not need any fertilizers during the rest of the period. Orchids needed more potassium and phosphorous and less nitrogen during the flower initiation and inflorescence development. Fertilizers applied frequently with low concentration is the best way of feeding orchids. For the production of quality blooms 0.2 – 0.3 per cent of 30:10:10(N:P:K) at vegetative stage and 10:20:20 (N: P: K) at blooming

stage was recommended. Occasionally, diluted cows urine, fresh coconut water and fishmeal emulsions were also useful as foliar spay (De *et al.*, 2014).

2.7.4 Aeration

Air circulation is essential as it evaporates moisture on leaves and stems and helps to protect the plants from the spread of diseases. Air movement alone keeps away many diseases. Stagnant and humid air affect adversely on plant growth as are cold drafts. Stagnant and still air hastens fungal growth. Tropical areas were always enjoyed with a constant and gentle air movement with high humidity.

2.7.5 Irrigation

As a general rule, irrigate typical orchid once or twice a week in the growing season and once every two or three weeks while it is resting. Commence watering when the new growth shows in the spring. Keep the plant evenly moist while they are growing and allow resting to dry out partially. Shrivelled pseudobulbs or limp foliage may indicate under watering or even over watering. In both epiphytes and terrestrials water requirement is different. Water well once a day in the morning and sprinkling in the evening is the best way of irrigation (Sheela, 2008). Ideal pH of irrigation water is 5.0 – 6.5. Watering with lower or higher pH or with high levels of dissolved minerals could hamper nutrient uptake. In high temperature conditions, regular watering is essential. Watering should be reduced in late summer and keep the plants barely moist during winter. To improve the keeping quality in thick leaved orchid genera like *Aranda* and *Dendrobium* irrigate in the late afternoon prior to harvesting season (De *et al.*, 2014).

2.7.6 Temperature and photoperiod

Based on the origin of the species, orchids are divided into cool growing, intermediate and warm growing types whereas each has its own temperature

requirements. Cool growing are the largest group and thrives with in a temperature band between 10° C to 30°C. Warm growing orchids require minimum 18° C winter night temperature and maximum 32°C in summer days (Brian and Rittershausen, 2014).

Temperature is crucial for flowering. Higher temperature results in higher rate of respiration. Cooling is required to slow down the maturation of flowers by reducing the enzymatic activities. In many of the orchid genera, flowering is accelerated in short day periods. Spike length, flower number and longevity are found to be increased in
short days. Regulation of temperature and light along with manipulation of photoperiod may delay or advance the onset of flowering in orchids.

2.7.7 Light

Orchids are shade loving plants. Light plays an important role in the growth and flowering in orchids and its requirement rate varies among species. Light intensity can be controlled by adopting shading methods. A system for cultivation of dendrobium orchids in Kerala was established, which involves double layer roofing, the lower layer being at a height of 2.5m for the purpose of changing according to weather conditions (Rajeevan, 1997). Light intensity controls the carbohydrate levels which influence the keeping quality. Cymbidiums and vandaceous groups belong to high light requiring genera. Indirect and filtered light and 50% shading are preferred by most of the orchids (De *et al.,* 2014).

2.7.8 Humidity

For the satisfactory growth of orchids 80-85 per cent humidity is required.
Sympodial orchids need lower humidity than the monopodials.

2.9 Post-harvest handling

2.8.1 Time of harvest: flowers are harvested in the early morning or late evening. Flowers should be turgid due to transpiration at night with higher sugar level. Like that in the afternoon, flower stalks retain a higher level of stored carbohydrates.

2.8.2 Method of harvest: sharp secateurs or some other sharp tools are used to cut the spike from plant. A slanting cut is given during harvesting of spikes. The cut spikes are to be dipped in water immediately after harvest to remove field heat.

2.8.3 Factors effecting post-harvest life

The post-harvest life is influenced by the following factors.

2.8.3.1 Temperature: Higher temperature results in higher level of respiration. Respiration and ethylene production will be low during low temperature conditions. Bud opening and senescence rate increase at higher temperature. Temperature has a vital role for harvested flowers at the immature stage for full expansion of buds and the flower buds are usually kept at temperatures as low as 0.5 to 4.0° C in *Cymbidium* and *Paphiopedilum,* 5 to 7°C in *Dendrobium* and 7 to 10^0 C in *Cattelya.*

2.8.3.2 Light intensity: Keeping quality is determined by the level of carbohydrates before harvest which is directly influenced by light intensity. For long distance transport and prolonged storage, light is a very essential factor.

2.8.3.3 Humidity: Relative humidity of 90-95 per cent helps to keep the turgidity in cut flower spikes. Flowers started to show wilting symptoms when they lose 10-15 per cent of their fresh weight. When the relative humidity was high, rate of transpiration was found to be reduced.

Optimum post-harvest handling determines the quality and vase life. Paul, (1991) stated that water uptake rate will decline after harvest, due to the microbial

contamination which blocks the xylem vessels. Pre harvest factors like ethylene sources, storage temperature and relative humidity are controlling the quality and post-harvest life. Both vascular blockage and rate of transpiration determine the early wilting of tropical cut flowers (Doorn, 1999).

According to Latha and Jayasree (2002) in vanda 'John Club' silver nitrate solution significantly increased vase life.

2.8.3.4 Storage: Low temperature treatment during storage or shipment period reduces the entire metabolism in the tissues, slows down the respiration, transpiration and ethylene action and retards the multiplication of bacteria and fungi. Temperate orchids are stored at lower temperature even at 5°C in cold chambers whereas tropical orchids are stored at 7-10°C. To minimize moisture loss and to prevent wilting90-95 per cent relative humidity is necessary during storage. 'Wet storage' and 'Dry storage' are two types of storage. In wet storage, flower bases are dipped in water or preservative solution for a short time and in dry storage fresh flowers are harvested in the morning, graded and sealed in plastic bags or boxes to prevent the loss of moisture. In Controlled Atmosphere (CA) storage, cut flowers are kept in gas tight cool chambers equipped with cooling systems at a higher level of CO_2 and lower level of O_2 to reduce the respiration rate and production and action of ethylene. The concentration of CO2 should be maintained higher than 4 per cent and not below 0.4 per cent in CA storage.

2.8.3.5 Grading and packing: Appearance, stage of maturity, blemishes or injuries due to diseases, infestations caused by insect pests, colour and size of the bud, straightness, strength as well as length of stem are the parameters considering during grading. Flowers are generally grouped into bunches of 5, 10, 12 or 20 stems and loosely tied with rubber bands. Individual flower bunches are wrapped with suitable packing materials like cellophane paper, craft paper, newspaper, tissue paper or corrugated cardboard sheet before placing them in the package. For local

markets, bunches are kept in buckets containing water or preservative solution. For long distance transport and storage, flower bunches are held in dry cardboard boxes.

2.8.3.6 Packaging

Cut flowers are inserted in tubes containing water or water with preservatives or simply wrapped in wet cotton swab and the same is covered with a piece of plastic and tied with rubber band to keep in its place. Such 5 or 10 spikes are bunched together. Bunches or individual spikes are placed inside the box in alternate fashion. Ethylene absorbents with KMnO4 or Purafil may also be kept in the box. Single flowers of cymbidiums are packed in small flasks containing preservative solution which are again packed in 3 sided box with a display window. It provides a festive look for the flowers. In *Dendrobium*, hybrid 'Sonia-17' when covered with cotton dipped in 8-HQS (25ppm) solution the base of the spike recorded maximum vase life in packing.

2.8.3.7 The wholesale orchid market

The floral industry is a highly dynamic business. With the increase in demand for flowers, floriculture has become one of the important commercial trades in Indian Agriculture. The important criterion to spend money on flowers is the relationship between quantity, quality and price (Kras, 1999). Market preference also varies among importing countries. Cymbidiums rank 7th in top 10 cut flowers and it is the leader among all orchids in global cut flower trade. *Vanda, Mokara, Dendrobium, Aranda*, *Arachnis*, *Oncidium* and *Cattelya* are also popular in world wide.

Since the USDA began keeping statistics on orchid production, sales of orchid cut flowers and potted plants have increased significantly in the United States. Since 1996 there has been an increase of 29 per cent in the number of orchid

growers (Jerardo, 2006; Nash, 2003). Wholesale values of potted flowering orchids reached $100 million in 2001 with cut orchid flower sales adding an additional $8.6 million. Value of wholesale of potted flowering orchids rose to $144 million in 2005. Commercial orchid production has not yet met demand (Griesbach, 2002) as evidenced by the steadily increasing number of orchids sold annually (Jerardo, 2006).

Ascocenda hybrids are typically compact in stature, form numerous large flowers and are free blooming (Fitch, 2005). Other bigeneric hybrids like Vandafinetia offer an even more compact habit with unusual flowers. Such plants may be marketable for windowsill cultivation (Grove, 1995). Although vanda hybrids have many qualities that make them highly marketable, the production of Vanda hybrids is currently confined to small-scale growing operations (Johnson, 2007).

2. 9 Value addition in orchids

Value addition in floriculture is the process of increasing the economic value and consumer appeal of any floral commodity. In a billion-dollar international industry, orchids are prized for their spectacular beauty and longevity. Orchid flowers are known for their high magnitude of diversity in form, colour, size, shape, attractiveness, longer life span and response to the environment.

De and Medhi (2015) categorized the uses of orchids into four broad categories: landscape uses, as cut flowers, for symbolism in special occasions and for making value-added products. Value-addition in orchids is directed towards the uses such as dry flowers, edible orchids, herbal medicine preparations, extraction of pharmaceutical and neutraceutical compounds and for manufacturing the perfumes. Aromatherapy using aromatic oils extracted from fragrant orchids is an unexplored sector.

2.9.1 Orchidscaping: Orchidscaping is the use of orchids permanently planted into specially prepared beds or attached to trees, shrubs rocks in the appropriate spot in the garden. They can be combined with other traditional ornamentals such as palms, ferns, flowering perennials, shrubs, trees, herbs etc. It is easy to create some of the most interesting and beautiful gardens depending upon the cost involvement and microclimatic factors. Many orchids can be grown on rocks and logs for placing in the landscape. They are attached to either cut wooden logs, coconut logs or living trees and shrubs (De *et al.*, 2014)

2.9.1.1 Potted plants/hanging baskets/ trays: Potted orchids last for longer than cut flowers, their shelf life being three weeks to four months depending upon species. Basket culture is useful for those orchids like *Vanda, Rhyncostylis* and *Arachnis* with pendent flower spikes and long dangling roots. Important orchid genera used as potted plants in the international market are *Phalaenopsis, Oncidium, Miltonia, Cymbidium, Paphiopedilum, Dendrobium, Cattleya, Ascocenda, Vanda, Brassia, Miltonia and Epidendrum.*

2.9.1.2 Orchid tree: An orchid tree is a variation on mounting orchids except the placement of many orchids on a branch or branches to give a completely natural look (De and Singh, 2016). It is used in those areas of the country where orchids are grown outdoors during most of the year. Usually, the larger plants are attached to the bottom and the smallest on the upper portions for aesthetic reasons and to provide extra weight at the bottom to balance the weight of the structure. It is better to select those plants which require similar light, temperature and humidity conditions. Another factor that has to be considered is flowering period to get different colours on the tree throughout the year.

2.9.1.3 Balcony gardens: In balcony gardens, lithophytic orchids can be grown by attaching them in free standing rocks or to the balcony's masonry walls.

Genera suitable for shady location may include *Bulbophyllum, Coelogyne, Eria, Maxillaria*, some *Oncidiums, Sarchochilus* hybrids, *Phalaenopsis* and *Cattleya* hybrids (De *et al*, 2014)

2.9.1.4 Colour Scheme with Orchids: To develop an orchidscape,. gardener should aware of the flowering period of each orchid. Some gardeners enjoy seasonal burst of colour. For them, cymbidiums and *Dendrobiums* which flower from winter to spring should be the first choice (De *et al*, 2014).

2.9.1.5 Moon garden: white or light coloured night blooming plants are used in moon garden which can reflect moon light. Green leaved with contrasting white blooms while silver or grey, blue green, and variegated foliage also enhance the garden.

2.9.1.6 Orchids as source of phytochemical and Herbal garden with orchids: Tribal people of north eastern hill region use wild orchids for a variety of folk medicine as they are rich in alkaloids, flavonoids, glycosides, carbohydrates and other phytochemicals. Many medicinal orchids are rich in alkaloids. Isolation of a number of alkaloids like anthocyanins, stilebnoids and triterpenoids from orchids. Orchinol, hircinol, cypripedin, jibantine, nidemin and loroglossin have been reported from orchids (Hossain, 2010; Khouri *et al*., 2006; Saleem, 2007).

2.9.1.7 Fragrant garden: Fragrant orchids are delightful in the outdoor living areas. According to Trembloy (2011), orchids are essential for developing a landscape theme and for creating better ambience and physical comfort in a garden. Orchids can add exotic beauty, amazing colour and incomparable fragrance to landscape. Fragrant orchids also have better scope as natural room fresheners with an amazing fragrance. Some of the fragrant species like *Dendrobium cruminatum, Cattleya intermedia, Epidendrum radicans,* etc. hardly last for a day. These hybrids

remain on the plant for several days. This feature also makes it a novelty in sensory/fragrant gardens.Other aromatic orchids are *Aerides multiflorum, Aerides odoratum, Aeranthes Bulbophyllum odoratissimum, Cattleya maxima, Coelogyne cristata, Coelogyne ochracea, Cymbidium ensifolium, Dendrobium nobile, Epidendrum cristatum, Epidendrum floribundum, Epidendrum nocturnum, Lycaste, Oncidium spaceolatum, Phaius tankervilleae, Rhyncostylis retusa, Vanda cristata, Vanda tessellata and Zygopetalum intermedium.*

2.9.2 Flower Arrangements: Flower arrangements with orchids are good table adornments and for wedding decorations (De *et al*, 2014).

2.9.3 Dry flowers: Orchids can be dried best using silica gel in microwave drying or by freeze drying. Drying orchids is a challenging task as these flowers are considered difficult to be preserved. Dried orchids are used for different purposes such as, for use in vases, baskets and sometimes in shadow boxes (De *et al*, 2014).

2.9.4 Other uses: In Philippines and New Guinea, the stem of some *Dendrobium* species is used to make baskets and bracelets. Some tribes use sap of *Cattleya labiata var. autumnalis* as glue for preparation of musical instruments. In Central America, the Schomburgkias empty the pseudobulbs of orchids and make horn with them. (De *et al*, 2014).

Materials and methods

3. MATERIALS AND METHODS

The present study to evaluate the performance of fragrant vandaceous orchids for ornamental traits was conducted at the Department of Floriculture and Landscaping, College of Horticulture, Vellanikkara, Trissur during the period from June 2016 to May 2017. The materials used and methodology adopted for the investigation are given in this chapter.

1. Location

Vellanikkara is situated at the latitude of 10^0 31' N and the longitude of $76^0$13' E. The area lies at 22.25 m above MSL.

2. Climate

The site enjoyed a humid tropical climate with maximum temperature varying from 29.8° C to 36.1° C and the minimum temperature from 21.7° C to 26. ° C during the period of investigation. The mean relative humidity varied from 51 per cent to 89 per cent. The total rainfall recorded during the period of investigation was 1618.4 mm. Weather data during period of the present study is given in Appendix.

3. Performance evaluation

3.1. Materials

Twenty five fragrant vandaceous orchid varieties / hybrids (intermediate type) were grown in an open ventilated polyhouse to evaluate their performance and to assess the suitability for various landscaping purposes. List of selected varieties/ hybrids is given in Table 1.

3.2. Shade

Vandaceous orchids were grown in an open ventilated polyhouse (12m x 8m) providing 25 per cent shade, which was found to be the best for their growth.

3.3 Media

All varieties/ hybrids were grown in hanging pots with slots with little (brick pieces, coconut husk and broken tiles) or no media.

Table. 1. Vanda varieties / hybrids selected for evaluation

Sl. No	Variety / hybrid
1	*Neostylis* Lou Sneary
2	*Rhynchorides* Bangkok Sunset
3	*Rhy.* Sri Siam x *Rhy. gigantea*
4	*V.* Kultana Fragrance
5	*Vasco* Blue Bay Blue
6	*Vasco* Blue Bay White
7	*Vasco* Blue Bay Pink
8	*Ascda* Sirichai Fragrance
9	*V.* Indian Incense x *V. tessellata*
10	*V.* Mimi Palmer
11	*V. coerulea* x *V.* Mimi Palmer
12	*Vascostylis* Crownfox Red Gem
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue
14	*Ascda.* Udomchai
15	*Darwineria* Cream Puff
16	*V.* Rothschildiana
17	*V.* Pranerm Prai x V. *tessellata*
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)
19	*Aerides quinque Vulnera Rhy. coelestis*
20	*Ascda.* Suksamran Sunlight Yellow
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold
24	*Vasco* Kultana Million Bhat
25	*V.* JVB X *Ascocenda* Yip Sum Wah

3.4. General management

These plants require good aeration for the roots. Slots of hanging pots ensured better aeration and free downward growth of the roots. Plants were irrigated twice a day to provide good moisture.

Foliar application of N: P: K 19:19:19 at 0.3 per cent (3g/l) concentration was given at weekly intervals. Need based plant protection chemical application was also carried out.

3.5. Design of the experiment

A completely randomized design having twenty five varieties with three replications was laid out.

3.6 Observations

3.6.1 Quantitative characters

Three plants per replication in each variety / hybrid were used for recording observations at monthly intervals. Following observations were recorded for evaluating the suitability of the orchids for landscaping.

A. Plant characters

1.Plant height

Height of the plant from the base to the growing apex was measured and expressed in centimeter.

2. Plant spread

Plant spread was measured and expressed in centimeters.

3. Shoot girth

Shoot girth was measured at 10.0 cm above the base and expressed in centimeter

4. Internodal length

Internodal length of the plant was measured at 20.0 cm below the growing tip of the shoot and expressed in centimeter.

5. Number of leaves/ plant

Total number of leaves present at the time of each observation was counted and recorded as number of leaves.

6. Leaf length

Leaf length was taken from the base to the tip of the expanded leaf and expressed in centimeter.

7. Leaf breadth

The maximum width of the expanded leaf was measured and recorded in centimeter.

8. Leaf area

Leaf area was derived from the formula 1.03 x Length x Breadth, where 1.03 is a constant. The constant was calculated using statistical package of nonlinear regression method (Sankar, 2003) and it expressed in cm^2.

9. Interval of leaf production

The interval between the production of two successive leaves was noted and expressed in days.

10. Number of roots

Number of roots produced by each variety/ hybrid was counted and recorded.

11. Length of roots

Root length was measured and expressed in centimeter.

12. Girth of roots

Root girth at 5.0 cm from the base of the plant was measured and expressed in centimeter.

B. Floral characters

1. Days from spike emergence to opening of first floret

Duration taken for the opening of first floret after spike emergence was recorded in days.

2. Days from spike emergence to harvest

Duration taken for the opening of fifty per cent of the flowers after spike emergence was recorded in days.

3. Days from spike emergence to complete opening of florets

Duration taken for complete (100%) opening of all the florets on the spike was recorded in days.

4. Longevity of spike on the plant

Spike longevity was measured from the day the spike becomes suitable for use as cut flower to wilting of first floret.

5. Interval of spike production

The interval between the production of two consecutive spikes was noted in days.

6. Number of spikes produced per year

Number of spikes produced on each plant was noted and number of spikes per plant per year in each variety/ hybrid was estimated.

7. Blooming period / season

Emergence of spike in each variety/ hybrid was observed throughout the year and blooming period with respect to each variety was recorded.

8. Length of spike

Length of the spike from base to tip was measured and expressed in centimeter.

9. Length of rachis

Length of rachis (portion of spike bearing florets) per spike in each plant of the variety / hybrid was measured and expressed in centimeter.

10. Length of flower stalk

Stalk length of the spike in each plant was measured and expressed in centimeter.

11. Girth of spike at base

The circumference of the spike at 5.0 cm from the point of attachment to the stem was measured as spike girth and expressed in centimeter.

12. Number of florets per spike

Number of florets per spike in each variety was recorded.

13. Internodal length

Between florets at the base: length between the nodes of base florets was measured and expressed in centimeter.

Between florets at the top: length between the nodes of top florets was measured and expressed in cm^2.

14. Flower size

Size of an individual floret was recorded as the product of length (vertically) and width (across) of flower and expressed in cm^2.

15. Length of labellum

Length of labellum (lip) was measured and expressed in centimeter

16. Width of labellum

Width of the labellum (lip) was measured and expressed in centimeter.

17. Length of column

Column length was measured from the base to the tip of the column and expressed in centimeter.

18. Floret stalk length

Floret stalk length was measured from the base of attachment of floret to the spike to the portion where the sepals are attached and expressed in centimeter.

19. Life of individual floret on the spike

Life of individual floret on the spike was measured for four florets per spike from the day the floret opens to the day it wilts and the mean values were expressed.

C. Post-harvest characters

The spikes were harvested when ½ to $^{2}/_{3}$ florets were open and they were kept in water. The following characters were observed during the vase study.

1. Fresh weight

After harvest, fresh weight of the freshly cut spike was taken immediately and expressed in grams.

2. Spike longevity

Time taken from the harvest of the spike till it remained fresh without wilting, shriveling or drooping is noted and expressed in days.

3. Bud opening in vase

Number of buds on cut spike opening in vase was counted and recorded.

4. Wilting of first floret

Days taken from the harvest to wilting of first floret were noted.

5. Physiological loss in weight (PLW)

The loss in weight of the spike in vase life was recorded by deducting the weight at the end of vase study from the initial fresh weight of the spike and expressed in grams.

6. Water uptake

The total uptake of water by the spike was determined by finding the difference between the initial and final volume of the vase solution and expressed in milliliters.

7. Life span of floret

Life of individual floret in vase was counted for four florets per spike from the day of harvest till the day it wilted in vase and mean values were expressed in days.

3.6.2. Qualitative characters

A. Plant characters

1. Nature of growth- erect, hanging, prostrate
2. Nature of shoot – medium sized. sturdy, slender.

3. Shoot colour – green, brown

4. Branching of shoot – present/ absent

5. Root location – along the stem(aerial), basal

6. Nature of roots – cylindrical, thread like, shrivelled/ creeping/ robust and flattened

7. Branching of roots – present/ absent

8. Colour of roots – light green, grey, white

B. Leaf characters

1. Shape – terete, semi-terete,strap, channelled

2. Texture – smooth, verucose, rigid, pubescent, leathery, glabrous, fleshy

3. Margin – entire, wavy, serrate, coriaceous

4. Apex – bilobed, retuse, praemorse, tridentate, truncate, emarginated

5 Leaf colour – green, dark green, dark green with reddish purple underneath

6. Marking – present/absent

7. Colour of sheath – light green, dark green

8. Nature of sheath – membraneous, nerved or not

9. Orientation – straight, arching, deflexed, horizontal

10. Arrangement – spiral, alternate, clustered at base, distichous

11. Pigmentation – colour changes during maturity

12. Other characters – channelled at apex, channelled at base, deeply channelled, channel not prominent

C. Floral characters

1. Spike orientation – erect, horizontal, and drooping

2 Inflorescence – dense/ lax

3 Arrangement of florets on spike – facing all directions, facing one direction, facing two directions

4. Petal shape – linear, oblong, obovate, elliptic, lanceolate

5. Petal curvature – straight, deflexed, incurved with deflexed apex, deflexed with incurved apex, incurved with straight apex

6. Petal margin – entire, erose, undulate

7. Petal apex – acute, obtuse, truncate, bilobed

8 Petal colour pattern – uniform, spotted, blotched, streaked/ striped, tessellated

9. Lip mid lobe shape – ovate, lanceolate, orbicular

10 Lip lateral lobe shape – orbicular, ovate, lanceolate

11. Lip apex – acute, obtuse, and bilobed

12. Lip curvature – straight, deflexed, deflexed with straight apex, deflexed with incurved apex.

13 Lip colour – single, double, triple or more

14 Lip surface – glabrous, pubescent

15 Lip colour pattern - uniform, spotted, blotched, streaked/ striped, tessellated

16 Column colour pattern – uniform, spotted, blotched, streaked/ striped

17 Pigmentation – present/ absent

18 Spur type – conical, cylindrical, tubular, saccate

19 Spur length – short (<0.5 cm), medium (0.5 – 1.0 cm), long (> 1.0 cm)

20 Fragrance – present/ absent

Explanations for floral characteristics used for grouping orchids (PPV & FRA. 2012) are given in Appendix II

3.6.3. Incidence of pests and diseases

Incidence of pests and diseases was also recorded during the study

3.6.4 Sensory evaluation

Spikes of vandaceous orchid varieties/ hybrids were visually scored by ten individuals for use as cut flower as well as for indoor display and their general acceptability was observed. Scoring was done based on flower colour and pigmentation, size, shape, arrangement of florets on spike and texture.

Plant quality rating was done based on growth, fullness and visual appearance viz. spike longevity, flower colour and pigmentation, shape and arrangement of foliage

during the growth period. For each character, grades ranged from 1-10 and its total was determined for each variety or hybrid.

The fragrance of the flowers were judged based on intensity or diffusiveness (maximum of five points), beautifulness, elegance and freshness (maximum of 10 points) and newness (maximum of five points) and it's totality (maximum of 20 points) to each variety or hybrid. (Nakamura *et al.* 2007).

3.7 Statistical analysis

Data collected with respect to different quantitative characters were subjected to an analysis of variance using WASP 2, developed by ICARGOA.

The varieties were compared for significant difference using Duncan's Multiple Range Test (DMRT).

Results

4. RESULTS

The results of the 'Evaluation of fragrant vandaceous orchids for ornamental traits' conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 2016- 2017 are presented in this chapter.

4.1 QUANTITATIVE CHARACTERS

4.1.1. Plant characters

Data pertaining to the quantitative characters of the vandaceous orchid varieties/ hybrids are presented in Tables 2 to 4.

Plant height

Plant height recorded at monthly intervals during the period of study (June 2016 to May 2017 is presented in Table 2 and Fig.2. Among the twenty five varieties, *Vascostylis* Crownfox Red Gem recorded maximum plant height (68.73 cm) at the end of the observation period and was closely followed by *V.* Pranerm Prai x *V. tessellata* (63.50 cm) and *V.* JVB X *Ascocenda* Yip Sum Wah (59.67 cm) which were on par. Minimum plant height (9.30cm) was observed in *Neostylis* Lou Sneary followed by *Rhynchorides* Bangkok Sunset (10.87 cm). Almost similar situation continued during the entire period of observation.

Plant spread

Significant differences were observed with regard to plant spread in different vandaceous orchid varieties/ hybrids. Highest value for plant spread was noticed in *Vascostylis* Crownfox Red Gem during the entire period of observation except during the initial month (June) and was comparable with *Ascda.* Udomchai. At the end of the study, highest plant spread (59.23 cm) was observed in *Vascostylis* Crownfox Red

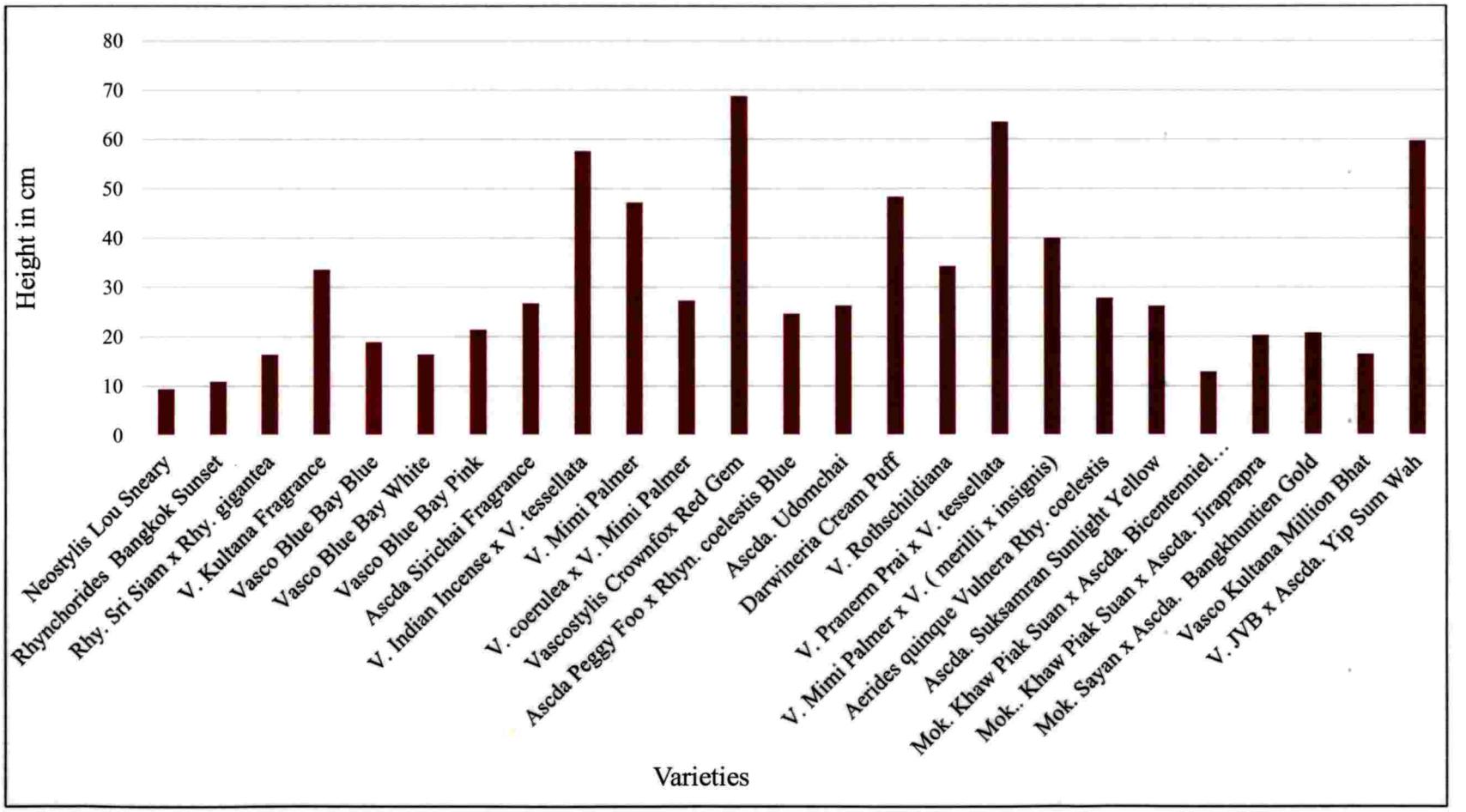
Table. 2. Plant height in vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties /hybrids	Plant height (cm)											
		June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	5.93^{l}	6.63^{m}	7.27^{l}	7.53^{l}	7.73^{m}	8.07^{k}	8.30^{k}	8.50^{l}	8.67^{l}	8.87^{m}	9.10^{j}	9.30^{k}
2	*Rhynchorides* Bangkok Sunset	7.13^{l}	8.07^{lm}	8.57^{lm}	8.77^{kl}	9.10^{lm}	9.27^{k}	9.57^{jk}	10.07^{kl}	10.23^{kl}	10.40^{lm}	10.27^{j}	10.87^{jk}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	10.00^{kl}	11.27^{jklm}	11.87^{jklm}	12.30^{jkl}	12.83^{klm}	13.33^{ijl}	13.73^{ikl}	14.07^{ijkl}	14.50^{jkli}	14.80^{jklm}	15.63^{ij}	16.33^{hijk}
4	*V.* Kultana Fragrance	27.17^{de}	27.57^{de}	27.80^{de}	28.03^{de}	28.17^{ef}	28.63^{ef}	28.90^{ef}	29.13^{ef}	29.50^{ef}	29.80^{ef}	30.00^{ef}	33.53^{de}
5	*Vasco* Blue Bay Blue	11.27^{jkl}	11.93^{jklm}	12.70^{jklm}	13.30^{ijkl}	14.03^{jklm}	14.70^{hijk}	15.27^{hij}	16.20^{hijk}	16.97^{hijk}	17.67^{hijk}	18.37^{hi}	18.90^{ghij}
6	*Vasco* Blue Bay White	9.33^{kl}	10.67^{klm}	11.53^{jklm}	12.17^{jkl}	12.70^{klm}	13.20^{ijk}	13.63^{ijk}	14.27^{ijkl}	15.00^{ijkl}	15.60^{ijkl}	16.00^{ij}	16.37^{hijk}
7	*Vasco* Blue Bay Pink	14.47^{hijk}	15.60^{hijk}	16.23^{hijk}	16.80^{ghij}	17.27^{hijk}	17.73^{ghij}	18.27^{ghi}	19.97^{ghi}	19.87^{ghi}	20.33^{ghij}	20.83^{ghi}	21.40^{fgh}
8	*Ascda* Sirichai Fragrance	19.80^{fgh}	20.87^{fgh}	21.57^{fgh}	22.00^{efg}	22.60^{fgh}	22.93^{fg}	23.60^{fg}	24.00^{fg}	24.40^{fgh}	25.20^{fg}	25.93^{fgh}	26.73^{efg}
9	*V.* Indian Incense x *V. tessellata*	38.77^{b}	41.23^{b}	43.30^{b}	46.47^{b}	48.70^{b}	50.50^{b}	51.93^{c}	53.63^{b}	54.80^{b}	55.67^{b}	56.77^{b}	57.57^{b}
10	*V.* Mimi Palmer	30.10^{cd}	33.63^{c}	34.87^{c}	36.97^{c}	37.80^{cd}	38.87^{cd}	40.57^{d}	41.93^{c}	42.97^{c}	44.43^{c}	45.90^{c}	47.17^{c}
11	*V. coerulea* x *V.* Mimi Palmer	21.70^{f}	22.57^{ef}	23.00^{ef}	23.37^{ef}	23.77^{fg}	24.20^{fg}	24.60^{fg}	25.20^{fg}	25.70^{fg}	26.17^{fg}	26.70^{efg}	27.30^{ef}
12	*Vascostylis* Crownfox Red Gem	56.2^{a}	56.83^{a}	58.23^{a}	58.87^{a}	59.90^{a}	60.97^{a}	64.20^{a}	65.83^{a}	67.10^{a}	67.63^{a}	68.13^{a}	68.73^{a}
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	21.80^{ef}	22.03^{f}	22.33^{efg}	22.57^{efg}	22.87^{fgh}	23.20^{fg}	23.40^{fg}	23.70^{fg}	23.9^{fgh}	24.13^{fgh}	24.37^{fgh}	24.60^{fgh}
14	*Ascda.* Udomchai	18.13^{fghi}	18.77^{fgh}	19.37^{fgh}	19.73^{fgh}	20.50^{ghi}	21.33^{gh}	22.63^{fg}	23.70^{fg}	24.20^{fgh}	25.17^{fg}	25.77^{fgh}	26.30^{efg}
15	*Darwineria* Cream Puff	33.70^{bc}	35.60^{c}	37.00^{c}	38.17^{c}	39.17^{c}	41.03^{c}	42.30^{d}	43.10^{c}	44.47^{c}	45.73^{c}	47.00^{c}	48.33^{c}

Plant height in vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties /hybrids	Plant height (cm)											
		June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
16	*V.* Rothschildiana	31.50^{cd}	31.77^{cd}	32.00^{cd}	32.20^{cd}	32.40^{de}	32.57^{de}	32.83^{e}	33.47^{de}	33.70^{de}	33.87^{de}	34.03^{de}	34.23^{de}
17	*V.* Pranerm Prai x *V. tessellata*	54.83^{a}	55.87^{a}	56.87^{a}	57.53^{a}	58.33^{a}	59.17^{a}	60.13^{ab}	60.50^{ab}	60.90^{ab}	62.07^{ab}	63.00^{ab}	63.50^{ab}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	33.10^{c}	33.80^{c}	34.53^{c}	35.23^{c}	35.77^{cd}	36.57^{cd}	39.70^{d}	37.70^{cd}	38.13^{cd}	38.77^{cd}	39.40^{cd}	39.97^{cd}
19	*Aerides quinque Vulnera Rhy. coelestis*	20.03^{fg}	20.73^{fgh}	21.23^{fgh}	22.10^{efg}	22.80^{fgh}	23.67^{fg}	24.33^{fg}	24.93^{fg}	25.67^{fg}	26.43^{fg}	27.07^{efg}	27.87^{ef}
20	*Ascda.* Suksamran Sunlight Yellow	21.07^{fg}	21.50^{fg}	22.07^{efg}	22.40^{efg}	22.73^{fgh}	23.20^{fg}	23.77^{fg}	24.17^{fg}	24.60^{fg}	25.17^{fg}	25.77^{fgh}	26.23^{efg}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	10.13^{kl}	10.50^{klm}	10.77^{klm}	11.07^{jkl}	11.33^{klm}	11.57^{jk}	11.80^{ijk}	12.07^{jkl}	12.30^{jkl}	12.60^{klm}	12.77^{ij}	12.90^{ijk}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	17.67^{fghi}	18.10^{fghi}	18.57^{fghi}	19.07^{fghi}	19.43^{ghij}	20.00^{ghi}	20.57^{gh}	21.60^{gh}	21.87^{ghi}	22.33^{ghi}	22.93^{ghi}	23.46^{fghi}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	16.17^{ghij}	16.53^{ghi}j	16.80^{ghij}	17.20^{fghij}	17.404^{hijk}	17.77ghij	18.20ghi	18.73^{ghij}	19.17^{ghij}	19.53^{ghijk}	20.17^{ghi}	20.77^{fghi}
24	*Vasco* Kultana Million Bhat	12.80^{ijk}	13.07^{ijkl}	13.50^{ijkl}	13.87^{hijk}	14.20^{ijkl}	14.53^{hijk}	14.87hijk	15.20^{hijkl}	15.57^{ijkl}	15.93^{ijkl}	16.27^{ij}	16.47^{hijk}
25	*V.* JVB x *Ascda.* Yip Sum Wah	53.50^{a}	53.83^{a}	54.37^{a}	54.77^{a}	55.33^{a}	56.07^{ab}	56.80^{bc}	57.23^{b}	57.77^{b}	58.40^{b}	59.10^{b}	59.67^{b}

Fig. 1. Plant height in vandaceous orchid varieties/ hybrids during the period of observation



Gem, followed by *Ascda*. Udomchai and were statistically comparable. (Table. 3 and Fig. 2)

Plant spread was considerably minimum (21.73 cm) in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold followed by *Neostylis* Lou Sneary (27.43 cm) and *Rhynchorides* Bangkok Sunset (27.70 cm).

Shoot girth

The data regarding the shoot characters of vandaceous orchid varieties/ hybrids are presented in Table 4.

Vandaceous orchid varieties/ hybrids showed considerable variation in shoot girth. Maximum shoot girth (4.99 cm) was observed in *V.* Pranerm Prai x V. *tessellata* followed by *Vascostylis* Crownfox Red Gem (4.93cm) and was significantly superior to all other varieties. The lower value for shoot girth was recorded in *Neostylis* Lou Sneary (2.83 cm) followed by *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (3.07 cm).

Internodal length

Significant differences were observed in the internodal lengths of the selected vandaceous orchids. It was significantly maximum in *Vascostylis* Crownfox Red Gem (1.95 cm) compared to other varieties. This was followed by *V.* Pranerm Prai x V. *tessellata* (1.44 cm), *Aerides quinque Vulnera Rhy. coelestis* (1.43 cm), *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (1.42 cm) and *Darwineria* Cream Puff (1.41cm) which were on par. Least internodal length was recorded in *Neostylis* Lou Sneary (0.59cm) followed by *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (0.63 cm), *Vasco* Blue Bay White (0.71 cm) and they did not exhibit significant variation. (Table 4)

4.1.2. Leaf characters

The data pertaining to the leaf characters of different vandaceous orchid varieties/ hybrids are presented in Tables 5-10.

Table. 3. Plant spread of Vandaceous orchid varieties / hybrids during the period of observation

Varieties /hybrids	Plant spread(cm)											
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Neostylis Lou Sneary	25.67^{lm}	25.83^{jk}	26.00^{ij}	26.07^{kl}	26.33^{jk}	26.50^{jk}	26.67^{i}	26.77^{i}	26.93^{j}	27.17^{l}	27.30^{l}	27.43^{l}
Rhynchorides Bangkok Sunset	23.93^{m}	24.10^{k}	24.30^{j}	24.67^{l}	25.10^{k}	25.23^{k}	25.73^{i}	26.07^{i}	26.50^{j}	26.93^{l}	27.33^{l}	27.70^{l}
Rhy. Sri Siam x *Rhy. gigantea*	43.50^{cd}	43.60^{c}	43.83^{c}	43.93^{d}	44.07^{d}	44.20^{c}	44.30^{d}	44.47^{d}	44.60^{d}	44.73^{ef}	44.83^{efg}	44.97^{efg}
V. Kultana Fragrance	28.93^{kl}	29.87^{hij}	30.67^{gh}	30.93^{ij}	31.83^{hi}	32.43^{hi}	32.83^{gh}	33.50^{gh}	34.20^{ghi}	35.07^{ijk}	35.70^{jk}	36.47^{jk}
Vasco Blue Bay Blue	29..00^{kl}	29.30^{ij}	29.87^{hi}	30.07^{jk}	30.47^{ij}	30.83^{ij}	31.17^{h}	31.50^{h}	31.77^{i}	32.00^{k}	32.37^{k}	32.67^{k}
Vasco Blue Bay White	31.23^{jk}	31.40^{hi}	31.60^{gh}	31.83^{ij}	32.10^{hi}	32.37^{hi}	32.57^{h}	32.87^{h}	33.10^{hi}	33.40^{jk}	33.63^{k}	33.83^{k}
Vasco Blue Bay Pink	36.33^{ghi}	36.57^{efg}	36.73^{ef}	36.97^{gh}	37.23^{fg}	37.43^{fg}	37.63^{fg}	37.80^{fg}	38.07^{fg}	38.27^{hi}	38.60^{ij}	38.83^{ij}
Ascda Sirichai Fragrance	38.23^{efgh}	38.43^{def}	38.57^{de}	38.8^{efg}	39.00^{ef}	39.27^{def}	39.50^{ef}	39.50^{ef}	39.87^{ef}	40.10^{gh}	40.30^{hi}	40.60^{ghij}
V. Indian Incense x *V. tessellata*	36.77^{ghi}	36.87^{efg}	37.03^{e}	37.27^{gh}	37.50^{fg}	37.70^{fg}	37.90^{f}	38.30^{f}	38.53^{f}	38.70^{hi}	38.97^{ij}	39.43^{hij}
V. Mimi Palmer	42.67^{de}	42.83^{c}	43.00^{c}	43.37^{d}	43.57^{d}	43.8^{c}	44.03^{d}	44.27^{d}	44.47^{d}	45.03^{ef}	45.47^{ef}	45.83^{ef}
V. coerulea x *V.* Mimi Palmer	40.60^{defg}	40.93^{cde}	41.47^{cd}	42.20^{def}	42.63^{de}	43.17^{cd}	43.87^{d}	44.67^{d}	45.37^{d}	46.00^{de}	46.73^{de}	47.40^{de}
Vascostylis Crownfox Red Gem	54.27^{a}	54.63^{a}	54.97^{a}	55.27^{a}	55.67^{a}	56.30^{a}	56.37^{a}	57.37^{a}	57.73^{a}	58.27^{a}	58.63^{a}	59.23^{a}
Ascda Peggy Foo x *Rhyn. coelestis* Blue	42.83^{d}	43.10^{c}	43.30^{c}	43.53^{d}	43.80^{d}	43.97^{c}	44.20^{d}	44.57^{d}	45.00^{d}	45.43^{e}	45.87^{ef}	46.10^{ef}
Ascda. Udomchai	54.37^{a}	54.50^{a}	54.60^{a}	54.70^{a}	54.83^{a}	55.03^{a}	55.13^{ab}	55.33^{ab}	55.40^{ab}	55.53^{ab}	55.73^{ab}	55.86^{ab}
Darwineria Cream Puff	35.80^{hi}	36.47^{fg}	36.97^{ef}	37.57^{gh}	37.970^{fg}	38.50^{efg}	38.93^{efg}	39.27^{ef}	39.97^{ef}	41.03^{fgh}	41.53^{fghi}	42.40^{fghi}

Plant spread of Vandaceous orchid varieties / hybrids during the period of observation contd...

Sl. No	Varieties /hybrids	Plant spread(cm)											
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
16	*V.* Rothschildiana	31.3^{jk}	31.77^{hi}	32.57^{fgh}	33.30^{hij}	33.80^{ghi}	34.30^{ghi}	34.77^{ghi}	35.30^{fgh}	36.20^{fgh}	37.30^{hij}	38.37^{ij}	39.83^{hij}
17	*V.* Pranerm Prai x V. *tessellata*	47.97^{bc}	48.3^{b}	48.7^{b}	49.13b^{c}	49.50^{bc}	49.90^{b}	50.30c	50.77^{c}	51.13^{bc}	51.67^{bc}	52.10^{bc}	52.93^{bc}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	33.53^{ij}	33.87^{gh}	34.47^{efg}	35.17^{ghi}	35.77^{fgh}	36.30^{fgh}	36.93^{fgh}	37.50^{fg}	38.10^{fg}	38.77^{hi}	39.27^{hij}	39.70^{hij}
19	*Aerides quinque Vulnera Rhy. coelestis*	41.73^{def}	41.8^{cd}	41.87^{cd}	42.4^{de}	42.60^{de}	42.73^{cde}	42.97^{de}	43.10^{de}	43.27d^{e}	43.37^{efg}	43.37^{efgh}	43.77^{efgh}
20	*Ascda.* Suksamran Sunlight Yellow	53.06^{a}	53.17^{a}	53.27^{a}	53.43^{ab}	53.53^{ab}	53.73^{ab}	53.87^{abc}	54.03^{bc}	54.20^{abc}	54.40^{abc}	54.50^{abc}	54.67^{bc}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	37.6^{fghi}	37.9^{defg}	38.2^{de}	38.43^{efg}	38.60^{ef}	39.10^{def}	39.17^{ef}	39.60^{ef}	40.0e^{f}	40.40^{gh}	40.80^{ghi}	41.10^{ghi}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	37.23^{ghi}	37.43^{defg}	37.63^{de}	37.87^{fg}	38.10^{fg}	38.23^{fg}	38.57^{fg}	38.73^{f}	39.13e^{f}	39.53^{gh}	39.83^{hij}	40.13^{hij}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	18.7^{n}	18.9^{l}	19.17^{k}	19.40^{m}	19.60^{l}	19.83^{l}	20.17^{k}	20.40^{j}	20.67^{k}	21.13^{m}	21.40^{m}	21.73^{m}
24	*Vasco* Kultana Million Bhat	50.1^{ab}	50.47^{ab}	50.9^{ab}	51.30^{abc}	51.67^{abc}	51.97^{b}	52.23^{bc}	52.70^{bc}	53.10^{bc}	53.43^{bc}	53.67^{bc}	54.00^{bc}
25	*V.* JVB x *Ascda.* Yip Sum Wah	48^{b}	48.27^{b}	48.5^{b}	48.87^{c}	49.20^{c}	49.40^{b}	49.67^{c}	49.90^{c}	50.03^{c}	50.20^{cd}	50.43^{cd}	50.60^{cd}

Fig. 2. Plant spread in vandaceous orchid varieties/ hybrids during the period of observation

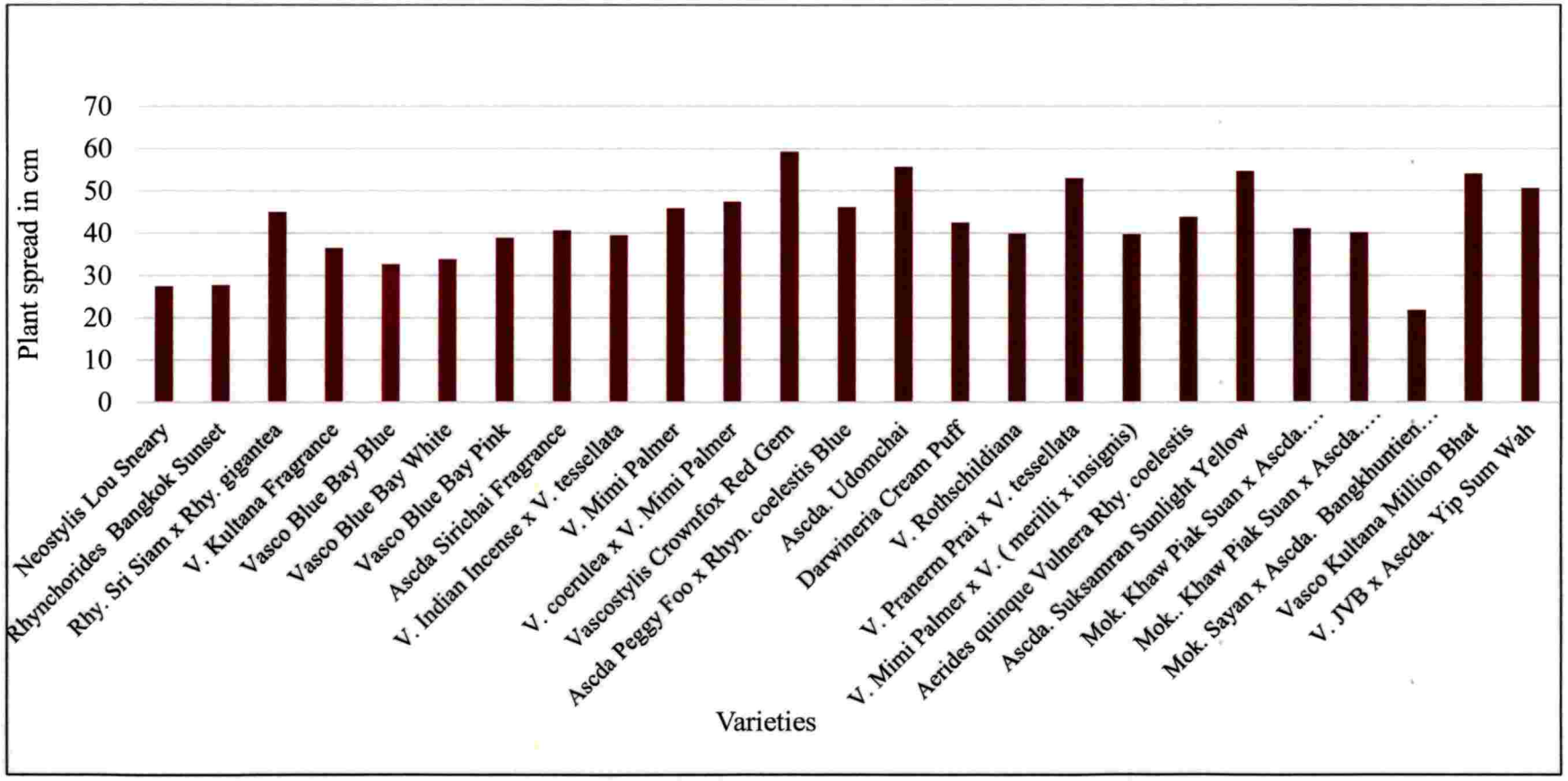


Table 4.Shoot characters of vandaceous orchid varieties/ hybrids

Sl. No	Varieties	Shoot characters				
		Shoot girth (cm)	Internodal length (cm)	Nature of shoot	Shoot colour	Branching
1	*Neostylis* Lou Sneary	2.83^{pq}	0.59^{l}	Slender	Brown	Absent
2	*Rhynchorides* Bangkok Sunset	3.69^{ij}	0.81^{hijk}	Stout	Brown	Absent
3	*Rhy.* Sri Siam x *Rhy. gigantea*	4.51^{bc}	0.96^{defgh}	Stout	Brown	Absent
4	*V.* Kultana Fragrance	3.42^{klm}	1.08^{cd}	Stout	Brown	Absent
5	*Vasco* Blue Bay Blue	3.84^{ghi}	0.81^{hijk}	Stout	Brown	Absent
6	*Vasco* Blue Bay White	3.66^{ijk}	0.71^{jkl}	Stout	Brown	Absent
7	*Vasco* Blue Bay Pink	4.15^{def}	0.99^{cdefg}	Stout	Brown	Absent
8	*Ascda* Sirichai Fragrance	3.35^{lm}	0.78^{ijk}	Stout	Brown	Absent
9	*V.* Indian Incense x *V. tessellata*	3.85^{ghi}	1.02^{cdef}	Stout	Brown	Absent
10	*V.* Mimi Palmer	4.14^{def}	1.16^{c}	Stout	Brown	Absent
11	*V. coerulea* x *V.* Mimi Palmer	4.04^{efg}	0.84^{fghij}	Stout	Brown	Absent
12	*Vascostylis* Crownfox Red Gem	4.93^{a}	1.95^{a}	Stout	Brown	Absent
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	4.38^{bcd}	1.42^{b}	Stout	Brown	Absent
14	*Ascda.* Udomchai	3.77^{hij}	1.02^{cdef}	Stout	Brown	Absent
15	*Darwineria* Cream Puff	4.23^{de}	1.41^{b}	Stout	Brown	Absent
16	*V.* Rothschildiana	4.32^{cd}	0.78^{hijk}	Stout	Brown	Absent
17	*V.* Pranerm Prai x V. *tessellata*	4.99^{a}	1.44^{b}	Stout	Brown	Absent
18	*V.* Mimi Palmer x *V.* (*merilli x insignis*)	3.07^{nop}	0.83^{ghij}	Stout	Brown	Absent
19	*Aerides quinque Vulnera Rhy. coelestis*	4.60^{b}	1.43^{b}	Stout	Brown	Absent
20	*Ascda.* Suksamran Sunlight Yellow	3.97^{fgh}	0.87^{efghij}	Stout	Brown	Absent
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	3.32^{mn}	1.03^{cde}	Stout	Brown	Absent
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	3.66^{ijk}	1.00^{cdefg}	Stout	Brown	Absent
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	3.57^{jkl}	0.63^{kl}	Stout	Brown	Absent
24	*Vasco* Kultana Million Bhat	4.39^{bcd}	0.89^{efgh}	Stout	Brown	Absent
25	*V.* JVB x *Ascda.* Yip Sum Wah	3.83^{ghi}	1.15^{c}	Stout	Brown	Absent

Leaf length

The vandaceous orchid varieties / hybrids showed considerable variation in leaf length during the period of observation (Table 5 and Fig.3). *Vascostylis* Crownfox Red Gem was significantly superior to all others throughout the observation period, except *Vasco* Kultana Million Bhat and were on par. During the later part of the study, maximum leaf length (33.83 cm) was recorded by *Vascostylis* Crownfox Red Gem, and this was followed by *Vasco* Kultana Million Bhat (31.27cm) where it was comparable with *V.* Pranerm Prai x V. *tessellata* (29.00cm).

Minimum leaf length was observed in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (14.63 cm) followed by *Rhynchorides* Bangkok Sunset (14.83 cm) and *Neostylis* Lou Sneary (15.23 cm) which were on par.

Leaf breadth

Differences in leaf breadth were clearly evident among varieties (Table 6 and Fig.4). During the entire period of study, *Aerides quinque Vulnera Rhy. coelestis* recorded significant by which leaf breadth which was on par with the leaf breadth of *V.* Pranerm Prai x V. *tessellata* during June 2016 to Feb 2017. At the end of the study period, *Aerides quinque Vulnera Rhy. coelestis* recorded maximum leaf breadth (3.87 cm) and was significantly superior to all other varieties and followed by *V.* Pranerm Prai x V. *tessellata* (3.53 cm) and was on par with *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (3.23 cm).

Minimum leaf breadth was recorded in *Neostylis* Lou Sneary (1.13 cm) which was on par with *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (1.53 cm), followed by *V.* JVB X *Ascocenda* Yip Sum Wah (1.23cm).

Leaf area

Significant differences were observed in the leaf area of different varieties/ hybrids of vandaceous orchid. Maximum leaf area recorded throughout the study

Table. 5. Leaf length of vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties/ hybrids	Leaf length (cm)											
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	13.63^{m}	13.77^{m}	13.87^{n}	14.03^{lm}	14.23^{n}	14.43^{m}	14.67^{j}	14.83^{j}	14.90^{lm}	15.10^{lm}	15.10^{kl}	15.23^{l}
2	*Rhynchorides* Bangkok Sunset	13.87^{m}	13.93^{m}	13.93^{mn}	14.07^{lm}	14.20^{n}	14.27^{m}	14.40^{j}	14.47^{j}	14.57^{m}	14.67^{m}	14.73^{l}	14.83^{l}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	23.47^{defg}	23.60^{def}	23.73^{def}	23.87^{cdefg}	23.97^{def}	24.10^{de}	24.27^{de}	24.50^{defg}	24.57^{defg}	24.70^{defg}	24.83^{defg}	24.93^{efgh}
4	*V.* Kultana Fragrance	20.23^{ghijk}	20.30^{ghij}	20.47^{ghij}	20.56^{ghij}	20.70^{hijk}	20.90^{fghij}	20.97^{fg}	21.20^{hij}	21.30^{hi}	21.33^{ij}	21.43^{i}	21.57^{j}
5	*Vasco* Blue Bay Blue	13.97^{m}	14.33^{m}	14.67^{mn}	15.03^{klm}	15.37^{mn}	15.73^{lm}	16.13^{ij}	16.53^{ij}	17.17^{klm}	17.57^{kl}	17.90^{ik}	18.33^{k}
6	*Vasco* Blue Bay White	16.07^{lm}	16.13^{lm}	16.33^{lmn}	16.47^{jklm}	16.47^{lmn}	16.90^{klm}	17.17^{hij}	17.40^{hij}	17.67^{jkl}	17.83^{kl}	18.30^{j}	18.17^{k}
7	*Vasco* Blue Bay Pink	18.87^{jkl}	18.97^{ijkl}	19.03^{ijkl}	19.23^{ghijk}	19.43^{ijkl}	19.63^{hijk}	19.80^{fgh}	19.93^{fgh}	20.13^{hij}	20.33^{ijk}	20.50^{ij}	20.77^{jk}
8	*Ascda* Sirichai Fragrance	20.20^{hijk}	20.40 ^{fghi}	20.63^{fghij}	20.80^{fghij}	21.07^{fghi}	21.27^{efghi}	21.50^{efg}	21.70^{ghij}	21.87^{ghi}	22.23^{ghij}	22.70^{ghi}	23.43^{ghij}
9	*V.* Indian Incense x *V. tessellata*	16.33^{lm}	16.70^{klm}	17.07^{klm}	17.40^{ijklm}	17.73^{klm}	18.10^{jkl}	18.53^{jkl}	19.30^{jkl}	19.80^{hijk}	20.17^{ijk}	20.60^{ij}	21.33^{j}
10	*V.* Mimi Palmer	22.73^{efghi}	22.90^{efghi}	23.13^{efghi}	23.43^{cdefgh}	23.67^{efghi}	23.87^{defg}	24.17^{de}	24.37^{defg}	24.73^{defg}	24.97^{defg}	25.27^{defg}	25.50^{defgh}
11	*V. coerulea* x *V.* Mimi Palmer	21.17^{ghij}	21.27^{fghi}	21.27^{fghi}	21.67^{efghi}	21.87^{fghi}	22.03^{efghi}	22.30^{ef}	22.50^{fghi}	22.70^{fgh}	22.93^{fghi}	23.10^{fghi}	23.30^{ghij}
12	*Vascostylis* Crownfox Red Gem	31.70^{a}	31.83^{a}	32.00^{a}	32.10^{a}	32.33^{a}	32.47^{a}	32.67^{a}	32.97^{a}	33.20^{a}	33.37^{a}	33.43^{a}	33.83^{a}
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	23.40^{defg}	23.47^{defg}	23.53^{defg}	23.67^{cdefgh}	23.67^{efghi}	23.93^{def}	24.03^{de}	24.13^{efg}	24.27^{efg}	24.40^{efgh}	24.50^{efgh}	24.57^{fghi}

Leaf length of vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties/ hybrids	Leaf length (cm)											
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
14	*Ascda.* Udomchai	25.43^{cde}	25.63^{cde}	25.80^{cde}	26.00^{bcde}	26.20^{cde}	26.40^{cd}	26.57^{cd}	26.83^{cde}	27.07^{cde}	27.37^{cd}	27.63^{cd}	27.83^{cd}
15	*Darwineria* Cream Puff	21.47$_{fghij}$	21.57^{fghi}	21.73^{fghi}	21.83^{defghi}	21.90^{fghi}	22.07^{efgh}	22.20^{ef}	22.33^{fghi}	22.53^{fgh}	22.73^{fghij}	22.87^{fghi}	23.00^{hij}
16	*V.* Rothschildiana	22.83$_{efghi}$	22.97^{efgh}	23.23^{efgh}	23.43^{cdefg}	23.77^{defg}	23.97^{de}	24.33^{de}	24.67^{def}	25.03^{def}	25.37^{def}	25.70^{def}	26.00^{defg}
17	*V.* Pranerm Prai x V. *tessellata*	27.43bc	27.50^{bc}	27.63^{bc}	27.83^{abc}	27.93^{bc}	28.00^{bc}	28.17^{bc}	28.37^{bc}	28.47^{bc}	28.67^{bc}	28.83^{bc}	29.00^{bc}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	17.63kl	17.83^{jkl}	18.03^{jkl}	18.40^{ijklm}	18.63^{jkl}	18.97^{ijk}	19.03^{ghi}	19.23^{jkl}	19.53^{ijk}	19.93^{jk}	20.27^{ij}	20.63^{jk}
19	*Aerides quinque Vulnera Rhy. coelestis*	20.33^{ghijk}	20.40^{fghij}	20.50^{ghij}	20.63^{fghij}	20.73^{ghijk}	20.83^{ghij}	20.97^{fg}	21.13^{ij}	21.30^{hi}	21.57^{hij}	21.73^{hi}	21.87^{ij}
20	*Ascda.* Suksamran Sunlight Yellow	26.43$_{bcd}$	26.53^{bcd}	26.53^{cd}	26.67^{bcd}	26.73^{cd}	26.83^{cd}	26.90^{cd}	27.10^{cd}	27.20^{cd}	27.33^{cd}	27.40^{cde}	27.47^{cde}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	18.30^{jkl}	18.50^{ijkl}	18.67^{ijkl}	18.83^{hijkl}	19.00^{ijkl}	19.30^{hijk}	19.53^{fgh}	19.73^{ijk}	20.00^{hijk}	20.37^{ijk}	20.63^{ij}	20.87^{jk}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	19.80^{ijk}	19.90^{hijk}	20.10^{hijk}	20.30^{ghij}	20.53^{ijk}	20.60^{hij}	20.73^{fg}	20.97^{ij}	21.17^{hi}	21.47^{ij}	21.73^{hi}	21.97^{ij}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	13.73^{m}	13.77^{m}	13.80^{n}	13.87^{m}	14.00^{n}	14.07^{m}	14.17^{j}	14.20^{n}	14.30^{m}	14.40^{m}	14.43^{l}	14.63^{l}
24	*Vasco* Kultana Million Bhat	29.47^{ab}	29.53^{ab}	29.73^{ab}	29.93^{ab}	30.07^{ab}	30.13^{ab}	30.30^{ab}	30.47^{ab}	30.67^{ab}	30.80^{ab}	31.00^{ab}	31.27^{ab}
25	*V.* JVB x *Ascda.* Yip Sum Wah	24.70^{cdef}	24.90^{cde}	25.03^{cde}	25.20^{bcdef}	25.43^{cde}	25.57^{cd}	25.83^{cd}	25.97^{cde}	26.07^{cde}	26.30^{cde}	26.60^{cde}	26.73^{cdef}

Fig. 3. Leaf length in vandaceous orchid varieties/ hybrids during the period of observation

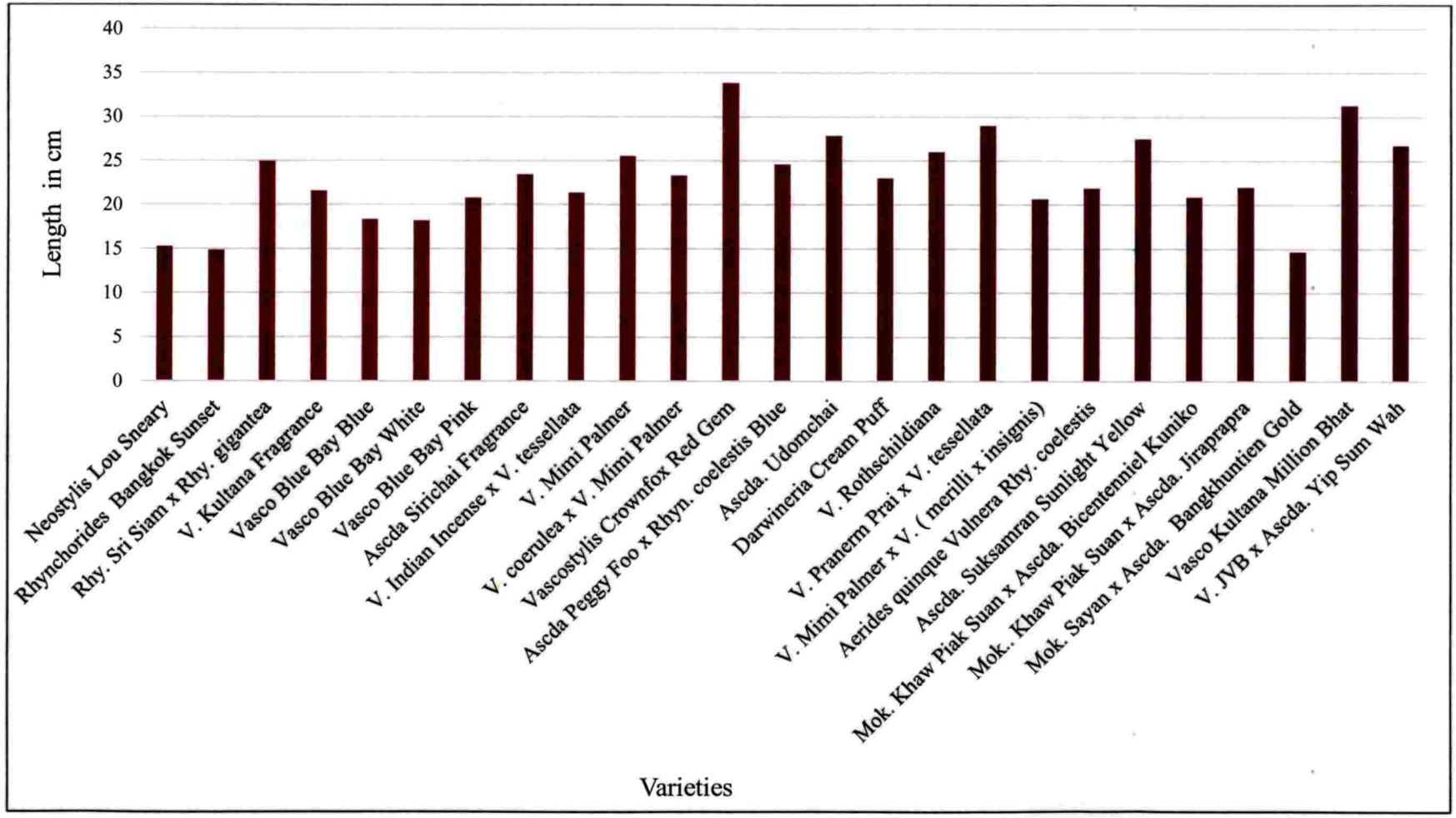


Table. 6. Leaf breadth of vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties /hybrids	Leaf breadth(cm)											
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	1.13^{k}	1.13^{k}	1.17^{m}	1.20^{k}	1.23^{j}	1.27^{k}	1.30^{j}	1.33^{m}	1.37^{m}	1.47^{n}	1.47^{m}	1.53^{n}
2	*Rhy.* Bangkok Sunset	2.43^{def}	2.43^{def}	2.47	2.47^{def}	2.47^{ef}	2.57^{def}	2.57^{defg}	2.60^{efg}	2.60e^{fghi}	2.63^{fghi}	2.67^{efg}	2.67^{efgh}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	2.30^{efgh}	2.30^{efgh}	2.33^{efgh}	2.37^{efgh}	2.37^{fg}	2.40^{fgh}	2.47^{efg}	2.50^{fgh}	2.50^{ghi}	2.57^{ghi}	2.57^{fgh}	2.63^{fghi}
4	*V.* Kultana Fragrance	2.03^{hi}	2.03^{hi}	2.03^{hi}	2.03^{i}	2.03^{h}	2.07^{i}	2.07^{h}	2.13^{k}	2.13^{k}	2.13^{kl}	2.13^{jk}	2.13^{kl}
5	*Vasco* Blue Bay Blue	2.33^{efg}	2.33^{efg}	2.40^{efg}	2.40^{efgh}	2.47^{efg}	2.53^{efg}	2.57^{defg}	2.63^{efg}	2.70^{defg}	2.73^{efgh}	2.77^{def}	2.80^{def}
6	*Vasco* Blue Bay White	2.20^{fghi}	2.27^{efgh}	2.37^{efgh}	2.37^{efgh}	2.47^{efg}	2.53^{efg}	2.60^{def}	2.70^{def}	2.80^{cdef}	2.87^{def}	2.97^{cde}	2.97^{cde}
7	*Vasco* Blue Bay Pink	2.20^{fghi}	2.20^{fghi}	2.30^{fgh}	2.37^{efgh}	2.47^{efg}	2.53^{efg}	2.60^{def}	2.70^{def}	2.80^{cdef}	2.90^{def}	3.03^{cd}	3.13^{c}
8	*Ascda* Sirichai Fragrance	1.97^{i}	1.97^{i}	1.97^{jk}	2.03^{i}	2.03^{h}	2.07^{i}	2.13h	2.17^{ijk}	2.20^{jk}	2.23^{ij}	2.27^{hijk}	2.33^{ijk}
9	*V.* Indian Incense x *V. tessellata*	2.40^{def}	2.40^{defg}	2.40^{defgh}	2.40^{efgh}	2.43^{efg}	2.47^{efgh}	2.47^{efg}	2.47^{fgh}	2.53^{fghi}	2.57^{ghi}	2.57^{fgh}	2.57^{fghi}
10	*V.* Mimi Palmer	2.10^{ghi}	2.13^{ghi}	2.23^{fghi}	2.23^{fghi}	2.27^{gh}	2.30^{ghi}	2.33^{fgh}	2.40^{ghi}	2.40^{hijk}	2.47^{hij}	2.50^{fghi}	2.57^{fghi}
11	*V. coerulea* x *V.* Mimi Palmer	2.20^{fghi}	2.20^{fghi}	2.20^{ghij}	2.20^{ghi}	2.30^{g}	2.30^{ghi}	2.33^{fgh}	2.33^{hij}	2.37^{ijk}	2.37^{ijk}	2.40^{ghij}	2.40^{hijk}
12	*Vascostylis* Crownfox Red Gem	2.43^{def}	2.43^{def}	2.47^{def}	2.47^{ef}	2.50^{defg}	2.53^{efg}	2.60^{def}	2.67^{def}	2.67^{defg}	2.73^{efg}	2.77^{def}	2.77^{defg}

Leaf breadth of vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties /hybrids	Leaf breadth(cm)											
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	3.07^{b}	3.07^{b}	3.07^{b}	3.07^{b}	3.13^{b}	3.13^{b}	3.20^{b}	3.23^{b}	3.23^{b}	3.23^{b}	3.23^{bc}	3.23bc
14	*Ascda.* Udomchai	2.50^{de}	2.50^{de}	2.57^{de}	2.60^{cde}	2.67^{cde}	2.67^{cde}	2.83^{cd}	2.80^{cde}	2.83^{cde}	2.93^{de}	2.97^{cde}	3.03^{cd}
15	*Darwineria* Cream Puff	2.63^{cd}	2.63^{cd}	2.63^{cd}	2.73^{cd}	2.73^{cd}	2.80^{cd}	2.80^{cd}	2.90^{cd}	2.90^{cd}	3.00^{cde}	3.03^{cd}	3.03^{cd}
16	*V.* Rothschildiana	2.43^{def}	2.43^{def}	2.47^{def}	2.50^{def}	2.57^{def}	2.57^{def}	2.63^{de}	2.70^{def}	2.73^{defg}	2.77^{defg}	2.77^{def}	2.80^{def}
17	*V.* Pranerm Prai x V. *tessellata*	3.40^{a}	3.40^{a}	3.40^{a}	3.40^{a}	3.43^{a}	3.43^{a}	3.50^{a}	3.50^{a}	3.53^{a}	3.53^{b}	3.53^{b}	3.53^{b}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	1.53^{j}	1.53^{j}	1.53^{j}	1.53^{j}	1.60^{i}	1.63^{j}	1.63^{i}	1.73^{l}	1.73^{l}	1.77^{m}	1.771^{m}	1.77^{mn}
19	*Aerides quinque Vulnera Rhy. coelestis*	3.43^{a}	3.43^{a}	3.47^{a}	3.5^{3a}	3.5^{3a}	3.6^{3a}	3.67^{a}	3.70^{a}	3.73^{a}	3.87^{a}	3.87^{a}	3.87^{a}
20	*Ascda.* Suksamran Sunlight Yellow	2.83^{bc}	2.83^{bc}	2.83^{bc}	2.83^{bc}	2.87^{bc}	2.9^{bc}	2.93^{bc}	3.00^{bc}	3.03^{bc}	3.03^{cd}	3.03^{cd}	3.03^{cd}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	2.37^{defg}	2.37^{defg}	2.37^{efgh}	2.37^{efgh}	2.37^{efgh}	2.40^{fgh}	2.43^{efg}	2.47^{fgh}	2.47^{ghij}	2.47^{hij}	2.43^{ghij}	2.47^{ghij}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	2.43^{def}	2.43^{def}	2.43^{defg}	2.43^{efg}	2.47^{efg}	2.47^{efgh}	2.50^{efg}	2.53^{fgh}	2.57^{efghi}	2.57^{ghi}	2.57^{fgh}	2.57^{fghi}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	1.93^{i}	1.93^{i}	1.93^{k}	2.00^{i}	2.03^{i}	2.07^{i}	2.10^{h}	2.10^{jk}	2.13^{k}	2.20^{jkl}	2.23^{ijk}	2.23^{jkl}
24	*Vasco* Kultana Million Bhat	2.17^{fghi}	2.17^{fghi}	2.17^{hijk}	2.17^{hi}	2.27^{hi}	2.27^{hi}	2.30^{gh}	2.30^{hijk}	2.37^{ijk}	2.40^{ijk}	2.40^{ghij}	2.40^{hijk}
25	*V.* JVB x *Ascda.* Yip Sum Wah	1.23^{k}	1.23^{k}	1.33^{lm}	1.40^{ij}	1.53^{jk}	1.63^{j}	1.60^{i}	1.77^{l}	1.80^{l}	1.93^{lm}	1.97^{kl}	2.00^{lm}

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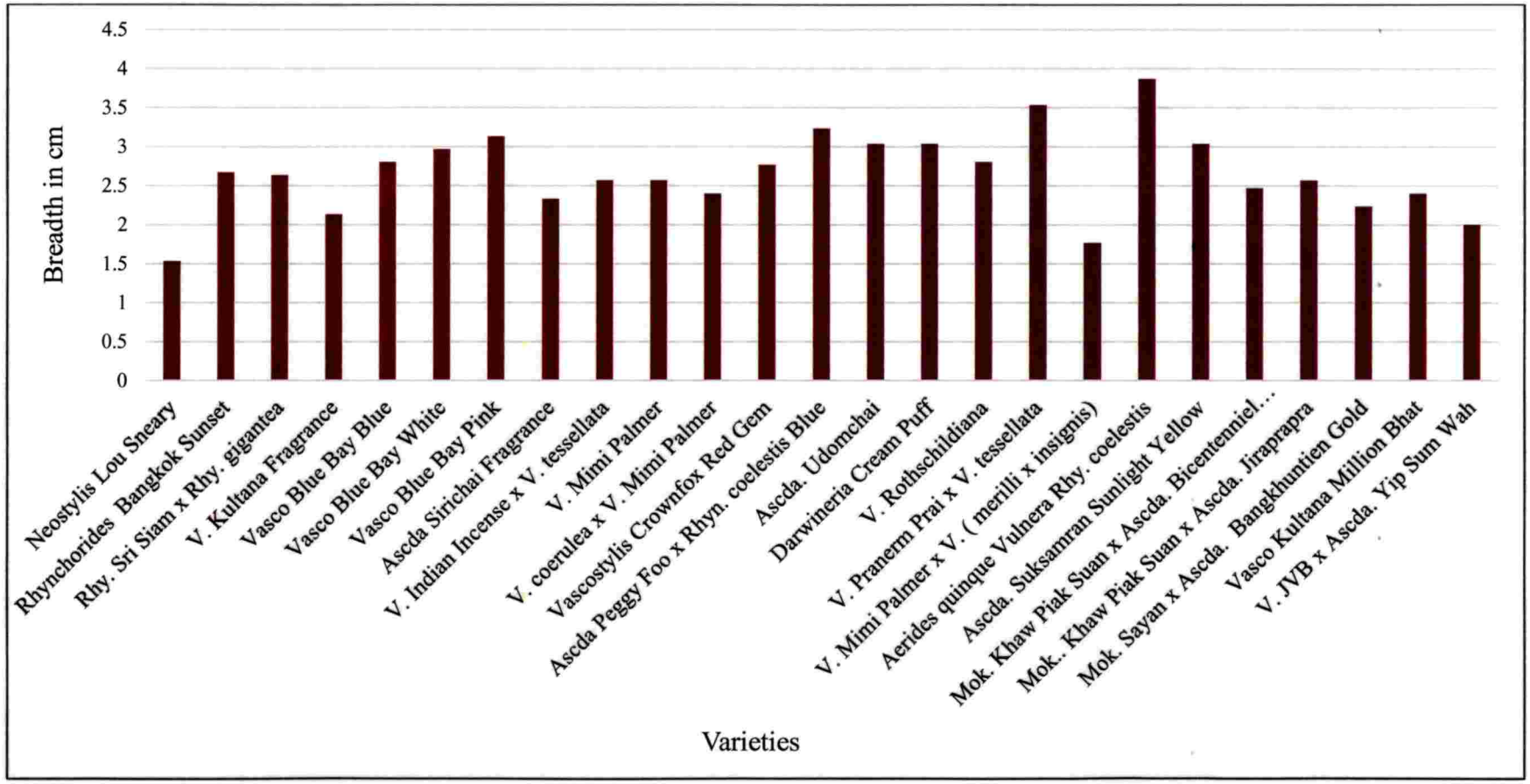
Fig. 4. Leaf breadth in vandaceous orchid varieties/ hybrids during the period of observation



period was in *V.* Pranerm Prai x V. *tessellata* which was on par with the leaf area of *Vascostylis* Crownfox Red Gem during the later period of study (March-May).

By the end of the study, leaf area was significantly high (105.54 cm^2) in *V.* Pranerm Prai x V. *tessellata* and was superior to other varieties/ hybrids except *Vascostylis* Crownfox Red Gem (96.39 cm^2). Minimum leaf area (24.09 cm^2) was recorded in *Neostylis* Lou Sneary.(Table 7 and Fig.5)

Number of leaves

Marked variation was noticed in the number of leaves produced by the varieties/ hybrids (Table.8 and Fig.6). During the entire study period *Vascostylis* Crown fox Red Gem had the maximum number of leaves. Minimum number of leaves was observed in *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko.

At the end of the study period, *V.* Indian Incense x *V. tessellata* recorded maximum (37.00) number of leaves and was on par with *Vascostylis* Crownfox Red Gem (36.00). Minimum leaf number was observed in *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (7.67), followed by *V.* Rothschildiana (9.00), *Vasco* Kultana Million Bhat (11.00), *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (11.33) and *Rhy.* Sri Siam x *Rhy. gigantea* (11.33).

Interval of leaf production

Significant variation was observed in the interval of leaf production among the varieties/ hybrids (Table 9). It varied from 40.17 days (V. Mimi Palmer) to 269.67 days (*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko). Leaf production interval was significantly more in *Vasco* Kultana Million Bhat (194.33 days) followed by *V.* Rothschildiana (176.00 days), *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (138.33 days), *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (117.67 days) and *V.* Pranerm Prai x V. *tessellata* (117.33). Minimum interval of leaf production (40.55 days) was recorded in *V.* Indian Incense x *V. tessellata.*

Table. 7. Leaf area of vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties /hybrids	Leaf area (cm^2)											
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	15.90^{m}	16.05^{l}	16.64^{m}	17.32^{r}	18.08^{q}	18.83^{n}	19.61^{l}	20.34^{m}	20.97^{op}	22.81^{n}	22.81^{op}	24.09^{l}
2	*Rhy.* Bangkok Sunset	34.77^{jkl}	34.94^{ijk}	35.41^{kl}	35.75^{nop}	36.11^{mnop}	37.74^{lm}	38.09^{jk}	38.75^{kl}	39.02^{mn}	39.78^{lm}	40.45^{lmn}	40.72^{jk}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	55.73^{ef}	56.05^{ef}	57.14^{ef}	58.28^{fghi}	58.54^{fgh}	59.66^{fg}	61.76^{ef}	63.16^{fgh}	63.33^{ghi}	65.34^{fgh}	65.69^{fgh}	67.61^{fg}
4	*V.* Kultana Fragrance	42.36^{ghij}	42.49^{ghi}	42.84^{hijk}	43.06^{klmn}	43.34^{jklm}	44.50^{ijkl}	45.38^{hij}	45.88^{ijk}	47.53^{lm}	47.60^{lm}	47.83^{klm}	48.13^{ij}
5	*Vasco* Blue Bay Blue	33.82^{jkl}	34.68^{lij}	36.41^{ikl}	37.30^{mnop}	39.11^{lmn}	$41.^{kl06}$	42.58^{ij}	44.84^{jk}	47.66^{lm}	49.35^{kl}	50.87^{kl}	52.69^{i}
6	*Vasco* Blue Bay White	36.55^{ijkl}	37.83^{hij}	39.98^{ijk}	40.30^{lmn}	42.00^{klm}	44.15^{ijkl}	46.06^{hij}	48.49^{ijk}	51.06^{kl}	53.00^{ijk}	56.34^{hijk}	55.87^{hi}
7	*Vasco* Blue Bay Pink	42.73^{ghij}	42.95^{ghi}	45.06^{ghij}	46.88^{jkl}	49.36^{hijk}	51.25^{ghij}	53.07^{fgh}	55.49^{hi}	58.15^{hijk}	60.84^{ghij}	64.21^{ghij}	67.25^{fgh}
8	*Ascda* Sirichai Fragrance	40.60^{ghijk}	41.00^{ghij}	41.50^{hijk}	43.34^{klmn}	43.91^{jklm}	45.03^{ijkl}	47.04^{hij}	48.33^{ijk}	49.42^{kl}	51.00^{jk}	52.82^{jk}	56.19^{ghi}
9	*V.* Indian Incense x *V. tessellata*	40.03^{hijk}	40.97^{ghij}	41.90^{hijk}	42.76^{klmn}	44.14^{jklm}	45.75^{ijkl}	46.87^{hij}	48.94^{ij}	51.62^{jkl}	53.32^{ijk}	54.52^{hijk}	56.57^{ghi}
10	*V.* Mimi Palmer	49.10^{efgh}	50.23^{efg}	53.17^{efg}	53.86^{ghij}	55.21^{fghi}	56.51^{fgh}	58.00^{efg}	60.19^{gh}	61.07^{ghij}	63.35^{fghi}	64.90^{ghi}	67.22^{fgh}
11	*V. coerulea* x *V.* Mimi Palmer	48.01^{fgh}	48.24^{fg}	48.22^{fghi}	49.15^{ijkl}	51.85^{ghij}	52.25^{ghij}	53.71^{fgh}	54.20^{hij}	55.40^{ijkl}	55.97^{hijk}	57.18^{hijk}	57.68^{ghi}
12	*Vascostylis* Crownfox Red Gem	79.53^{b}	79.87^{a}	81.35^{a}	81.60^{a}	83.31^{a}	84.72^{a}	87.48^{a}	90.53^{a}	91.17^{a}	93.90^{ab}	95.22^{ab}	96.39^{ab}

Leaf area of vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties /hybrids	Leaf area (cm^2)											
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	73.93b^{c}	74.15^{bc}	74.35^{bc}	74.78^{bcd}	76.45^{bc}	77.32^{bcd}	79.25^{bc}	80.45^{cd}	80.89^{cd}	81.35^{cd}	81.69^{cde}	81.91^{cde}
14	*Ascda.* Udomchai	65.56^{cd}	66.08^{cd}	68.21^{c}	69.69^{cde}	71.96^{cd}	72.51^{cd}	77.41^{c}	78.19^{cde}	78.98^{cd}	82.59^{cd}	84.40^{bcd}	87.06^{bc}
15	*Darwineria* Cream Puff	57.82^{de}	58.10^{de}	58.55^{de}	61.08^{efg}	61.28^{efg}	63.17^{ef}	63.57^{de}	66.25^{fg}	66.85f^{gh}	69.80^{efg}	71.08^{efg}	71.51^{ef}
16	*V.* Rothschildiana	56.86^{def}	57.18^{def}	58.75^{de}	60.16^{fgh}	62.65^{def}	63.17^{ef}	65.91^{de}	68.52^{efg}	70.48^{efg}	72.37^{def}	73.33^{defg}	75.16^{def}
17	*V.* Pranerm Prai x V. *tessellata*	96.24^{a}	96.46^{a}	96.91^{a}	97.60^{a}	98.88^{a}	99.10^{a}	101.62^{a}	102.32^{a}	103.65^{a}	104.36a	104.95^{a}	105.54^{a}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	27.50^{l}	27.83^{k}	28.13^{l}	28.72^{op}	30.43^{nop}	31.62^{m}	31.70^{k}	34.02^{l}	34.55^{n}	35.89^{n}	36.50^{mn}	37.18^{jk}
19	*Aerides quinque Vulnera Rhy. coelestis*	71.82^{bc}	72.06^{bc}	73.18^{bc}	75.15^{bcd}	75.51^{bc}	78.02^{bcd}	79.29^{bc}	80.65^{cd}	82.05^{bcd}	86.07^{bc}	86.71^{bc}	87.22^{bc}
20	*Ascda.* Suksamran Sunlight Yellow	77.08^{b}	77.37^{b}	77.37^{b}	77.76^{bc}	78.94^{bc}	80.09^{bc}	81.21^{bc}	83.82^{bc}	85.00^{bc}	85.41^{bc}	85.63^{bc}	85.83^{bcd}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	44.80^{ghi}	45.29^{gh}	45.68^{ghi}	46.09^{jklm}	46.50^{ijkl}	47.96^{hijk}	49.22^{ghi}	50.33^{ij}	50.99^{kl}	51.91^{jk}	51.92^{k}	53.17^{i}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	49.57^{efg}	49.83^{efg}	50.34^{efgh}	50.84^{hijk}	52.15^{ghij}	52.33^{ghi}	53.41^{fgh}	54.73^{hi}	56.00^{ijk}l	56.80^{hijk}	57.54^{hijk}	58.17^{ghi}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	27.45^{l}	27.51^{k}	27.57^{l}	28.77^{op}	29.45^{op}	30.12^{m}	30.82^{k}	30.89^{l}	31.64^{n}	32.74^{mn}	33.36^{nop}	33.81^{kl}
24	*Vasco* Kultana Million Bhat	65.77^{cd}	65.92^{cd}	66.36^{cd}	66.81^{def}	70.20^{cde}	70.36^{de}	71.79^{cd}	72.19^{def}	74.76^{def}	76.14^{cde}	76.64^{cdef}	77.30^{cdef}
25	*V.* JVB x *Ascda.* Yip Sum Wah	31.44^{kl}	31.69^{jk}	34.45^{kl}	36.41^{nop}	40.24^{klm}	43.00^{jkl}	44.32^{hij}	47.23^{ijk}	48.23^{lm}	52.25^{jk}	53.85^{ijk}	54.96^{i}

Fig. 5. Leaf area in vandaceous orchid varieties/ hybrids during the period of observation

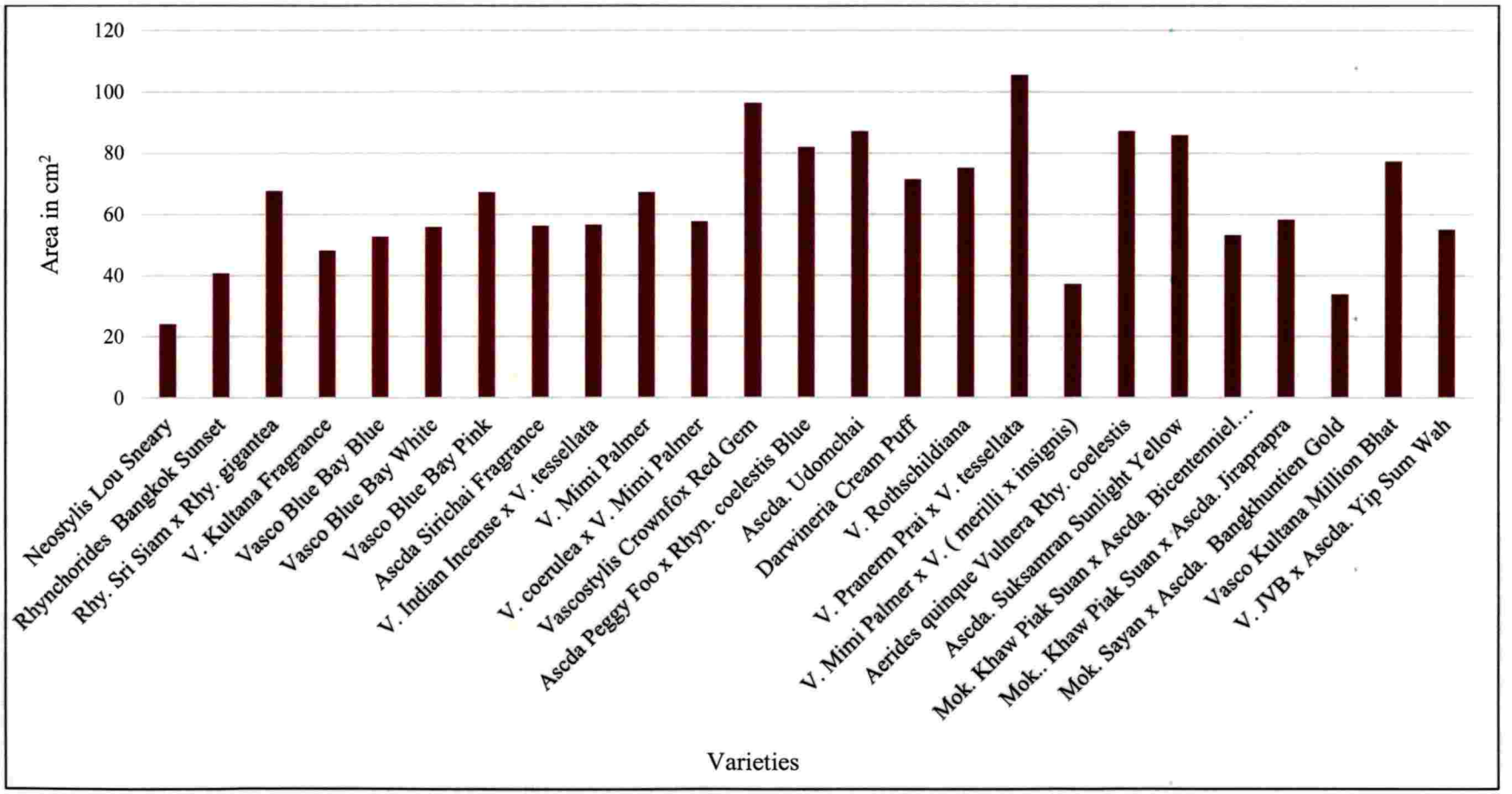


Table. 8. Number of leaves in vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties/hybrids	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	10.33^{efg}	10.33^{fg}	11.67^{hijk}	11.33^{jkl}	11.67^{hij}	11.67^{ijklm}	12.00^{ijklm}	12.67^{jklmn}	12.33^{ijkl}	12.33^{ijklm}	13.33^{ijkl}	13.33^{hijk}
2	*Rhy.* Bangkok Sunset	14.67^{cde}	14.33^{cdef}	15.67^{fgh}	15.67^{cdefgh}	15.67^{ghij}	16.33^{efgh}i	16.67^{fghi}	17.33^{efgh}i	18.33^{efghi}	18.33^{efghi}	18.00^{efghi}	18.00^{efghi}
3	Rhy. Sri Siam x Rhy. *gigantea*	9.00^{fg}	9.00^{fg}	9.67^{ijk}	9.00^{jk}	9.33^{kl}	10.00^{ij}	10.33^{klm}	10.33^{ijk}	10.33^{jkl}	10.33^{klm}	11.33^{jkl}	11.33^{jk}
4	*V.* Kultana Fragrance	12.33^{defg}	12.33^{fg}	14.33^{ghij}	14.00^{fghij}	14.33^{hijk}	14.33^{ghi}	14.67^{hijkl}	13.67^{jklm}	13.67^{hijk}	13.67^{hijkl}	14.33^{hijk}	14.33^{hij}
5	*Vasco* Blue Bay Blue	16.00^{cd}	14.33^{cdef}	15.33^{fghi}	16.00^{cdefghi}	16.00^{fghij}	16.33^{efgh}i	17.67^{efghi}	16.67^{fghijk}	17.33^{efghi}	17.33^{efghi}	18.33^{defghi}	18.33^{defghi}
6	*Vasco* Blue Bay White	14.67^{cde}	14.33^{cdef}	16.00^{efgh}	15.67^{cdefgh}	16.00^{fghij}	16.00^{fghi}	17.00^{fgh}i	16.33^{fghijkl}	16.67^{fghi}	16.67^{fghi}	18.33^{defghi}	18.33^{defgh}
7	*Vasco* Blue Bay Pink	14.67^{cde}	15.33^{cdef}	16.33^{efgh}	16.67^{cdefgh}	16.67^{efghij}	17.67^{defgh}	18.33^{efgh}	18.67^{efghij}	19.67^{efgh}	19.67^{efgh}	21.33^{defg}	21.33^{def}
8	*Ascda.* Sirichai Fragrance	19.33^{bc}	20.00^{bcde}	20.67^{def}	20.33^{bcdef}	23.00^{bcd}	23.33^{bcde}	23.33^{cde}	23.67^{bcde}	23.00^{de}	23.00^{cde}	24.33^{bcd}	24.33^{bcd}
9	*V.* Indian Incense x *V. tessellata*	26.67^{a}	25.00^{ab}	28.00^{ab}	26.00^{ab}	29.00^{ab}	29.67^{ab}	29.67^{ab}	34.00^{a}	34.33^{ab}	34.33^{ab}	37.00^{a}	37.00^{a}
10	*V.* Mimi Palmer	20.00^{bc}	20.67^{bc}	21.67^{cde}	22.00^{bc}	22.00c^{def}	22.00^{cdef}	22.33^{cdef}	27.00^{cdef}	27.00^{cd}	27.00^{cd}	28.67^{bc}	28.67^{bc}
11	*V. coerulea* x V. Mimi Palmer	12.67^{def}	13.00^{fg}	13.33^{hij}	13.67f^{ghijk}	14.00^{ijk}	14.67^{ghi}	15.00^{hijkl}	15.00^{hijklm}	15.33^{ghijk}	15.67^{ghij}	15.67^{ghij}	15.00^{ghij}
12	*Vascostylis* Crownfox Red Gem	28.33^{a}	30.00^{a}	30.00^{a}	29.67^{a}	32.00^{a}	33.00^{a}	34.33^{a}	35.33^{a}	35.67^{a}	35.67^{a}	36.00^{a}	36.00^{a}
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	13.00^{def}	9.33^{fg}	13.33^{hi}j	13.33^{ghij}	13.33^{jk}	13.67^{ghij}	13.67^{hijkl}	14.00^{ijklm}	14.00^{hijk}	14.33^{ghijkl}	14.33^{hijk}	14.67^{hij}

Number of leaves in vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties/hybrids	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
14	*Ascda.* Udomchai	14.67^{cde}	14.00^{def}	14.33^{ghij}	15.00^{defghij}	15.33^{ghijk}	15.67^{fghi}	15.33^{ghijkl}	15.67^{ghijkl}	16.33^{fghij}	16.67^{fghij}	16.67^{fghij}	17.00^{fghi}
15	*Darwineria* Cream Puff	25.67^{a}	23.67^{ab}	27.33^{abc}	26.67^{ab}	27.00^{abc}	27.33^{abc}	27.67^{bc}	29.00^{ab}	29.33^{bc}	28.67^{bc}	29.00^{b}	29.00^{b}
16	*V.* Rothschildiana	9.67^{efg}	11.33^{fg}	10.67^{hijk}	10.67^{hijk}	10.67^{jkl}	11.00^{hij}	11.00^{jklm}	10.00^{lmn}	10.00^{kl}	10.00^{klm}	9.00^{kl}	9.00^{jk}
17	*V.* Pranerm Prai x *V. tessellata*	23.00^{ab}	24.00$^{a\ b}$	24.00^{bcd}	24.00^{ab}	24.00^{bcd}	24.00^{bcd}	24.67^{bcd}	25.33^{bcd}	23.00^{de}	23.00^{cde}	23.33^{bcde}	23.33^{bcde}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	12.67^{def}	13.67^{ef}	14.33^{ghij}	14.33^{hijk}	14.67^{fghi}	15.67^{ghijk}	15.67^{fghijk}	16.67^{fghi}	16.67^{fghij}	16.67^{defghi}	18.33^{defghi}	18.33^{defgh}
19	*Aerides quinque Vulnera. Rhy. coelestis*	20.00^{bc}	20.33^{bcd}	21.00^{def}	21.33^{def}	21.33^{bcd}	22.33^{cdefg}	22.00^{cdef}	20.33^{defghi}	20.33^{efg}	20.33^{efg}	22.67^{cdef}	22.67^{cdef}
20	*Ascda.* Suksamran Sunlight Yellow	19.33^{bc}	20.33^{bcd}	19.67^{defg}	20.00^{bcdefg}	20.00^{defghi}	20.33^{cdefghi}	21.00d^{efg}	21.67^{cdefg}	22.00^{def}	22.00^{def}	22.33^{def}	22.33^{def}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	7.00^{g}	7.00^{g}	7.00^{k}	7.00^{k}	7.00^{l}	7.00^{j}	7.00^{m}	6.67^{n}	7.00^{l}	7.33^{m}	7.33^{l}	7.67^{k}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	8.67^{fg}	9.33^{fg}	9.00^{jk}	9.33^{ijk}	9.33^{ij}	10.00^{klm}	10.00^{mn}	9.33^{kl}	9.33^{lm}	9.33^{jkl}	11.33^{jkl}	11.33^{ijk}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	20.00^{bc}	20.33^{bcd}	20.33^{def}	22.33^{bc}	22.33^{cde}	22.33^{cdef}	22.33^{cdef}	22.3^{cdef3}	22.33^{def}	22.33	24.00^{def}	24.00^{bcde}
24	*Vasco.* Kultana Million Bhat	8.33^{fg}	9.33^{fg}	9.67^{ijk}	9.33^{kl}	9.33^{ij}	9.33^{lm}	9.67^{lmn}	10.00^{jk}	10.33^{jkl}	10.67^{jklm}	11.00^{jkl}	11.00^{ijk}
25	*V.* JVB x *Ascda.* Yip Sum Wah	19.67^{bc}	20.33^{bcd}	20.67^{def}	21.00^{defg}	20.33^{defgh}	14.67^{ghi}	21.67^{def}	20.67^{cdefghi}	20.67^{efg}	20.33^{efg}	20.00^{defgh}	21.00^{defg}

Fig. 6. Number of leaves in vandaceous orchid varieties/ hybrids during the period of observation

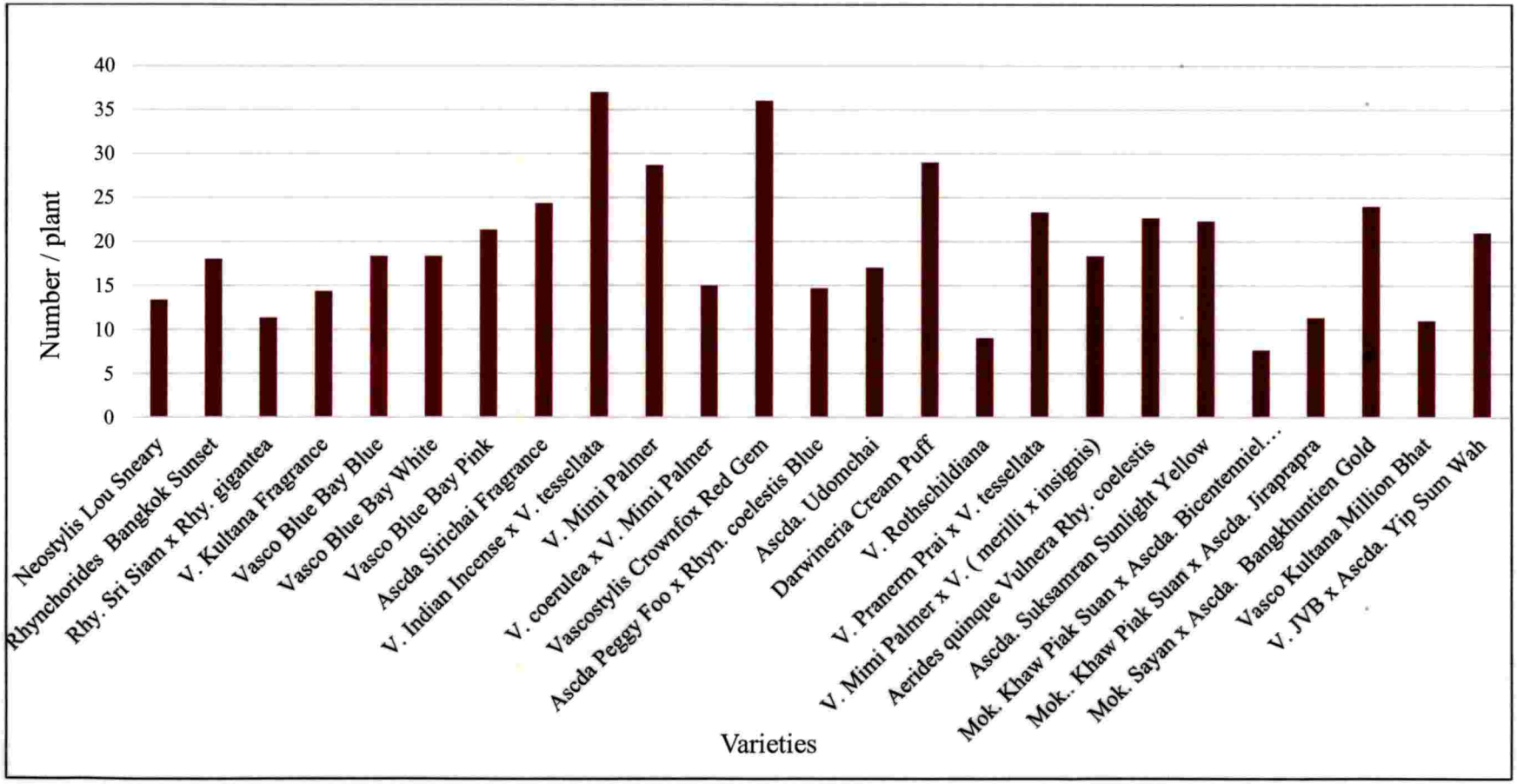


Table. 9. Other leaf characters of vandaceous orchid varieties/ hybrids

Sl No	Varieties/ hybrids	Leaf orientation	Interval of production (days)	Leaf texture	Leaf apex	Leaf base	Leaf margin	Leaf colour	Leaf pigmentation	Leaf type
1	*Neostylis* Lou Sneary	Straight with arching tendency	79.33 ^{hij}	Smooth, rigid	Acute	Sheathed	Entire	Green	Absent	Channelled
2	*Rhynchorides* Bangkok Sunset	Horizontal	55.58 ^{klm}	Smooth, rigid	Bilobed	Sheathed	Entire	Light Green	Present	Strap
3	*Rhy.* Sri Siam x *Rhy. gigantea*	Arching	99.30 ^{g}	Smooth, rigid	tridentate	Sheathed	Entire	Green	Absent	Channelled
4	*V.* Kultana Fragrance	Arching	82.33 ^{hij}	Smooth, rigid	tridentate	Sheathed	Entire	Green	Absent	Channelled
5	*Vasco* Blue Bay Blue	Arching	51.43 ^{lmn}	Smooth, rigid	Bilobed	Sheathed	Entire	Green	Absent	Strap
6	*Vasco* Blue Bay White	Arching	76.17 ^{hij}	Smooth, rigid	Bilobed	Sheathed	Entire	Green	Absent	Strap
7	*Vasco* Blue Bay Pink	Arching	42.62 ^{lmn}	Smooth, rigid	Bilobed	Sheathed	Entire	Green	Absent	Strap
8	*Ascda* Sirichai Fragrance	Arching	72.67 ^{ij}	Smooth, rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
9	*V.* Indian Incense x *V. tessellata*	Arching	40.55 ^{mn}	Smooth, rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
10	*V.* Mimi Palmer	Arching	40.17 ^{n}	Smooth, rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
11	*V. coerulea* x *V.* Mimi Palmer	Arching	78.83 ^{hij}	Smooth, rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
12	*Vascostylis* Crownfox Red Gem	Arching	89.00 ^{gh}	Smooth, rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled

Other leaf characters of vandaceous orchid varieties/ hybrids contd...

Sl No	Varieties/ hybrids	Leaf orientation	Interval of production (days)	Leaf texture	Leaf apex	Leaf base	Leaf margin	Leaf colour	Leaf pigmentation	Leaf type
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	Arching	115.00 ^{ef}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
14	*Ascda.* Udomchai	Arching	86.00 ^{ghi}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
15	*Darwineria* Cream Puff	Arching	76.67 ^{hij}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
16	*V.* Rothschildiana	Straight with arching tendency	176.00 ^{c}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
17	*V.* Pranerm Prai x V. *tessellata*	Arching	117.33 ^{e}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	Arching	99.67 ^{fg}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
19	*Aerides quinque Vulnera Rhy. coelestis*	Arching	70.00 ^{jk}	Smooth, Rigid	Retuse	Sheathed	Entire	Green	Absent	Strap
20	*Ascda.* Suksamran Sunlight Yellow	Arching	81.67 ^{hij}	Smooth, Rigid	Acute	Sheathed	Entire	Green	Absent	Channelled
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	Arching	269.67 ^{a}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	channelled
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	Arching	138.33 ^{d}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	Straight	117.67 ^{e}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
24	*Vasco* Kultana Million Bhat	Arching	194.33 ^{b}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled
25	*V.* JVB x *Ascda.* Yip Sum Wah	Arching	56.00 ^{kl}	Smooth, Rigid	Tridentate	Sheathed	Entire	Green	Absent	Channelled

Table. 10. Leaf sheath characters of vandaceous orchid varieties/ hybrids

Sl. No	Varieties /hybrids	Leaf sheath characters	
		Nature of leaf sheath	Sheath colour
1	*Neostylis* Lou Sneary	Membraneous, thick	Green
2	*Rhynchorides* Bangkok Sunset	Membraneous, thick	Green
3	*Rhy.* Sri Siam x *Rhy. gigantea*	Membraneous, thick	Green
4	*V.* Kultana Fragrance	Membraneous, thick	Green
5	*Vasco* Blue Bay Blue	Membraneous, thick	Green
6	*Vasco* Blue Bay White	Membraneous, thick	Green
7	*Vasco* Blue Bay Pink	Membraneous, thick	Green
8	*Ascda* Sirichai Fragrance	Membraneous, thick	Green
9	*V.* Indian Incense x *V. tessellata*	Membraneous, thick	Green
10	*V.* Mimi Palmer	Membraneous, thick	Green
11	*V. coerulea* x *V.* Mimi Palmer	Membraneous, thick	Green
12	*Vascostylis* Crownfox Red Gem	Membraneous, thick	Green
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	Membraneous, thick	Green
14	*Ascda.* Udomchai	Membraneous, thick	Green
15	*Darwineria* Cream Puff	Membraneous, thick	Green
16	*V.* Rothschildiana	Membraneous, thick	Green
17	*V.* Pranerm Prai x *V. tessellata*	Membraneous, thick	Green
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	Membraneous, thick	Green
19	*Aerides quinque Vulnera Rhy. coelestis*	Membraneous, thick	Green
20	*Ascda.* Suksamran Sunlight Yellow	Membraneous, thick	Green
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	Membraneous, thick	Green
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	Membraneous, thick	Green
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	Membraneous, thick	Green
24	*Vasco* Kultana Million Bhat	Membraneous, thick	Green
25	*V.* JVB x *Ascda.* Yip Sum Wah	Membraneous, thick	Green

4.1.3. Aerial root characters

Data pertaining to aerial root characters of vandaceous orchid varieties/ hybrids are presented in Tables 11 &12.

Root length

Marked variation was recorded in the root length of the selected varieties/hybrids (Table 11). Maximum root length was recorded in *V.* Pranerm Prai x V. *tessellata* (181.75 cm) followed by *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (174.5 cm) and *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (164.63cm), while it was minimum (70.32 cm) in *V. coerulea* x *V.* Mimi Palmer followed by *V.* Kultana Fragrance (75.22cm)

Root girth

Varietal differences were evident in the girth of aerial roots also (Table 11). Maximum root girth (2.60 cm) was observed in *V.* Indian Incense x *V. tessellata* followed by *Aerides quinque Vulnera Rhy. coelestis* (2.55cm), *Vascostylis* Crownfox Red Gem (2.54 cm), *V.* Pranerm Prai x V. *tessellata* (2.51 cm), *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (2.45 cm), *Vasco* Blue Bay Blue (2.35 cm) which were on par. Minimum root girth (1.22 cm) was recorded in *Neostylis* Lou Sneary

Number of roots

Noticeable differences were observed in the number of roots produced by vandaceous orchid varieties/ hybrids (Table 12 and Fig.7). Throughout the study period, *Neostylis* Lou Sneary had maximum number of roots and was significantly superior to all other varieties. It was on par with *V.* JVB X *Ascocenda* Yip Sum Wah during the earlier period of observation (June – March)

At the end of the study period, *Neostylis* Lou Sneary had maximum number of roots (28.00) and significantly superior to all other varieties. This was followed by *V.* JVB X *Ascocenda* Yip Sum Wah (21.67), *V.* Mimi Palmer (18.67), *Rhynchorides*

Table. 11. Aerial root characters of vandaceous orchid varieties/ hybrids

Sl. No	Varieties/hybrids	Aerial root characters					
		Root length (cm)	Root girth (cm)	Location	Branching	Nature of roots	Root colour
1	*Neostylis* Lou Sneary	137.42	1.22^{k}	Basal	Present	Cylindrical	Whitish Green
2	*Rhy.* Bangkok Sunset	94.93	1.77^{ghij}	Along the stem	Present	Cylindrical	Silvery grey
3	*Rhy.* Sri Siam x *Rhy. gigantea*	137.17	2.10^{defg}	Basal	Present	Cylindrical	Greenish grey
4	*V.* Kultana Fragrance	75.22	1.87^{fghi}	Along the stem	Present	Cylindrical	Greenish grey
5	*Vasco* Blue Bay Blue	128.08	2.35^{fghi}	Basal	Present	Cylindrical	Greenish grey
6	*Vasco* Blue Bay White	91.35	2.00^{efghi}	Basal	Present	Cylindrical	Greenish grey
7	*Vasco* Blue Bay Pink	131.62	2.52^{ab}	Basal	Present	Cylindrical	Greenish grey
8	*Ascda* Sirichai Fragrance	136.38	1.88^{fghi}	Along the stem	Present	Cylindrical	Greenish grey
9	*V.* Indian Incense x *V. tessellata*	136.13	2.60^{a}	Along the stem	Present	Cylindrical	Greenish grey
10	*V.* Mimi Palmer	144.83	1.93^{fghi}	Along the stem	Present	Cylindrical	Greenish grey
11	*V. coerulea* x *V.* Mimi Palmer	70.32	2.10^{defg}	Basal	Present	Cylindrical	Greenish grey
12	*Vascostylis* Crownfox Red Gem	139.08	2.54^{ab}	Along the stem	Present	Cylindrical	Greenish grey
13	*Ascda* Peggy Foo X *Rhyn. coelestis* Blue	89.93	2.45^{abc}	Basal	Present	Cylindrical	Greenish grey
14	*Ascda.* Udomchai	132.52	1.73^{hij}	Basal	Present	Cylindrical	Greyish brown
15	*Darwineria* Cream Puff	87.55	2.05^{defgh}	Along the stem	Present	Cylindrical	Greenish grey
16	*V.* Rothschildiana	140.95	2.28^{abcde}	Along the stem	Present	Cylindrical	Green
17	*V.* Pranerm Prai x V. *tessellata*	181.75	2.17^{cdef}	Along the stem	Present	Cylindrical	Green
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	105.33	1.90^{fghi}	Along the stem	Present	Cylindrical	Greyish brown
19	*Aerides quinque Vulnera Rhy. coelestis*	101.17	2.55^{a}	Basal	Present	Cylindrical	Greenish grey
20	*Ascda.* Suksamran Sunlight Yellow	126.82	2.20^{bcdef}	Basal	Present	Cylindrical	Greenish grey
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	140.52	1.98^{efghi}	Basal	Present	Cylindrical	Greyish brown
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	164.63	2.00^{efghi}	Along the stem	Present	Cylindrical	Greyish brown
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	174.45	1.50^{jk}	Along the stem	Present	Cylindrical	Greyish brown
24	*Vasco* Kultana Million Bhat	144.22	2.05^{defgh}	Basal	Present	Cylindrical	Greyish brown
25	*V.* JVB x *Ascda.* Yip Sum Wah	163.93	1.70^{ij}	Along the stem	Present	Cylindrical	Greyish brown

Table. 12. Root number in vandaceous orchid varieties/ hybrids during the period of observation

Sl. No	Varieties /hybrids	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	*Neostylis* Lou Sneary	20.00^{a}	20.33^{a}	21.00^{a}	21.67^{a}	22.67^{a}	24.00^{a}	24.00^{a}	25.00^{a}	25.67^{a}	26.33^{a}	27.33^{a}	28.00^{a}
2	*Rhy.* Bangkok Sunset	12.67^{bcd}	13.00^{bc}	13.00^{bcd}	13.33^{b}	13.67^{bc}	14.00^{bc}	14.67^{cd}	15.00^{cd}	15.00^{cd}	15.33^{cd}	16.00^{cd}	16.00^{bcd}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	5.33^{gh}	5.33^{fg}	5.33^{f}	5.33^{f}	5.67^{h}	5.67^{i}	5.67^{i}	5.67^{h}	6.00^{i}	6.33^{i}	6.33^{h}	6.33^{g}
4	*V.* Kultana Fragrance	11.00^{bcdef}	11.67^{bcd}	11.67^{bcde}	12.00^{bcde}	12.33^{bcde}	12.33^{bcdef}	12.67^{cdefg}	12.67^{cdefg}	13.00^{cdefg}	13.33^{cdefg}	13.33^{cdef}	13.67^{cdef}
5	*Vasco* Blue Bay Blue	8.67^{bcdefgh}	8.67^{bcdefg}	8.67^{bcdefgh}	9.00^{bcdef}	9.33^{cdefg}	10.00^{bcdef}	10.00^{defghi}	10.67^{cdefgh}	11.00^{defghi}	11.00^{defghi}	11.33^{defgh}	11.33^{defg}
6	*Vasco* Blue Bay White	11.00^{bcdef}	11.00^{bcde}	11.33^{bcde}	11.33^{bcd}	11.67^{bcdef}	12.67^{bcdef}	12.67^{cdefg}	12.67^{cdefgh}	13.67^{cdefg}	14.33^{cdef}	14.33^{cde}	14.33^{cdef}
7	*Vasco* Blue Bay Pink	5.00^{h}	5.00^{g}	5.00^{h}	5.33^{f}	5.67^{h}	6.00^{hi}	6.33^{hi}	6.67^{h}	7.00^{hi}	7.33^{hi}	7.67^{gh}	7.67^{g}
8	*Ascda* Sirichai Fragrance	10.33^{bcdefg}	10.33^{bcdef}	10.33^{bcdefgh}	10.67^{bcde}	10.67^{bcdefg}	11.33^{bcdefg}	11.33^{cdefgh}	11.33^{cdefgh}	11.67^{cdefgh}	12.00^{cdefgh}	12.00^{defg}	12.00^{defg}
9	*V.* Indian Incense x *V. tessellata*	7.67^{defgh}	7.67^{defg}	7.67^{defgh}	7.67^{def}	8.33^{defgh}	8.33^{efghi}	8.67^{efghi}	8.67^{fgh}	9.33^{efghi}	9.33^{efghi}	9.33^{efgh}	9.33^{efg}
10	*V.* Mimi Palmer	12.67^{bcd}	13.00^{bc}	13.33^{b}	14.00^{b}	14.67^{b}	14.67^{b}	15.67^{bc}	16.33^{bc}	16.67^{bc}	17.33^{bc}	18.00^{bc}	18.67^{bc}
11	*V.* coerulea x *V.* Mimi Palmer	9.33^{bcdefgh}	9.33^{bcdfg}	9.33^{bcdefgh}	9.67^{bcdef}	10.00^{bcdefgh}	10.00^{bcdefghi}	10.33^{defghi}	11.00^{cdefgh}	11.00^{defghi}	11.00^{defghi}	11.33^{defgh}	11.33^{defg}
12	*Vascostylis* Crownfox Red Gem	11.33^{bcde}	11.33^{bcd}	12.00^{bcde}	12.33^{bcd}	12.67^{bcde}	13.00^{bcdef}	13.00^{cdefg}	14.00^{cdef}	14.33^{cdef}	14.67^{cde}	15.00^{cd}	15.33^{cd}
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	7.33^{efgh}	7.33^{defg}	7.33^{efgh}	7.33^{def}	7.33^{fgh}	8.33^{efghi}	8.33^{fghi}	8.33^{fgh}	8.67^{ghi}	8.67^{ghi}	8.67^{fgh}	8.67^{fg}
14	*Ascda.* Udomchai	13.00^{bc}	13.00^{bc}	13.00^{bc}	13.00^{bc}	13.00^{bcd}	13.33^{bcde}	13.67^{cde}	13.67^{cdef}	13.67^{cdefg}	14.00^{cdefg}	14.00^{cdef}	14.00^{cdef}
15	*Darwineria* Cream Puff	10.33^{bcdefg}	10.33^{bcdef}	10.33^{bcdef}	10.33^{bcdef}	10.33^{bcdef}	11.00^{bcdefg}	11.00^{cdefgh}	11.00^{cdefgh}	11.33^{cdefghi}	11.67^{defghi}	11.67^{defgh}	11.67^{defg}

Root number in vandaceous orchid varieties/ hybrids during the period of observation contd...

Sl. No	Varieties /hybrids	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
16	*V.* Rothschildiana	6.00^{fgh}	6.00^{efg}	6.00^{fgh}	6.00^{ef}	6.33^{gh}	6.33^{ghi}	6.33^{hi}	7.00^{gh}	7.33^{hi}	7.67^{hi}	7.67^{gh}	7.67^{g}
17	*V.* Pranerm Prai x V. *tessellata*	12.33^{bcde}	12.33^{bcd}	12.67^{bcd}	13.00^{bc}	13.00^{bcd}	13.67^{bcd}	13.67^{cde}	13.67^{cdef}	14.33^{cdef}	14.33^{cdef}	15.00^{cd}	15.00^{cde}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	13.33^{b}	13.33^{b}	13.67^{b}	13.67^{b}	14.00^{bc}	14.00^{bc}	14.33^{cd}	14.67^{cde}	14.67^{cde}	15.00^{cd}	15.00^{cd}	15.00^{cde}
19	*Aerides quinque Vulnera Rhy. coelestis*	8.00^{cdefgh}	8.00^{cdef}	8.00^{cdefgh}	8.00^{cdef}	8.33^{defgh}	9.00^{cdefghi}	9.00^{efghi}	9.33^{defgh}	9.67^{defghi}	10.33^{defghi}	10.67^{defgh}	10.67^{defg}
20	*Ascda.* Suksamran Sunlight Yellow	10.33^{bcdefg}	10.33^{bcdef}	11.00^{bcdef}	11.67^{bcd}	12.33^{bcde}	13.00^{bcdef}	13.33^{cdef}	14.00^{cdef}	14.67^{cde}	15.33^{cd}	15.67^{cd}	15.67^{cd}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	8.00^{cdefgh}	8.00^{cdefg}	8.00^{cdefgh}	8.00^{cdef}	8.33^{defgh}	8.67^{fghi}	8.67^{efghi}	8.67^{fgh}	9.00^{fghi}	9.00^{fghi}	9.00^{efgh}	9.00^{fg}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	7.67^{defgh}	7.67^{defg}	7.67^{defgh}	7.67^{def}	8.00^{efgh}	8.00^{fghi}	8.00^{ghi}	8.33^{fgh}	8.67^{ghi}	8.67^{ghi}	8.67^{fgh}	8.67^{fg}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	8.33^{bcdefgh}	8.33^{bcdefg}	9.00^{bcdefgh}	9.33^{bcdef}	10.00^{bcdefgh}	10.33^{bcdefghi}	10.67^{cdefghi}	11.00^{cdefgh}	11.33^{cdefghi}	12.00^{cdefgh}	12.00^{defg}	12.00^{defg}
24	*Vasco* Kultana Million Bhat	7.67^{defgh}	7.67^{defg}	7.67^{defgh}	7.67^{def}	8.00^{efgh}	8.00^{fghi}	8.33^{fghi}	9.00^{efgh}	9.00^{fghi}	9.00^{fghi}	9.33^{efgh}	9.33^{efg}
25	*V.* JVB x *Ascda.* Yip Sum Wah	19.33^{a}	19.33^{a}	19.33^{a}	19.67^{a}	20.00^{a}	20.67^{a}	20.67^{ab}	21.00^{ab}	21.67^{ab}	21.67^{ab}	21.67^{b}	21.67^{b}

Fig. 7. Number of roots in vandaceous orchid varieties/ hybrids during the period of observation

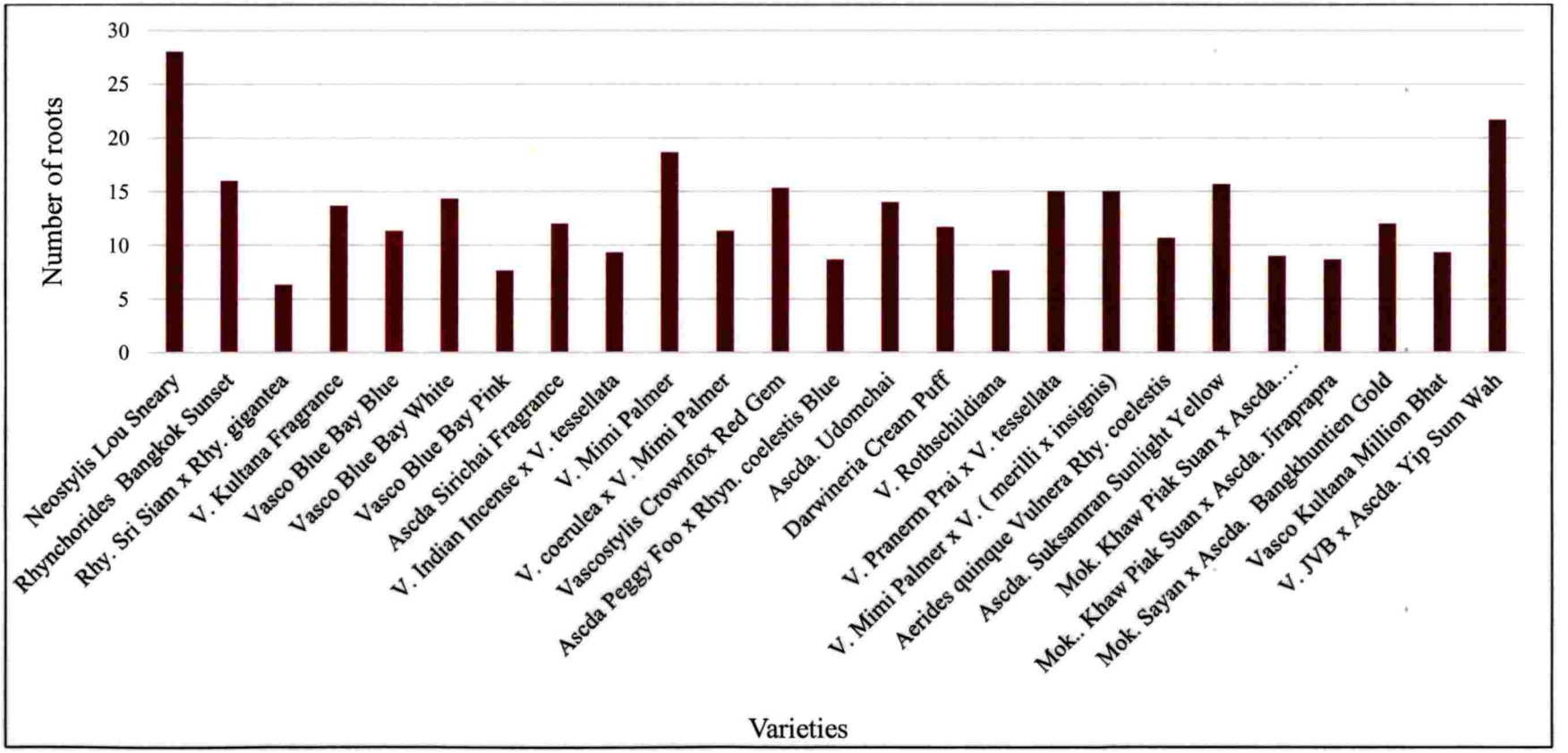
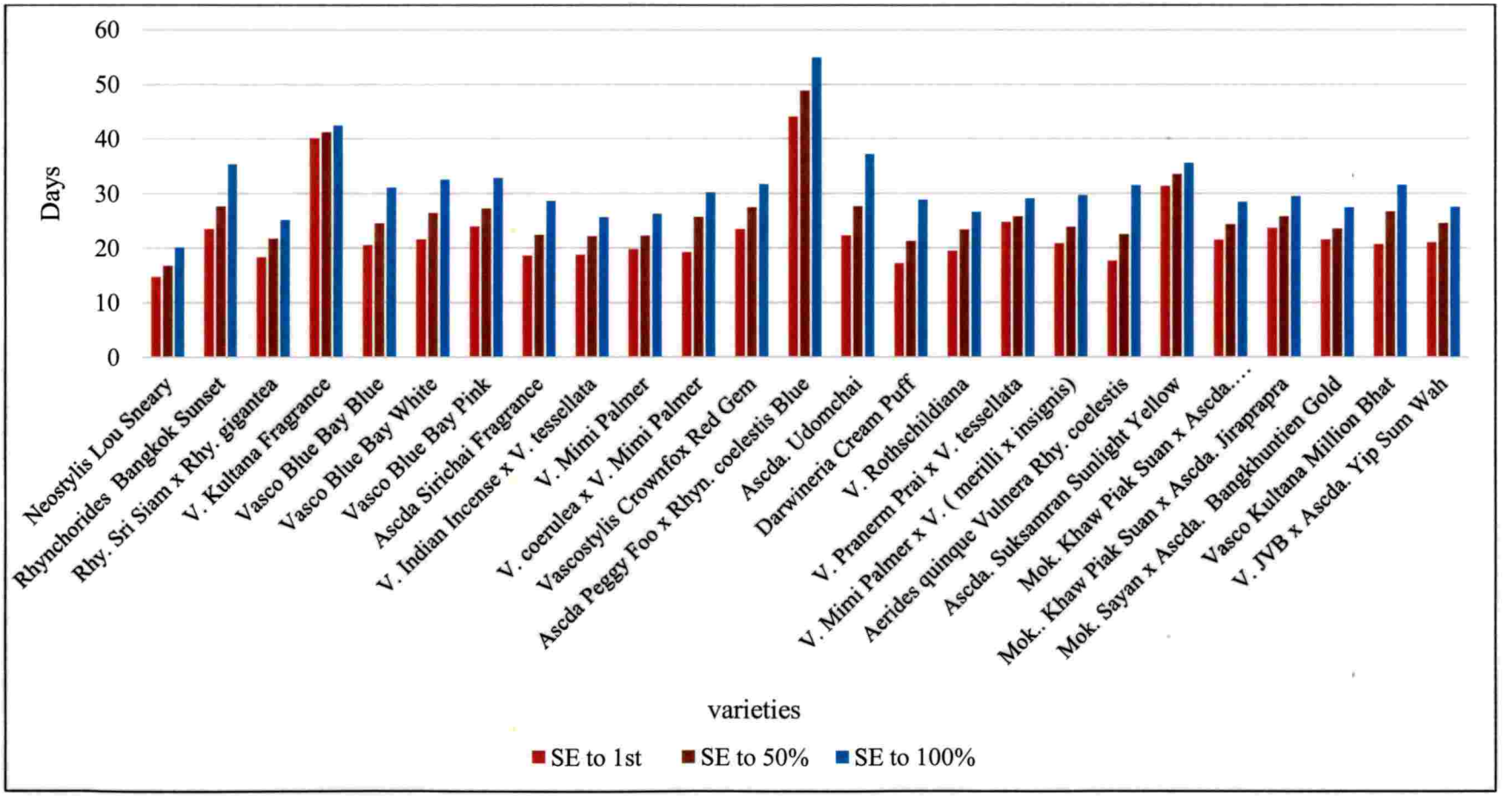


Fig. 8. Days taken from spike emergence to opening of florets in vandaceous orchid varieties/ hybrids



Bangkok Sunset (16.00), *Ascda.* Suksamran Sunlight Yellow (15.67), *Vascostylis* Crownfox Red Gem (15.33). Minimum number of roots was recorded in *Rhy.* Sri Siam x *Rhy. gigantea* (6.33), *Vasco* Blue Bay Pink (7.67) and *V.* Rothschildiana (7.67).

4.1.4. Floral characters

4.1.4.1. Flowering characters

Data relating to the flowering characteristics of selected` vandaceous orchid varieties / hybrids such as days from the spike emergence to opening of first floret, 50 per cent florets, opening of 100 per cent florets, spike longevity, interval of spike production, number of spikes / plant /year and blooming period are given in Table 13 and figures 8 and 10.

Spike emergence to opening of first floret

Wide variation was noticed with regard to the duration from spike emergence to opening of first floret (Table 13 and Fi.8). The duration was maximum in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (44.01 days) and was significantly superior to all other varieties. This was followed by *V.* Kultana Fragrance (40.08 days), *Ascda.* Suksamran Sunlight Yellow (31.29 days) whereas, *Neostylis* Lou Sneary recorded the minimum (14.67 days) followed by *Darwineria* Cream Puff (17.16 days), *Aerides quinque Vulnera Rhy. coelestis* (17.60 days) and *Rhy.* Sri Siam x *Rhy. gigantea* (18.27 days).

Spike emergence to opening of 50 per cent florets

Duration from spike emergence to opening of 50 per cent florets also differed significantly. It was maximum in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (48.80 days) followed by *V.* Kultana Fragrance (41.21 days) and *Ascda.* Suksamran Sunlight Yellow (33.50 days). (Table 13 and Fig.8)

Neostylis Lou Sneary recorded the minimum (16.73 days), followed by *Darwineria* Cream Puff (21.25 days) and *Rhy.* Sri Siam x *Rhy. gigantea* (21.67 days).

Spike emergence to opening of all florets

Varietal difference were clearly evident with respect to the duration from spike emergence to opening of all florets. (Table 13 and Fig.8) Among all the varieties *Ascda* Peggy Foo x *Rhyn. Coelestis* Blue recorded the maximum (54.99 days) and was significantly superior to all others followed by *V.* Kultana Fragrance (42.50 days), *Ascda.* Udomchai (37.21 days), *Ascda.* Suksamran Sunlight Yellow (35.57 days), *Rhynchorides* Bangkok Sunset(35.36 days), *Vasco* Blue Bay Pink (32.84days), *Vasco* Blue Bay White(32.55 days) and *Vascostylis* Crownfox Red Gem (31.68 days). *Neostylis* Lou Sneary recorded the minimum (20.12 days) for spike emergence to opening of all florets, followed by *Rhy.* Sri Siam x *Rhy. gigantea*(25.13 days).

Spike longevity

Marked differences were noticed with respect to longevity of spike on the plant in selected varieties / hybrids (Table 13 and Figure 9). Among the varieties,

V. Rothschildiana recorded the maximum value (29.30 days) which was significantly superior to all other varieties / hybrids. This was followed by *V.* Pranerm Prai x V. *tessellata* (25.00 days), *V. coerulea* x *V.* Mimi Palmer (23.67 days), *Vascostylis* Crownfox Red Gem (22.33 days), *Darwineria* Cream Puff (18.67 days), *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (18.53 days) and *Ascda* Sirichai Fragrance (18.00 days) and were significantly different.

Minimum spike longevity was recorded in *Rhy.* Sri Siam x *Rhy. gigantea* (7.50 days) followed by *V.* Kultana Fragrance (8.00 days) and *Vasco* Blue Bay Blue(9.50 days) which were statistically comparable.

Interval of spike production

Significant differences were noticed in vandaceous orchid varieties/ hybrids with respect to the interval of spike production. *Ascda* Peggy Foo x *Rhyn. coelestis* Blue took significantly more days for spike production (375.33 days), followed by *V.* JVB X *Ascocenda* Yip Sum Wah (366.87 days) and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (353.83 days). Interval of spike production was minimum (80.67 days) in *Rhynchorides* Bangkok Sunset and *Vascostylis* Crownfox Red Gem (142.70 days).

Number of spikes produced per year

Distinguishable differences in spike production per year was observed in selected vandaceous orchid varieties/ hybrids. Annual spike modulation was maximum (11.50) in *Neostylis* Lou Sneary and was significantly superior to all other varieties. This was followed by *Ascda* Sirichai Fragrance (6.43), *Vascostylis* Crownfox Red Gem (4.54), *V.* Mimi Palmer x *V.* (merilli x *insignis*) (4.52) and *V. coerulea* x *V.* Mimi Palmer (4.17) which were statistically different.

V. Kultana Fragrance (1.02) recorded the minimum number of spikes and was comparable with *Ascda.* Suksamran Sunlight Yellow (1.04), *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (1.06) *Vasco* Kultana Million Bhat (1.06) and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (1.07).

Blooming period / season

The vandaceous orchid varieties were compared with respect their blooming period and noticeable differences were noticed. (Table 13)

Among the varieties evaluated, single flowering season was observed in *Vasco* Blue Bay Blue (May- July), *Vasco* Blue Bay White (May- June), *Vasco* Blue Bay Pink (May- June), *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (Feb-May), *V.* Rothschildiana (May –June), *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (May- July), *Mok.*

Khaw Piak Suan x *Ascda.* Jiraprapra (May- July) , *Vasco* Kultana Million Bhat (May-July) and *V.* Kultana Fragrance (Sep-Oct).

Two flowering seasons were noticed in *Neostylis* Lou Sneary (May –July and Nov-Dec), *Rhynchorides* Bangkok Sunset (Sept –Oct and Dec- Jan), *Ascda* Sirichai Fragrance (May-Jun and Aug- Sept), *V.* Indian Incense x *V. tessellata (*Apr –May and Aug –Sep), *V.* Coerulea x *V.* Mimi Palmer (March-May and Sept-Nov), *Ascda.* Udomchai (Aug-Sept and Nov – Dec), *Darwineria* Cream Puff (May-Jun and Aug-Oct), *V.* Pranerm Prai x V. *tessellata (*March-May and Jan-Feb), *V.* Mimi Palmer x *V.* (merilli x insignis) (May – Sept and Dec-March), *Aerides quinque Vulnera Rhy. Coelestis (*May-Jun and Sept –Nov), *Ascda.* Suksamran Sunlight Yellow (Feb – Apr and Aug-Oct), *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (Feb-Apr and Nov- Dec).

Three flowering seasons were noticed in *Rhy.* Sri Siam x *Rhy. gigantea (*May – June,Sep- Oct and Jan –Feb), *V.* Mimi Palmer(May-June, Aug-Oct and Feb-Mar), *Vascostylis* Crownfox Red Gem (May-June, Aug-Sept and Nov-Dec), *V.* JVB X *Ascocenda* Yip Sum Wah (Jan-Feb, May-July and Sept-Oct).

4.1.4.2. Spike characters

Data pertaining to the spike characters of different vandaceous orchid varieties/ hybrids are presented in Table 14.

Spike length

The varieties/ hybrids differed significantly with respect to spike length (Table 14 and Fig.10). *Aerides quinque Vulnera Rhy. coelestis* recorded the maximum (33.17 cm) and was significantly superior to all other varieties except *Vascostylis* Crownfox Red Gem (32.73 cm). This was followed by *Ascda* Sirichai Fragrance (29.50 cm), *Ascda.* Udomchai (28.80 cm), *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (28.41 cm) and *Ascda.* Suksamran Sunlight Yellow (27.43 cm) which were statistically comparable. Minimum spike length was recorded in *Rhy.* Sri Siam x *Rhy. gigantea* (14.80 cm)

Table. 13. Flowering characters of vandaceous orchid varieties /hybrids

Sl No	Varieties /hybrids	Flowering characters						
		Days from spike emergence to			Spike longevity (days)	Interval of spike production (days)	No. of spikes produced / year	Blooming period
		1st floret open	50% florets open	100% floret open				
1	*Neostylis* Lou Sneary	14.69^{s}	16.73^{n}	20.12^{r}	10.33^{jkl}	164.83^{jkl}	11.50^{a}	May –July Nov-Dec
2	*Rhynchorides* Bangkok Sunset	23.42^{ef}	27.62^{d}	35.36^{d}	10.67^{jkl}	80.67^{s}	3.01^{h}	Sep –Oct Dec- Jan
3	*Rhy.* Sri Siam x *Rhy. gigantea*	18.27^{q}	21.67^{lm}	25.12^{q}	7.50^{n}	127.23^{op}	2.33^{j}	May –Jun Sep- Oct Jan –Feb
4	*V.* Kultana Fragrance	40.08^{b}	41.21^{b}	42.50^{b}	8.00^{mn}	165.53^{l}	1.02^{m}	Sep – Oct
5	*Vasco* Blue Bay Blue	20.46^{k}	24.52^{n}	31.09^{g}	9.50^{lmn}	318.23^{f}	3.75^{e}	May – July
6	*Vasco* Blue Bay White	21.54^{h}	26.42^{f}	32.55^{e}	12.53^{ijk}	304.90^{g}	2.93^{h}	May- Jun
7	*Vasco* Blue Bay Pink	23.88^{e}	27.20^{de}	32.85^{e}	12.00^{d}	325.70^{ef}	3.52^{efg}	May –Jun
8	*Ascda* Sirichai Fragrance	18.56^{op}	22.40^{k}	28.64^{kl}	18.00^{fgh}	186.57^{k}	6.43^{b}	May-Jun Aug- Sep
9	*V.* Indian Incense x *V. tessellata*	18.73^{nop}	22.13^{kl}	25.64^{op}	14.67^{de}	214.60^{i}	2.47^{ij}	Apr –May Aug –Sep
10	*V.* Mimi Palmer	19.70l	22.24^{k}	26.26^{n}	17.67^{bc}	90.12^{r}	3.27^{g}	May-Jun Aug-Oct Feb-Mar
11	*V. coerulea* x *V.* Mimi Palmer	19.18^{mn}	25.68^{g}	30.18^{h}	23.67c	154.93^{m}	4.18^{a}	Mar-May Sep-Nov
12	*Vascostylis* Crownfox Red Gem	23.39^{f}	27.40^{d}	31.68^{f}	22.33^{efg}	142.70^{s}	4.54^{c}	May-Jun Aug-Sep Nov-Dec
13	*Ascda* Peggy Foo x *Rhyn. Coelestis* Blue	44.02^{a}	48.81^{a}	54.^{99}	15.50	375.34^{a}	2.07^{k}	Feb-May
14	*Ascda.* Udomchai	22.21^{g}	27.61^{d}	37.21^{c}	17.27^{de}	196.37^{j}	2.41^{ij}	Aug-Sep Nov – Dec
15	*Darwineria* Cream Puff	17.16^{r}	21.25^{m}	28.83^{kl}	18.67^{d}	271.73^{h}	3.57^{ef}	May-Jun Aug-Oct
16	*V.* Rothschildiana	19.41^{lm}	23.34^{j}	26.63^{n}	29.30^{a}	330.70^{de}	1.35^{l}	May-Jun
17	*V.* Pranerm Prai x V. *tessellata*	24.70^{d}	25.78^{g}	29.08^{jk}	25.00^{b}	105.83^{q}	3.31^{fg}	Mar-May Jan-Feb
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	20.78^{jk}	23.82^{ij}	29.71^{hi}	18.53^{d}	100.67^{q}	4.52^{c}	May – Sep Dec-Mar
19	*Aerides quinque Vulnera Rhy. coelestis*	17.60^{r}	22.50^{k}	31.51^{fg}	10.00^{klm}	220.33^{i}	2.63^{i}	May-Jun Sep –Nov
20	*Ascda.* Suksamran Sunlight Yellow	31.29^{c}	33.51^{c}	35.57^{d}	10.67^{ghi}	186.67^{k}	1.04^{m}	Feb – Apr Aug-Oct
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	21.41^{hi}	24.28^{hi}	28.44^{l}	14.00^{ghi}	352.30^{c}	1.06^{m}	May-July
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	23.58^{ef}	25.77	29.51^{ij}	11.77^{ijkl}	346.20^{c}	1.13^{l}	May-July
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	21.48^{h}	23.50	27.41^{m}	11.67^{jkl}	353.83^{be}	1.07^{m}	Feb-Apr Nov- Dec
24	*Vasco* Kultana Million Bhat	20.64^{jk}	26.69^{ef}	31.55^{fg}	12.37^{hij}	335.73^{d}	1.06^{m}	May –July
25	*V.* JVB x *Ascda.* Yip Sum Wah	20.99^{ij}	24.49^{h}	27.52^{m}	16.73^{def}	366.87^{b}	2.37^{j}	Jan-Feb May-July Sep-Oct

Fig. 9. Spike longevity in vandaceous orchid varieties/ hybrids

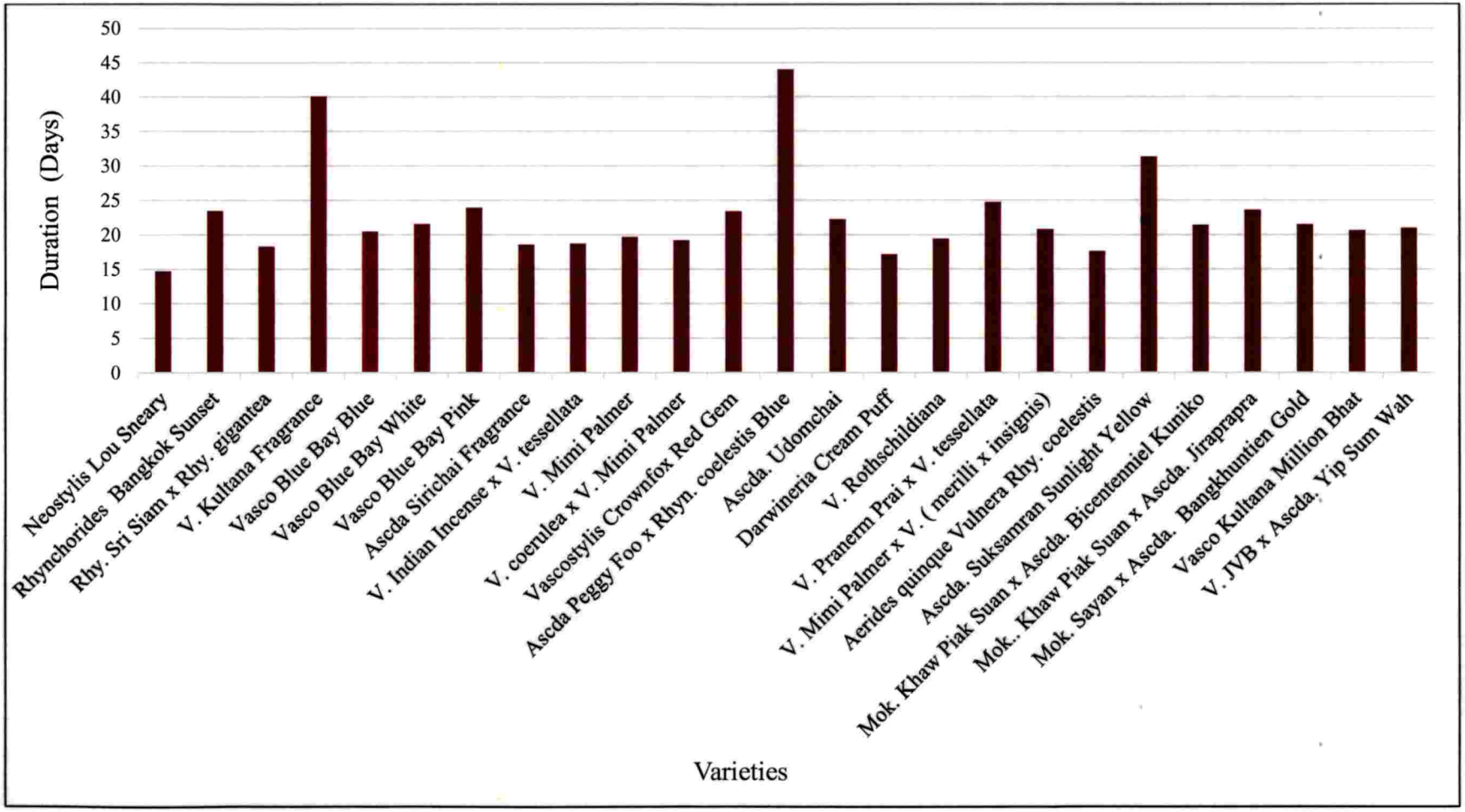
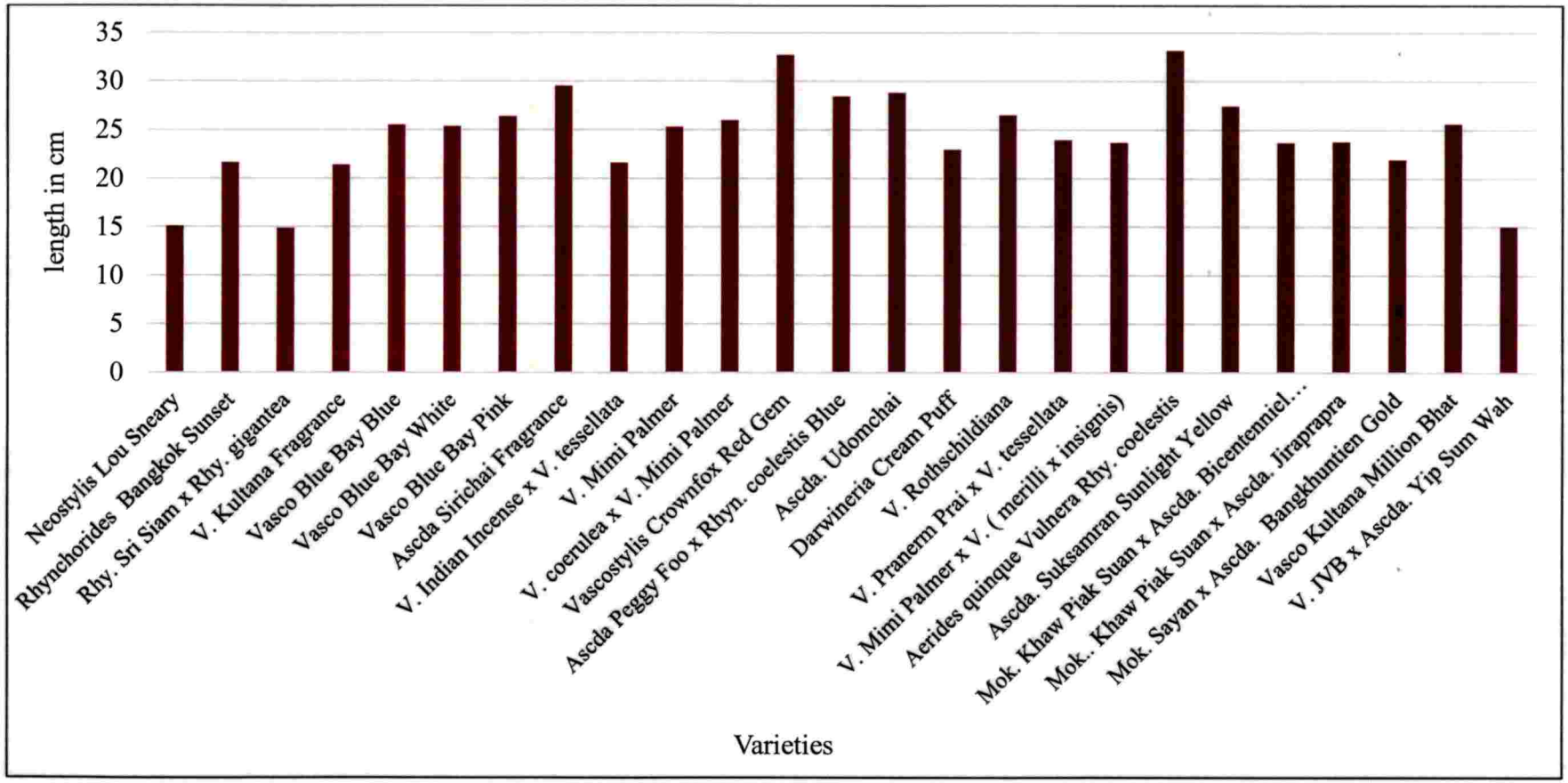


Fig. 10. Spike length of vandaceous orchid varieties/ hybrids



followed by *V.* JVB X *Ascocenda* Yip Sum Wah (15.00 cm) and *Neostylis* Lou Sneary (15.07 cm) and were on par with each other.

Rachis length

Varietal differences were clearly evident with regard to rachis length (Table 14). Among the varieties, *Aerides quinque Vulnera Rhy. coelestis* recorded the maximum length (22.23 cm) and was significantly superior to all others except *Ascda.* Udomchai (20.43cm), *Vascostylis* Crownfox Red Gem (19.80cm) and *Vasco* Blue Bay Blue (19.33cm), which were on par. Minimum length (5.83 cm) though statistically not significant was recorded in *V.* JVB X *Ascocenda* Yip Sum Wah followed by *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (7.63 cm) and *V.* Pranerm Prai x V. *tessellata* (7.67 cm).

Stalk length/ Peduncle length

There was detectable difference in stalk/ peduncle length of selected vandaceous orchid varieties/ hybrids. *Ascda* Peggy Foo x *Rhyn. coelestis* Blue recorded the maximum stalk length (18.14 cm) and was significantly superior to all others except *V.* Pranerm Prai x V. *tessellata* (16.28 cm). Minimum stalk length was observed in *Neostylis* Lou Sneary (5.52 cm) followed by *Rhy.* Sri Siam x *Rhy. gigantea* (5.54 cm) and were on par.

Girth of spike

Considerable variations were observed in girth of spikes among the vandaceous orchid varieties / hybrids (Table 14). *Vascostylis* Crownfox Red Gem recorded the maximum spike girth (2.30 cm) which is on par with Pranerm Prai x V. *tessellata (2.23 cm), Vasco* Blue Bay Blue(2.20cm), *Vasco* Blue Bay Pink(2.17 cm) and *Ascda.* Suksamran Sunlight Yellow (2.17 cm). The minimum spike girth was observed in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (0.67 cm) and was on par with *Neostylis* Lou Sneary (0.86 cm).

Table. 14. Spike characters of vandaceous orchid varieties / hybrids

Sl. No	Varieties/hybrids	Spike characters							
		Spike length (cm)	Rachis length (cm)	Stalk length/ Peduncle length (cm)	Girth of spike (cm)	No. of spikes per plant at a time	Spike orientation	Spike colour	Nature of spike
1	*Neostylis* Lou Sneary	15.07^{k}	9.55^{jk}	5.52^{i}	0.86^{k}	6	Erect	Green	Dense
2	*Rhynchorides* Bangkok Sunset	21.63^{j}	14.92^{efg}	7.35^{ghi}	1.50^{ij}	2	Erect	Green	Dense
3	*Rhy.* Sri Siam x *Rhy. gigantea*	14.85^{k}	9.03^{jk}	5.54^{i}	1.70^{fghi}	1	Arching /horizontal	Green	Lax
4	*V.* Kultana Fragrance	21.38^{j}	10.63	10.50^{def}	1.53^{ij}	1	Erect	Green	Lax
5	*Vasco* Blue Bay Blue	$25.50e^{fghi}$	19.33^{abc}	6.17^{hi}	2.20^{abc}	3	Erect	Green	Dense
6	*Vasco* Blue Bay White	25.33_{efghi}	17.03^{cde}	8.30^{fgh}	1.50^{ij}	2	Erect	Green	Dense
7	*Vasco* Blue Bay Pink	26.37^{cdefg}	18.43^{bcd}	7.33^{ghi}	2.17^{abc}	3	Erect	Green	Dense
8	*Ascda* Sirichai Fragrance	29.50^{b}	18.40^{bcd}	9.43^{efg}	1.27^{j}	4	Erect	Green	Dense
9	*V.* Indian Incense x *V. tessellata*	21.60^{j}	13.00^{fghi}	8.60^{efgh}	1.63^{hi}	1	Erect	Green	Lax
10	*V.* Mimi Palmer	25.27^{efghi}	15.73^{def}	9.53^{efg}	1.47^{ij}	1	Arching /erect	Green	Lax
11	*V.* Coerulea x *V.* Mimi Palmer	25.97^{defgh}	13.35^{fgh}	12.59^{cd}	1.62^{hi}	1	Arching /erect	Green	Lax
12	*Vascostylis* Crownfox Red Gem	32.73^{a}	19.80^{abc}	12.93^{d}	2.30^{a}	2	Arching /erect	Green	Dense
13	*Ascda* Peggy Foo x *Rhyn. Coelestis* Blue	28.41^{bcd}	10.27^{ijk}	18.14^{a}	1.93^{cdefg}	1	Erect	Green	Lax
14	*Ascda.* Udomchai	28.80^{bc}	20.43^{ab}	8.37^{fgh}	1.97^{bcdef}	1	Erect	Green	Dense
15	*Darwineria* Cream Puff	22.93^{ij}	14.50^{efg}	8.43^{efgh}	1.67^{ghi}	2	Erect	Green	Lax
16	*V.* Rothschildiana	26.47^{cdef}	14.58^{efg}	12.17^{cd}	2.10^{abcd}	1	Erect	Green	Lax
17	*V.* Pranerm Prai x V. *tessellata*	23.93^{fghij}	7.67^{kl}	16.27^{ab}	2.23^{ab}	1	Erect	Green	Lax
18	*V.* Mimi Palmer x *V.* (merilli x insignis)	23.67^{hij}	15.27^{efg}	8.40^{efgh}	0.67^{k}	1	Erect	Green	Lax
19	*Aerides quinque Vulnera Rhy. coelestis*	33.17^{a}	22.23^{a}	10.93^{de}	2.03^{abcde}	1	Erect	Green	Dense
20	*Ascda.* Suksamran Sunlight Yellow	27.43^{bcde}	12.87^{fghi}	14.57^{bc}	2.17^{abc}	1	Erect	Green	Lax
21	*Mok..* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	23.67^{hij}	7.63^{kl}	10.80^{def}	1.47^{ij}	1	Erect	Green	Lax
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	23.77^{ghij}	11.33^{hij}	10.60^{def}	1.80^{efgh}	1	Erect	Green	Lax
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	21.93^{j}	11.13^{hij}	10.80^{def}	1.50^{ij}	1	Erect	Green	Lax
24	*Vasco* Kultana Million Bhat	25.60^{efgh}	12.73^{ghi}	12.87^{cd}	1.85^{defgh}	1	Erect	Green	Lax
25	*V.* JVB x *Ascda.* Yip Sum Wah	15.00^{k}	5.83^{l}	9.17^{efg}	1.61^{hi}	1	Erect	Green	Lax

4.1.4.3. Flower characters

Data pertaining to various floral characters of vandaceous orchid varieties/ hybrids like number of florets/ spike, internodal length of spike, pedicel length, flower size, individual floret life, lip length and width, column length, spur type and length are presented in Table 15.

Number of florets per spike

Significant differences were noticed with regard to the number of florets per spike in selected vandaceous orchid varieties/ hybrids. (Table 15 and Fig 10). Maximum number of florets was noticed in *Vasco* Blue Bay Pink (44.33) followed by *Vasco* Blue Bay White (40.33) and *Vasco* Blue Bay Blue (39.67). Minimum number of florets was recorded in *V.* Pranerm Prai x V. *tessellata* (4.83) followed by *Ascda.* Suksamran Sunlight Yellow (5.67) and *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (6.17).

Internodal length (between florets at the base)

Internodal length between the florets at the base differed significantly (Table 15) and was maximum in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (3.20 cm) followed by *V.* Mimi Palmer (2.60 cm) and *V.Kultana* Fragrance (2.43cm). The minimum internodal length (0.90cm) was observed in *Vasco* Blue Bay Pink which was on par with *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (0.93cm)

Internodal length (between florets at the top)

Internodal length between the florets at the top also showed significant differences (Table 15) and was maximum in *V.* Pranerm Prai x V. *tessellata* (2.27 cm). The minimum internodal length was observed in *Ascda.* Suksamran Sunlight Yellow (0.47cm) followed by *Neostylis* Lou Sneary (0.53 cm).

Pedicel length / Length of flower stalk

Significant differences could be noticed with regard to the pedicel length in vandaceous orchid varieties/ hybrids (Table 15). *V.* Kultana Fragrance recorded the maximum (6.54 cm) and was on par with *V.* Pranerm Prai x V. *tessellata* (6.51cm) *and V.* Rothschildiana (6.34 cm). *Neostylis* Lou Sneary recorded the minimum pedicel length (2.17 cm), followed by *Vasco* Blue Bay Blue (2.50 cm), *Rhynchorides* Bangkok Sunset (2.53 cm) and *Vasco* Blue Bay White (2.63cm).

Flower size

Detectable differences were noticed in vandaceous orchid varieties / hybrids with regard to the flower size (Table 15 and Fig. 11). *V.* Rothschildiana recorded the maximum (83.23 cm^2) followed by *Ascda.* Suksamran Sunlight Yellow (78.27 cm^2) and *V.* Pranerm Prai x V. *tessellata* (72.00 cm^2). Flower size was minimum in *Vasco* Blue Bay Blue (4.17 cm^2), followed by *Vasco* Blue Bay White (4.29 cm^2) and *Vasco* Blue Bay Pink (5.22 cm^2).

Individual flower life

Appreciable differences were noticed with respect to individual flower life within vandaceous orchid varieties/ hybrids (Table 15). Among the varieties, individual flower life was same (10.07 days) for *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata* and *V.* Pranerm Prai x V. *tessellata*, followed by *Aerides quinque Vulnera Rhy. Coelestis* (10.00 days). Floret life was minimum on *Neostylis* Lou Sneary (2.07 days) followed by *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (3.23 days) and *Vasco* Blue Bay White (3.57 days).

Length of labellum

Distinguishable differences were noticed with respect to length of labellum within varieties (Table 15). *Ascda* Peggy Foo x *Rhyn. coelestis* Blue recorded the maximum length of labellum (2.07 cm) which was on par with *V.* Kultana Fragrance

Table. 15. Floral characters of vandaceous orchid varieties/ hybrids

Sl. No	Varieties / hybrids	Florets/ Spike (No)	Internodal length (cm)base	Internodal Length (cm) top	Flower stalk length (cm)	Flower size		Floret life (days)	Lip length (cm)	Lip width (cm)	Column length (cm)	Spur length	Spur Type
						LXW (cm x cm)	Area(cm2)						
1	*Neostylis* Lou Sneary	14.50^{g}	1.21^{ghi}	0.53^{ij}	2.17^{m}	2.56x2.56	6.57	2.07^{m}	1.36e^{fghi}	0.40^{j}	0.20^{jk}	Long	Tubular
2	*Rhy.* Bangkok Sunset	27.33^{c}	1.37^{gh}	0.60h^{ij}	2.53^{l}	2.17x2.50	5.42	4.50^{i}	1.30f^{ghij}	1.17^{cdef}	0.37^{i}	Medium	Conical
3	*Rhy.* Sri Siam x *Rhy. gigantea*	12.67^{g}	1.77^{ef}	0.70f^{ghij}	3.27^{jk}	3.37x3.57	12.01	4.27^{ij}	1.53^{def}	0.90^{fgh}	0.47^{fghi}	Medium	Conical
4	*V.* Kultana Fragrance	6.47^{ijk}	2.43^{bc}	1.33^{d}	6.54^{a}	6.00x6.27	37.60	5.20^{h}	2.03^{a}	1.37^{c}	0.60^{cde}	Medium	Conical
5	*Vasco* Blue Bay Blue	39.67^{b}	1.09^{hi}	0.58^{ij}	2.50^{l}	1.88x2.22	4.17	6.60^{ef}	1.33^{efghij}	0.99^{defgh}	0.21^{j}	Medium	Conical
6	*Vasco* Blue Bay White	40.33^{b}	1.40^{fgh}	0.63^{ghij}	2.63^{l}	1.97x2.17	4.29	3.57^{kl}	1.22^{hij}	1.01^{defg}	0.67^{bc}	Medium	Conical
7	*Vasco* Blue Bay Pink	44.33^{b}	0.90^{i}	0.57^{ij}	2.70^{l}	2.19x2.39	5.22	4.23^{ij}	1.70^{bcd}	1.12^{cdef}	0.37^{i}	Medium	Conical
8	*Ascda* Sirichai Fragrance	19.33^{f}	2.03^{de}	0.93^{ef}	3.03^{k}	3.12x3.48	10.86	10.07^{a}	1.28f^{ghij}	0.77^{ghi}	0.40^{hi}	Medium	Conical
9	*V.* Indian Incense x *V. tessellata*	7.33^{ijk}	1.37^{gh}	0.77^{efghi}	4.53^{f}	5.87x5.83	34.22	10.07^{a}	1.53^{def}	1.00^{defg}	0.63^{bcd}	Medium	Conical
10	*V.* Mimi Palmer	7.00^{ijk}	2.60^{b}	1.57^{bcd}	6.01^{c}	5.33x5.43	28.97	7.03^{de}	1.83^{abc}	1.20^{cde}	0.83^{a}	Medium	Conical
11	*V. coerulea* x *V.* Mimi Palmer	7.67^{ijk}	2.43^{bc}	1.70b^{c}	6.23^{bc}	5.33x5.27	28.09	6.88^{de}	1.53^{def}	1.10^{cdef}	0.73$_{ab}$	Medium	Conical
12	*Vascostylis* Crownfox Red Gem	25.00^{cd}	1.47^{fgh}	0.97^{e}	3.90^{g}	4.93x4.75	23.43	6.00^{g}	1.23^{ghij}	0.60^{ij}	0.40^{hi}	Medium	Conical
13	*Ascda* Peggy Foo x *Rhyn. Coelestis*Blue	12.33^{g}	0.93$_{i}$	0.63^{ghij}	3.88^{gh}	5.07x4.51	22.84	4.48^{i}	2.07^{a}	1.23^{cd}	0.10^{k}	Medium	Conical

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Floral characters of vandaceous orchid varieties/ hybrids contd...

Sl. No	Varieties / hybrids	Florets/ Spike (No)	Internodal length (cm)base	Internodal Length (cm) top	Flower stalk length (cm)	Flower size		Floret life (days)	Lip length (cm)	Lip width (cm)	Column length (cm)	Spur length	Spur Type
						LXW (cm x cm)	Area(cm2)						
14	*Ascda.* Udomchai	22.67^{de}	1.30^{ghi}	0.70^{fghij}	4.07g	3.95x3.98	15.73	8.17^{c}	1.07^{j}	$0.72h^{i}$	0.45^{ghi}	Medium	Conical
15	*Darwineria* Cream Puff	9.33^{hi}	1.47^{fgh}	0.83^{efgh}	5.70^{d}	5.07x5.07	25.67	8.90^{b}	1.60^{cde}	1.37^{c}	0.67^{bc}	Medium	Conical
16	*V.* Rothschildiana	6.67^{ijk}	1.53^{fg}	1.50^{cd}	6.34^{ab}	9.57x8.70	83.23	8.04c	2.00^{a}	1.87^{b}	0.67^{bc}	Medium	Conical
17	*V.* Pranerm Prai x V. *tessellata*	4.83^{k}	2.17^{cde}	2.27^{a}	6.51^{ab}	9.00x8.00	72.00	10.07^{a}	1.51^{defgh}	1.33^{c}	0.57^{cdef}	Medium	Conical
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	6.17^{jk}	3.20^{a}	2.25^{a}	5.60^{d}	5.70x5.32	30.31	4.13^{ijk}	1.55^{cdef}	0.93^{efgh}	0.82^{a}	Medium	Conical
19	*Aerides quinque Vulnera Rhy. coelestis*	21.33^{ef}	1.20^{ghi}	0.87^{efg}	4.90e	4.47x4.67	20.85	10.00^{a}	1.52^{defg}	2.15^{a}	0.80^{a}	Medium	Conical
20	*Ascda.* Suksamran Sunlight Yellow	5.67^{jk}	1.27^{ghi}	0.47^{j}	5.07e	10.33x7.63	78.27	6.17^{fg}	1.43^{defgh}	1.85^{b}	0.83^{a}	Medium	Conical
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	6.67^{ijk}	1.43^{fgh}	1.73^{bc}	3.60^{hi}	2.90x2.57	7.44	4.47^{i}	1.53^{def}	0.93^{efgh}	0.58^{cde}	Medium	Conical
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	11.67^{gh}	1.50^{fg}	0.60^{hij}	3.39^{ij}	5.23x5.30	27.33	3.73^{jkl}	1.50^{defgh}	0.55^{ij}	0.53^{defg}	Medium	Conical
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	8.33^{ij}	2.03^{de}	1.53^{cd}	3.31^{jk}	6.20x5.20	32.24	3.23^{l}	1.60^{cde}	0.60^{ij}	0.53^{defg}	Medium	Conical
24	*Vasco* Kultana Million Bhat	8.33^{ij}	2.10^{cde}	1.80^{b}	3.80^{gh}	5.50x5.87	32.27	4.03^{ijk}	1.90^{ab}	0.90^{fgh}	0.60^{cde}	Medium	Conical
25	*V.* JVB X Ascda. Yip Sum Wah	6.33^{jk}	2.07^{cde}	1.53^{cd}	5.01^{e}	5.97x5.13	30.63	7.33^{d}	1.13^{ij}	0.57^{ij}	0.50^{efgh}	Medium	Conical

Fig. 11. Flower size in vandaceous orchid varieties/ hybrids

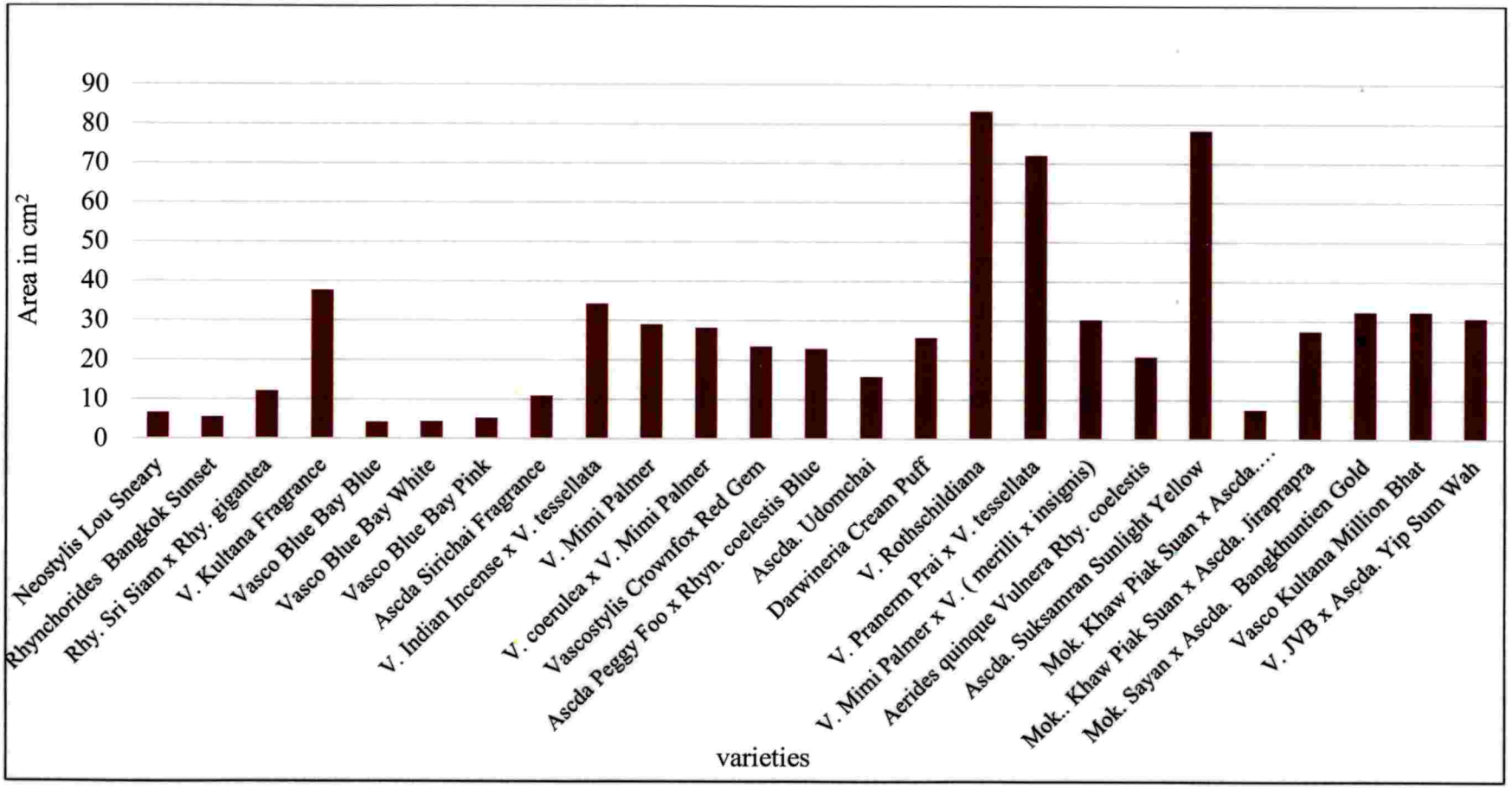

Table .16. Qualitative characters of flower/ petal of vandaceous orchid varieties / hybrids

Sl. No	Varieties	Orientation of flowers	Petal shape	Petal curvature	Petal apex	Petal margin	Petal colour	Petal colour pattern	Flower predominant colour	Flower fragrance	Terminology to denote fragrance
1	*Neostylis* Lou Sneary	Facing all directions	Oblong	Deflexed	acute	entire	Single	Uniform	White	Present	Sweet note -vanilla
2	*Rhynchorides* Bangkok Sunset	Facing all directions	Obovate	Incurved with straight apex	Obtuse	Entire	Double	Shaded	Vivid reddish orange, light yellow and white	Present	Floral note – honey suckle
3	*Rhy.* Sri Siam x *Rhy. gigantea*	Facing all directions	Obovate	Deflexed	Obtuse	Entire	Single	uniform	Light purple	Present	Fruity note - citrus
4	*V.* Kultana Fragrance	Facing all directions	Oblong	Incurved without deflexed apex	Obtuse	Undulate	Single	Tessellated	Strong purple	Present	Floral note – jasmine
5	*Vasco* Blue Bay Blue	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Entire	Double	Shaded	White petal with light violet tinged apex	Present	Floral note- jasmine
6	*Vasco* Blue Bay White	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Entire	Single	Uniform	White	Present	Floral note - tuberose
7	*Vasco* Blue Bay Pink	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Entire	Double	Shaded	White petal with deep purplish pink tinged apex	Present	Floral note - tuberose
8	*Ascda* Sirichai Fragrance	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Entire	Double	Spotted	Light yellowish pink and strong yellowish pink dots	Present	Sweet note – honey
9	*V.* Indian Incense x *V. tessellata*	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Undulate	Double	Spotted	Brilliant yellowish green with moderate reddish brown spots	Present	Fruity note- grape
10	*V.* Mimi Palmer	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Undulate	Double	Tessellated	Strong purple	Present	Floral note – jasmine

Qualitative characters of flower/ petal of vandaceous orchid varieties / hybrids contd...

Sl. No	Varieties	Orientation of flowers	Petal shape	Petal curvature	Petal apex	Petal margin	Petal colour	Petal colour pattern	Flower predominant colour	Flower fragrance	Terminology to denote fragrance
11	*V. coerulea* x *V.* Mimi Palmer	Facing all directions	Obovate	Incurved with deflexed apex	Obtuse	Undulate	Double	Tessellated	Pale yellowish green with strong purplish red	Present	Fruity note –grape
12	*Vascostylis* Crownfox Red Gem	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Entire	Single	Uniform	Strong Red	Present	Fruity note- citrus
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	Facing all directions	Obovate	Deflexed with incurved apex	Truncate	Entire	Double	Shaded	Very light purple	Present	Fruit note – citrus
14	*Ascda*. Udomchai	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Entire	Double	Spotted	Strong orange with strong reddish orange spots	Present	Floral note – tuberose
15	*Darwineria* Cream Puff	Facing all directions	Obovate	Deflexed with incurved apex	Obtuse	Entire	Double	Spotted	Light yellow with moderate reddish orange spots	Present	Miscellaneous – musty, unpleasant odour of bug
16	*V.* Rothschildiana	Facing all directions	Obovate	Deflexed with incurved apex	Truncate	Undulate	Double	Uniform	Vivid reddish purple	Present	Sweet note – honey
17	*V.* Pranerm Prai x V. *tessellata*	Facing all directions	Obovate	Straight	Obtuse	Entire	Single	Spotted	Light yellowish green with strong yellowish green spots	Present	Floral note – jasmine
18	*V.* Mimi Palmer x *V. (merilli* x *insignis*)	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Slightly undulate	Double	Tessellated	Vivid purple and yellowish white	Present	Spicy note – clove
19	*Aerides quinque Vulnera Rhy. coelestis*	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Slightly undulate	Double	Shaded	Very pale purple to light purple	Present	Green note – mint

Qualitative characters of flower/ petal of vandaceous orchid varieties / hybrids contd...

Sl. No	Varieties	Orientation of flowers	Petal shape	Petal curvature	Petal apex	Petal margin	Petal colour	Petal colour pattern	Flower predominant Colour	Flower fragrance	Terminology to denote fragrance
20	*Ascda.* Suksamran Sunlight Yellow	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Entire	Single	Netted	Pale yellowish Green	Present	Fruity note – citrus
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	Facing all directions	Obovate	Deflexed with incurved apex	Acute	Entire	Double	Spotted	Light orangish yellow and strong orangish yellow spots	Present	Floral note – tuberose
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	Facing all directions	Obovate	Deflexed	Obtuse	Entire	Single	Uniform	Light orangish yellow	Present	Sweet note – honey
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	Facing all directions	Obovate	Deflexed	Obtuse	Entire	Single	Shaded	Light orangish yellow with strong yellowish pink tip	Present	Sweet note –honey
24	*Vasco* Kultana Million Bhat	Facing all directions	obovate	Straight	Obtuse	Entire	Double	Shaded	Light purple & white	Present	Sweet note – honey
25	*V.* JVB x *Ascda.* Yip Sum Wah	Facing all directions	Obovate	Incurved petal	Obtuse	Entire	Single	Uniform	Deep yellowish pink	Present	Sweet note - honey

Table. 17. Qualitative lip characters of flowers of vandaceous orchid variety/ hybrid

Sl. No	Varieties	Lip mid lobe shape	Lip lateral lobe	Lip curvature	Lip apex	Lip surface	Lip colour	Lip colour pattern	Column colour pattern
1	*Neostylis* Lou Sneary	Lanceolate	Obovate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Uniform	Uniform
2	*Rhynchorides* Bangkok Sunset	Obovate	Orbicular	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Shaded	Uniform
3	*Rhy.* Sri Siam x *Rhy. gigantea*	Orbicular	Ovate	Deflexed with straight apex	Bilobed	Glabrous	Single	Shaded	Uniform
4	*V.* Kultana Fragrance	Lanceolate	Obovate	Straight	Bilobed	Glabrous	Double	Streaked	Uniform
5	*Vasco* Blue Bay Blue	Ovate	Orbicular	Straight with incurved apex	Obtuse	Glabrous	Single	Uniform	Uniform
6	*Vasco* Blue Bay White	Ovate	Orbicular	Straight with incurved apex	Bilobed	Glabrous	Single	Uniform	Uniform
7	*Vasco* Blue Bay Pink	Ovate	Orbicular	Straight with incurved apex	Bilobed	Glabrous	Single	Uniform	Uniform
8	*Ascda* Sirichai Fragrance	Lanceolate	Orbicular	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Streaked	Uniform
9	*V.* Indian Incense x *V. tessellata*	Lanceolate	Ovate	Deflexed with deflexed apex	Bilobed	Glabrous	Double	Streaked	Uniform
10	*V.* Mimi Palmer	Lanceolate	Orbicular	Deflexed with straight apex	Bilobed	Glabrous	Double	Streaked	Uniform

Qualitative lip characters of flowers of vandaceous orchid variety/ hybrid contd...

Sl. No	Varieties	Lip mid lobe shape	Lip lateral lobe	Lip curvature	Lip apex	Lip surface	Lip colour	Lip colour pattern	Column colour pattern
11	*V. Coerulea* x *V.* Mimi Palmer	Lanceolate	Orbicular	Deflexed with straight apex	Bilobed	Glabrous	Double	Streaked	Uniform
12	*Vascostylis* Crownfox Red Gem	Lanceolate	Obovate	Deflexed with straight apex	Bilobed	Glabrous	Single	Uniform	Uniform
13	*Ascda* Peggy Foo x *Rhyn. Coelestis* Blue	Lanceolate	Ovate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Shaded	Uniform
14	*Ascda.* Udomchai	Lanceolate	Ovate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Uniform	Uniform
15	*Darwineria* Cream Puff	Lanceolate	Obovate	Deflexed with straight apex	Bilobed	Glabrous	Double	Streaked	Uniform
16	*V.* Rothschildiana	Orbicular	Ovate	Deflexed with incurved apex	Bilobed	Glabrous	Double	Uniform	Uniform
17	*V.* Pranerm Prai x V. *tessellata*	Lanceolate	Ovate	Straight	Bilobed	Glabrous	Double	Uniform	Uniform
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	Lanceolate	Ovate	Deflexed with straight apex	Bilobed	Glabrous	Double	Streaked	Uniform
19	*Aerides quinque Vulnera Rhy. Coelestis*	Lanceolate	Ovate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Shaded	Uniform
20	*Ascda.* Suksamran Sunlight Yellow	Ovate	Obovate	Straight	Bilobed	Glabrous	Double	Shaded	Uniform
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	Lanceolate	Ovate	Straight	Bilobed	Glabrous	Double	Uniform	Uniform
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	Lanceolate	Lanceolate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Uniform	Uniform
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	Lanceolate	Ovate	Deflexed with deflexed apex	Bilobed	Glabrous	Single	Uniform	Uniform
24	*Vasco* Kultana Million Bhat	Lanceolate	Orbicular	Deflexed with straight apex	Bilobed	Glabrous	Single	Uniform	Uniform
25	*V.* JVB x *Ascda.* Yip Sum Wah	Lanceolate	Ovate	Deflexed with straight apex	Bilobed	Glabrous	Single	Uniform	Uniform

(2.03cm), *V.* Rothschildiana (2.00cm), *Vasco* Kultana Million Bhat (1.90cm) and *V.* Mimi Palmer (1.83cm). Length of labellum was minimum in *Ascda.* Udomchai (1.07cm) which was on par with *V.* JVB X *Ascocenda* Yip Sum Wah (1.13 cm).

Width of labellum

The width of labellum also showed marked difference within the varieties (Table 15). Lip width was maximum in *Aerides quinque Vulnera Rhy. coelestis* (2.15 cm) followed by V. Rothschildiana (1.87 cm) and *Ascda.* Suksamran Sunlight Yellow (1.85 cm) and minimum in *Neostylis* Lou Sneary (0.40 cm).

Length of column

Significant differences were noticed with respect to length of column within selected varieties (Table 15). Column length was maximum in *Ascda.* Suksamran Sunlight Yellow as well as *V.* Mimi Palmer (0.83 cm) which is on par with *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (0.82 cm), *Aerides quinque Vulnera Rhy. coelestis (0.80 cm) and V. coerulea* x *V.* Mimi Palmer (0.73 cm). Length of column was minimum in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (0.10 cm) which were on par with *Neostylis* Lou Sneary (0.20 cm) followed by *Vasco* Blue Bay Blue (0.21 cm) and *Rhynchorides* Bangkok Sunset (0.37 cm).

4.1.5. Post-harvest characters

The data pertaining to the post-harvest characters namely, fresh weight of spike, floret life span, spike longevity, number of buds opening in the vase, days taken for wilting of first floret, water uptake and physiological loss in weight are presented in Table 18.

Fresh weight of the spike

Significant differences were observed in fresh weight of spike among varieties (Table 18). Maximum fresh weight was observed in *V.* Pranerm Prai x V. *tessellata*

(30.82 g) and was significantly superior to all others and it was minimum in *Neostylis* Lou Sneary (4.21 g).

Wilting of first floret

The varieties/ hybrids also varied in their time taken for wilting of first floret. It was significantly high in *V.* Pranerm Prai x V. *tessellata* (14.03 days), as compared to the other varieties. Minimum duration was observed in *Neostylis* Lou Sneary (1.53 days) followed by *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (2.13 days), *Vasco* Blue Bay White (2.27 days) and *V.* Indian Incense x *V. tessellata* (3.30 days).

Floret life span

The life span of each floret in vase also differed significantly among varieties. It was maximum (8.13 days) in *V.* Rothschildiana, and significantly superior to all other varieties. It was followed by *V.* Pranerm Prai x V. *tessellata* (6.70 days) and *Ascda.* Suksamran Sunlight Yellow (6.27 days). Minimum (1.63 days) life span was observed in *Vasco* Blue Bay Pink.

Number of buds opening in vase

Among the varieties, opening of maximum number of buds in vase was observed in *Neostylis* Lou Sneary (4.03) followed by *Vascostylis* Crownfox Red Gem (3.73), *Ascda.* Udomchai (3.00) and *Rhynchorides* Bangkok Sunset(2.33). Bud opening was not observed in vase in *V.* Pranerm Prai x V. *tessellata, Darwineria* Cream Puff, *Ascda.* Suksamran Sunlight Yellow, *V.* Indian Incense x *V. tessellata, V.* Mimi Palmer and *V.* Kultana Fragrance.

Spike longevity

The varieties varied significantly with respect to spike longevity in vase. *V.* JVB X *Ascocenda* Yip Sum Wah recorded significantly maximum spike longevity (17.30 days) among all the selected varieties / hybrids, followed by *V.* Pranerm Prai x V. *tessellata (15.00 days)* and *Ascda.* Udomchai (14.00 days). Minimum spike

longevity was recorded in *V.* Mimi Palmer (5.00 days), followed by *Vasco* Blue Bay White (5.23 days), *Neostylis* Lou Sneary (5.50 days) and *Rhy.* Sri Siam x *Rhy. gigantea* (6.17 days) and they were statistically comparable.

Water uptake

Differences were also noticed among varieties (Table 18) and maximum uptake was in *V.* Rothschildiana (12.00 ml), followed by *V.* Pranerm Prai x V. *tessellata* (9.57 ml), *Vascostylis* Crownfox Red Gem (6.37 ml) and *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (5.73 ml). Minimum water uptake was observed in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (2.10 ml) followed *Neostylis* Lou Sneary (2.20 ml), *Rhy.* Sri Siam x *Rhy. gigantea* (2.43ml) and *Vasco* Blue Bay White(2.50 ml).

Physiological loss in weight

Marked differences were noticed in physiological loss in weight among the varieties. Maximum weight loss was observed in *Vascostylis* Crownfox Red Gem (12.51 g), followed by *Vasco* Blue Bay White (10.65 g), *Vasco* Blue Bay Pink(10.42 g) and *V.* Pranerm Prai x V. *tessellata* (9.52g) and minimum in *Neostylis* Lou Sneary (1.93 g)

4.2 QUALITATIVE CHARACTERS

The qualitative characters of the varieties varied in all aspects and wide range of variation could be observed. Data on qualitative stem and root characters are presented in Table 4 and 12, respectively and floral characters in Tables 14-17.

4.2.1. Plant characters

All the vandaceous orchid varieties / hybrids were hanging type; having medium sized, stout, brown colored shoots, with little or no branching (Table 4). *Neostylis* Lou Sneary and *Rhynchorides* Bangkok Sunset showed branching with 3-5 spouts from the base of the plant. *Vasco* Blue Bay White, *V.* Indian Incense x *V.*

Table.18. Post-harvest characters of spikes of vandaceous orchid varieties/ hybrids

Sl. No	Varieties /hybrids	Post-harvest characters						
		Fresh wt. of spike (g)	Wilting of first floret (days)	Floret life span(days)	Buds opening in vase(No.s)	Spike longevity (days)	Water uptake (ml)	Physiological loss in wt.(g)
1	*Neostylis* Lou Sneary	4.21^{r}	1.53^{l}	2.00^{lm}	4.03	5.50^{mnop}	2.20^{nop}	1.93^{a}
2	*Rhynchorides* Bangkok Sunset	9.23^{n}	3.30^{j}	3.17^{hi}	2.33	6.90^{ijkl}	5.10^{def}	5.44^{g}
3	*Rhy.* Sri Siam x *Rhy. gigantea*	$7.24o^{pq}$	6.33^{d}	4.73^{f}	0.97	6.17^{lmn}	2.43^{mnop}	2.40^{pdr}
4	*V.* Kultana Fragrance	16.38^{fg}	8.47^{b}	5.43^{de}	0.00	7.33^{ghijk}	4.40^{fg}	3.37^{mn}
5	*Vasco* Blue Bay Blue	14.71^{ghi}	4.97^{fg}	2.17^{klm}	0.10	7.73^{ghi}	3.40^{hijkl}	7.37^{f}
6	*Vasco* Blue Bay White	26.40^{c}	2.27^{k}	1.77^{m}	0.47	5.23^{nop}	2.50^{lmnop}	10.65^{b}
7	*Vasco* Blue Bay Pink	26.52^{c}	3.64^{ij}	1.63^{m}	0.77	7.40^{ghijk}	3.17^{ijklm}	10.42^{b}
8	*Ascda* Sirichai Fragrance	8.55^{nop}	6.33^{d}	2.63^{ijk}	2.10	13.00^{cd}	4.67^{efg}	8.23^{e}
9	*V.* Indian Incense x *V. tessellata*	20.05^{e}	3.30^{j}	5.27^{def}	0.00	8.30^{fg}	3.87^{ghij}	8.17^{e}
10	*V.* Mimi Palmer	17.81^{f}	4.50^{h}	5.07^{ef}	0.00	5.00^{op}	3.30^{hijklm}	3.79^{klm}
11	*V. coerulea* x *V.* Mimi Palmer	14.30^{ijk}	4.80^{g}	5.80^{cd}	0.73	8.30^{fg}	3.80^{ghij}	2.74^{opd}
12	*Vascostylis* Crownfox Red Gem	28.39^{b}	6.00^{de}	3.74^{gh}	3.73	10.17^{e}	6.37^{c}	12.51^{a}
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	15.33^{ghi}	3.30^{j}	3.7^{ij}	0.70	8.80^{f}	5.73^{cd}	3.481^{mn}
14	*Ascda.* Udomchai	14.28^{ijk}	7.10^{c}	3.93^{g}	3.00	14.00_{bc}	4.00_{ghi}	2.79^{opq}
15	*Darwineria* Cream Puff	12.12^{lm}	4.10^{hi}	5.43^{de}	0.00	8.00^{fgh}	3.20^{ijklm}	3.93^{jkl}
16	*V.* Rothschildiana	24.02^{d}	5.57ef	8.13^{a}	0.57	12.00d	12.00a	8.74^{d}
17	*V.* Pranerm Prai x V. *tessellata*	30.82^{a}	14.03^{a}	6.70^{b}	0.00	15.00^{b}	9.57^{b}	9.52^{c}
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	8.87^{n}	$2.13k^{l}$	5.67^{d}	2.00	6.40^{klm}	4.50^{efg}	5.61^{g}
19	*Aerides quinque Vulnera Rhy. coelestis*	27.11^{bc}	5.00^{fg}	3.19^{hi}	1.40	7.17^{hijkl}	3.43^{hijk}	4.43^{hi}
20	*Ascda.* Suksamran Sunlight Yellow	16.31^{fgh}	5.67^{e}	6.27^{bc}	0.00	13.60^{c}	3.18^{ijklm}	4.74^{h}
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	12.87^{klm}	3.83^{ij}	2.53^{jkl}	1.60	8.22^{fg}	2.81^{kmnop}	3.15^{nop}
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	13.50^{jkl}	3.57^{ij}	2.07^{klm}	1.60	7.47^{ghij}	3.03^{jklmn}	3.66^{klm}
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	6.82^{q}	4.73^{g}	2.00^{lm}	1.00	8.20^{fgh}	2.10^{g}	2.73^{opt}
24	*Vasco* Kultana Million Bhat	11.63^{m}	3.93^{hi}	2.37^{kl}	1.00	6.57^{jkl}	4.20^{fgh}	4.00^{ijk}
25	*V.* JVB x *Ascda.* Yip Sum Wah	21.36^{e}	6.33^{d}	3.73^{gh}	0.90	17.30^{a}	5.40^{de}	4.37^{hij}

tessellata, *V.* Mimi Palmer and *Vascostylis* Crownfox Red Gem produced sprouts along the stem towards the end of study.

The roots were cylindrical and branching of roots was present in all selected varieties/ hybrids of vandaceous orchids. Almost all varieties had greenish grey colour roots. *Neostylis* Lou Sneary had whitish green coloured roots. .*V.*Rothschildiana and *V.* Pranerm Prai x V. *tessellata* had green coloured roots whereas *Ascda.* Udomchai, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold, *Vasco* Kultana Million Bhat and *V.* JVB X *Ascocenda* Yip Sum Wah had greyish brown roots. In some varieties roots were emerged from basal portion and in others roots along the stem.

4.2.2. Leaf characters

Qualitative characters of leaf and leaf sheath are presented in Tables 9 and 10, respectively.

Most of the varieties / hybrids had channelled leaves, except strap leaved ones namely *Rhynchorides* Bangkok Sunset,*Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink and *Aerides quinque Vulnera Rhy. coelestis.* The leaf texture, was smooth and rigid in all varieties. The leaves were green coloured with no pigmentation or markings, except in *Rhynchorides* Bangkok Sunset where there were purple spots on leaves, and leaf margin was entire (Table 9).

Most of the selected vandaceous orchid varieties / hybrids showed tridentate leaf apex, whereas *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White and *Vasco* Blue Bay Pink had bilobed leaf apex. Leaf apex was acute in ,*Neostylis* Lou Sneary and *Ascda.* Suksamran Sunlight Yellow and retuse in *Aerides quinque Vulnera Rhy. coelestis.*

In almost all varieties, leaves were oriented with an arching tendency and arranged alternately. Leaf orientation was horizontal in *Rhynchorides* Bangkok Sunset

and straight in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold. *Neostylis* Lou Sneary and *V.* Rothschildiana showed straight with arching type leaf orientation.

Leaf sheaths were green, thick and membraneous in all the selected varieties/ hybrids (Table 10) observed for the character.

4.2.3 Floral characters

Data pertaining to the floral characters are presented in Tables 14- 17 and depicted in Plates 1-25.

Inflorescence nature was dense in *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *Vascostylis* Crownfox Red Gem, *Ascda.* Udomchai and *Aerides quinque Vulnera Rhy. coelestis* whereas it were lax in all others. (Table 14). In all varieties, spike colour was green. Spike orientation was erect in all the selected varieties, except in *Rhy.* Sri Siam x *Rhy. gigantea, V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem. They had arching or erect spike orientation.

In all varieties inflorescence arose from lateral position and there were florets on the spike facing all the directions (Table 16). Petal shape was obovate in all the varieties evaluated except in *Neostylis* Lou Sneary and *V.* Kultana Fragrance, where, the shape was oblong.

Petal curvature was observed as deflexed with incurved apex in (*Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *Ascda.* Udomchai, *Darwineria* Cream Puff, *V.* Rothschildiana, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, and *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko. Deflexed petal curvature was also observed in *Neostylis* Lou Sneary, *Rhy.* Sri Siam x *Rhy.*

gigantea, Mok. Khaw Piak Suan x *Ascda.* Jiraprapra and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold.

Majority of the varieties had entire petal margin, except in *V.* Kultana Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *V.* Rothschildiana, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis* where the petal margin was undulate.

Petal apex is obtuse in almost all varieties. *Neostylis* Lou Sneary, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, *Ascda.* Suksamran Sunlight Yellow, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko had acute petal apex, whereas it was truncate in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue and *V.* Rothschildiana.

Petal colour pattern also varied among varieties (Table 16). *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay Pink, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *Aerides quinque Vulnera Rhy. coelestis, Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *Vasco* Kultana Million Bhat had shaded colour pattern. The petal colour pattern was spotted in *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *Ascda.* Udomchai, *Darwineria* Cream Puff, *V.* Pranerm Prai x V. *tessellata* and *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko and tessellated pattern was observed in *V.* Mimi Palmer, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *V. coerulea* x *V.* Mimi Palmer and *V.* Kultana Fragrance whereas, *Ascda.* Suksamran Sunlight Yellow had netted colour pattern. Other varieties have uniform petal colour pattern.

All the evaluated varieties/ hybrids are fragrant. The observed fragrances are floral (*Vasco* Blue Bay Blue (jasmine), *V.* Mimi Palmer (jasmine), *V. Kultana Fragrance*(jasmine), *V.* Pranerm Prai x V. *tessellata* (jasmine), *Rhynchorides* Bangkok Sunset (honey suckle) and *Vasco* Blue Bay White (tuberose), *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (tuberose), *Vasco* Blue Bay Pink (tuberose), *Ascda.*

Udomchai (tuberose)), fruity (citrus in *Vascostylis* Crownfox Red Gem, *Rhy.* Sri Siam x Rhy. *gigantea, Ascda.* Peggy Foo x *Rhyn. coelestis* Blue and *Ascda.* Suksamran Sunlight Yellow and grape in *V.* Indian Incense x *V. tessellata* and *V. coerulea* x V. Mimi Palmer.), sweet (honey in *Ascda.* Sirichai Fragrance, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold, *Vasco* Kultana Million Bhat, *V.* JVB x *Ascda.* Yip Sum Wah and *V.* Rothschildiana whereas vanilla in *Neostylis* Lou Sneary), spicy in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) and green in *Aerides quinque Vulnera Rhy. coelestis*.. Only in *Darwineria* Cream Puff, the fragrance was musty, unpleasant odour of a bug (Table. 16). In *Neostylis* Lou Sneary, *Rhy.* Sri Siam x *Rhy. gigantea*, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) and *Aerides quinque Vulnera Rhy. coelestis* the fragrance was observed throughout the day and lasted till all the florets are open in the spike. *V.* Rothschildiana, *V.* Pranerm Prai x *V. tessellata*, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko, *Mok.*. Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold, *Vasco* Kultana Million Bhat*V.* JVB x *Ascda.* Yip Sum Wah, *Rhynchorides* Bangkok Sunset, *V.* Kultana Fragrance, *Vascostylis* Crownfox Red Gem, *Ascda.* Udomchai and *Darwineria* Cream Puff, fragrance was noted during evening hours, ie, at the time of flower opening and could be observed till all the florets open in a spike and in others fragrance was present only in the morning.

Shape of the lip mid- lobe was lanceolate in almost all varieties. But it was ovate in *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink and *Ascda.* Suksamran Sunlight Yellow; orbicular in *Rhy.* Sri Siam x *Rhy. gigantea* and *V.* Rothschildiana and obovate in *Rhynchorides* Bangkok Sunset (Table 17).

Shape of the lip lateral lobe also varied among varieties and in most of the varieties, it was ovate. In *Neostylis* Lou Sneary, *V.* Kultana Fragrance, *Vascostylis* Crownfox Red Gem, *Darwineria* Cream Puff and *Ascda.* Suksamran Sunlight Yellow lateral mid lobe shape was obovate. But it was orbicular in *Rhynchorides* Bangkok

Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer and *Vasco* Kultana Million Bhat and lanceolate in *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra.

Lip curvature also showed wide variation among varieties, such as deflexed with deflexed apex (*Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *Ascda.* Udomchai, *Aerides quinque Vulnera Rhy. coelestis, Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold); deflexed with straight apex (*Rhy.* Sri Siam x *Rhy. gigantea*, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Darwineria* Cream Puff, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Vasco* Kultana Million Bhat and *V.* JVB X *Ascocenda* Yip Sum Wah; straight (*V.* Kultana Fragrance, *V.* Pranerm Prai x V. *tessellata*, *Ascda.* Suksamran Sunlight Yellow and *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko), straight with incurved apex (*Vasco* Blue Bay Blue, *Vasco* Blue Bay White and *Vasco* Blue Bay Pink) and deflexed with incurved apex in *V.* Rothschildiana.

Lip surface was glabrous and lip apex was bilobed in all vandaceous orchid varieties / hybrids. Only *Vasco* Blue Bay Blue showed obtuse lip apex.

Variation was also noticed among selected varieties with respect to lip colour pattern such as shaded (*Rhynchorides* Bangkok Sunset, *Rhy.* Sri Siam x *Rhy. gigantea*, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *Aerides quinque Vulnera Rhy. coelestis* and *Ascda.* Suksamran Sunlight Yellow and streaked (*V.* Kultana Fragrance, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *Darwineria* Cream Puff and *V.* Mimi Palmer x *V.* (*merilli* x *insignis*)). Other varieties had uniform lip colour pattern.

Column colour pattern was uniform in all selected vandaceous orchid varieties / hybrids.

PLATES 1-25

1. Neostylis Lou Sneary

A hybrid (*Neofinetia falcata* x *Rhyncostylis coestis*), Plant compact, 8-12 cm tall, many sprouts / plantlets appear from the base; shoots slender; leaves channelled, narrowly oblong, leathery, apex acute; leaf sheath membraneous; Roots numerous, whitish green, branched; flowers at multiple times, mostly summer bloomer; spike suberect; flowers white, very fragrant with a characteristic curved tubular spur; lip mid lobe lanceolate, deflexed with deflexed apex.

Flowering branch: 6
Average yield / year: 11.50

2. Rhynchorides Bangkok Sunset

Plant slow growing monopodial epiphyte; Shoot stout, brown in colour, plantlets appear from the base; Leaves strap shaped, smooth, rigid, fleshy, light green with dark purple spots, apex bilobed, base sheathed, horizontally oriented; Roots silvery grey, tip green, cylindrical, branched, and seen along the stem; Spike erect; 26-28 soft waxy textured, fragrant florets; petal obovate, shaded, and deflexed with straight apex, Petals shaded, vivid reddish orange at the apex and fades into light yellow and white at base; Labellum bilobed, mid lobe prominent, obovate, shaded, light purple at the apex and white towards base; Bloom once or twice a year.

Flowering branch: 2
Average yield / year: 3.01

3. Rhy. Sri Siam x Rhy. gigantea

Plant intermediate climbing epiphyte; shoot medium thick, stout; Leaves arching, channelled, smooth, rigid, green, apex tridentate; leaf sheath membraneous; Roots cylindrical, fleshy, greenish grey, branched; Spike arching / horizontal; 12-13 fragrant florets; petals light purple, uniform, obovate, deflexed with obtuse apex; Lip mid lobe orbicular, deflexed and shaded, light purple colour turns to dark towards apex.

Flowering branch: 1
Average yield / year: 2.33

4. *V.* Kultana Fragrance

Plant intermediate climbing epiphyte; shoot medium thick, stout; Leaves channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, branched, greenish grey, along the stem; Spike erect; 6-7 fragrant florets; petals tessellated, strong purple in colour, oblong, incurved without deflexed, obtuse apex; Lip lateral mid-lobe obovate, straight, streaked with brilliant violet and white towards base.

Flowering branch: 1
Average yield / year: 1.02

5. *Vasco* Blue Bay Blue

Plant intermediate climbing epiphyte; shoot medium thick, stout; Leaves arching, smooth, rigid , bilobed apex, strap shaped, leaf sheath membraneous; Roots cylindrical, greenish grey, branched, arise at basal portion; Spike erect, produce 39-40 fragrant florets; petals shaded, white with light purple towards the margin, obovate, deflexed with incurved acute apex; Lip colour pattern uniform, light violet, mid lobe ovate.

Flowering branch: 3
Average yield / year: 3.75

6. *Vasco* Blue Bay White

Plant intermediate climbing epiphyte; shoot stout medium thick, stout; Leaves arching, strap shaped, smooth, rigid , bilobed apex; leaf sheath membraneous; Roots cylindrical, greenish grey, branched, arise from the basal portion; Spike erect, dense with 40-41 white fragrant florets; Petal obovate, deflexed with incurved, acute apex; lip colour pattern uniform, white , mid lobe ovate

Flowering branch: 2
Average yield / year: 2.93

7. *Vasco* Blue Bay Pink

Plant intermediate climbing epiphyte; shoot stout, medium thick; leaves arching, strap shaped, smooth, rigid, bilobed apex; leaf sheath membraneous; Roots cylindrical, greenish grey, branched, arise from the basal portion; spike erect, dense with 44-45 fragrant florets; petal colour pattern shaded deep purplish pink at the apex and colour fades to white at the base, obovate, deflexed with incurved, acute apex; lip colour pattern uniform, deep purplish pink, mid lobe ovate.

Flowering branch: 3
Average yield / year: 3.52

8. Ascda. Sirichai Fragrance

Plant intermediate climbing epiphyte; shoot stout, medium thick, Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; Leaf sheath membraneous; Roots cylindrical, branched, greenish grey, along the stem; Spike erect, dense with 19-20 fragrant florets; petal colour pattern spotted light yellowish pink with strong yellowish pink spotted, obovate, deflexed with incurved apex, obtuse apex; lip colour pattern streaked with strong yellowish pink. lip lateral mid-lobe lanceolate, deflexed with deflexed apex.

Flowering branch: 4
Average yield / year: 6.43

9. V. Indian Incense x *V. tessellata*

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy, upright, produces sprouts/ branches (3-5) along the shoot; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; Leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched; Spike erect, produce 7-8 fragrant florets; colour pattern spotted with brilliant yellowish green with moderate reddish brown spots; petals obovate, deflexed with incurved apex, obtuse apex; lip colour pattern streaked with moderate reddish brown lip lateral mid-lobe lanceolate, deflexed with deflexed apex, , bilobed

Flowering branch: 1
Average yield / year: 2.47

10. V. Mimi Palmer

Hybrid of Tan Chay Yan x *Vanda tessellata;* Plant intermediate climbing epiphyte; shoot stout, medium thick; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; Leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched; Spike arching/ erect, 7-8 fragrant florets; petal colour pattern tessellated, strong purple; petals obovate, deflexed with incurved apex, obtuse apex; lip colour pattern streaked with brilliant violet, lateral mid-lobe lanceolate, deflexed with straight apex, , bilobed

Flowering branch: 1
Average yield / year: .3.

11. V. coerulea x *V.* Mimi Palmer

Plant intermediate climbing epiphyte; shoot stout, medium thick; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, basal, branched; Spike arching/ erect, 7-8 fragrant florets; petal colour pattern tessellated, strong purplish red patches on pale yellow green background; Petals-Twisted, obovate, incurved with deflexed apex, obtuse; lip colour pattern streaked, brilliant violet, white on base, lip lateral mid-lobe lanceolate, deflexed with straight apex, bilobed

Flowering branch: 1
Average yield / year: 4.18

12. Vascostylis Crownfox Red Gem

Plant intermediate climbing epiphyte, shoot stout, medium thick Leave arching, channelled, smooth, rigid green base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched; Spike arching/erect, 25-26 fragrant florets; petal colour pattern Uniform, strong red florets. Petals-Obovate, deflexed with incurved apex, Obtuse; lip colour pattern uniform, strong Red, bilobed, lateral mid-lobe lanceolate, Deflexed with straight apex

Flowering branch:
Average yield / year: 4.54

13. Ascda. Peggy Foo x *Rhy. coelestis* Blue

Plant intermediate climbing epiphyte; shoot stout, medium thick; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; Leaf sheath membraneous; Roots cylindrical, greenish grey, basal, branched; Spike arching/erect, dense with 12-13 fragrant florets; petal colour pattern shaded very light purple dark toward the tip; Petals obovate, deflexed with incurved apex, truncated apex; lip colour pattern shaded, light purple, lateral mid-lobe lanceolate, deflexed with deflexed apex, bilobed.

Flowering branch: 1
Average yield / year: 2.07

14. *Ascda.* Udomchai

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy, upright;Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, basal, branched; Spike erect, dense, 22-23 fragrant florets, petal colour pattern spotted with strong orange with strong reddish orange spots; Petals-obovate, deflexed with incurved apex, obtuse; Lip colour pattern , uniform with strong yellowish pink, lateral mid-lobe lanceolate, deflexed with deflexed apex, bilobed.

Flowering branch: 1
Average yield / year: 2.41

15. *Darwineria Cream Puff*

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy , upright; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched; Spike erect, lax, 9-10 florets, petal colour pattern spotted with light yellow with moderate reddish orange spots; Petals- obovate, deflexed with incurved apex, obtuse; Lip colour pattern streaked, light yellow with moderate reddish orange, lateral mid-lobe lanceolate, deflexed with straight apex, bilobed

Flowering branch: 2
Average yield / year: 3.57

16. *V.* Rothschildiana

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy, upright; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex, leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched; Spike erect, lax, 6-7 florets; petal colour pattern uniform, vivid reddish purple; Petals- obovate, deflexed with incurved, truncate apex; Lip colour pattern uniform, vivid purple .mid lobe orbicular, deflexed with incurved apex, bilobed

Flowering branch: 1
Yield / year: 1.35

17. *V.* Pranerm Prai x *V. tessellata*

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy, upright; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, along the stem, branched, Spike erect, lax, 4-5 fragrant florets; petal colour pattern spotted with light yellowish green petal with strong yellowish green spots. Petals-obovate, straight, obtuse apex; Lip colour pattern uniform, greenish reddish orange, lateral lobe ovate, straight, bilobed.

Flowering branch: 1
Average yield / year: 3.31

18. V. Mimi Palmer x *V. (merilli* x *insignis)*

Plant intermediate climbing epiphyte; shoot stout, medium thick; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greenish grey, basal, branched; Spike arching/ erect, lax, 6-7 fragrant florets; petal colour pattern tessellated vivid purple with yellowish white . Petals- obovate, deflexed with incurved, acute; Lip lateral mid-lobe lanceolate and streaked, deflexed with straight apex, lateral lobe spotted, brilliant violet, white on base, bilobed

Flowering branch: 1
Average yield / year: 4.52

19. Aerides quinque Vulnera. Rhy. coelestis

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy, upright stems, round; Leaves strap shaped, smooth, rigid, green, base sheathed, retuse apex, arching orientation, distichous, leathery, keeled nearing the base; leaf sheath membraneous; Roots cylindrical, greenish grey, basal, branched, robust, distichous; Spike erect, dense, 21-22fragrat florets, facing all directions; petal colour pattern shaded light purple to very light purple; Petals-obovate, deflexed with incurved apex, acute , thick, secrete a sweet fluid attracts ants, numerous buds, racemose, , fleshy, waxy, mint scented, particularly on morning. Lip colour pattern shaded with light purple with lateral lobe vivid reddish purple, lateral mid-lobe lanceolate, deflexed with deflexed, bilobed.

Flowering branch: 1
Average yield / year: 2.63

20. Ascda. Suksamran Sunlight Yellow

Plant intermediate climbing epiphyte; shoot stout, medium thick; Shoot sturdy, upright stems, round and thick; leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, branching, basal, greenish grey; Spike erect, lax, 5-6 fragrant florets; petal colour pattern netted pale yellowish green, Petals-obovate, deflexed with incurved, acute apex; Lip colour pattern uniform, moderate yellowish pink, lateral mid-lobe ovate, straight, bilobed.

Flowering branch: 1
Average yield / year: 1.83

21. *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel kuniko

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy , upright; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greyish brown, basal, branched; Spike erect, lax, 6-7 fragrant florets, petal colour pattern spotted ,light orangish yellow with strong orangish yellow spots, Petals- obovate, deflexed with incurved acute apex; Lip colour pattern is uniform, strong orange ,mid lobe lanceolate, straight, deflexed with incurved apex, bilobed

Flowering branch: 1
Average yield / year: 1.58

22. Mok. Khaw Piak Suan x *Ascda.* Jiraprapra

Plant intermediate climbing epiphyte shoot stout, medium thick, sturdy, upright leaves arching, channelled, smooth, rigid green, base sheathed, tridentate apex; Lea sheath membraneous; Roots cylindrical greyish brown, along the stem, branched Spike erect, lax, 11-12 fragrant florets; peta colour pattern uniform, light orangish yellow Petals- obovate, deflexed, obtuse apex; Lip colour pattern uniform, light orangish yellow mid lobe lanceolate, deflexed with deflexe apex, bilobed

Flowering branch: 1
Average yield / year: 1.53

23. Mok. Sayan x *Ascda.* Bangkhuntien Gold

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy , upright; Leaves straight, channelled, smooth, rigid, green, base sheathed, tridentate apex; leaf sheath membraneous; Roots cylindrical, greyish brown, along the stem, branched; Spike erect, lax, 7-8 fragrant florets, petal colour pattern shaded, light orangish yellow with strong yellowish pink on apex; Petals- obovate, deflexed , obtuse apex; Lip colour pattern uniform, strong yellowish pink, mid lobe lanceolate, deflexed with deflexed apex, bilobed

Flowering branch: 1
Average yield / year: 1.53

24. Vasco Kultana Million Bhat

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy , upright; Leaves arching, channelled, smooth, rigid, green, base sheathed, tridentate apex; Roots cylindrical, greyish brown, basal, branched; Spike erect, lax, 8-9 fragrant florets, petal colour pattern blotched, light purple with white; Petals- ovate, straight , obtuse apex; Lip colour pattern uniform, moderate purple, mid lobe lanceolate, deflexed with straight apex, bilobed

Flowering branch: 1
Average yield / year: 1.60

25. V. JVB x *Ascda.* Yip Sum Wah

Plant intermediate climbing epiphyte; shoot stout, medium thick, sturdy , upright; Leaves : quarter terete, smooth, rigid, green, base sheathed, acute apex, arching orientation; leaf sheath thick; Roots cylindrical, greyish brown, along the stem, branched; Spike erect, lax, 6-9 fragrant florets, petal colour pattern uniform, deep yellowish pink. Petals-obovate, incurved, obtuse apex; Lip colour pattern uniform with vivid reddish orange, mid lobe lanceolate, deflexed with straight apex, bilobed

Flowering branch: 1
Average yield / year: 1.50

Most of the varieties had conical spur with medium spur length except *Neostylis* Lou Sneary where it was long and tubular in this variety. (Table 15)

4.2.4 Visual scoring / evaluation

Data regarding the scores obtained for the spikes of twenty five vandaceous orchid varieties are presented in Table 19. The highest mean total score was obtained for *Vascostylis* Crownfox Red Gem (43.7), followed by *Vasco* Blue Bay Pink (43.6), *Vasco* Blue Bay Blue (43.3) *Vasco* Blue Bay White (43.0) and *Rhy.* Sri Siam x *Rhy. gigantea* (42.9). The lowest score (39.2) was obtained for *V.* Rothschildiana was followed by *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (39.6), *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (39.60) and *Vasco* Kultana Million Bhat (39.8). The highest score for the three characters, viz, colour and pigmentation (8.9.) texture (8.8) and shape and pattern (9.0) was obtained for *Vascostylis* Crownfox Red Gem, whereas the highest score (9.0) for floret size was recorded by *V.* Mimi Palmer and for arrangement of florets on spike (9.0) was recorded by *Vasco* Blue Bay Blue and *Vasco* Blue Bay Pink.

Plant quality rating was done based on fullness, growth and visual appearance, flower colour and pigmentation, spike longevity, shape and arrangement of foliage during the growth period(Table 20). The highest mean total score was obtained by *Vasco* Blue Bay Pink (44.8), followed by *Vascostylis* Crownfox Red Gem (44.7), *Vasco* Blue Bay Blue (44.6) and *Rhynchorides* Bangkok Sunset (44.5). Lowest score (41.3) was recorded in *V.* Kultana Fragrance followed by *V.* Rothschildiana (41.7) and *Ascda* Peggy Foo x *Rhyn. Coelestis* Blue (41.8).

Fragrance scoring was done based on intensity and diffusiveness, newness and beautifulness. Beautifulness was considered based on elegance and freshness. *V.* Mimi Palmer recorded the highest mean total score (18.50), followed by *Neostylis* Lou Sneary (18.30), *V. coerulea* x *V.* Mimi Palmer (18.20) and *Vasco* Blue Bay Blue (18.10). Lowest score was recorded by *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (15.70) (Table. 21).

Table. 19. Visual scoring of spikes of twenty five vandaceous orchid varieties/ hybrids

Sl. No	Varieties /hybrids	Scoring (each Out of 10)					
		Colour & pigmentation (out of 10)	Texture (Out of 10)	Shape &pattern (Out of 10)	Size of floret (Out of 10)	Arrangement Of florets on Spike (Out of 10)	Total Out of 50
1	*Neostylis* Lou Sneary	8.0	8.3	8.5	8.5	8.3	41.6
2	*Rhynchorides* Bangkok Sunset	8.6	8.2	8.3	8.1	9.0	42.2
3	*Rhy.* Sri Siam x *Rhy. gigantea*	9.0	9.0	8.9	8.6	8.5	44.0
4	*V.* Kultana Fragrance	8.0	8.1	8.4	8.2	7.9	40.6
5	*Vasco* Blue Bay Blue	8.8	8.3	8.5	8.7	9.0	43.3
6	*Vasco* Blue Bay White	8.7	8.2	8.4	8.8	8.9	43.0
7	*Vasco* Blue Bay Pink	8.8	8.4	8.6	8.8	9.0	43.6
8	*Ascda* Sirichai Fragrance	8.5	8.4	8.5	8.6	8.4	42.4
9	*V.* Indian Incense x *V. tessellata*	8.6	8.2	8.3	8.4	8.0	41.5
10	*V.* Mimi Palmer	8.5	8.6	8.5	8.9	8.3	42.8
11	*V. coerulea* x *V.* Mimi Palmer	8.0	8.0	8.0	8.1	8.2	40.3
12	*Vascostylis* Crownfox Red Gem	8.9	8.8	9.0	8.5	8.5	43.7
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	8.3	8.1	8.2	8.0	8.1	40.7
14	*Ascda.* Udomchai	8.1	8.3	8.1	8.3	8.4	41.2
15	*Darwineria* Cream Puff	8.0	8.0	8.3	8.6	8.1	41.0
16	*V.* Rothschildiana	7.9	7.8	8.2	8.1	7.2	39.2
17	*V.* Pranerm Prai x V. *tessellata*	8.0	8.1	8.3	8.1	8.0	40.5
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	8.1	8.3	8.1	8.2	8.0	40.7
19	*Aerides quinque Vulnera Rhy. coelestis*	8.4	8.1	8.0	8.2	8.3	41
20	*Ascda.* Suksamran Sunlight Yellow	8.3	8	8.1	8.0	8.1	40.5
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	8.1	8.0	8.1	8.2	8.2	40.6
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	8.0	8.0	7.9	7.9	7.8	39.6
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	8.0	7.9	7.9	8.0	7.7	39.5
24	*Vasco* Kultana Million Bhat	7.9	7.8	8.0	8.1	8.0	39.8
25	*V.* JVB x *Ascda.* Yip Sum Wah	8.2	7.4	8.5	8.6	8.0	40.7

Table. 20. Plant quality rating of twenty five vandaceous orchid varieties / hybrids

Sl No	Varieties /hybrids	Scores (each out of 10)					
		Growth & fullness	Shape & arrangement (leaves)	Flower colour & pigmentation	Spike longevity on plant	Visual appeal/ general appearance	Total (Out of 50)
1	*Neostylis* Lou Sneary	9	8.9	8.6	8	9	43.5
2	*Rhynchorides* Bangkok Sunset	9	8.8	9	9	8.7	44.5
3	*Rhy.* Sri Siam x *Rhy. gigantea*	8.7	8.4	8.9	8.7	8.8	43.5
4	*V.*Kultana Fragrance	8	8	8.1	8.9	8.3	41.3
5	*Vasco* Blue Bay Blue	9	8.8	9	8.8	9	44.6
6	*Vasco* Blue Bay White	8.9	8.9	8.9	8.8	8.9	44.4
7	*Vasco* Blue Bay Pink	9	8.9	9	8.9	9	44.8
8	*Ascda* Sirichai Fragrance	8.9	8.9	8.7	8.7	8.8	44.0
9	*V.* Indian Incense x *V. tessellata*	8.9	8.5	8.9	8.8	8.4	43.5
10	*V.* Mimi Palmer	8.5	8.5	8.4	8.8	8.8	43
11	*V. coerulea* x *V.* Mimi Palmer	8.3	8.2	8.4	8.6	8.6	42.1
12	*Vascostylis* Crownfox Red Gem	9	8.9	8.8	9	9	44.7
13	*Ascda* Peggy Foo x *Rhyn. Coelestis* Blue	8.7	8	8.2	8.3	8.6	41.8
14	*Ascda.* Udomchai	8.6	8.4	8.3	8.5	8.4	42.2
15	*Darwineria* Cream Puff	8.7	8.6	8.9	8.7	8.8	43.7
16	*V.* Rothschildiana	8	8.2	8.4	8.5	8.6	41.7
17	*V.* Pranerm Prai x V. *tessellata*	8.3	8.5	8.3	8.7	8.7	42.5
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	8.5	8.4	8.4	8.7	8.7	42.7
19	*Aerides quinque Vulnera Rhy. coelestis*	8.9	8.7	8.7	8.7	8.8	43.8
20	*Ascda.* Suksamran Sunlight Yellow	8.7	8.6	8.5	8.6	8.7	43.1
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	8.4	8.5	8.6	8.5	8.5	42.5
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	8.3	8.6	8.7	8.3	8.6	42.5
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	8.4	8.5	8.5	8.4	8.6	42.4
24	*Vasco*Kultana Million Bhat	8.4	8.7	8.5	8.7	8.6	42.9
25	*V.* JVB x *Ascda.* Yip Sum Wah	8.8	8.5	8.6	8.7	8.7	43.3

Table. 21. Fragrance scoring of twenty five vandaceous orchid varieties / hybrids

Sl. No	Varieties/ hybrids	Scores			
		Intensity & diffusiveness (out of 5)	Newness (out of 5)	Beautifulness (out of 10)	Total (out of 20)
1	*Neostylis* Lou Sneary	4.7	4.6	9.0	18.3
2	*Rhynchorides* Bangkok Sunset	4.0	4.0	8.6	16.6
3	*Rhy.* Sri Siam x *Rhy. gigantea*	4.7	4.4	8.9	18.0
4	*V.*Kultana Fragrance	3.9	3.8	8.5	16.2
5	*Vasco* Blue Bay Blue	4.6	4.6	8.9	18.1
6	*Vasco* Blue Bay White	4.5	4.6	8.9	18.0
7	*Vasco* Blue Bay Pink	4.6	4.5	8.8	17.9
8	*Ascda* Sirichai Fragrance	4.3	4.4	8.6	17.3
9	*V.* Indian Incense x *V. tessellata*	4.5	4.5	8.7	17.7
10	*V.* Mimi Palmer	4.7	4.8	9.0	18.5
11	*V. coerulea* x *V.* Mimi Palmer	4.6	4.7	8.9	18.2
12	*Vascostylis* Crownfox Red Gem	4.4	4.5	8.9	17.8
13	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	4.2	4.3	8.6	17.1
14	*Ascda.* Udomchai	4.1	4.2	8.6	16.9
15	*Darwineria* Cream Puff	4.0	4.0	8.7	16.7
16	*V.* Rothschildiana	4.0	4.0	8.2	16.2
17	*V.* Pranerm Prai x V. *tessellata*	4.0	4.0	8.6	16.6
18	*V.* Mimi Palmer x *V.* (*merilli* x *insignis*)	4.1	4.3	8.8	17.2
19	*Aerides quinque Vulnera Rhy. coelestis*	4.3	4.6	8.8	17.7
20	*Ascda.* Suksamran Sunlight Yellow	4.0	4.1	8.5	16.6
21	*Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	3.8	3.8	8.2	15.8
22	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra	3.8	3.8	8.1	15.7
23	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold	4.0	3.9	8.8	16.7
24	*Vasco*Kultana Million Bhat	4.0	4.0	8.6	16.6
25	*V.* JVB x *Ascda.* Yip Sum Wah	4.0	4.0	8.7	16.7

4.4. Grouping of vandaceous orchids for ornamental traits

Considering the overall quantitative and qualitative paramers, *Vascostylis* Crownfox Red Gem, *Rhynchorides* Bangkok Sunset, *Rhy.* Sri Siam x *Rhy. gigantea*, *Vasco* Blue Bay Blue, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* JVB x *Ascda.* Yip Sum Wah were found excellent for cut flower production. All the evaluated varieties have potential as garden plant, with the fragrance being an added advantage.

The twenty five vandaceous orchids were grouped according to their flowering phenology, spike and floral characters. Spike characters like number of spikes produced / year, nature of spike, orientation, number of florets/ spike, spike longevity and floral characters like flower colour (both petal and lip), flower size and fragrance were taken into consideration for grouping of varieties (Table 22 – 27)

4.4.1.Configuration of phenological group of vandaceous orchid varieties/ hybrids

Flowering phenology should be considered for selecting any flowering plant for indoor and outdoor landscaping. The twenty five vandaceous orchids were observed for their visually attractive phenophases, (ie, full blooming) and classified accordingly. The varieties showed marked variation in blooming time when a spike reached at least 25- 50 per cent of its full bloom; it was considered to be at its phenophase. By observing flowering phenology of these orchids, four phenophases ie Nov – Jan, Feb – April, May – July and Aug – Oct, were recorded and they were categorized to respective phenophases.

Different varieties/ hybrids (side–runs) which behaved identically in a particular phenophase were also observed. The configuration of phonological group

Table. 22. Configuration of phenological group of vandaceous orchid varieties/ hybrids

Phenophase	Side Runs	Colour & pattern	
		Petal	Lip
November December January	*Neostylis* Lou Sneary	White -Uniform	White –Uniform
	Rhynchorides Bangkok Sunset	Vivid reddish orange, light yellow and white-shaded	Light purple with white towards base-shaded
	Rhy. Sri Siam x *Rhy. gigantea*	Light purple-uniform	Light purple dark towards tip-uniform
	Vascostylis Crownfox Red Gem	Strong Red - uniform	Strong Red – uniform
	Ascda. Udomchai	Strong orange with strong reddish orange spots-spotted	Strong yellowish pink- uniform
	V. Pranerm Prai x V. *tessellata*	Light yellowish green with strong yellowish green spots- spotted	Greenish reddish orange- shaded
	V. Mimi Palmer x *V.* (*merilli* x *insignis*)	Vivid purple and yellowish white- tessellated	Brilliant violet – streaked
	Mok. Sayan x *Ascda.* Bangkhuntien Gold	Light orangish yellow with strong yellowish pink tip-shaded	Strong yellowish pink- uniform
	V. JVB x *Ascda.* Yip Sum Wah	Deep yellowish pink - uniform	Vivid reddish orange- uniform
February March April	*V.* Indian Incense x *V. tessellata*	Brilliant yellowish green with moderate reddish brown spots- spotted	Moderate reddish brown -streaked
	V. Mimi Palmer	Strong purple -tessellated	Brilliant violet- streaked
	V. coerulea x *V.* Mimi Palmer	Pale yellowish green with strong purplish red-tessellated	Brilliant violet- streaked
	Ascda Peggy Foo x *Rhyn. coelestis* Blue	Very light purple-shaded	Light purple- shaded
	Darwineria Cream Puff	Light yellow with moderate reddish orange spots-spotted	light yellow with moderate reddish orange-streaked
	V. Pranerm Prai x V. *tessellata*	Light yellowish green with strong yellowish green spots-spotted	Greenish reddish orange- shaded
	Ascda. Suksamran Sunlight Yellow	Pale yellowish green –netted	moderate yellowish pink- shaded
	Mok. Sayan x *Ascda.* Bangkhuntien Gold	Light orangish yellow with strong yellowish pink tip-shaded	Strong yellowish pink- uniform
May June July	*Neostylis* Lou Sneary	White -Uniform	White –Uniform
	Rhy. Sri Siam x *Rhy. gigantea*	Light purple- uniform	Light purple dark towards tip-uniform
	Vasco Blue Bay Blue	White petal with light violet tinged apex-shaded	Light violet-uniform
	Vasco Blue Bay White	White- uniform	White- uniform
	Vasco Blue Bay Pink	White petal with deep purplish pink tinged apex-uniform	Deep purplish pink-uniform
	Ascda Sirichai Fragrance	Light yellowish pink and strong yellowish pink dots- spotted	strong yellowish pink- streaked
	V. Mimi Palmer	Strong purple -tessellated	Brilliant violet – streaked
	Vascostylis Crownfox Red Gem	Strong Red - uniform	Strong red –uniform

Configuration of phenological group of vandaceous orchid varieties/ hybrids contd...

Phenophase	Side Runs	Colour & pattern	
		Petal	Lip
	Vasco Kultana Million Bhat	Light purple & white-tessellated	Moderate purple- streaked
	V. Rothschildiana	Vivid reddish purple- uniform	Vivid purple-uniform
	V. Mimi Palmer x *V.* (*merilli* x *insignis*)	Vivid purple and yellowish white-tessellated	Brilliant violet - streaked
	Aerides quinque Vulnera Rhy. coelestis	Very pale purple to light purple-shaded	light purple to vivid reddish purple-shaded
	Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	Light orangish yellow and strong orangish yellow spots -spotted	Strong orange-uniform
	Mok. Khaw Piak Suan x *Ascda.* Jiraprapra	Light orangish yellow- uniform	Light orangish yellow-uniform
	V. JVB x *Ascda.* Yip Sum Wah	Deep yellowish pink- uniform	Vivid reddish orange- uniform
August September October	*Rhynchorides* Bangkok Sunset	Vivid reddish orange, light yellow and white-shaded	Light purple with white towards base-shaded
	Rhy. Sri Siam x *Rhy. gigantea*	Light purple- uniform	Light purple dark towards tip-uniform
	V. Kultana Fragrance	Strong purple-tessellated	Brilliant violet and white towards base- streaked
	Ascda Sirichai Fragrance	Light yellowish pink and strong yellowish pink dots-spotted	strong yellowish pink- streaked
	V. Indian Incense x *V. tessellata*	Brilliant yellowish green with moderate reddish brown spots-spotted	Moderate reddish brown -streaked
	V. Mimi Palmer	Strong purple -tessellated	Brilliant violet - streaked
	V. coerulea x *V.* Mimi Palmer	Pale yellowish green with strong purplish red – tessellated	Brilliant violet – streaked
	Vascostylis Crownfox Red Gem	Strong Red- uniform	Strong red –uniform
	Ascda. Udomchai	Strong orange with strong reddish orange spots-spotted	Strong yellowish pink- uniform
	Darwineria Cream Puff	Light yellow with moderate reddish orange spots-spotted	light yellow with moderate reddish orange-streaked
	Aerides quinque Vulnera Rhy. coelestis	Very pale purple to light purple-shaded	light purple to vivid reddish purple-shaded
	Ascda. Suksamran Sunlight Yellow	Pale yellowish green-netted	moderate yellowish pink- shaded
	V. JVB x *Ascda.* Yip Sum Wah	Deep yellowish pink -uniform	Vivid reddish orange- uniform

of vandaceous orchids are given in Table 22. In a single phenophase different flower colour combinations were also noticed. Identification of phenological side –runs also helps in a proper design of different components in a landscape garden, for imparting time specific interests to gardeners.

4.4.2. Grouping of vandaceous orchids based on flower colour

Among the orchids all the three categories of colours, ie warm, cool and neutral colours were observed. The flower colour of different orchids are given in Table.23.

Orchids with warm colours were *Rhynchorides* Bangkok Sunset, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Ascda.* Udomchai, *Darwineria* Cream Puff, *Mok.* Khaw Piak Suan, *Ascda.* Bicentenniel Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *V.* JVB x *Ascda.* Yip Sum Wah. The varieties *Rhy.* Sri Siam x *Rhy. gigantea*, *V.* Kultana Fragrance, *Vasco* Blue Bay Blue, *Vasco* Blue Bay Pink, *V.* Mimi Palmer, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *V.* Rothschildiana, *V.* Pranerm Prai x V. *tessellata, V.* Mimi Palmer x *V.*(*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, *Ascda.* Suksamran Sunlight Yellow and *Vasco* Kultana Million Bhat produced cool coloured flowers. Neutral coloured (white) flowers were produced by *Neostylis* Lou Sneary and *Vasco* Blue Bay White.

4.4.3. Grouping vandaceous orchids/ hybrids based on number of florets/ spike and floret size

Among the evaluated orchid varieties, four categories were obtained based on the number of florets/ spike and floret size. Maximum number of florets (> 30) were produced by the varieties, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White and *Vasco* Blue Bay Pink whereas floret size was less. The number of florets/ spike was

Table. 23. Grouping of vandaceous orchids based on flower colour

Warm colour	Cool colour	Neutral colour
Rhynchorides Bangkok Sunset	*Rhy.* Sri Siam x *Rhy. gigantea*	*Neostylis* Lou Sneary
Ascda Sirichai Fragrance	*V.* Kultana Fragrance	*Vasco* Blue Bay White
V. Indian Incense x *V. tessellata*	*Vasco* Blue Bay Blue	
V. coerulea x *V.* Mimi Palmer	*Vasco* Blue Bay Pink	
Vascostylis Crownfox Red Gem	*V.* Mimi Palmer	
Ascda. Udomchai	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	
Darwineria Cream Puff	*V.* Rothschildiana	
Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	*V.* Pranerm Prai x V. *tessellata*	
Mok. Khaw Piak Suan x *Ascda.* Jiraprapra	*V.* Mimi Palmer x *V.* (merilli x insignis)	
Mok. Sayan x *Ascda.* Bangkhuntien Gold	*Aerides quinque Vulnera Rhy. coelestis*	
V. JVB x *Ascda.* Yip Sum Wah	*Ascda.* Suksamran Sunlight Yellow	
	Vasco Kultana Million Bhat	

comparatively high (21–30) in *Rhynchorides* Bangkok Sunset, *Vascostylis* Crownfox Red Gem, *Ascda*. Udomchai and *Aerides quinque Vulnera Rhy. coelestis*. (Table. 24).

4.4.4. Grouping of vandaceous orchids based on longevity of spike on the plant

Based on longevity of spike on the plant, few categories wee obtained (Table 25). The longevity of the spike on the plant was more (20-30 days) in *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *V.* Rothschildiana and *V.* Pranerm Prai x V. *tessellata*

4.4.5. Grouping of vandaceous orchids based on spikes produced / year

Based on the number of spikes produced/ year four categories were obtained, viz, <3, 3-6, 6-9 and >9. Among the varieties, *Neostylis* Lou Sneary, produced maximum number of spikes/ year (Table. 26). This was followed by *Ascda* Sirichai Fragrance (6-9).

4.4.6. Grouping vandaceous orchids based on fragrance

All the evaluated vandaceous orchids were grouped based on similarity of fragrance viz, floral, fruity, sweet, spicy, green and miscellaneous and are given in Table. 27.

4.4.7. Selection as value added plants

Value addition in floriculture is the process of increasing the economic value and consumer appeal of any floral commodity. In the case of ornamental plants, where and how they are displayed also contribute the value.

Flowers of vandaceous orchids are known for their magnitude of diversity in form, colour, size, shape fragrance, attractive form and longer life span. The added advantage of displaying the plants in various ways widens the opportunity to use them for multiple purposes, both outdoors and indoors.

Based on the observations on growth, flowering and morphological characters, the 25 vandaceous hybrids were categorized for diverse uses.

Table. 24. Grouping of vandaceous orchids based on number of florets/ spike and floret size

No. of florets /spike	Varieties / hybrids	Floret size (cm^2)
1-10 (low)	*V.* Kultana Fragrance	37.60
	V. Indian Incense x *V. tessellata*	34.22
	V. Mimi Palmer	28.97
	V. coerulea x *V.* Mimi Palmer	28.09
	Darwineria Cream Puff	25.67
	V. Rothschildiana	83.23
	V. Pranerm Prai x V. *tessellata*	72.00
	V. Mimi Palmer x *V.* (*merilli* x *insignis*)	30.31
	Ascda. Suksamran Sunlight Yellow	78.27
	Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko	7.44
	Vasco Kultana Million Bhat	32.27
	Mok. Sayan x *Ascda.* Bangkhuntien Gold	32.24
	V. JVB x *Ascda.* Yip Sum Wah	30.63
11-20 (medium)	*Neostylis* Lou Sneary	6.57
	Rhy. Sri Siam x *Rhy. gigantea*	12.01
	Ascda Sirichai Fragrance	10.86
	Ascda Peggy Foo x *Rhyn. coelestis* Blue	22.84
	Mok. Khaw Piak Suan x *Ascda.* Jiraprapra	27.33
21-30 (high)	*Rhynchorides* Bangkok Sunset	5.42
	Vascostylis Crownfox Red Gem	23.43
	Ascda. Udomchai	15.73
	Aerides quinque Vulnera Rhy. coelestis	20.85
>30(very high)	*Vasco* Blue Bay Blue	4.17
	Vasco Blue Bay White	4.29

Table. 25. Grouping of vandaceous orchids based on longevity of spike on the plant

Spike longevity(days)	Varieties / hybrids
< 10	*Rhy.* Sri Siam x *Rhy. gigantea*
	V. Kultana Fragrance
	Vasco Blue Bay Blue
10-20	*Neostylis* Lou Sneary
	Rhynchorides Bangkok Sunset
	Vasco Blue Bay White
	Vasco Blue Bay Pink
	Ascda Sirichai Fragrance
	V. Indian Incense x *V. tessellata*
	V. Mimi Palmer
	Ascda Peggy Foo x *Rhyn. coelestis* Blue
	Ascda. Udomchai
	Darwineria Cream Puff
	V. Mimi Palmer x *V.* (*merilli* x *insignis*)
	Aerides quinque Vulnera Rhy. coelestis
	Ascda. Suksamran Sunlight Yellow
	Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko
	Mok. Khaw Piak Suan x *Ascda.* Jiraprapra
	Mok. Sayan x *Ascda.* Bangkhuntien Gold
	Vasco Kultana Million Bhat
	V. JVB x *Ascda*. Yip Sum Wah
20-30	*V. coerulea* x *V.* Mimi Palmer
	Vascostylis Crownfox Red Gem
	V. Rothschildiana
	V. Pranerm Prai x V. *tessellata*

Table.26. Grouping of vandaceous orchids based on spikes produced / year

No. of spikes produced	Varieties
< 3	*Rhy.* Sri Siam x *Rhy. gigantea*
	V. Kultana Fragrance
	Vasco Blue Bay White
	V. Indian Incense x *V. tessellata*
	Ascda Peggy Foo x *Rhyn. coelestis* Blue
	Ascda. Udomchai
	V. Rothschildiana
	Aerides quinque Vulnera Rhy. coelestis
	Ascda. Suksamran Sunlight Yellow
	Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko
	Mok. Khaw Piak Suan x *Ascda.* Jiraprapra
	Mok. Sayan x *Ascda.* Bangkhuntien Gold
	Vasco Kultana Million Bhat
	V. JVB x *Ascda.* Yip Sum Wah
3-6	*Rhynchorides* Bangkok Sunset
	Vasco Blue Bay Blue
	Vasco Blue Bay Pink
	V. Mimi Palmer
	V. coerulea x *V.* Mimi Palmer
	Vascostylis Crownfox Red Gem
	Darwineria Cream Puff
	V. Pranerm Prai x V. *tessellata*
	V. Mimi Palmer x *V.* (*merilli* x *insignis*)
6-9	*Ascda* Sirichai Fragrance
>9	*Neostylis* Lou Sneary

Tabl 27. Grouping vandaceous orchids based on fragrance

Fragrance Terminology					
Floral	**Fruity**	**Sweet**	**Spicy**	**Green**	**Miscellaneous**
Rhynchorides Bangkok Sunset	*Rhy.* Sri Siam x *Rhy. gigantea*	*Neostylis* Lou Sneary	*V.* Mimi Palmer x *V.* (*merilli* x *insignis)*	*Aerides quinque Vulnera Rhy. coelestis*	*Darwineria* Cream Puff
Vasco Blue Bay Blue	*V.* Indian Incense x *V. tessellata*	*Ascda* Sirichai Fragrance			
Vasco Blue Bay White	*V. coerulea* x *V.* Mimi Palmer	*Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra			
Vasco Blue Bay Pink	*Vascostylis* Crownfox Red Gem	*Mok.* Sayan x *Ascda.* Bangkhuntien Gold			
V. Mimi Palmer	*Ascda* Peggy Foo x *Rhyn. coelestis* Blue	*Vasco* Kultana Million Bhat			
Ascda. Udomchai	*Ascda.* Suksamran Sunlight Yellow	*V.* JVB x *Ascda.* Yip Sum Wah			
V. Pranerm Prai x V. *tessellata*		*V.* Rothschildiana			
Mok. Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko					
V. Kultana Fragrance					

4.4.7.1 As cut flower

Cut flowers are put broadly to two purposes; preparation of bouquets and flower arrangements. Various attributes of the cut flowers, like, length of spike, size and number of flowers, orientation and display of flowers on the axis, colour of lip and florets, fragrance etc. observed in the vandaceous orchids evaluated, qualify them for versatile uses.

For large bouquets and tall arrangements

Varieties with long spike and large flowers can be used.

Varieties suitable: *Ascda Sirichai Fragrance, Vascostylis Crownfox Red Gem, Ascda Peggy Foo x Rhyn. coelestis Blue, Ascda. Udomchai, Aerides quinque Vulnera Rhy. coelestis*

For compact arrangements and bouquets

Varieties with more number of florets/ spike (dense) can be used.

The following varieties displaying short spikes and small flowers are better choice: *Neostylis Lou Sneary, Rhynchorides Bangkok Sunset, Vasco Blue Bay Blue, Vasco Blue Bay White, and Vasco* Blue Bay Pink.

For use as corsage

The varieties displaying large flower, attractive colour and form and long flower stalk are suitable.

Varieties suitable*: V. Kultana Fragrance, V. Mimi Palmer, V. coerulea x V. Mimi Palmer, V. Rothschildiana, V. Pranerm Prai x V. tessellata*

4.4.7.2. As garden plant

All the evaluated vandaceous orchids can be recommended as garden plants. How they can be displayed largely depends on where they are used.

Outdoor gardens

As vandaceous orchids require good amount of sunlight, they can be used outdoors under partially shaded conditions.

Pergolas and arbours

They will be a good choice for planting in hanging baskets under pergolas, where the fragrance of flower will also contribute the aesthetic value. The height of the plants should be adjusted so as to enjoy the display, colour and fragrance of flowers.

Varieties suitable: *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, and *Ascda* Sirichai Fragrance,

Fragrant garden

All the evaluated varieties be included in the fragrant garden, except *Darwineria* Cream Puff

Moon garden

The white flowered varieties will find a place in the moon garden and fragrance will be an added advantage.

Varieties suitable: *Neostylis* Lou Sneary and *Vasco* Blue Bay White

Green house

In garden greenhouses they can be used in various ways, as pot plants on the benches, in hanging baskets or in a vertical display.

Varieties suitable: *Rhynchorides* Bangkok Sunset, *Rhy.* Sri Siam x *Rhy. gigantea*, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *V.* Pranerm Prai x *V. tessellata.*

On tree branches

They can also be tied on to the branches of trees so as to set a natural display of the plants under the dappled light available.

Varieties suitable: *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Darwineria* Cream Puff

V. Mimi Palmer x *V.* (*merilli* x *insignis*)

Indoor gardens

Areas inside the house or other buildings which receive better sunlight are choice places for displaying vandaceous orchids.

In corridors

Displaying their beauty and enjoying the fragrance. They have to be placed at a convenient height for facilitating irrigation and other management activities.

Varieties suitable: *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*)

On the floor

Potted plants can be placed on the floors of patios and corridors receiving better sunlight. Tall plants with long spikes can be planted in tall pots for a good display.

Varieties suitable: *V.* Indian Incense x *V. tessellata*, *Vascostylis* Crownfox Red Gem and *Aerides quinque Vulnera Rhy. coelestis, V.* Mimi Palmer

On window sills

Window sills of outer walls receive better sunlight. Elegant varieties can be displayed here as they receive better attention in view of the height and location. They also need to be rotated periodically to prevent bending of the apex towards the increased light from outside.

Varieties suitable: *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Rhy.* Sri Siam x *Rhy. gigantea*, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *Vasco* Kultana Million Bhat.

Vertical gardens

Walls which receive good light can be used for displaying the plants. If this is combined with an indoor pool, increased humidity will be an added advantage.

Varieties suitable: *V.* Rothschildiana, *V.* Pranerm Prai x *V. tessellata*, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, *V.* JVB x *Ascda*. Yip Sum Wah, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *V.* Indian Incense x *V. tessellata*, *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *V.* Rothschildiana, *V.* Pranerm Prai x *V. tessellata* and *V.* Mimi Palmer x *V.* (*merilli* x *insignis*).

Roof top gardens:

Roof tops offer a better choice because all the methods discussed under outdoor gardens are suitable here too.

While using plants indoors, two or three times the number of required plants will be necessary, as they have to be cooled off under a near natural condition outside, in a greenhouse. High humidity related health problems also need to be cautioned as orchids require a very high level of humidity for their growth and development.

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Discussion

5. DISCUSSION

The results of the evaluation of fragrant vandaceous orchids for ornamental traits are discussed in this chapter.

Flamboyant, intriguing, beautiful and exotic, orchids have evolved to become the largest family of plants in the world. They are unique with their versatility in form, flower colour, size, shape and longer life span of flowers. The family Orchidaceae consists of both monopodial and sympodial genera. Among the monopodial orchids, *Phalaenopsis* and *Vanda* and the intergeneric hybrids like *Aranda, Mokara* are the most popular in the world market.

Orchids in view of the vast number of genera and cross pollinating nature have several species that produce fragrant flowers to attract pollinators. However, the hybrids rarely express the attributes, barring a few genera, viz, *Aerides, Ascocentrum, Neofinetia, Renanthera, Rhyncostylis, Vanda* etc., generally referred to as vandaceous orchids. The advantage here is a unique mix of longevity and fragrance. This feature makes these orchids a novelty in the ornamental plant industry.

In the present study, twenty five fragrant vandaceous varieties / hybrids of orchids were evaluated to assess the suitability for commercial exploitation as value added plants.

QUANTITATIVE CHARACTERS

The quantitative characters evaluated under this study were plant height, plant spread, shoot girth, internodal length; leaf characters namely length, breadth, area, interval of leaf production and number of leaves along with the characters length, girth and number of roots. Floral characters namely, days taken from spike emergence to opening of first floret, 50 per cent florets and complete opening of all florets; longevity

of spike on plants, interval and annual spike production, blooming period; spike length, rachis length, flower stalk length, number of florets/ spike, internodal length between florets, flower size, flower stalk length, length and width of labellum, length of spur and column and life of individual florets on the spike were observed to compare the varieties. Post-harvest characters observed were, fresh weight, wilting of first floret in vase, spike longevity, bud opening, water uptake by spike, physiological loss in weight and floret span in vase.

Generally, vandaceous orchids enjoy a warm humid, tropical climate. During the period of study, the varieties performed well during May to July, *ie* rainy season both in vegetative growth and flower production. Vegetative growth is essential for better flower production. Majority of the cultivated orchids are the natives of tropical climate and occurr profusely in humid tropical forest of Central and South America, India, Indonesia and many other countries (Behra *et al,* 2013). According to Abraham and Vatsala (1981), orchid expresses a high magnitude and diversity and responds very well to the environment.

5.1.1. Plant characters

Significant variation was observed in plant height among the varieties. Though height is an inherent character, it can be influenced by growing conditions. It is mainly due to the differences in internodal length. Maximum plant height recorded was in *Vascostylis* Crownfox Red Gem and *V.* Pranerm Prai x *V. tessellata,* which were having a comparatively good internodal length, whereas the minimum plant height was recorded in *Neostylis* Lou Sneary which had the least internodal length.

The area occupied by the plant indicates the plant spread which determines the plant density in the growing environment. Leaf characteristics such as length, orientation and arrangement have a direct influence on plant spread, especially in the case of vandas, since it is non branching. *Vascostylis* Crownfox Red Gem recorded maximum plant spread while *Mok.* Sayan x *Ascda.* Bangkhuntien Gold, the minimum,

followed by *Neostylis* Lou Sneary. The more the spread, the spacing between the plants should also be more. So it indicates that the long and arching nature of leaves and spikes have better role in determining the spacing between plants.

Shoot girth determines the strength of stem. Maximum shoot girth was recorded in *V.* Pranerm Prai x V. *tessellata* whereas the minimum was in *Neostylis* Lou Sneary.

Leaf characters, both quantitative and qualitative also have an important role in the selection of plants for commercial exploitation. Leaf length and width are indicators of leaf size. leaf size, leaf number, leaf production interval along with leaf sheath characters that directly contribute to the photosynthetic efficiency of plant.

Leaf length was maximum in *Vascostylis* Crownfox Red Gem followed by *Vasco* Kultana Million Bhat and *V.* Pranerm Prai x V. *tessellata* whereas it was minimum in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold. While comparing length and width of leaves, it was noticed that leaf length largely contributed to the leaf area. Leaf area was also maximum in *Vascostylis* Crownfox Red Gem. Such characters of different orchids were described by Bose *et al.*, (1999); Bhattacharjee *et al.* (2002); Kaveriamma, (2007) and Minnu, (2015) in their studies.

Leaf production interval influences the leaf yield. It was maximum in *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko. Hence it had minimum leaf number. Leaf number was maximum in *Vascostylis* Crown fox Red Gem which recorded the minimum interval for leaf production. Appreciable differences were also observed with respect to the orientation of leaf. It benefits, the plant by proper interception of light.

In vandaceous orchids, roots are long and hang freely and need to cling on a support (Bose *et al*, 1999). The aerial roots araising from the base of the stem or seen along the stem help the plant to absorb nutrients and moisture from the growing environment. In 1983, Goh based on the study conducted in *Aranda* orchids reported that production pattern of roots is not driven by the genetic constitution but possibly

by the physiological and environmental factors. The varieties showed wide variation with regard to the root characteristics. Maximum root length was observed in *V.* Pranerm Prai x V. *tessellata* and minimum in *V. coerulea* x *V.* Mimi Palmer. Maximum root girth was noticed in *V.* Indian Incense x *V. tessellata* and minimum in *Neostylis* Lou Sneary. Root number was maximum in *Neostylis* Lou Sneary whereas minimum in *Rhy.* Sri Siam x *Rhy. gigantea.* Besides, the absorbent outer cover of roots made by a layer of dead cells called velamen helps in easy absorption of water and nutrients (Brian and Rittershausen, 2014).

5.1.2. Floral characters

The vandaceous orchid varieties/ hybrids exhibited considerable variation with regard to the blooming season. Among the varieties single flowering season was observed in *V.* Kultana Fragrance, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *V.* Rothschildiana, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *Vasco* Kultana Million Bhat and three flowering season are noticed in *Rhy.* Sri Siam x *Rhy. gigantea*, *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem and *V.* JVB x *Ascda*. Yip Sum Wah. All the other flowered twice a year. Majority had flowering peak during May – July.

Dressler (1981) reported that rainfall has a direct correlation with the flowering phenology in tropics. Amin *et al.* (2004) studied the performance of six indigenous monopodial orchids of Bangladesh and stated that all the species flowered during March to July. Photoperiodism, vernalisation and juvenility are the three important factors that determine the flowering season and ontogeny (Yong and Hew, 2004). Natural flowering occurs when environmental conditions become favourable for the reproduction of plants, sincere the plant starts to respond to the photoperiod and temperature (Lopez and Runkle, 2004).

Growth requirements also vary among different varieties. Many species of *Arachnis, Renanthera, Ascocentrum* and *Vanda* require full sun light for their free flowering and any shading delays the flowering process. Many of the intergeneric hybrids such as *Aranda* and *Aranthera* are following the same conditions for flowering, whereas *Phalaenopsis, Dendrobium* etc. require shading for flower production. (Soon, 1980). According to Brian and Rittershausen, (2014) *Vanda coerulea* growing on oak trees require full sun for flowering.

In orchids flower bud initiation occurred after the spike had reached a certain length under the required environmental conditions (Lee and Lin, 1984). Once the flower bud formation has started, the development time is dependent upon the temperature and genetic constitution (Lopez and Runkle, 2005). The duration from spike emergence to opening of first floret was minimum in *Neostylis* Lou Sneary followed by *Darwineria* Cream Puff and *Aerides quinque Vulnera Rhy. coelestis,* whereas, it was maximum *in Ascda* Peggy Foo x *Rhyn. coelestis* Blue followed by *V.* Kultana Fragrance. It was noted that in the varieties / hybrids florets open in an acropetal succession. Flowers in the inflorescence of Vanda – *Arachnis* tribe open acropetally at one day interval (Goh, 1977).

Stage of harvest is determined based on the opening of 50 per cent florets. *Neostylis* Lou Sneary could be harvested first, followed by *Darwineria* Cream Puff, whereas *Ascda* Peggy Foo x *Rhyn. coelestis* Blue attained harvestable stage late. The duration between the spike emergence to opening of all florets also showed significant differences among varieties. Maximum number of days for opening of all florets was observed in *Ascda* Peggy Foo x *Rhyn. Coelestis* Blue whereas *Neostylis* Lou Sneary, the minimum.

Orchids with good spike length are generally selected as cut flower. Appreciable variations were noted in spike length among varieties. Significantly higher spike length was observed in *Aerides quinque Vulnera Rhy. coelestis* followed by

Vascostylis Crownfox Red Gem whereas the length was minimum in *Rhy.* Sri Siam x *Rhy. gigantea* followed by *V.* JVB X *Ascocenda* Yip Sum Wah.

Rachis length determines flower bearing area. *Aerides quinque Vulnera Rhy. coelestis* recorded maximum rachis length followed by *Ascda.* Udomchai and *Vascostylis* Crownfox Red Gem, whereas it was the minimum in *V.* JVB X *Ascocenda* Yip Sum Wah followed by *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko and *V.* Pranerm Prai x V. *tessellata.* From the ornamental point of view, rachis length has to be assessed together with number and size of florets.

Spikes with good girth would be sturdier and will be suitable as cut flower. Significant variation was noticed in girth of spike among the varieties. It was maximum in *Vascostylis* Crownfox Red Gem which was on par with Pranerm Prai x V. *tessellata,* and was minimum in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) which are on par with *Neostylis* Lou Sneary. Spike girth determines the space occupied by spike in arrangement.

During the period of study, *Neostylis* Lou Sneary produced maximum number of spikes/ plant / year and was significantly superior to all other varieties. The interval of spike production was less.

Appreciable differences were observed in the number of florets produced per spike. *Vasco* Blue Bay Pink recorded maximum number of florets per spike followed by *Vasco* Blue Bay White. It was minimum in *V.* Pranerm Prai x V. *tessellata* followed by *Ascda.* Suksamran Sunlight Yellow. The internodal length between the florets and number of florets were negatively correlated. *Vasco* Blue Bay Pink showed minimum internodal length between florets. This character give the compactness of the spike which is important in the ornamental point of view.

Spike longevity on the plant is a major criterion for the determination of the plant as a cut flower or as a pot plant. Spike longevity varies with respect to the growing conditions, environmental factors and genetic factors. *V.* Rothschildiana recorded

maximum longevity under normal growing conditions, followed by *V.* Pranerm Prai x V. *tessellata.*

Good floret size is an added advantage from the commercial point of view. Length and width of petal together determines the floret size. Among the varieties *V.* Rothschildiana recorded maximum floret size followed by *Ascda.* Suksamran Sunlight Yellow and *V.* Pranerm Prai x V. *tessellata,* whereas floret size was minimum in *Vasco* Blue Bay Blue followed by *Vasco* Blue Bay White and *Vasco* Blue Bay Pink.

Vandaceous orchid varieties or hybrids showed detectable differences with regard to the pedicel/ flower stalk length. Flowers with good pedicel length are suitable for corsages. Maximum pedicel length was recorded in *V.* Kultana Fragrance followed by *V.* Pranerm Prai x V. *tessellata* and *V.* Rothschildiana.

Lip or labellum is the most attractive part of an orchid flower. It varies in colour, size and shape among varieties. Considerable variations were observed in quantitative characters like length and width of labellum and column length.

Marked variations were noted in post-harvest behaviour and lasting quality of flowers in different varieties. Significantly longest vase life was observed in *V.* JVB X *Ascocenda* Yip Sum Wah followed by *V.* Pranerm Prai x V. *tessellata.* It was minimum in *V.* Mimi Palmer followed by *Vasco* Blue Bay White. Usually, spike longevity is determined by senescence and wilting of petals. Floret life span was maximum in *V.* Rothschildiana followed by *V.* Pranerm Prai x V. *tessellata* as well as *V.* Pranerm Prai x V. *tessellata* took maximum duration for the wilting of first floret. The opening of buds in vase indicates active growth of internal tissues and hormonal functions in the plant. Hence, it also contributes to vase life .It was maximum in *Neostylis* Lou Sneary followed by followed by *Vascostylis* Crownfox Red Gem which determine the post-harvest quality of spike as a cut flower.

Water absorption indicates the metabolic activities as well as the retention of the tissues. It is related to the physiological loss in weight of spike under vase condition which was observed as the minimum in *Vascostylis* Crownfox Red Gem.

5.2 QUALITATIVE CHARACTERS

Qualitative characters with respect to plant, leaf and florets of twenty five vandaceous orchid varieties/ hybrids were observed. Plant type, leaf shape and orientation, inflorescence type, flower fragrance, sepal and petal shape, lip shape, colour and ornamentation and column orientation showed uniqueness to formulate DUS guidelines in *Oncidium* from the 60 morphological characters. (Geetha *et al.*, 2014). These type of characters have economic relevance for the identification and protection of plant varieties as well as encouraging the development of new varieties.

All the vandaceous orchid varieties/ hybrids were intermediate climbing epiphytes; Shoots were medium thick, sturdy, brown with little or no branching. Roots were commonly green, greyish brown and greenish grey in colour with branching. Profuse growth, branching and large number of roots were noticed in varieties/ hybrids like *Neostylis* Lou Sneary followed by *V.* Mimi Palmer and *Rhynchorides* Bangkok Sunset. If the branching were higher in the variety means absorption rate of water and nutrient will also be higher.

Leaves of vandaceous orchid varieties/ hybrids were green in colour, mostly channelled, except in *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink and *Aerides quinque Vulnera Rhy. Coelestis* which had strap leaves. Leaf texture was smooth, rigid, without any pigmentation or marking, except *Rhynchorides* Bangkok Sunset which had small purple spots on leaves. Apex being acute, retuse, tridentate and bilobed; leaf margin entire; leaf base sheathed and they were membraneous and green. Straight, arching and horizontal leaf orientations were also observed among varieties/ hybrids.

Different varieties/ hybrids (side –runs) which behaved identically in a particular phenophase were also observed. By observing, flowering phenology of these of these orchids, four phenophases ie Dec – Feb, March – May, June – Aug and Sept – Nov, were recorded and they were categorized to respective phenophases.

Among most of the varieties peak flowering was observed during June to August followed by September to November. *Rhy.* Sri Siam x *Rhy. gigantea*, *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem and *V.* JVB x *Ascda*. Yip Sum Wah flowered thrice in a year whereas *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V. coerulea* x *V.* Mimi Palmer, *Ascda*. Udomchai, *Darwineria* Cream Puff, *V.* Pranerm Prai x V. *tessellata*, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. Coelestis*, *Ascda.* Suksamran Sunlight Yellow and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold had two blooming period whereas other varieties had a single blooming period during a year.

In general evaluated varieties showed better performance during the entire period of study. Several tropical low land orchid flora show year round flowering which is mainly controlled by their genetic constitution (Goh, 1984). In 1971, Stanford conducted a study in West African orchids and found that flowering phenology of some orchids were genetically controlled. Peak flowering were noticed in the month of May to June after the commencement of rainy season. Least flowering were observed during November to February. It may because of shorter day lengths. So flowering characters in monopodial orchids were directly influenced by the environmental factors.

Regarding the inflorescence of vandaceous orchid varieties or hybrids, it aroused from lateral position and oriented in an arching or erect manner and florets are displayed in facing all directions. Erect nature of spike is an added advantage as cut flower as an ornamental quality. According to Amin *et al.* (2004) the inflorescence of *Vanda teres* were stout and erect which is suitable for keeping in vase, as it is stout and straight where drooping spike of *Rhynchostylis retusa* is not suitable. They also found

that *Aerides multiflorum* had longest inflorescence with maximum flowering area and number of florets per inflorescence. Flowering nature of the plant determines the method of display especially in the case of orchids. Tiny miniature orchids were grown in pots as small *Rhynchostylis* having pendant flower spikes and long dangling roots as best suited for basket culture (De and Medhi, 2015).

Petals displayed a wide range of shape (obovate and oblong), curvature (straight, deflexed, deflexed with incurved apex, incurved with deflexed apex and incurved), petal margin (entire, undulate and slightly undulate), colour pattern (shaded, uniform, spotted, netted and tessellated), shades (white, violet, lavender, purple, red, pink, yellow, green and orange) and apex (acute, obtuse and truncate). Delle- Vendove *et al.*, (2011), stated that colour is not always a good indicator of odour and that colour scent association may be complex, depending of concerned pollination ecology of the population.

Labellum is a modified petal which is the most attractive and highlighting part of an orchid flower. It is usually glabrous with bilobed apex. Among varieties/ hybrids labellum showed different colours like white, purple, green, red, violet, yellow and orange with uniform, shaded and streaked colour pattern. Column colour pattern was also uniform, streaked or spotted. Most of the varieties had medium spur length and conical spur type except *Neostylis* Lou Sneary. It was long and tubular in this variety.

In breeding programme, selection of good and healthy plant and flower by visual observation accounts to a great extent. Rating of market acceptability and consumer appealness is an important step which have to be done before the introduction of a new variety into the trade, especially in floriculture. The highest mean total score was obtained by *Vasco* Blue Bay Pink in plant quality rating followed by *Vascostylis* Crownfox Red Gem and *Vasco* Blue Bay Blue. For the visual scoring of spikes, highest mean total score was obtained for *Vascostylis* Crownfox Red Gem followed by *Vasco* Blue Bay Pink and *Vasco* Blue Bay Blue.

While considering flowers of vandaceous orchid varieties/ hybrids, fragrance is an essential character for general acceptance. Highly scented orchid flowers add immeasurably to their overall appeal. *Brassovola cuculata*, ghost orchid blooms autumn and is highly fragrant at night (Brian and Rittershausen, 2014). Kaveriamma (2007) conducted a study in forty monopodial orchids and found that *Vanda* Prolific had sweet fragrance. Flach *et al.*, (2004) reported that major chemical class of compounds present in the labellar secretions are triterpenoids. Fragrant substance produced in osmophores of many orchids serve as attractant for pollinators and they have an impact in plant reproduction (Huber *et al.*, 2005). Considering the fragrance scoring *V.* Mimi Palmer recorded the highest mean total score followed by *Neostylis* Lou Sneary.

The foregoing discussions on the present study suggest that there were consistent differences in the growth and performance of the selected vandaceous orchid varieties/ hybrids. They were grouped according to their flowering phenology, spike and floral characters. Spike characters like number of spike produced / year, nature of spike, orientation, number of florets/ spike, spike longevity and floral characters like flower colour (both petal and lip), flower size and fragrance were taken into consideration for grouping of varieties.

By observing the flowering phenology of orchids, four phenophases ie Nov – Jan, Feb – April, May- July and Aug – Oct were recorded and they were categorized in to respective phenophase. Different hybrids (side – runs) which behaved identically on a particular phenophase was also observed. Different colour combinations were also noticed with in a phenophase. Plants having contrasting or augmenting colours can be grouped together for best visual appeal. It is also possible to select varieties to have flowering throughout the year in a garden. Warm coloured varieties are *Rhynchorides* Bangkok Sunset, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V. coerulea* x *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Ascda.* Udomchai, *Darwineria* Cream Puff, *Mok.* Khaw Piak Suan x *Ascda.*,Bicentenniel

Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *V.* JVB x *Ascda.* Yip Sum Wah whereas flower colour was neutral (white) in *Neostylis* Lou Sneary and *Vasco* Blue Bay.

An important aspect for evaluating a plant in terms of its economic feasibility, more important as cut flower, and at times as garden plant (pot plant) is the number of spikes produced by the plant per annum. Moreover, spike length, spike orientation, number of florets/ spike, floret size, fragrance etc. are also important. These characters give visual effect for use as cut flower and pot plants (garden plant).

Flowers of vandaceous orchids are known for their magnitude of diversity in form, colour, size, shape, fragrance, attractive form and longer life span. The added advantage of displaying the plant in various ways gives the opportunity to use them for multiple purposes, both outdoors and indoors.

They are also suitable for interior plantscaping to create a peaceful, relaxing and inviting environment, the fragrance being an added advantage.

Based on the foregoing discussion, it was observed that fragrant vandaceous orchid varieties/ hybrids vary in overall quantitative and qualitative parameters. Useful information have been obtained on growth differences, flowering phenology and behaviour.

Further studies have to be conducted to improve the yield and quality of cut flower and pot plants of vandaceous orchids by critically understanding the essential inputs in order to fully exploit the commercial feasibility. The scope of indoor vertical gardening using fragrant vandaceous orchids may be exploited to create peaceful, relaxing environment, with the fragrance being an added advantage. More fragrant vandaceous orchids have to be evaluated and classified, aesthetically and functionally for diverse uses to create product diversity in floriculture industry.

Summary

6. SUMMARY

Evaluation of the performance of fragrant vandaceous orchids for ornamental traits was conducted at the Department of Floriculture and Landscaping, College of Horticulture, Vellanikkara, Trissur during the period from June 2016 to May 2017. The main objective was to assess the suitability for commercial exploitation as value added plants.

Twenty five intermediate climbing vanda varieties / hybrids were used for the study. The varieties exhibited wide variation in both vegetative and floral characters. The salient findings are summarized here.

- Maximum plant height was recorded in *Vascostylis* Crownfox Red Gem (68.73 cm) followed by *V.* Pranerm Prai x *V. tessellata* (63.50 cm) while it was minimum in *Neostylis* Lou Sneary (9.30cm).
- Marked differences were observed with respect to plant spread. Plant spread recorded was maximum in *Vascostylis* Crownfox Red Gem (59.23 cm) followed by *Ascda*. Udomchai and were statistically comparable, whereas minimum in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (21.73 cm), followed by *Neostylis* Lou Sneary (27.43 cm).
- The vandaceous orchid varieties were hanging type having medium sized brown coloured shoots, with little or no branching. Branching was observed in *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay White, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer and *Vascostylis* Crownfox Red Gem.
- Maximum shoot girth (4.99 cm) was observed in *V.* Pranerm Prai x V. *tessellata* followed by *Vascostylis* Crownfox Red Gem (4.93cm) while it was minimum in *Neostylis* Lou Sneary (2.83 cm) followed by *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (3.07 cm).

- Internodal length among the selected varieties was maximum in *Vascostylis* Crownfox Red Gem (1.95 cm) and *Neostylis* Lou Sneary the minimum (0.59cm).
- During the entire study period *Vascostylis* Crown fox Red Gem had the maximum number of leaves. But at the end of the study period, *V.* Indian Incense x *V. tessellata* recorded maximum (37.00) number of leaves which was on par with *Vascostylis* Crownfox Red Gem (36.00). Minimum leaf number (7.67) was observed in *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko. Leaf length was maximum (33.83 cm) in *Vascostylis* Crownfox Red Gem, followed by *Vasco* Kultana Million Bhat (31.27cm). Minimum leaf length was observed in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (14.63 cm).
- Leaf breadth was maximum (3.87 cm) in *Aerides quinque Vulnera Rhy. coelestis,* whereas minimum in *Neostylis* Lou Sneary (1.13 cm).
- Leaf area was significantly high (105.54 cm^2) in *V.* Pranerm Prai x V. *tessellata* and was superior to other varieties/ hybrids except *Vascostylis* Crownfox Red Gem (96.39 cm^2). Minimum leaf area (24.09 cm^2) was recorded in *Neostylis* Lou Sneary.
- The interval of leaf production was maximum in *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko (269.67 days) and minimum (40.55 days) in *V.* Indian Incense x *V. tessellata.*
- Most of the hybrids had channelled leaves, however *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink and Aerides *quinque Vulnera Rhy. coelestis* had strap shaped leaves.
- Leaves were green in colour with smooth and rigid texture and entire leaf margin. Pigmentation of leaves was observed only in *Rhynchorides* Bangkok Sunset.

- Leaf apex was acute in *Neostylis* Lou Sneary and *Ascda.* Suksamran Sunlight Yellow, whereas retuse in *Aerides quinque Vulnera Rhy. coelestis.* Other varieties had tridentate apex.
- Leaves were oriented as straight or horizontal with an arching tendency. It was horizontal in *Rhynchorides* Bangkok Sunset and straight in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold. *Neostylis* Lou Sneary and *V.* Rothschildiana had straight with arching type leaf orientation.
- Vandaceous orchids differed in their length, girth and number of roots. *Neostylis* Lou Sneary recorded the maximum root number (28.00).
- *V.* Pranerm Prai x V. *tessellata* had the maximum (181.75 cm) root length.
- *V.* Indian Incense x *V. tessellata* had the maximum root girth (2.60).
- Duration from spike emergence to opening of first floret and 50 per cent florets was maximum in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue minimum in (16.73 days) in *Neostylis* Lou Sneary. For all florets to open, *Ascda* Peggy Foo x *Rhyn. Coelestis* Blue recorded the maximum duration (54.99 days) duration and *Neostylis* Lou Sneary the minimum (20.12 days).
- Distinguishable differences was noticed with respect to the spike longevity on the plant. Among the varieties, spike longevity on the plant was maximum in *V.* Rothschildiana (29.30 days), followed by *V.* Pranerm Prai x V. *tessellata* (25.00 days*), V. coerulea* x *V.* Mimi Palmer (23.67 days), *Vascostylis* Crownfox Red Gem (22.33 days) whereas minimum in *Rhy.* Sri Siam x *Rhy. gigantea* (7.50 days) followed by *V.* Kultana Fragrance(8.00 days) and *Vasco* Blue Bay Blue(9.50 days).
- Spike production interval was maximum (375.33 days), in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue while it was minimum (80.67 days) in *Rhynchorides* Bangkok Sunset
- Maximum number of spikes was produced (11.50) in *Neostylis* Lou Sneary and was significantly superior to all other varieties and which followed by *Ascda*

Sirichai Fragrance (6.43) and *Vascostylis* Crownfox Red Gem (4.54). Annual spike production was minimum in *V.* Kultana Fragrance (1.02).

- *Aerides quinque Vulnera Rhy. coelestis* recorded the maximum spike length (33.17 cm) and was significantly superior to all other varieties except *Vascostylis* Crownfox Red Gem (32.73 cm). Minimum spike length was recorded by *Rhy.* Sri Siam x *Rhy. gigantea* (14.80 cm)
- Among the varieties *Aerides quinque Vulnera Rhy. coelestis* recorded the maximum (22.23 cm) rachis length followed by *Ascda.* Udomchai (20.43cm), *Vascostylis* Crownfox Red Gem (19.80cm) and *Vasco* Blue Bay Blue (19.33cm), where the minimum (5.83 cm) was in *V.* JVB X *Ascocenda* Yip Sum Wah.
- Variations were also observed in the stalk length among the varieties. *Ascda* Peggy Foo x *Rhyn. coelestis* Blue recorded the maximum (18.14 cm) and *Neostylis* Lou Sneary (5.52 cm), the minimum.
- *Vascostylis* Crownfox Red Gem recorded the maximum spike girth (2.30 cm) and was minimum in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) (0.67 cm) which was on par with *Neostylis* Lou Sneary (0.86 cm).
- Maximum number of florets was produced in *Vasco* Blue Bay Pink (44.33) followed by *Vasco* Blue Bay White (40.33) and *Vasco* Blue Bay Blue (39.67) and was minimum in *V.* Pranerm Prai x V. *tessellata,* (4.83).
- Internodal length between the florets at the base was maximum (3.20 cm) in *V.* Mimi Palmer x *V.* (*merilli* x *insignis*) whereas it was minimum (0.90cm) in *Vasco* Blue Bay Pink.
- Internodal length between the florets at the top was maximum in *V.* Pranerm Prai x V. *tessellata* (2.27 cm) and minimum in *Ascda.* Suksamran Sunlight Yellow (0.47cm).
- *V.* Rothschildiana recorded maximum flower size (83.23 cm^2) followed by *Ascda.* Suksamran Sunlight Yellow (78.27 cm^2) and *V.* Pranerm Prai x V.

tessellata (72.00 cm^2). Flower size was minimum in *Vasco* Blue Bay Blue (4.17 cm^2), followed by *Vasco* Blue Bay White (4.29 cm^2) and *Vasco* Blue Bay Pink (5.22 cm^2).

- *V.* Kultana Fragrance recorded the maximum (6.54 cm) length of flower stalk length and *Neostylis* Lou Sneary recorded the minimum (2.17 cm).
- Individual flower life was same (10.07 days) for *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata* and *V.* Pranerm Prai x V. *tessellata*, followed by *Aerides quinque Vulnera Rhy. Coelestis* (10.00 days).
- Among the lip characters *Ascda* Peggy Foo x *Rhyn. coelestis* Blue recorded the maximum lip length (2.07 cm) . *Ascda*. Udomchai (1.07cm) the minimum. Lip width was maximum in *Aerides quinque Vulnera Rhy. coelestis* (2.15 cm) followed by V. Rothschildiana (1.87 cm) and minimum in *Neostylis* Lou Sneary (0.40 cm).
- Flowers of vandaceous orchids showed wide variation in column length. It was maximum in *Ascda.* Suksamran Sunlight Yellow as well as in *V.* Mimi Palmer and minimum in *Ascda* Peggy Foo x *Rhyn. coelestis* Blue.
- In all the varieties inflorescences were in lateral position, florets were arranged in a manner facing all directions. Florets displayed wide range of size and pattern of shades.
- Inflorescence nature was dense in *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *Vascostylis* Crownfox Red Gem, *Ascda.* Udomchai and *Aerides quinque Vulnera Rhy. coelestis* whereas it was lax in nature in all others.
- Fragrance was observed in all varieties whereas it was very faint in *V.* Rothschildiana. Resemblance of fragrance was categorized based on different notes such as floral, fruity, spicy, green, sweet and miscellaneous.

- Among post-harvest characters studied *V.* JVB X *Ascocenda* Yip Sum Wah recorded the maximum spike longevity (17.30 days) whereas it was maximum (5.00 days) in *V.* Mimi Palmer.
- Individual floret life was maximum (8.13 days) in *V.* Rothschildiana whereas it minimum (1.63 days) in *Vasco* Blue Bay Pink.
- *Neostylis* Lou Sneary recorded the maximum (4.03) number of buds opening in vase and was significantly superior o all other varieties.
- Maximum water uptake was observed in *V.* Rothschildiana (12.00 ml), followed by *V.* Pranerm Prai x V. *tessellata* (9.57 ml), *Vascostylis* Crownfox Red Gem (6.37 ml) and *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (5.73 ml) and the minimum (2.10 ml) in *Mok.* Sayan x *Ascda.* Bangkhuntien Gold.
- *Vascostylis* Crownfox Red Gem (12.51 g) had maximum physiological loss in weight under vase condition followed by *Vasco* Blue Bay White (10.65 g), *Vasco* Blue Bay Pink (10.42) whereas it was minimum (1.93 g) in *Neostylis* Lou Sneary.
- The vandaceous orchids varied with regard to blooming period. The peak flowering period was from May to July. *V.* Kultana Fragrance, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *V.* Rothschildiana, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko, *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra, *Mok.* Sayan x *Ascda.* Bangkhuntien Gold and *Vasco* Kultana Million Bhat bloomed once a year, but *Neostylis* Lou Sneary, *Rhynchorides* Bangkok Sunset, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V. coerulea* x *V.* Mimi Palmer, *Ascda*. Udomchai, *Darwineria* Cream Puff, *V.* Pranerm Prai x V. *tessellata, V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis* and *Ascda.* Suksamran Sunlight Yellow had two blooming periods. All others had three blooming periods.

- Significant variations were noted in floral parts (petal, lip, column, spur) of selected vandaceous orchid varieties/ hybrids.
- Petal curvature was observed as deflexed with incurved apex in (*Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *Vascostylis* Crownfox Red Gem, *Ascda* Peggy Foo x *Rhyn. coelestis* Blue, *Ascda.* Udomchai, *Darwineria* Cream Puff, *V.* Rothschildiana, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, and *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko. Deflexed petal curvature was also observed in *Neostylis* Lou Sneary, *Rhy.* Sri Siam x *Rhy. gigantea, Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra and *Mok.* Sayan x *Ascda.* Bangkhuntien Gold.
- Petal shape was obovate in all the varieties evaluated except *Neostylis* Lou Sneary and *V.* Kultana Fragrance, which was oblong.
- Majority of the varieties had entire petal margin, except *V.* Kultana Fragrance, *V.* Indian Incense x *V. tessellata*, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer, *V.* Rothschildiana, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis* where the petal margin was undulate.
- Petal apex is obtuse in almost all varieties. Acute petal apex was noticed in *Neostylis* Lou Sneary, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *Aerides quinque Vulnera Rhy. coelestis*, *Ascda.* Suksamran Sunlight Yellow, *Mok.* Khaw Piak Suan x *Ascda.* Bicentenniel Kuniko. whereas *Ascda* Peggy Foo x *Rhyn. coelestis* Blue and *V.* Rothschildiana has truncate petal apex.
- Petal colour pattern also varied among varieties. Most of he varieties showed shaded, spotted and uniform colour pattern whereas *V.* Mimi Palmer, *V.* Mimi Palmer x *V.* (*merilli* x *insignis*), *V. coerulea* x *V.* Mimi Palmer and *V.* Kultana Fragrance had tessellated and *Ascda.* Suksamran Sunlight Yellow had netted colour pattern.

- In most of the varieties mid- lobe is lanceolate in shape. Ovate, obovate and orbicular shapes were also noticed in some varieties.
- Lateral lobe shape is ovate in most of the varieties whereas it is obovate in *Neostylis* Lou Sneary, *V.* Kultana Fragrance, *Vascostylis* Crownfox Red Gem, *Darwineria* Cream Puff and *Ascda.* Suksamran Sunlight Yellow, orbicular in *Rhynchorides* Bangkok Sunset, *Vasco* Blue Bay Blue, *Vasco* Blue Bay White, *Vasco* Blue Bay Pink, *Ascda* Sirichai Fragrance, *V.* Mimi Palmer, *V. coerulea* x *V.* Mimi Palmer and *Vasco* Kultana Million Bhat and lanceolate in *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra.
- Lip curvature was also showed wide variations among varieties. Lip surface was glabrous and lip apex was bilobed in all vandaceous orchid varieties / hybrids. Only *Vasco* Blue Bay Blue showed obtuse lip apex.
- Uniform, shaded and streaked lip colour patterns were observed different varieties / hybrids of vandaceous orchids. Most of the varieties showed uniform lip colour pattern.
- Most of the varieties had medium spur length and conical spur type except in *Neostylis* Lou Sneary. It was long and tubular in this variety.
- Colour and pigmentation, texture, shape and pattern as well as size of florets and arrangement of florets on spike were considered for the visual evaluation of a variety for use as a cut flower. The highest mean total score was obtained for *Vascostylis* Crownfox Red Gem (43.7), followed by *Vasco* Blue Bay Pink (43.60), *Vasco* Blue Bay Blue (43.30) *Vasco* Blue Bay White (43.0) and *Rhy.* Sri Siam x *Rhy. gigantea* (42.9). The lowest score (39.2) was obtained for *V.* Rothschildiana followed by *Mok.* Sayan x *Ascda.* Bangkhuntien Gold (39.60), *Mok.* Khaw Piak Suan x *Ascda.* Jiraprapra (39.60) and *Vasco* Kultana Million Bhat (39.8).
- Plant quality rating was carried out considering the characters like fullness, growth and visual appearance, flower colour and pigmentation, spike longevity,

shape and arrangement of foliage during the growth period. The highest total mean score was observed in *Vasco* Blue Bay Pink (44.8), followed by *Vascostylis* Crownfox Red Gem (44.7), *Vasco* Blue Bay Blue (44.6) and *Rhynchorides* Bangkok Sunset (44.5). Lowest total mean score (41.3) was recorded in *V.* Kultana Fragrance followed by *V.* Rothschildiana (41.7) and *Ascda* Peggy Foo x *Rhyn. coelestis* Blue (41.8).

- Considering the overall qualitative and quantitative attributes, *Vascostylis* Crownfox Red Gem, *Vasco* Blue Bay Blue, *Rhynchorides* Bangkok Sunset, *V.* Mimi Palmer, *V.* JVB X *Ascocenda* Yip Sum Wah and *Vasco* Blue Bay Pink were found excellent for cut flower production. All the varieties evaluated were also suitable as garden plant. The fragrance will be an added advantage.
- The flowering season of the orchids was observed and accordingly they were categorized into four phenophases, ie Nov – Jan, Feb – April, May – July and Aug – Oct. Side- runs were also observed and phenological configurations was made.
- The varieties were also categorized on the basis of flower colour, number of florets/ spike and floret size, longevity of spike on the plant , number of spikes produced / year and resemblance of fragrance.

Based on the characters studied, the vandaceous orchids were selected for indoor and outdoor gardens as value added plants. The fragrance also makes it a novelty in landscaping to create a peaceful, relaxing environment.

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Appendices

APPENDIX I

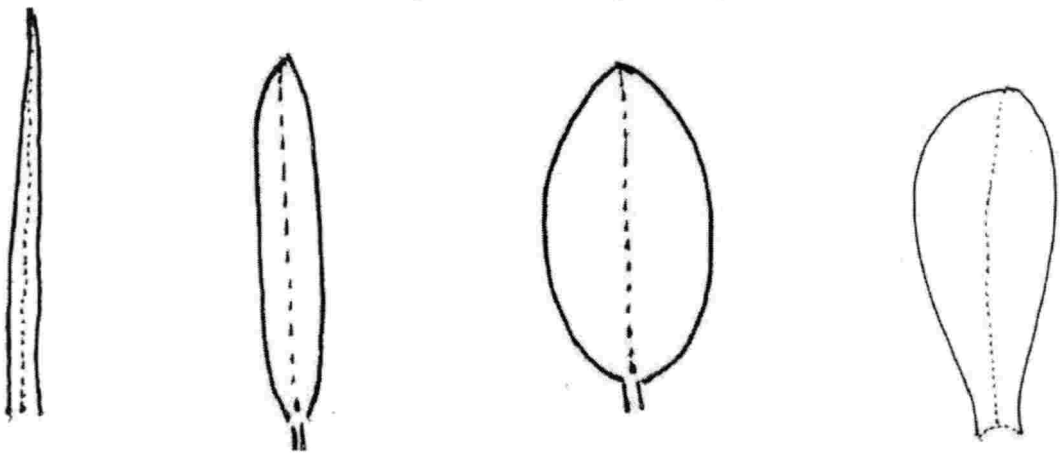
Monthly distribution of weather parameters during the experiment June 2016- May 2017

Parameters	Jun '16	Jul '16	Aug '16	Sep '16	Oct '16	Nov '16	Dec '16	Jan '17	Feb '17	Mar '17	Apr '17	May '17
Mean maximum (^{0}C)	29.8	29.9	30.4	30.3	31.5	32.9	32.4	34.1	36.0	36.1	35.7	34.6
Mean minimum(^{0}C)	21.7	21.6	23.2	23.6	22.7	22.2	22.3	22.9	23.2	24.7	26.0	24.9
Mean RH (%)	89	85	83	82	81	69	69	53	51	67	70	72
Rainfall (mm)	654.7	390.4	183.5	086.0	037.3	013.8	052.9	0.0	0.0	13.2	19.1	167.5
No. of rainy days	22	19	19	10	4	1	3	0	0	1	1	11
Mean sunshine hours	1.6	2.3	4.9	4.8	5.5	5.8	6.5	7.6	8.7	7.4	6.5	5.5

APPENDIX II

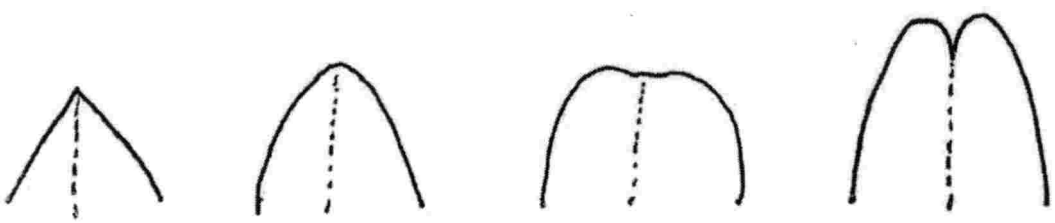
Explanations for floral characteristics

Dorsal sepal, lateral sepal shape



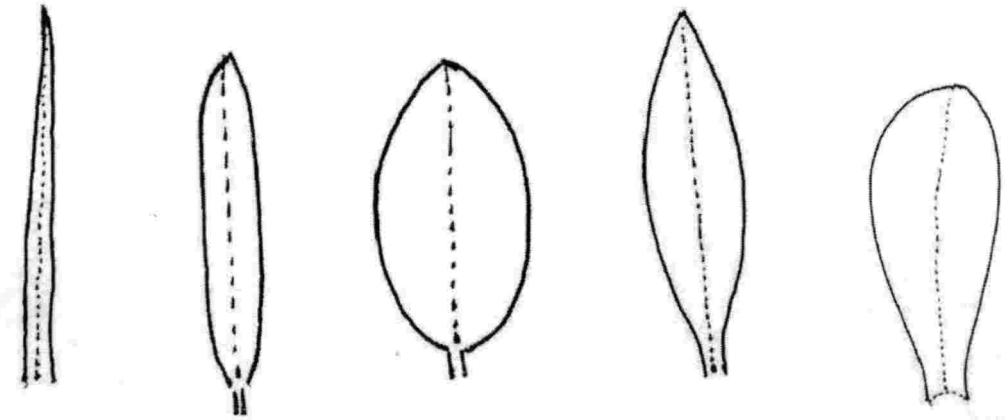
Linear **Oblong** **Elliptic** **Obovate**

Dorsal sepal, lateral sepal and petal apex



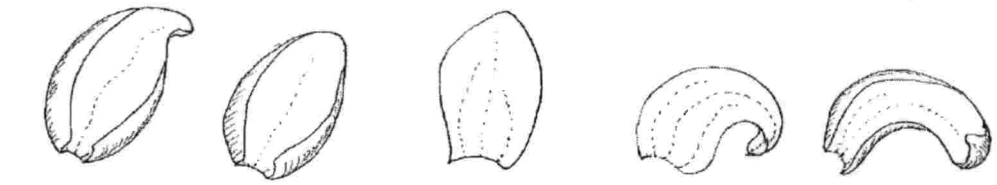
Acute **Obtuse** **Truncate** **Bilobed**

Petal shape



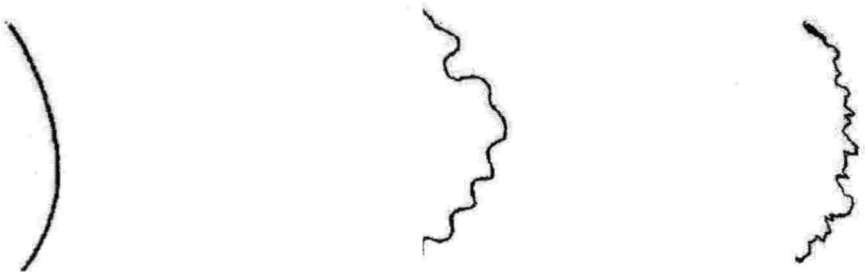
Linear Oblong Elliptic Lanceolate Obovate

Petal curvature



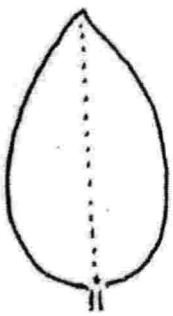
Incurved with deflexed apex | Incurved with straight apex | Straight | Deflexed | Deflexed with incurved apex

Petal margin



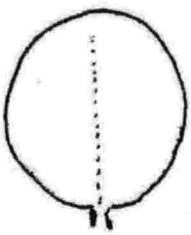
Entire Undulate Erose

Lip mid- lobe and lateral lobe shape



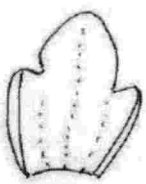
Ovate

Lanceolate

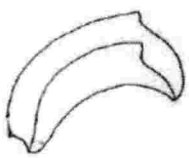


Orbicular

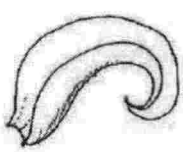
Lip mid-lobe and lateral-lobe curvature



Straight



Deflexed with straight apex

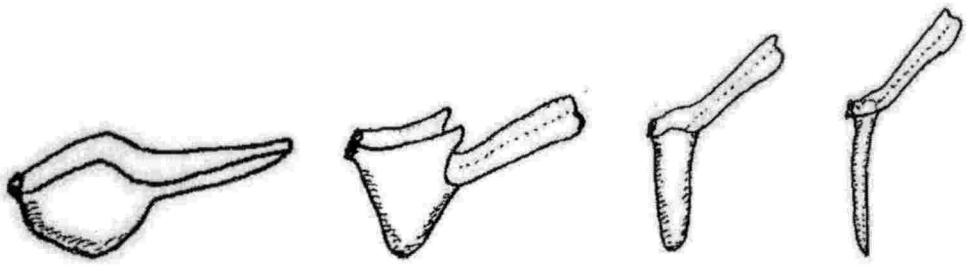


Deflexed with incurved apex

Lip apex

Acute **Obtuse** **Bilobed**

Spur type



Saccate **Conical** **Cylindric** **Tubular**

EVALUATION OF FRAGRANT VANDACEOUS ORCHIDS FOR ORNAMENTAL TRAITS

BY

Deepa. T
(2015-12-006)

ABSTRACT OF THE THESIS

Submitted in partial fulfillment of the requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture
Kerala Agricultural University

DEPARTMENT OF FLORICULTURE AND LANDSCAPING
COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR - 680 656
KERALA, INDIA
2017

ABSTRACT

Twenty five fragrant vandaceous orchids were evaluated in the Department of Floriculture and Landscaping during the period from June 2016 to May 2017 with the objective of classifying them based on aesthetic and economic parameters for commercial exploitation as value added plants.

The varieties exhibited wide variation in both vegetative and floral characters. Considering quantitative characters, *Vasco* Crownfox Red Gem recorded the maximum plant height (68.73cm), spread (52.23cm), internodal length (1.95cm) and leaf length (33.83cm). *V.* Pranerm Prai x *V. tessellata* showed maximum shoot girth (4.99cm), leaf area (105.54cm^2), leaf number (37) and root length (181.75cm). The least values for all these characters were for *Neostylis* Lou Sneary.

Duration from spike emergence to opening of florets was the maximum in *Ascda* Peggy Foo x *Rhyn. Coelestis* Blue and minimum in *Neostylis* Lou Sneary. Maximum spike longevity was recorded in *V.* Rothschildiana (29.30 days) whereas it was minimum in *Rhy* Sri Siam x *Rhy gigantia* (7.50 days). Interval of spike production was also the longest in *Ascda.* Peggy Foo x *Rhyn. coelestis* Blue and the minimum in *Rhynchorides* Bangkok Sunset. Spike production was the maximum in *Neostylis* Lou Sneary, followed by *Ascda* Srichai and *Vasco* Crownfox Red Gem. The varieties/ hybrids varied with regard to blooming period. The peak flowering was from May to July.

Longer spike and rachis were noticed in *Aerides quinque Vulnera Rhy. Coelestis. Vasco* Blue Bay Pink had the highest number of florets/ spike and the shortest internodal length. Largest flowers were observed in *V.* Rothschildiana. Petal and labellum of the varieties also exhibited different colour patterns such as uniform, spotted, netted, tessellated and shaded. All the evaluated varieties were fragrant and were categorized based on different notes such as floral, fruity, spicy, green, sweet and miscellaneous. Fragrance was very faint in *V.* Rothschildiana whereas it was musty in *Darwineria* Cream Puff.

With respect to the post-harvest characters longevity (vase life) was the maximum in *V.* JVB X *Ascda* Yip Sum Wah (17.30 days) and individual floret life (8.13 days) in *V.* Rothschildiana.

Colour and pigmentation, texture, shape, pattern and size of florets as well as arrangement of florets on the spike were considered for the visual evaluation of a variety for use as cut flower. Considering the overall qualitative and quantitative attributes, *Vascostylis* Crownfox Red Gem, *Vasco* Blue Bay Blue, *Rhynchorides* Bangkok Sunset, *V.* Mimi Palmer, *V.* JVB X *Ascda* Yip Sum Wah and *Vasco* Blue Bay Pink were excellent for cut flower production.

Plant quality evaluation was done based on fullness, growth and visual appearance, flower colour and pigmentation, spike longevity, shape and arrangement of foliage during the growth period. Fragrance scoring was also done based on intensity and diffusiveness, newness and beautifulness of fragrance.

Based on the flowering phenology, four phenophases, namely, November – January, February – April, May – July and August – September were recorded and the varieties were categorized accordingly. Side-runs with different colour combinations were observed within a phenophase. The varieties were also categorized on the basis of flower colour, number of florets/ spike and floret size, longevity of spike on the plant , number of spikes produced / year and fragrance.

Considering overall quantitative and qualitative characteristics, the evaluated varieties/ hybrids were categorized for cut flower, indoor and outdoor gardens for commercial exploitation as value added plants. The fragrance also makes it a novelty in landscaping to create a peaceful, relaxing environment.