

Current Status and Prospects of Orchid Crop in Sri Lankan Floriculture - Review

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ABSTRACT

Sri Lanka has become one of the hot spots for quality floricultural products in South Asia. As floricultural products, Sri Lanka exports ornamental foliage plants, cut decorative foliage, cut flowers, aquarium plants, landscaping plants, flowers seeds and tissue culture plants. In the current floricultural market in Sri Lanka Orchid has been established well as a cut flower and potted plant. *Dendrobium*, *Phalanopsis*, *Cattleya* and *Vanda* are the most popular orchid genera in family Orchidaceae. *Vanilla* belongs to Orchid genera and is well-known ingredient in the food industry. Orchids have been used in Chinese and Japanese medicinal treatments since ancient times. Medicinal properties of orchids include anti-inflammatory, antiviral, neuroprotective, wound healing and other valuable properties. Secondary metabolites which are known as phytochemicals leads to create these properties in orchids. Orchid cultivation in Sri Lanka can be developed by introducing new technologies such as gene transformation, biotechnology etc. methods. Developments in infrastructural facilities also contribute to uplift the industry in the future. This article focused on the status of orchid cultivation in the current floricultural industry in Sri Lanka.

Keywords: floriculture industry, food, Sri Lanka, medicine, Orchid, ornamental

Geographical suitability of Sri Lanka

Sri Lanka is an island that belongs to the tropical region of the world. Even though Sri Lanka is a tropical country, there is a wide range of climatic variations within the country (Kumara *et al.*, 2022). Basically it is divided into three parts climatic zones; wet zone, intermediate zone and dry zone. In each part of this zone contains unique climatic conditions in contrast to others. Due to this specific reason Sri Lanka has become one of the hotspots in the world's best-quality floriculture production centers (Gamage *et al.*, 2017). Orchids are a diverse group of plants that have varying climatic, soil, and nutritional requirements depending on their specific species. However, in general, here are some of the basic requirements for growing healthy orchids (Barman and Devadas, 2013).

As Climatic requirements: Temperature: Orchids generally prefer warm to hot temperatures during the day, ranging from 60-85°F (16-29°C) with cooler nights. However, specific orchid species can have different temperature preferences. Humidity: Most orchids require a high level of humidity, around 50-70%. Light: Orchids require moderate to bright, indirect light. Direct sunlight can burn the leaves and damage the plant. Air circulation: Orchids need good air movement to prevent stagnant air which can lead to fungal and bacterial growth (McConnell and Cruz, 1996).

As Soil requirements: Orchids prefer well-draining, porous soil mixtures that allow for good air circulation around their roots. Most orchids are epiphytes, which means they grow on other plants or surfaces, rather than in soil. Therefore, they can also be grown in specialized orchid bark mixtures, sphagnum moss, or even mounted on a wooden or cork board.

Nutritional requirements: Orchids require a balanced fertilizer that contains nitrogen, phosphorus, and potassium, as well as other trace elements such as calcium, magnesium, and iron. The pH of the soil or growing media should be slightly acidic, around 5.5-6.5, to ensure proper nutrient uptake (Nabieva *et al.*, 2020). Some orchids also require periodic applications of calcium and magnesium, especially if grown in pure bark mixtures or rainwater. In summary, orchids require warm temperatures, high humidity, moderate to bright light, good air circulation, well-draining soil or growing media, and a balanced fertilizer with trace elements. Careful attention to these requirements can help ensure healthy and vibrant orchids.

History of flower cultivation

For various religious and cultural reasons, flower cultivation has existed in Sri Lanka since ancient times. During the time of British governs the cultivation of flowers turned into hobby of some gorgeous people. With the open economy, the arrival of new cultivars to the island expanded the availability of flower diversity in Sri Lanka. The year 1970 was a milestone in Sri Lankan economy since the cultivation of flowers turned into the floriculture industry (Ranil *et al.*, 2015). Flower culture in Sri Lanka has a long and rich history dating back to ancient times (Premathilake and Seneviratne, 2015). Sri Lanka is home to a wide cultivar of native flowers, including the blue water lily, the Sri Lankan rose, the frangipani, and the flame tree, which have been used in various cultural practices and religious ceremonies.

The ancient Sinhalese kingdom, which dates back to the 4th century BC, was known for its elaborate floral decorations and gardens. The Sinhalese people believed that flowers had spiritual significance and were used in rituals and ceremonies to honor the gods (Nandadeva, 2009). During the colonial era, Sri Lanka's flower industry expanded with the introduction of new flowers and plants from Europe, including roses, chrysanthemums, and carnations. These flowers were grown on large plantations and exported to other countries.

Today, the floriculture industry in Sri Lanka is a major contributor to the country's economy. The country exports a wide cultivar of flowers and plants to markets around the world, including the United States, Japan, and Europe. Flowers are also used in Sri Lanka's tourism industry, with many hotels and resorts featuring elaborate flower gardens and displays. In recent years, the Sri Lankan government has taken steps to promote the floriculture sector, including providing tax concessions and other incentives to encourage investment in the industry. This has led to increased growth and development in the sector, with many small-scale farmers now involved in flower cultivation and trade (Lakshanthi *et al.*, 2019).

General description about orchid

Orchids are a diverse family of flowering plants, which are known for their stunning and intricate flowers, which come in a wide range of colours, shapes, and sizes. Orchids have been cultivated for thousands of years and are one of the most popular plants for indoor and outdoor gardening. Orchids belong to the family Orchidaceae with 850 generas, 25,000 species (Singh *et al.*, 2012) and 30,000 cultivars (Philips *et al.*, 2020). Now there are more than 100,000 of man-made registered hybrids in the market. Orchids are more popular as cut flowers and ornamental plants in the international market. With the technology achievements, scientists were able to develop hybrid cultivars with 8 – 12-week shelf life. Long duration of shelf life helps to uplift the value of orchids. In tropical countries, the native

cultivation of orchids can be identified and their distribution is abundant in tropical rain forests in South and Central America, India, Sri Lanka, Myanmar, South China, Thailand, Malaysia, Philippines, New Guinea, and Australia. Brazilian Cattleyas, Mexican Laelias, and Indian Dendrobium, Cymbidiums and Paphilopedilum are the valuable parental plants that lead to producing modern hybrid orchids (Wraith *et al.*, 2020).

Orchids are bilaterally symmetrical as human faces in their morphology (Zipori *et al.*, 2020). Due to their morphological features, they arrest pollination by insects. The reproductive parts of orchid are like insect that they hope to attract and once the insect is interested, the orchid's pollen sticks to the bug until it flies off to find another orchid that it mistakes for a mate. A fossil which is 20 million years ago found that a pollen of Orchid which attached to a bee. So, it can be concluded that the Orchidaceae family is quite old (Rezamand *et al.*, 2020).

Most orchids are epiphytes, meaning they grow on other plants or surfaces, rather than in soil. They have adapted to this lifestyle by developing specialized aerial roots that absorb moisture and nutrients from the air. Orchids also have a unique reproductive system, with their flowers producing a sticky substance called pollinia that attaches to pollinators such as bees, butterflies, and moths (Pemberton, 2010). Orchids have a long history of cultural significance and have been used for medicinal purposes, food, and even perfume. They are also highly valued for their ornamental qualities, and many species and hybrids are bred specifically for their beauty.

Despite their reputation as delicate and difficult plants to grow, many orchids can be relatively easy to care for with the right conditions. They require good air circulation, moderate to bright indirect light, high humidity, and a well-draining growing medium. Proper fertilization and watering are also important to ensure healthy growth and vibrant blooms (Wang and Gregg, 1994)

CURRENT STATUS OF FLORICULTURE INDUSTRY IN SRI LANKA

Now the floriculture industry has become one of the major sources of foreign exchange producers in Sri Lankan economy. Not only in foreign exchange but also it stands as one of the most popular self-employment ventures in both rural and semi-urban communities. The total number of direct employment generated with this is about 4000 in rural and semi-urban areas. In the recent past Sri Lankan government also contributed their capacity to enhance the productivity of the floriculture industry through the programs of Divinaguma and Suwasmal (Padmini and Kodagoda, 2017).

Economic reports status that there is a 5% growth in foreign exchange in the year 2021 by 2020 exporting floricultural products while making total earnings of US\$ 5.2 million (Table 1). This status indicates that there is a developing demand in foreign countries for floricultural products from Sri Lanka (Sri Lanka Export Development Board, 2022). When considering about the world floricultural trade, Sri Lankan contribution is less than 0.2% towards this. The main buyers of our floricultural products are Europe (40%), Asian countries (40%) and USA (3%), (Table 2)

When considering the world market Taiwan is the world's largest producer of orchids by shipment number and the Netherland owns the name for the largest producer by its income. In the global floricultural market Orchids are significant as cut flowers and potted plants and the contribution of fresh orchids is 10%. In the year 2021, more than 40 countries export orchids, and 60 countries import Orchids for their purposes. The total global value for the orchids is US\$ 504 million, (Tiwari *et al.*, 2022). Now a day's government has identified floriculture as a fast-emerging industry in Sri Lanka. So that development programs and export promotions are being conducted throughout the country in order to enhance the status of this industry. A "Floriculture Policy" document is being prepared to focus the key resources in the country for the development of the sector (Tiwari *et al.*, 2022).

The Department of National Botanic Gardens is a leading institute which provides certain training programs for growers in Sri Lanka. Also, the National Plant Quarantine service under the Department of Agriculture accomplishes a great service for the development of the floriculture industry by providing extension services for pest and disease control. On the side of government, they provide various tax concessions, and loan facilities as well as encourage foreign direct investments in the floricultural sector. The Department of National Botanic Gardens is responsible for the management of the National Botanic Gardens, which is a public botanical garden located in Dublin, Ireland. The gardens are renowned for their collection of plants from around the world, including rare and endangered species. The floriculture sector refers to the cultivation and sale of flowers, including cut flowers, potted plants, and ornamental trees and shrubs. This sector is an important contributor to the agricultural economy of many countries, including Ireland. In recent years, the Irish government has been promoting the development of the floriculture sector by providing various tax concessions, loan facilities, and other incentives to encourage investment in this area. The Department of Agriculture, Food, and the Marine also provides support and funding to the sector through various programs and initiatives.

Table 1. Merchandise Export Performance

Exports of Goods	Jan-May 2020	Jan-May 2021	Jan-May 2022	% Growth	May 2021	May 2022	% Growth
Apparel & Textiles	1,534.6	2,064.2	2400.6	16.3	370.9	482.7	30.1
Tea	456.7	526.6	460.9	-12.5	109.2	93.7	-14.2
Rubber-based	280.3	424.5	414.3	-2.4	91.2	76.7	-15.9
Coconut-based	216.6	317.2	350.0	10.4	66.7	70.6	5.8
Diamond, Gems&Jewelry	61.0	107.0	115.0	7.5	14.2	16.9	18.8
Electronics & Electronic Components	113.1	164.3	188.3	14.6	35.2	41.8	18.8
Spices and Essential Oils	82.8	162.0	128.6	-20.6	25.3	21.5	-14.9
Food & Beverges	124.7	147.7	164.6	11.5	30.2	32.2	6.4
Seafood	74.8	90.6	105.8	16.7	15.1	16.8	11.8
Omamental Fish	4.4	5.9	7.1	19.7	0.9	1.3	41.1
Vegetables	9.7	9.6	9.7	1.7	1.7	1.8	1.1
Fruits & Nuts	14.2	14.8	12.8	-13.4	2.8	2.3	-18.3
Other Export Crops	29.9	23.5	34.1	45.0	4.5	10.8	139.1
Flowers & Foliage	5.2	5.7	6.0	6.3	0.9	1.1	18.1
Boat Building	1.3	1.5	5.3	254.7	0.5	0.1	-73.6
Petroleum Products	141.0	51.1	72.2	41.1	27.7	7.1	-74.4
Others	368.3	575.8	670.0	16.4	94.6	102.9	8.7
Total Merchandize Exports	3,518.6	4,692.0	5,145.4	9.7	891.7	980.2	9.9

Sources: Central Bank of Sri Lanka, Sri Lanka Customs & Sri Lanka Export Development Board

Sri Lanka's Export Performance in Major Markets. Strong Export Growth was recorded for the top 5 export markets in May 2022 and the period of January to May 2022 (Table 2).

During May 2022, exports to the United States, Sri Lanka's single largest export destination, increased by 25.02% to US\$ 266.42 Mn compared to May 2021. The better performance was led by an increase in exports of Apparel & Textile (40.83%) and coconut-based products (29.69%) and flowers and foliage become 7th best export item. The single largest export destination of the United States of America recorded US\$ 1,364.08 Mn worth of exports in the period of January to May 2022 – a significant year-on-year increase of 20.32 % in comparison to US\$ 1,133.71 Mn recorded in 2021 (Table 1).

Table 2. Top 10 Export Destinations (Values in US\$ Mns)

Country	Jan-May 2020	Jan-May 2021	Jan-May 2022	% Growth	May 2021	May 2022	% Growth
United States	905.10	1,133.71	1,364.08	20.32	213.11	266.42	25.02
United Kingdom	296.21	366.53	411.62	12.30	72.29	78.22	8.20
India	220.53	302.63	364.99	20.61	55.28	82.51	49.26
Germany	195.85	286.00	303.55	6.14	53.80	56.20	4.46
Italy	135.66	226.02	243.86	7.89	40.45	51.45	27.19
Belgium	94.35	132.18	122.07	-7.65	26.71	27.05	1.24
Netherlands	88.16	162.21	161.58	-0.39	27.71	31.18	15.01
Canada	71.92	114.98	144.76	25.90	20.47	28.70	40.21
China	71.21	116.96	98.29	-15.96	20.91	18.56	-9.33
UAE	77.09	93.20	109.52	17.51	23.03	20.34	-11.68
Other Markets	1,362.52	1,757.58	1,821.08	3.61	338.54	319.18	-5.72
Total	3,518.6	4,692.0	5,145.4	9.7	891.7	980.2	9.9

Sources: Central Bank of Sri Lanka, Sri Lanka Customs & Sri Lanka Export Development Board

Western Province (Gampaha, Kaluthara, and Colombo districts), northwestern province (Kurunegala, Puttalam districts), and Central Province (Kandy, Kegalle, Matale, Nuwaraeliya, Bandarawela districts) are the major areas engaged in floriculture industry. The possible areas for expansion are the Southern Province and Sabaragamuwa Province (Sri Lanka Export Development Board, 2022). The climatic conditions in those areas are best fit with the flower types that are grown. There are two kinds of flower types grown in Sri Lanka, namely temperate flowers and tropical flowers. Temperate flowers need cool climatic conditions, so they are popular in the highlands of the central province. Carnation, Rose, Statice, Gypsophyla, Alstroemeria, Chrysanthemum, Lilies, and Irises are the major types of temperate flowers that are grown in highlands. Carnations and roses are the most demanded cut flower in the export market, so there huge range of cultivars of carnations and roses in cultivation (Ranil *et al.*, 2015; Padmini and Kodagoda, 2017).

The first written evidence about Sri Lankan orchids was in Carl Linnaeus collection as *Zeuxine strateumatica* (L.) Schltr. and *Peristylus cubitalis* (L.) Kraenzlin. Then J. G. König (1728-1785) reported some native orchids in Sri Lanka with Sinhala names. Establishment of botanical gardens was a milestone in Sri Lanka during the English colonial period. Colonel J. T. Walker and Mrs. A. W. Walker (fl.1830- 1840), George Gardner (1812-1849), George Henry Kendrick Thwaites (1812-1882), Henry Trimen (1843- 1896), J. D. Hooker (1898) and Don Martin Arthur Jayaweera (1912-1982) were the people who spent their valuable time and effort in identification of orchid in Sri Lanka (Kottawa-Arachchi and Gunasekara, 2020), (Table 3).

Table 3. Number of orchid species described in many leading works on Sri Lankan plants

Publication	Genera	Species	Endemic
Moon, 1924	10	17	-
Thwaites, 1864	65	145	-
Trimen, 1885	57	165	-
Hooker in Triment, 1896	61	158	67
Hooker, 1888-1890	57	151	76
Willis, 1911	61	161	78
Abeywickrama, 1959	67	160	-
Ekanayake, 1975	66	166	87
Jayaweera, 1981	69	168	74
Sumaithrarachchi, 1986	68	170	65
Fernando <i>et al.</i> , 2003	69	173	66
Present list	78	188	55

Source: Kottawa-Arachchi and Gunasekara, 2020

Sri Lanka is home to a diverse range of orchids, with over 200 species recorded on the island. Many of these orchids are endemic, meaning they are found nowhere else in the world. Some of the endemic orchids in Sri Lanka include: *Vanda tessellata* - commonly known as the tessellated vanda, this orchid is found in the wet zone forests of Sri Lanka. It has fragrant white flowers with purple spots and blooms in the winter months. *Dendrobium maccarthiae* - this orchid is named after Margaret MacCarthy, who was a botanist and the first woman to climb Adam's Peak in Sri Lanka. It is found in the central hills of Sri Lanka and has small white flowers that bloom in the summer months. *Bulbophyllum neilgherrense* - this orchid is found in the montane forests of Sri Lanka and has small yellow and red flowers (Fernando and Ormerod, 2008). It blooms in the winter months. *Eria coronaria* - commonly known as the crowned eria, this orchid is found in the lowland rainforests of Sri Lanka. It has white and purple flowers and blooms in the summer months. *Habenaria monticola* - this orchid is found in the montane forests of Sri Lanka and has small white flowers with yellow centers. It blooms in the summer months. These endemic orchids, along with many other native species, are an important part of Sri Lanka's biodiversity and are protected under the country's conservation laws. Many of these orchids are also used in traditional medicine and have cultural significance in Sri Lanka's history and folklore.

In Sri Lanka there is about 25% annual export income from floricultural products. In year 2021 the total value of exports is 5.7 US \$ million from cut flowers (Sri Lanka Export Development Board, 2022). When considering about orchids the total quantity of export in year 2011 is about 17.3 metric tons. It earned 25.37 million rupees of value to the Sri Lankan economy (Sri Lanka Export Development Board, 2021; Li *et al.*, 2021). Among orchid cultivars dendrobium is the most demanded cut flower in the export market since it has the most brilliant and contrasting colour variation (Kottawa-Arachchi and Gunasekara, 2020).



Figure 1. Cut flowers in Sri Lanka (A-Phalantopsis, B-Dendrobium, C-Vanda, D-Cattelya)

As cut flowers dendrobium, vanda, phalanopsis and cattelya (Figure 1) are more popular in the international market. In Sri Lanka there is a developing trend towards Orchid cultivation among urban and semi-urban populations. Some of them engaged in this cultivation as a hobby in their retirement age; some do this as their livelihood. Anyway, this theme has introduced a new concept for current and future youth to survive as entrepreneurs. Orchids can be grown easily if the required conditions are supplied correctly. As Sri Lankans we have all the assets that are given by our surroundings; temperature, humidity, water resources, adequate amount of space as well as the technology also available in Sri Lanka now. The most critical thing is the growers' interest and their day-to-day (Nage *et al.*, 2006; Pillion and Chase, 2007).

There are many commercial florists in Sri Lanka namely, Lassana Flora, Kapruka, Shirohana Petal Puru, Blooms Flower Shop, Greenet Plants & Flowers Privet Limited etc (Padmini and Kodagoda, 2021). They encourage local flower cultivators to grow standard and quality products. When the quality of the product increases the profit of the grower also increases. Commercial-scale tissue culture plant producers (K Orchids, Serandib flora, Heyleys Agro Biotec) supply quality plantlets to the market to maintain quality flower cultivation in Sri Lanka (Padmini and Kodagoda, 2021).

Some orchid importers who are importing tissue-cultured orchid plantlets and mature plants from different countries. They import them via the National Plant Quarantine Service. The vigor of these plants is not well as Sri Lankan plants, due to acclimatization failures and climate changes. Even if they are well-established for a few period there after they may restrain their growth. But tissue/seed cultured plants in Sri Lanka perform well than imported orchid plants due to high adaptability to Sri Lankan climatic conditions (Kumar and Rawat, 2022; Fernando *et al.*, 2008).

Climate change can have a significant impact on orchids, and their ability to acclimate or adapt to changing conditions can be crucial for their survival (Reina-Rodríguez *et al.*, 2017). Acclimatization refers to the ability of an individual organism to adjust its physiology or behaviour to better cope with changes in its environment. In the case of orchids, acclimatization may involve changes in their growth rate, flowering patterns, or physiological processes such as water use or nutrient uptake. However, if the changes in

the environment happen too rapidly or are too severe, orchids may not be able to acclimate in time to avoid negative impacts on their survival and reproduction.

On the other hand, successful adaptation refers to genetic changes in a population that occur over multiple generations in response to changing environmental conditions. In the case of orchids, successful adaptation may involve genetic changes that allow them to tolerate higher temperatures or drought conditions (Cozzolino and Widmer, 2005). Adaptation can take many years or even centuries to occur, but it can provide a long-term solution to the challenges posed by climate change.

Unfortunately, orchids are particularly vulnerable to the effects of climate change, as they are often highly specialized to specific environmental conditions, and their distribution may be limited to narrow ranges of temperature and rainfall. As a result, many orchid species are at risk of extinction due to climate change, and it may be difficult for them to acclimate or adapt quickly enough to cope with the rapid changes in their environment.

In conclusion, while acclimatization and adaptation are important mechanisms for orchids to cope with climate change, the severity and speed of the changes may make it challenging for orchids to keep up. Therefore, conservation efforts are necessary to help protect orchids and other vulnerable species from the impacts of climate change.

Even though orchid cultivation is time-consuming, it has a good market in Sri Lanka. As a cut flower and potted plant, it plays a significant role in Sri Lankan economy. After the establishment of these plants, it requires less attention and money, so it suits Sri Lankan housewives as a business.

POSSIBLE USES OF ORCHIDS

Sustainable products and technologies in orchid culture

Orchid cultivation can benefit from the adoption of sustainable products and technologies to reduce environmental impact, conserve resources, and promote eco-friendly practices.

Organic Fertilizers: Replace synthetic fertilizers with organic alternatives such as compost, vermicompost (worm castings), or organic liquid fertilizers. These options minimize the use of chemical inputs, enhance soil health, and reduce water pollution risks.

Water-Efficient Irrigation: Implement water-saving irrigation techniques like drip irrigation or hydroponics. These methods deliver water directly to the plant roots, minimizing water wastage through evaporation or runoff.

Energy-Efficient Lighting: Utilize energy-efficient lighting systems, such as LED (Light Emitting Diode) grow lights, to reduce energy consumption during the cultivation of orchids. LEDs provide targeted light wavelengths, consume less electricity, and have longer lifespans compared to traditional lighting technologies.

Rainwater Harvesting: Collect and store rainwater to supplement irrigation needs. Install rainwater harvesting systems that capture rainwater from roofs or other surfaces and store it for later use in watering orchids. This approach reduces reliance on municipal water sources and conserves water.

Natural Pest Control: Implement integrated pest management strategies to control pests and diseases in an environmentally friendly manner. This involves using beneficial insects, such as ladybugs or predatory mites, as natural predators, as well as employing cultural practices like proper sanitation and plant selection to minimize pest issues.

Recyclable or Biodegradable Pots: Opt for pots made from recyclable materials like recycled plastic or biodegradable options like coconut coir pots. These alternatives reduce plastic waste and promote sustainable disposal practices.

Renewable Energy Sources: Consider utilizing renewable energy sources, such as solar panels or wind turbines, to power greenhouse operations or other energy-intensive processes. This approach reduces reliance on fossil fuels and lowers greenhouse gas emissions.

Sustainable Packaging: Use eco-friendly packaging materials for transporting and selling orchids. Choose recyclable or biodegradable packaging options that reduce waste and minimize environmental impact. **Composting and Waste Management:** Implement a composting system to manage organic waste generated during orchid cultivation. Composting helps reduce waste, improve soil fertility, and close the nutrient loop on-site. **Education and Awareness:** Promote sustainability practices among orchid growers and consumers. Provide information and resources on sustainable cultivation techniques, eco-friendly products, and the importance of conservation to encourage the widespread adoption of sustainable approaches. By incorporating these sustainable products and technologies into orchid cultivation practices, growers can contribute to the preservation of the environment, reduce resource consumption, and promote a more sustainable and resilient industry.

Post-Harvest technologies

Post-harvest technologies play a crucial role in maintaining the quality, prolonging the shelf life, and ensuring the marketability of orchids. **Temperature and Humidity Control:** Orchids are highly sensitive to temperature and humidity changes. Post-harvest facilities should have proper climate control systems to maintain optimal conditions for the specific orchid species. This helps prevent wilting, dehydration, and deterioration of flowers or foliage. **Cold Chain Management:** Orchids are often transported over long distances, and maintaining a cold chain is essential to preserve their freshness. Cold storage facilities or refrigerated transportation ensure that the orchids are kept at the appropriate temperature from harvest to market, minimizing quality degradation. **Ethylene Management:** Orchids are susceptible to ethylene gas, which accelerates aging and wilting. Ethylene-sensitive cultivars should be stored separately from ethylene-producing fruits or flowers. Ethylene inhibitors or absorbers can also be used to reduce ethylene levels and extend the shelf life of orchids. **Water Management:** Proper water management is critical to prevent dehydration and maintain the turgidity of orchid flowers and foliage. Post-harvest treatments like hydration solutions, water sprays, or wet packaging materials help retain moisture and keep the orchids hydrated during transportation and storage. **Anti-Microbial Treatments:** To control microbial growth and prevent diseases, orchids can undergo treatments with fungicides or bactericides. These treatments are typically applied as dips, sprays, or fumigations to minimize the risk of post-harvest infections. **Packaging:** Orchids require careful packaging to protect them from physical damage and maintain their aesthetic appeal. Packaging materials should provide adequate support, ventilation, and protection against temperature fluctuations. Common packaging options include plastic sleeves, foam supports, mesh bags, or boxes with proper cushioning. **Grading and Sorting:** Orchids are graded based on size, quality, color, and uniformity. Sorting techniques, such as manual sorting or automated grading machines, help categorize orchids into different grades for targeted markets or specific customer requirements. **Post-Harvest Physiology Management:** Post-harvest treatments, such as pulsing or conditioning, can enhance the longevity of orchids. These treatments involve immersing the cut stems or spikes in solutions containing nutrients, sugars, or growth regulators to improve water uptake, delay senescence, and maintain flower quality. **Traceability Systems:** Implementing traceability systems, such as barcoding or RFID (Radio Frequency Identification) tags, allows for the tracking and monitoring of orchids throughout the post-harvest process. This helps ensure transparency, quality control, and better management of the supply chain. **Research and Development:** Continuous research and development efforts are essential for improving post-harvest technologies in the orchid industry. This includes exploring new treatments, storage techniques, and packaging innovations to extend shelf life, enhance quality, and reduce post-harvest losses.

By implementing these post-harvest technologies, orchid growers and distributors can optimize the quality, shelf life, and market value of their products, meeting consumer expectations and maintaining the overall sustainability of the orchid industry.

Molecular Biology and Biotechnologies

Molecular biology and biotechnologies have significantly contributed to the understanding and advancement of orchid research and cultivation. **Genetic Analysis:** Molecular techniques such as DNA sequencing, PCR (Polymerase Chain Reaction), and DNA fingerprinting are used to study the genetic diversity, phylogenetics, and taxonomy of orchid species. These tools help identify and classify orchid cultivars, study their evolutionary relationships, and conserve rare or endangered species. **Tissue Culture and Micropropagation:** Orchids are commonly propagated through tissue culture techniques. Explants, such as meristems, protocorms, or seeds, are cultured on a nutrient-rich medium supplemented with growth regulators to induce shoot multiplication and plantlet regeneration. Tissue culture allows for large-scale production of orchids with desirable traits and facilitates the conservation of rare or endangered species. **Somatic Embryogenesis:** Somatic embryogenesis is a biotechnological technique used to produce orchids from somatic cells. It involves the induction of embryogenic cells and the regeneration of embryos from non-reproductive tissues. This method enables the mass production of orchid plantlets and the production of orchid hybrids with specific characteristics.

Genetic Engineering: Genetic engineering techniques, such as gene transfer or transformation, have been employed in orchids to introduce desirable traits. Genes associated with traits like enhanced fragrance, longer shelf life, disease resistance, or altered flower color can be introduced into orchid genomes. Genetic engineering also provides a tool for studying gene function and understanding the molecular mechanisms underlying various biological processes in orchids. **Metabolic Engineering:** Metabolic engineering involves modifying metabolic pathways to enhance the production of specific compounds in plants. In orchids, this technique has been used to enhance the production of secondary metabolites, such as fragrance compounds or medicinal compounds with potential pharmaceutical applications. **Molecular Markers and Marker-Assisted Breeding:** Molecular markers, such as microsatellites or SNP (Single Nucleotide Polymorphism) markers, are utilized for genetic mapping, marker-assisted selection, and breeding programs in orchids. These markers help identify and select plants with desired traits, accelerating the breeding process and improving the efficiency of orchid breeding programs. **Transcriptomics and Gene Expression Analysis:** Transcriptomics involves studying the expression patterns of genes in different tissues or under specific conditions. Techniques like RNA sequencing (RNA-Seq) enable the identification and analysis of genes that are involved in key processes such as flower development, fragrance production, or stress responses in orchids. **Epigenetics:** Epigenetic modifications, such as DNA methylation or histone modifications, play a crucial role in gene expression regulation. Studying epigenetic modifications in orchids helps us understand the mechanisms underlying gene regulation and responses to environmental cues. Epigenetic modifications can also be manipulated to induce changes in gene expression and phenotype. **Cryopreservation:** Cryopreservation techniques are used for the long-term preservation of orchid germplasm. Orchid seeds, protocorms, or shoot tips can be cryopreserved at ultra-low temperatures, allowing for the long-term storage of genetic resources and conservation of rare or endangered orchid species. **Phytochemical Analysis:** Molecular biology techniques are employed to analyze the presence and quantity of phytochemicals in orchids. This helps identify bioactive compounds with medicinal or industrial potential and guides the selection and breeding of orchids with desired phytochemical profiles. These molecular biology and biotechnological approaches have revolutionized orchid

research, conservation, and commercial cultivation, enabling the production of improved cultivars, conservation of genetic diversity, and the development of sustainable practices in the orchid industry.

Propagation, Micropropagation

Propagation of orchids can be achieved through various methods, and micropropagation is a popular technique due to its ability to produce a large number of orchid plantlets with desirable traits in a relatively short time. **Selection of Explants:** The first step in orchid micropropagation is selecting suitable explants, which are small sections of plant tissue used as starting materials. Common explants include meristems (apical or axillary buds), protocorms (seedlings), or shoot tips. These explants are chosen based on their potential for rapid shoot multiplication and regeneration. **Surface Sterilization:** Explants are surface sterilized to eliminate potential contaminants like bacteria or fungi. This is usually done by washing the explants in a sterilizing solution (e.g., bleach or alcohol) followed by rinsing with sterile water to remove any residual sterilizing agents. **Initiation of Cultures:** Sterilized explants are placed on a nutrient-rich medium, commonly referred to as the initiation medium. The initiation medium contains essential nutrients, vitamins, and growth regulators like cytokinins to induce shoot initiation from the explant. **Multiplication:** After initiation, the explants are transferred to a multiplication medium. This medium is optimized to promote the rapid proliferation of shoots. Cytokinins, such as kinetin or BA (benzyladenine), are often used in the multiplication medium to stimulate shoot multiplication. **Subculturing:** As the shoots multiply and grow, they are periodically subcultured onto fresh multiplication media to maintain their vigor and prevent overcrowding. This process helps ensure that each shoot receives adequate nutrients and space for growth. **Rooting:** Once the desired number of shoots is obtained, the shoots are transferred to a rooting medium. The rooting medium contains plant growth regulators, typically auxins like indole-3-butyric acid (IBA) or naphthalene acetic acid (NAA), which promote root development. Rooting is crucial for the establishment of plantlets that can be transferred to soil or another growing medium. **Acclimatization:** Once rooted, the plantlets undergo a gradual acclimatization process to adapt to normal greenhouse or outdoor conditions. This involves transferring the plantlets to a controlled environment with high humidity and reduced light levels. Over time, the environmental conditions are gradually adjusted to mimic the conditions in which the mature orchids will be grown. **Transfer to Soil or Containers:** Finally, the well-acclimatized and rooted plantlets are transferred to pots or growing containers filled with suitable growing media. Orchid-specific media, such as bark mixtures or sphagnum moss, are commonly used. The plantlets continue to grow until they reach maturity and are ready for sale or further cultivation. Micropropagation allows for the rapid multiplication of orchids, including rare or endangered species, and facilitates the production of orchids with desired characteristics. It also plays a significant role in orchid conservation and commercial production by providing a reliable method for mass propagation and ensuring a consistent supply of high-quality plants.

Virology of horticultural species

Virology of horticultural species orchids focuses on the study of viruses that infect orchid plants. Orchid viruses can cause significant economic losses by reducing plant growth, altering flower morphology, and negatively impacting overall plant health. **Virus Identification:** Various viruses have been identified in orchids, including Cymbidium mosaic virus (CymMV), Odontoglossum ringspot virus (ORSV), Cattleya mosaic virus (CtMV), and others. Identification of these viruses is typically done using molecular techniques such as PCR, serological assays, or next-generation sequencing. These methods help in diagnosing viral infections and determining the specific viruses present in orchids.

Virus Transmission: Orchid viruses can be transmitted through different routes. One common mode of transmission is through vegetative propagation, where infected plant materials are used to produce new plants. Other modes of transmission include insect vectors (e.g., thrips or aphids), contaminated tools, or sap contact between plants. **Understanding the transmission routes is crucial for implementing effective management strategies.** **Symptomatology:** Orchid viruses can cause various symptoms in infected plants. These symptoms may include mosaic patterns on leaves, ring spots, chlorotic patterns, stunting, distorted growth, or flower abnormalities. However, it's important to note that viral symptoms can vary depending on the specific virus and the orchid species involved. **Impact on Orchid Cultivation:** Orchid viruses can have a significant impact on the horticultural industry. Infected plants may exhibit reduced growth, delayed flowering, or diminished flower quality, resulting in economic losses for growers. Additionally, viruses can negatively affect the establishment and survival of orchids during tissue culture propagation. **Detection and Elimination:** Early detection of viral infections is essential for preventing the spread of viruses within orchid collections or commercial operations. Regular testing of plants using diagnostic techniques allows for the identification of infected individuals, enabling prompt action to prevent further transmission. Infected plants are typically removed and destroyed to prevent the spread of the virus to healthy plants. **Virus-Free Production:** Virus-free orchids are highly valuable for commercial production and conservation purposes. Tissue culture techniques, such as meristem culture or thermotherapy, can be employed to produce virus-free orchids by eliminating viruses from infected plant materials. This process involves culturing and propagating virus-free meristems or subjecting infected plants to controlled heat treatments that eliminate the viruses. **Quarantine Measures:** Quarantine protocols are essential to prevent the introduction and spread of viruses in orchid collections or commercial operations. Strict quarantine measures, including testing, isolation, and proper sanitation practices, help minimize the risk of introducing or spreading viral infections. **Research and Management Strategies:** Ongoing research is focused on understanding the biology, ecology, and epidemiology of orchid viruses. This knowledge contributes to the development of effective management strategies, such as the use of insecticides to control viral vectors or the development of resistant orchid cultivars through breeding or genetic engineering. Efforts in virology related to horticultural orchids aim to improve virus detection, prevention, and control measures, leading to healthier orchid plants, increased productivity, and the preservation of orchid genetic resources.

Food

Vanilla belongs to family Orchidaceae with taxonomically known 110 species. Capsules/pods are commercially valuable plant parts that result in hand pollination. Countries with tropical climates favour the growth of vanilla such as Madagascar, Indonesia, Mexico, Comoro. Indonesia is the largest producer of vanilla in the world. Among 110 species only 3 vanilla species are important in the commercial market (*Vanilla planifolia*, *Vanilla pomona*, *Vanilla tahitensis*) (Pansarin and Suetsugu, 2022). Vanillin is the economically important compound that is extracted from vanilla beans. Vanillin is used as flavour ingredient in the confectionery industry, perfumery and pharmaceutical industries (Anderson *et al.*, 2022). Sri Lanka is also cultivating vanilla as a commercial crop (Thenuwara Acharige, 2022). The major vanilla growing areas are Kandy, Nuwaraeliya and Matale districts. The total extent is less than 100 ha and the production is about 1.5mt (Department of Export Agriculture, 2022).

Health benefits

Modern social human spends their life with numerous relationships and responsibilities. This makes his life depressed and it leads to several non-contagious diseases such as high blood pressure, mental imbalance, cholesterol, diabetes heart attacks etc. To escape from these conditions mind relaxation provides enormous help (Meng, W. and Guozeng, 2022). Orchid potted plants with flowers can be used as a method of mind relaxation by establishing them indoors and outdoors. Due to its aesthetic value and its natural beauty orchids are used in indoor homes and outdoor gardens. Most of the people who are in retirement age maintain their orchid cultivation in order to relax their minds. It acts as a stimulant to their sluggish lifestyle and helps to refresh their life. Other than using orchid as a horticultural crop these kind of benefits enhance the value of orchids in nature (Fay, 2018).

Horticulture

Orchids are grown all around the world as display plants due to their natural beauty (Utomo *et al.*, 2020). The different colour variations and shape the diversity of the flower add enormous value to the orchid plant. As an indoor plant and outdoor plant orchid has a high value in export as well as local market (Yuan *et al.*, 2021). For landscaping purposes, orchid adds an advantage to improve the appearance of the design. Local home gardens provide evidence to prove the importance of orchids and it is common to see at least one orchid plant in each home garden.

Ornamental flower

The ornamental value of an orchid is high due to its longest vase life and flower colour variation. According to the flower type, the value of the flower also varied. Orchids are among the most highly valued flower among the ornamental flowers (Wang *et al.*, 2021). Phalanopsis flowers are the most expensive in the market while dendrobium is the lowest. Orchid flowers are taken to different cultural festivals including weddings, parties as well as funerals in order to design floral decorations. Orchids were cultivated for commercial purposes in Britain in the early 18th century. But thereafter they used modern agricultural biotechnology tools (tissue culture, hybridization, gene transformation etc.) to improve the quality and ornamental value of flowers by changing the flower shape, colour and vase life (Gale *et al.*, 2019). Due to the wide range of colour and shape diversification, the purpose of using this flower is different. Vanda, Phalanopsis and Cattleya as cut flowers with more bright and contrasting colours are more expensive they are used mostly in gorgeous occasions. The rich-looking appearance of these flowers expresses the blissfulness of a moment. Such cultivars like dendrobium with quite small flowers and dull colours are suitable for occasions such as funerals. This specifies the wide range of uses for the orchid flower as an ornamental flower (Pujari and Babu, 2022; Li *et al.*, 2021).

Perfume industry

Modern hybrids those are having a fragrant can be used as a source for perfumes. There are several hybrids with different aromas such as *Caularthron bicornutum* with a mild citrusy fragrance and *Oncidium Sharry Baby* with vanilla-chocolate scent (Irimescu *et al.*, 2020).

Orchids are a popular ingredient in the perfume industry. The flower's delicate and exotic fragrance is widely used in perfumes, colognes, and other scented products.

There are many different species of orchids, each with its unique scent profile. Some of the most commonly used orchids in perfumery include *Vanilla planifolia*, *Cattleya*, and *Phalaenopsis*. *Vanilla planifolia*, also known as Bourbon vanilla, is one of the most popular orchids used in perfumes. The scent of the vanilla orchid is warm, sweet, and comforting, making it a popular choice for creating cozy and inviting fragrances.

Cattleya orchids, also known as corsage orchids, are another popular choice in perfumery. They have a strong and complex fragrance, often described as floral with a hint of spice. Cattleya orchids are commonly used in floral and oriental perfumes. Phalaenopsis orchids, also known as moth orchids, have a delicate and fresh scent. They are commonly used in lighter and more refreshing fragrances, such as floral or citrus-based scents. Overall, orchids are a popular and versatile ingredient in the perfume industry, offering a range of unique and alluring scents for perfumers to experiment with.

Expand the Job Market

The commencement of orchid cultivation of one person will provide the foundation for several other job opportunities too. Once the cultivation is started by one person it will provide jobs for the people who are the nursery structures builders, potters, labors etc. People who are occupied in fertilizer companies also earn benefits from orchid industry. Not only them, but the responsibility of scientists is also to launch new flower cultivars to farmers in order to develop this industry (Kriel, 2019).

Fresh and dry form of floral decoration

Due to the ornamental value of the orchid, it is widely used in floral decorations. Fresh floral decorations are seen on some occasions while dry flowers can be seen in the wall hangers. In modern culture, the flower bouquet of a bride may be preserved as a memory of that occasion. There is a high market value for floral preservation, while orchids add gorgeous value (Varfolomeeva *et al.*, 2021).

Medicine

Orchids are well-known as ornamentals and valued cut flowers due to their exotic beauty and their long long-lasting blooming period. Other than these identifications orchids are known as the source of herbal medicines. Chinese and Japanese people used orchids for medicinal purposes at the beginning. Many genera including Dendrobium, cymbidium, vanilla, and vanda contain the marvelous properties of medicine (Bhattacharyya *et al.*, 2020). These kinds of orchids are most popular in Traditional Chinese Medicine. Medicinal orchids are distributed around the tropical rain forests of southern cChina, Japan, Sri Lanka, India and Nepal. Roots, leaves, bulbs, pseudo bulb, rhizome, tubers, stem, swollen stem base, fruits and even whole plant are also used for medicinal purposes (Jodh *et al.*, 2022). The medicinal properties of orchids include that anti rheumatic, anti-inflammatory, antiviral, anti-carcinogenic, anticonvulsive, diuretic, neuroprotective, relaxation, anti-aging, wound healing, hypoglycemic, antitumor and anticancer, antimicrobial (Bhatt *et al.*, 2018), antiviral and many other activities. Different phytochemicals (secondary metabolites) such as alkaloids, flavonoids, stilbenoids, anthocyanins, triterpedoids, orchinol, hircinol, cypripedin, bibenzyl derivatives, phenanthrenes, jibantine, nidemin and loroglossin leads to enhance the medicinal properties of orchids (Bhatt *et al.*, 2018).

***Bletilla striata* (commonly called Pe-chi)**

Bletilla striata is commonly used in Chinese medicine and the distribution of this plant is confined to Asian region. The dried parts of this plant are used to treat tuberculosis (Pant, 2013), coughing up of blood from the respiratory tract, gastric and duodenal ulcers, bleeding and cracked skin on the hand and feet, pus, malignant swellings, breast cancer, flatulence, dysentery, fever, coughs, and chest pain (Jiang *et al.*, 2019).

***Dendrobium anosmum* (commonly called Shih Hu)**

Even though there are so many *Dendrobium* species in China only few of species are used for medicinal purposes (Yang *et al.*, 2020). Among them Chin Chai Shih Hu (Golden Hairpin

Dendrobium) *Dendrobium nobile* is the most common in Chinese treatments and dendrobine is the major alkaloid that is isolated from dendrobium species. More than 14 alkaloids of dendrobine species and other valuable phytochemicals are used as treatments for alleviating gastric, fever, inflammation, pain, and epilepsy. It is also used to treat rheumatism, excessive perspiration, bodily weakness brought about by thirst, vaginal discharge, and menstrual pain (Semiarti *et al.*, 2020; Ramesh *et al.*, 2019).

***Gastrodia elata* (commonly called Tianma)**

Gastrodia elata is an orchid which is grown symbiotically with a specific soil fungus. Tuber's rhizomes of *Gastrodia elata* are used for various diseases including headache, dizziness, blackout, numbness of limbs, paralysis of one side of the body, epilepsy, cramps, spasms, migraine, rheumatism and vertigo (Chen *et al.*, 2020; Li *et al.*, 2020).

How to improve orchid cultivation in SRI LANKA

Introduction of new cultivars should be introduced to local market that is matched with Sri Lankan climatic conditions. Since most of the imported cultivars do not perform a better survival rate; then our responsibility is to introduce new cultivars with high adaptability to tropical climatic conditions. Since many native orchid species in the country, it is possible to develop new cultivars through genetic breeding programs. New orchid cultivars can be created through genetic breeding programs, which involve selectively breeding orchids with desirable traits in order to produce offspring with those same traits.

One approach to orchid breeding is to cross two orchid plants with different desirable traits, such as flower color, size, or fragrance. The resulting offspring, or hybrids, may exhibit a combination of the parents' traits or a new trait altogether. These hybrids can then be selectively bred with other hybrids or with purebred orchids to further refine their desirable traits.

Another approach to orchid breeding is through genetic modification, which involves introducing new genes into an orchid's DNA to create desired traits, such as disease resistance or improved flower color. This process is often more complex and controversial than traditional breeding and requires careful consideration of potential risks and ethical concerns.

Regardless of the approach used, orchid breeding programs typically involve careful selection, propagation, and testing of new cultivars over several years before they are released for commercial cultivation.

In Sri Lanka, several institutions that conduct research on orchid breeding and work to develop new cultivars of orchids, such as the Department of National Botanic Gardens and the Sri Lanka Orchid Society. These organizations work to promote the conservation and cultivation of native orchid species, as well as the development of new cultivars that can be used for ornamental purposes or in traditional medicine.

Funding the farmers to develop and expand their cultivation The Initial establishment of orchid cultivation is quite expensive due to the cost of Shade houses, materials, and irrigation systems. So there may be a retreat for farmers to go ahead with their cultivation. Financial assistance which is lounged by the government is essential towards developing this industry in Sri Lanka. Financial assistance from the government can be essential for the development of the orchid industry in Sri Lanka. The orchid industry, like many agricultural sectors, requires significant investment in infrastructure, research, and marketing to reach its full potential.

Government financial assistance can take many forms, including tax incentives, subsidies, grants, and low-interest loans. These resources can be used to support the development of

new orchid cultivars, establish and maintain orchid nurseries, upgrade infrastructure such as greenhouses and irrigation systems, and support marketing and promotion efforts.

In addition to financial assistance, the government can also play a role in creating a favorable policy environment for the orchid industry. This includes measures such as streamlining regulations for orchid cultivation and export, ensuring fair market access and competition, and promoting sustainable farming practices.

By supporting the development of the orchid industry in Sri Lanka, the government can create new opportunities for economic growth and job creation, while also promoting the conservation of the country's native orchid species. This can be especially important for small-scale farmers and rural communities, who may benefit from increased access to markets and new income streams. Ultimately, a thriving orchid industry can help to diversify and strengthen Sri Lanka's economy, while also promoting the country's rich cultural and natural heritage.

Collaborate with university students University students who know floriculture, especially in orchids can contribute their knowledge farmers in purpose of developing their cultivation. These students have the theoretical knowledge of all floricultural aspects, while the farmers have the practical knowledge. In combination of these two, may result in a wonderful creation. Collaborating with university researchers can be a valuable way for orchid cultivators to access new knowledge and expertise that can help them improve their cultivation techniques and develop new cultivars.

University researchers often have specialized knowledge in areas such as plant genetics, plant pathology, and soil science, which can be directly applied to orchid cultivation. By working with researchers, orchid cultivators can gain insights into the underlying biological processes that affect orchid growth and development, as well as access to the latest research findings and techniques.

University collaborations can also provide opportunities for orchid cultivators to participate in research projects, such as breeding programs or studies on orchid pests and diseases. This can help cultivators develop new cultivars that are better adapted to local growing conditions, as well as identify and manage potential threats to their crops.

Collaborations with university researchers can also lead to the development of new technologies and techniques that can improve orchid cultivation practices. For example, researchers may develop new irrigation systems, lighting technologies, or fertilization methods that can help orchid cultivators optimize their growing conditions and improve yields.

Overall, collaborating with university researchers can be a valuable way for orchid cultivators to stay abreast of the latest developments in their field, access new knowledge and expertise, and develop new cultivars and cultivation techniques that can help them to remain competitive and successful in the marketplace.

Increase Government Intervention Since the floriculture industry is an emerging industry in Sri Lanka government should pay attention to this industry. Importation of materials for green houses, tissue culture labs and for other related work will be more advantageous for semi-urban farmers. The huge initial capital cost is the major reason that affects for the stagnation of this industry. Increased government intervention in orchid cultivation can bring many benefits, including improved crop yields, increased profitability for growers, and greater sustainability and conservation of native orchid species.

One way that the government can increase intervention is through the provision of financial assistance, as discussed earlier. This can include grants, low-interest loans, and subsidies that can help orchid cultivators invest in infrastructure, research, and marketing. This can help to expand the industry and make it more competitive, while also providing opportunities for small-scale growers and rural communities.

In addition to financial assistance, the government can also increase intervention by providing technical assistance to orchid cultivators. This can include training programs,

workshops, and seminars that can help growers improve their cultivation techniques, manage pests and diseases, and identify new market opportunities.

The government can also play a role in developing policies and regulations that support sustainable and responsible orchid cultivation practices. This can include measures to promote the conservation of native orchid species, ensure fair market access and competition, and reduce the environmental impacts of orchid cultivation.

Overall, increased government intervention in orchid cultivation can help to support the growth and development of the industry, while also promoting sustainable and responsible practices. This can lead to a more competitive and profitable orchid industry, while also promoting the conservation of Sri Lanka's unique and diverse orchid species.

The increase in extension services and Technology Lack of proper extension services is one of the reasons tardy growth in the floriculture industry. Farmer's attitude is difficult to change regarding new cultivars and technologies. So it is necessary to conduct proper extension services to pass new technologies (fertilizer application, drip irrigation, aeroponics and shade management) to flower growers.

Subsidize farmers there are so many women seeking work in the rural and semi-urban areas. The major difficulty with them is to lack of initial finance to start up the cultivation. If financial support has been provided this workforce category can effectively contribute to the national GDP (Gross Domestic Products). Financial support encourages farmers to initiate and develop the existing floricultural industry.

Increase opportunities for exporting Even though there is rich cultivation, if there is no market in local and foreign levels farmers will discouraged. So it is important to expand the local orchid industry targeting foreign markets is essential. Increasing opportunities for exporting orchids can be a valuable way to promote the growth and development of the orchid industry in Sri Lanka. Exporting orchids can help growers to access new markets and increase their profitability, while also promoting the conservation of native orchid species through the cultivation of new cultivars.

To increase opportunities for exporting orchids, growers can focus on producing high-quality, unique, and desirable orchid cultivars that can stand out in international markets. This can involve investing in research and development to produce new orchid cultivars that are better suited to export markets, as well as adopting best practices in cultivation, harvesting, and packaging to ensure the quality and freshness of the orchids.

Growers can also work with government agencies and trade organizations to identify new export markets and develop export strategies. This can involve participating in trade fairs and exhibitions, as well as engaging in market research and analysis to understand the preferences and needs of international buyers.

In addition to these efforts, the government can play a key role in supporting the export of orchids by providing technical assistance and resources to growers. This can include providing training and support in export regulations, logistics, and documentation, as well as investing in infrastructure such as transportation and storage facilities that can help to ensure the quality and safety of exported orchids.

Overall, increasing opportunities for exporting orchids can be a valuable way to promote the growth and development of the orchid industry in Sri Lanka, while also contributing to the conservation of the country's native orchid species. By working together with growers, government agencies, and trade organizations, it is possible to identify new export markets, develop export strategies, and promote the unique and diverse orchid cultivars that Sri Lanka has to offer.

Developing infrastructure facilities to develop facilities like electricity, water, roads and transport are essential to enhance the floriculture sector. Orchid industry be able to develop in rural areas too, if the required infrastructure facilities are provided. Also designing and constructing of greenhouses and net houses while minimizing the use of

electricity (eg. Solar panels, transparent windows, air circulation pathways) is important to maximize profit. Developing infrastructure facilities for orchid cultivation can play an important role in supporting the growth and development of the orchid industry in Sri Lanka. By investing in infrastructure, growers can improve their cultivation practices, increase their yields, and reduce their costs, which can help to make the industry more competitive and sustainable over the long term. One important infrastructure facility that can be developed is a research and development center—for orchid breeding and cultivation. These centers can provide growers with access to the latest research findings and techniques in orchid cultivation, as well as opportunities for collaboration with researchers and other growers. Another important infrastructure facility that can be developed is modern greenhouses and shade houses that can provide optimal growing conditions for orchids. These facilities can help to regulate temperature, humidity, and light levels, which can improve orchid growth and yield. They can also provide protection from pests and diseases, which can reduce the need for pesticides and other chemicals.

In addition to these facilities, the government can also invest in transportation and storage facilities that can help to ensure the quality and freshness of orchids during transit and storage. This can include refrigerated trucks and warehouses that can maintain optimal temperature and humidity levels, as well as packaging materials and labeling systems that can help to identify the origin and quality of the orchids.

Overall, developing infrastructure facilities for orchid cultivation can help to support the growth and development of the industry in Sri Lanka, while also promoting sustainability and conservation of native orchid species. By investing in research and development, modern greenhouses and shade houses, and transportation and storage facilities, it is possible to improve orchid cultivation practices, increase yields, and reduce costs, which can lead to a more competitive and profitable industry over the long term.

Conduct awareness and training programs to expand the orchid cultivation it is very important to conduct awareness programs among rural and semi-urban populations. School students, jobless women, and retired adults can contribute to these programs.

CONCLUSION

The current floricultural industry can be uplifted through developments of orchid cultivation since orchids have enormous uses as ornamental, horticultural, medicinal, and other miscellaneous values. Keeping indoor and outdoor orchid pots has several unexpected benefits to your overall health and well-being. Orchid vendors have a large selection of orchid flowers for you to choose from for that special person, special occasion, or yourself.

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