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# EXPORT FLORICULTURE PRODUCTION REPORT

AgEnt Project

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## 1. INTRODUCTION

### A. PURPOSE:

The primary objective of the first phase of this consultancy report is to examine the status of the current export floriculture industry in Sri Lanka, both at the individual producer and sectoral levels. To assist in developing a strategy to increase the margin of export capacity, and to provide a "Hands On" design/formula to enhance the efficiency and overall operations.

## 2. STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS

### A. STRENGTHS:

#### 1. Climactic Favorability

One of the most beneficial and cost efficient features of growing in Sri Lanka is its tropical climatic favorability. Few countries enjoy weather which is so appropriate for floriculture production year round.

#### 2. Competitive Labor and Management Cost

Availability of labor and an eager-to-learn employment pool at competitive production costs enhances the competitive edge in Sri Lanka over all other global competition.

#### 3. Market Sectors: Europe, Middle East, Asia

While each market sector has its inherent obstacles, each too has a substantially high demand for tropical floriculture products. Sri Lanka is uniquely situated, in geographical terms, to service each of these geographical areas on all competitive fronts.

#### 4. Varietal Species Access

The nation is sitting on a botanical treasure chest. Procurement of tropical species in no way implies the eradication of any such species nor any individual plant. To extract cuttings in a well-organized fashion is a proper and respectable use of a natural resource.

5. Long Range Production Costs

Proportionate to competitive countries, the favorable cost index of producing floriculture products should remain. As the industry grows, so will the rate of income and the quality of products produced. The proportionate ratios should give Sri Lanka a favorable advantage for years to come.

B. WEAKNESSES:

1. Profile at Import Level / Historical Performances

The image that has been projected at the Import level has displayed great potential, yet has been continuously hampered with problems of flight scheduling, inconsistent quality and poor communications. Recovery from past performances can only be achieved through precise handling of each individual order and each communication.

2. Inadequate Materials and Supplies Access

There is a gap in supplies and availability. Many of the components necessary to fulfil operations are abundant, while other key items require extensive search and costs. Collective purchasing could reduce much of the cost and better communications would improve the accessibility.

3. Insufficient Air Freight Capacity

The industry is poised to double its production / land use within the next 24 - 36-month period. Without sufficiently increasing the current Air Cargo capacity, Sri Lankan producers stand to have their efforts jeopardized at the final stage of delivery.

4. University Assistance / Curriculum

Efforts are currently underway to develop and expand the curriculum at the University level. This effort however is only now at the beginning stages.

A full spectrum of floriculture subjects needs to be available to the private sector. To assist in the development of solid nursery management practices, and

to avail the current trends and technologies relative to international floriculture.

5. **Horticulturally Oriented Pathology Laboratory**

Diagnostic assistance is paramount to combat the vast numbers of plant diseases. An accurate and timely response to the micro-biological obstacles that all producers face is critical. Accurate identification is virtually impossible to perform in the field and usually amounts to more costly "shotgun" methods of control.

6. **Bibliographical Access**

There are thousands of publications, magazine articles books, seminar reviews, university extension reports, etc., available on all aspects of tropical floriculture and marketing strategies, to give a more complete view of the subjects affecting floriculture production.

7. **Industry Associations**

There is no better way to project in international terms, the viability of the floriculture industry in Sri Lanka. The export association structure is in place, but the perception of its benefits in overall terms have yet to be realized on an individual basis.

C. **OPPORTUNITY:**

1. **Rural Employment**

The expected increases in employment will penetrate all interrelated support industries and will parallel the expansions projected in increased land usage. The requirement for labor in this phase will sky rocket to almost 20,000 jobs in the next three years or so. The majority of this employment will utilize labor available in the rural / outlying areas.

2. **Low Production Costs**

While other producer countries are heavily encumbered with operational costs; fuel, labor, property, etc., Sri Lanka is fortunate with its natural climatic favorability that lends well to the production of floriculture on a year round basis.

3. **Pivotal Market Location**

Not only is the European market staged for an increase in Sri Lankan floriculture products, but also the entire Middle East and all of Asia as well.

4. **Tropical Species Specialists**

The opportunity for Sri Lanka to assume a leadership role in tropical floriculture is unlimited. Lectures, seminars, trade fairs and product innovations are all prime areas for development.

5. **Assistance**

Numerous governmental and private sector departments and associations are strengthening their activities to support the industry. The Floriculture Export Association, Export Development Board, and the **AgEnt Project** are but a few.

6. **Interrelated Industries**

The support industries will dramatically expand as the production increases. Chemical and fertilizer companies for example dealing in organic and inorganic materials will develop well beyond their current status. Inventories, delivery and sales efforts will become more aggressive, while new opportunities will surface to broaden all brokerage and distribution centers and outlets.

7. **Product Diversity**

Specialists of every type will begin to expand into areas that are presently untapped. All phases of production will gradually accommodate specialists involved in propagation, unrooted material, landscape ornamentals, ground covers, grasses, cargo experts, sea ship packaging and escorts, product trends, advisors and research and development.

## D. THREATS:

### 1. Air Cargo Limitations

There currently exist limited cargo space / prime scheduling. The projected increases in production will be threatened by a lack of adequate delivery capabilities. This is one of the biggest obstacles facing the industries right now.

### 2. Standby Refrigeration

Flexibility in handling and expediting floriculture crops is dependent upon cool storage. Without public access of refrigeration to compensate for delays and last minute changes, the industry stands at threat due to its perishable nature.

### 3. Prohibitive Species Ban

Viral diseases and introductions of new plant pests are legitimate concerns to the industry and to the nation. There are however numerous plant varieties that could benefit the industry which should be examined for introduction. For example, a variety of palms that are highly sought after could provide a more attractive varietal selection and thus aid in market leveraging.

### 4. Non Unified Industry Profile / Approach

Efforts to attract importer countries can only be achieved on a massive scale and proportionate to projections that have already been outlined. To attempt this on a company by company basis will generate occasional flurries of activity but lessen the overall industry / national impact.

### 5. 12% EEC Tariff

The constraints of this exclusive duty are evident and are counter productive to all players at both ends of the business (exporter, importer).

6. Loan Costs

Conventional loan procedures and percentage rates are a detriment to all expansion plans and industry potential.

7. Availability and Costs of Support Products

Hard items such as shade cloth, injectors, fertilizers and chemicals are proportionately very expensive compared to other producing countries.

## 3. DESIGN AND CONSTRUCTION

### A. SHADE HOUSES:

Shade structures vary in height between two and a half meters to four meters. Varietal selection, desired air flow, mechanized support systems, irrigation systems and crop diversity are all key factors when considering shade house design.

Forty five degree angled side walls help divert wind turbulence and minimize out side influence that can inhibit optimal crop production. Pest infestations and dust turbulence from roads and adjacent properties account for excessive maintenance, additional chemical applications, added labor and inferior product. Each of these factors can significantly erode profitability.

Sixty three to sixty eight percent of actual shade area constitutes revenue generating space. The balance of thirty two to thirty seven percent is consumed by aisles, storage and packaging, work stations and general turn around and labor use.

Steel posts with guy devices to accommodate 1/4" cable or #8 tempered wire are sufficient to withstand shade cloth weight and stress from gusts of upto 80 m.p.h. and more. It is best to anchor steel vertical supports in concrete.

Vertical wood structures or wood posts should be anchored in compacted gravel (1/4" - 1/2" diameter) or a similar indigenous material. All wood structures that come in contact with ground surfaces should first

be treated for two hours in a Copper Napthanate solution. It is not recommended that vertical wood structures used for shade houses be anchored in concrete or any other tightly bonding material. Their ability to withstand winds is dependent upon their flexibility at ground level.

Sixty three to ninety percent shade (diffused light) is utilized in all tropical regions. These variances are predicated on product variety and production purposes. To facilitate minimal transpiration in propagation it is necessary to shade as much as possible yet not to the point of inducing elongated effects or chlorotic conditions. The same criteria applies to grow out.

B. GROWING BEDS

The width and lengths of beds can impair or aid in the production of floriculture products.

Keeping in mind the 63% - 68% utilization of space formula, beds should measure: one meter to one and a half meters by thirty one meters (327 / 495 square feet respectively). This allows for maximum mobility and maximum land use. Trying to extend either width or length can hamper production and reduces effectiveness of mechanized support. Too lengthy a bed encourages employees to walk across the beds which physically contaminates soil with Pythium, Phytophthera and Rhizoctonia to name only a few. Beds that are too wide are difficult to reach into for planting, cutting, etc.

Soil depth of 25 - 40 cm (10 - 12 inches) is sufficient for most prefinished plant growing.

A ground barrier of 10 - 12 mm black polyethylene should be utilized to isolate outside contaminants. A drainage system running the entire length of the bed needs to be incorporated to accommodate run off. A simple drainage ditch filled with porous rock / broken terra cotta pots is sufficient to carry off excess water.

4. PROPAGATION

A well accepted design of "Hoop" style propagation beds or benches are ideal features that are utilized world wide and are extremely economical. Visual and physical access are important for inspection, misting, spraying, drenching and constant consolidation of product.

Uniformity of product in propagation is paramount to creating a uniformed finished product. Stem length, caliper, foliage size and color and degree of variation on applicable varieties, are key elements to consider when selecting propagation plant material.

When 90% of propagated material is displaying sufficient root systems, that block of plant material should be moved immediately to its intended grow out area. To delay this phase of transference from propagation to grow out for the remaining 10% is detrimental to ratio and turn over objectives.

All plant material intended for propagation should be fully submerged in a non porous tub for a period of 10 to 25 minutes. A bath solution of a broad spectrum fungicide should be used at the rate of 1 oz. per 10 gals of water (see label). Time ratios are dependent upon caliper, herbaceous versus woody or semi-woody material.

Following are a few varied examples.

| Typical Drench Fungicides | Variety | Stem Caliper | Herbacious Quality | Time Submerged |
|---|---|---|---|---|
| | Agloanema | 3/8" | 3 | 10 minutes |
| ) | " | 3/4" | 3 | 15 minutes |
| ) | Deffenbacha | 1/2" | 2 | 15 minutes |
| **Truban** ) | " | 1"-1-1/2" | 2 | 20 minutes |
| ) | Croton | 1/8" | 4 | 10 minutes |
| **Banrot** ) | " | 3/8" | 6 | 20 minutes |
| ) | Cissus | 3/16" | 5 | 15 minutes |
| **Captum** ) | Epipremnum | 3/16"-1/4" | 3-4 | 15 minutes |
| ) | Ficus | 3/8" - 2" | 8-9 | 15-25 minutes |
| ) | Dracaena | 1/2" - 2" | 7 | 20-25 minutes |

Maintaining an accurate record is necessary so that a rotation of fungicides can be employed to off-set immunity and maintain optimal effectiveness.

Vegetative plant propagation continues to represent 90% of all plant procurement procedures.

Tissue culture is tremendously promising. However, at this particular time its contributions to tropical floriculture remains at less than 10% of the varieties under cultivation. Additionally, the cost of tissue cultural material in general is not conducive to products less than that of specimen sizes (10" to 20" diameter containers).

Air layering techniques of those species with cambium structures need more rigid specifications in order to achieve consistency of product. Calider, branching height initiation and overall branching structure need to be strictly adhered to in order to provide product duplication.

Semi woody or woody material can tolerate broader foot candle ranges but in many instances, must require more detailed propagation techniques.

Mother block material should ideally be grown under similar light intensities and cultural practices as that which are reflected in grow-out stages.

Following is a list of Ratios of mother block to number of cuts procured per year: (nursery cultivation only).

| VARIETY | NUMBER OF YEARS ESTABLISHED | # CUTS 1-2 YR | # CUTS 2-3 YR | # CUTS 3-5 YR | REPLACEMENT YEAR |
|---|---|---|---|---|---|
| AGLOANEMA SPP | 1 | 6 | 10-18 | 20-22 | 4-5 |
| DIEFFENBACHIA | 1 (tip 3-months after estd. | 3-4 | 6-8 | 8-18 | 4-5 |
| CROTON | 1 - 2 | 12-16 | 20-24 | 30-80 | 7-8 |
| CISSUS | 1 (multi planted 6-8 plants. | 30-80 | 95-150 | 150-300 | 5-7 |
| EPIPREMNUM | 1 (multi planted 6-8 plants. | 200-300 | 300-400 | 400-600 | 5 |
| FICUS | 1 | 25-40 | 75-300 | 700-1000 | 20-40 |
| DRACAENA | 1 (tip 3-months after estd. | 3-6 | 6-12 | 18-30 | 12 - 16 |

Automated misting systems, fogging systems and hand misting procedures are all acceptable methods of reducing

transporation at the propagation stage.

Approximate times of a typical misting / fogging schedule on an 80 degree F day with clear skies would be: 10.00 a.m. and 2.00 p.m. The intent is to eliminate 80% of the transporational (loss of water) process that occurs on all foliage species when its primary mechanism for translocation of moisture (root system) is removed. Without the aid of moisture to compensate for transporational loss, the ability to commercially control the quality of the product would be negligible. Uniformity and consistency of plant production is the key component to successful large volume production.

For plant species with large or numerous leaves of semi-woody or woody qualities, it is often necessary to cut all the individual leaves in half to reduce transportation by half. This process is applied to those pieces which are intended for specimen or near specimen sizes. Misting applications are then employed as previously mentioned.

Bottom heat systems, and soilless mediums are technologies which will eventually assist Sri Lankan growers. What is most applicable for the current period (24 months - 48 months) is attentive propagational management and utilization of climatic favorability.

## 4. GROW OUT

Grow out areas need to fully accommodate the variety from the moment they are brought from propagation to the time of sales. Ideally a product should not have to be touched until it is ready for packaging and shipment.

All precautions must be fully employed to prevent any mechanical, environmental or physiological mishaps. Simple devices such as vertical pipes (1/2" x 18") at bed ends (corners) eliminate the possibilities of mechanical damage as a result of hoses being dragged over prefinished plant materials.

Irrigation systems need to be fully operational so that uniform distribution of water enhances crop uniformity.

Complete nutritional requirements (major and micro elements) should begin immediately after the product is brought out of propagation and placed in a perminate grow out area. Organically amended soil mediums can supply the necessary "complete" formulations for optimal growth,

however most species of tropical varieties demand on occasion supplemental micro components to truly achieve world class quality and fortify Sri Lankan producers with a competitive edge on competition. This should be determined through leaf and soil analyses by a competent pathologist operating from a full service modern pathology laboratory.

In order for Managers and Supervisors to fully monitor their product, it is imperative that they walk every aisle at least once a day for a quick visual inspection of every plant under production. This is a laborious and often monotonous fact of life within the industry but a key factor and foundation for building and maintaining a quality oriented production nursery.

## 6. IRRIGATION

The ability to irrigate soil medium without saturating plant canopies is particularly desirable in tropical regions. Biotic and abiotic diseases are enhanced by water, high temperature and prolonged high humidity. Some species are more susceptible than others so grower discretion and the employment of regional experience is advised when selecting irrigation systems.

Irrigation design is particularly dependent upon plant varietal selection, however, many irrigation systems lend well to a wide variety of plant species. Cost, sophistication, maintenance, replacement of parts and quantity of water desired, are all factors in selecting an irrigation system.

Unnecessary saturation of aisles and mechanized pathways provide costly interruptions in labor flow and organizational objectives. Careful consideration is required when designing and selecting pipe installations and locations and emitter types.

All irrigation requirements must be carried out between 6.00 a.m. 3.30-4.00 p.m. This also includes all misting and fogging operations specific to propagation. Time sequences are dependent upon daily climatic conditions.

Bacterial and fungal diseases are compounded to an infinite degree if irrigation management is not observed and implemented properly. Irrigation scheduling should preclude any residual overnight saturated foliage.

Following are some common examples of abiotic (non infectious) diseases contributed in part by poor cultural practices or environmental conditions.

| Symptoms | Possible Cause |
|---|---|
| Chlorosis of entire plant | Nutritional disorder.<br>Excessive light intensity. |
| Chlorosis of young foliage | Inadequate micronutrient.<br>Poor soil aeration. |
| Marginal chlorosis | Magnesium or Potassium deficiency.<br>High soluble salts. |
| Necrotic spots or section | Cold water / cold roots.<br>Fertility toxicity. |
| Elongated petioles. | Low light / improper plant spacing. |

## 7. PERSONNEL

Treat personnel as an investment, and the return in the long run will far exceed any short term monetary cost.

Outline precisely what is required of each function and in all phases of the operation; duties, time, etc.... Give as full an explanation as possible as to why a certain job needs to be accomplished in a series of phases, and gradually increased value will begin to take form with all personnel. Cultivate a sense of real value no matter how seemingly unimportant the job (rolling up hoses/cleaning benches) and a "quality" operation will materialize.

Acknowledgement of a job well done instills pride in workmanship and eventually is reflected in profits.

The number of employees per square foot or meter is determined by varietal mix, size of product and labor intensity. Four to eight persons per acre is a rough estimate, applicable to Sri Lanka, and based on personal experiences in sixteen countries, ranging in product diversity from Lithop production to 40' specimen trees, vegetables, cut flowers, tropical foliage under green-house cultivation, tropical specimens under shade etc.

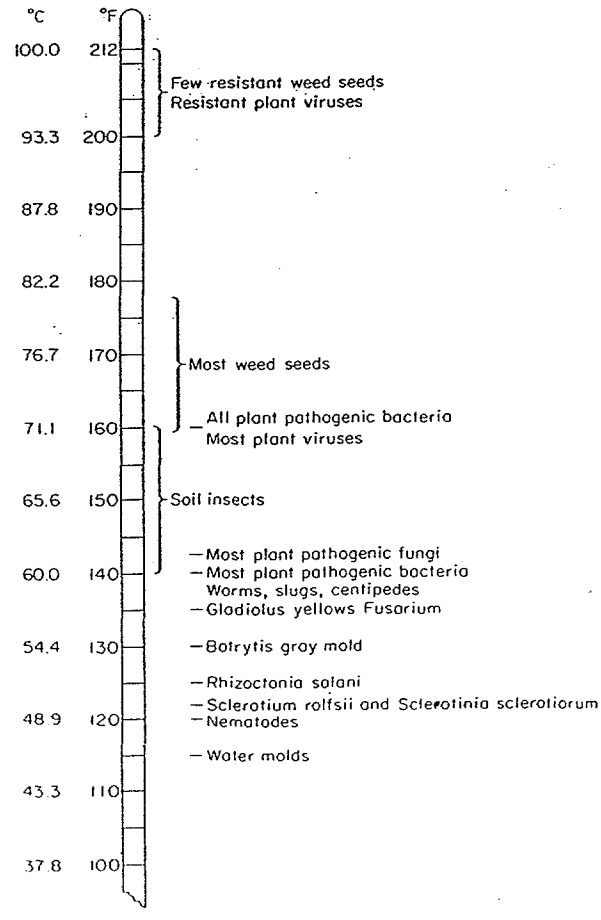
## 8. PREPLANT TREATMENT

Soil preparation and sterilization is imperative to quality plant production, especially in reference to large volume facilities. Consistent quality and minimal mortality cannot be achieved without thorough preplant soil treatment.

Formaldehyde, Methyl Bromide, Chloropicrin or Vapona have been widely utilized in recent times. However, steam treatments are again gaining prominence amongst growers, as ecological concerns and general safety issues are taking a more priorital role in preplant soil treatment processes.

The soil area should be moist (not wet) and covered with a plastic or polythene tarp. Steam treatment can be most effective if injected or released at a depth of 6"-8" (17-20 cm) below the surface. There is concern of knocking-out certain beneficial organisms at excessively high temperatures and extended time periods, thus rendering the soil medium to a more vulnerable state for reinfestation and contamination of the exact organisms of which one is attempting to eliminate.

Following is a precise knock-down schedule for disease and other detrimental soil-borne influences:



## 9. PLANTING TECHNIQUES

Sophisticated and mechanized planting equipment is currently a bit premature for the horticulture industry in Sri Lanka. I would estimate that a gradual introduction of mechanized features will begin to avail themselves to the industry within the next 2.5 to 4-year period.

Some respected substitutes and still viable, yet labor intensive, planting procedures are the "central stack" and "prefilled flat" assembly and "site planting" techniques.

The "central stack" procedure consists of a centralized mound of prepared soil accessible at 360 degrees. Workers surround themselves at the perimeter of the soil, containers are available either above or below (if working at a bench or table) the planting area with sufficient room to consolidate finished planted material which is to be distributed throughout the nursery by a plant movement crew. Plants and containers are within arms length of each planter and all supplies are constantly being replenished by a facilitor.

"Prefilled flat" assemblies can be set up anywhere within the nursery and is convenient to set up days in advance of actual planting. A predetermined quantity of a particular plant variety can be established with minimal communication and direction. One sample can be left at the site for instruction and a flag can be used to determine the block to be planted and an additional flag used to indicate where the finished product is to be placed. All of the various functions can be effectively accomplished without the aid of any movement crew or additional facilitor.

"Site planting" requires a trailer filled with soil and with containers and plants set adjacent to the planting location. This process is a duplicate of the "prefilled flat" process. However it lends itself to a wider plant size and range of plant material where movement of larger specimens for instance is unrealistic.

## 10. SANITATION, DISEASE & PEST CONTROL

Sanitation and cleanliness is the best defense against disease. All nursery operations need to aspire to the cleanest possible facilities and to maintain that level of cleanliness throughout the life of the operation.

Employees should never set foot in any growing bed for whatever reason. Tools, baskets, benches or table surfaces, cutters, knives and employees' hands should be sanitized prior to working on any plant block or engage in any series of plant handlings. A simple solution of household bleach (Sodium Hypochlorite) diluted at the rate of 1 part bleach to 9 parts water is a sufficient disinfecting agent.

When dealing with varieties that have high susceptibility to a particular pathogen, it is advised to dip cutters at each cut especially if symptoms indicate. Regardless of susceptibility, the foregoing precautions should be employed at the completion of each block of plant material or at each varietal change over.

Disease identification and control requires an intimate knowledge of the day-to-day influences and environmental variances subjected to each nursery. Without a thorough background on the immediate history; i.e. pesticides, temperature, rainfall, origin of plant material, fertilization, etc..., one is forced to speculate on the causes that have contributed to the damage, and refer only to the symptoms, which in some cases is strictly a matter of guess work.

## 1. DISINFECTANTS

| DISINFECTANTS | RATE | APPLICATION |
|---|---|---|
| Sodium Hypochlorite | 1 part bleach to 9 parts water | All tools, benches, tubs. Anything with contact with plant materials. Hands. |
| | | Watering systems (flush throughly with fresh water before re-application) |
| Copper Naphthenate | | All wood surfaces in contact with ground. (No plant application.) |

## 2. FUNGICIDE AND BACTERICIDE RECOMMENDATIONS {9 SAMPLES}

| DISEASE | CONTROL AGENT | RATE PER 100 GALLONS | REMARKS |
|---|---|---|---|
| Alternaria Blight | Zineb 75 WP | 1.5 lbs. (with spreader | Spray every 7 days/finish |
| Alternaria Leaf Spot | Chipco 50 WP<br>Manzanate 200 75 WP<br><br>Daconil 2787 4.17 F<br><br>or 75 WP | Refer Label recommendations<br><br>10 - 14 oz.<br><br>12 - 16 oz. | Specific for Brassaia / Calathea.<br><br>Specific on polyicias.<br><br>Not for Brassaia SPP |
| Botrytis Blight | Chipco 50 WP<br><br>Benlate 50 WP | Refer Label recommendations<br><br>08 oz. | 10 micron Fog Saturate surfaces. |
| Fusarium Stem Rot | Benlate 50 WP | 08 oz. | Drench / Spray |
| Fusarium Wilt | Steam (soil) | 165 - 175 degrees F'heit - 30 mins. | Replant with disease free stock. |
| Pythium Root Rot or Phytophthora Rot | Truban 30 WP<br>or Subdue 2E<br><br>Banrot 40 WP | 06 oz.<br>0.5 - 2 oz.<br><br>4 - 8 oz. | 4-8 weeks. Repeat at 8 weeks/finish |
| Powdery Mildew | Benlate 50 WP | 04 oz. | Spray 7-10 days/As needed |
| Rhizoctonia Root Rot | Banrot 40 WP | 6-10 oz. (400 sq. ft.) | Drench/6-12 week intervals |

(Wettable powders such as: Benlate, Banrot and Truban, need to be followed up immediately with additional water when drenching, to put formulation at root zone; This is imperative !)

(Refer to Day Temperature Recommendations on label for all above samples.)

3. INSECT, PEST AND RECOMMENDED CONTROL
[ 8 SAMPLES]

| INSECT/PEST | INSECTICIDE | RATE PER 100 GALLONS | REMARKS |
|---|---|---|---|
| APHIDS | Diazinon 23 EL<br>Lindane 25 WP<br>Insecticidal soap 50.5EC<br>Talstar 10 WP | 16-20 oz.<br>12-16 oz.<br>2.5-3 gallns<br>8-28 oz. | Re-entry 2 hours |
| BROAD MITE | Pental 50 WP<br>Pental Aqua Flow | 8 oz.<br>4-6 oz. | Repeat 7 days for 21 days.<br>Reapply if necessary. |
| SPIDER MITE | Mavrik 22.5 F<br>Avid 2 EC<br>Pental Aqua Flow | 5-10 oz.<br>5.5 oz.<br>4-6 oz. | Do not use on Ferns. Re-apply 8 weeks.<br>If necessary. |
| BROWN SOFT SCALE | Talstar 10 WP<br>Dycarb | 6-28 OZ.<br>5.5 oz. | Reentry 3 hours |
| CABBAGE LOOKER | Mavrik<br>Oibrom 60 EL | 4 oz.<br>16-20 oz. | As needed. See Label Varietal Caution. |
| FUNGUS GNAT | Bacillus Thuringiensis H-14 (Gnatrol 12.AS) | 8-32 oz. | |
| MEALY BUGS | Diazinon 23 EL | | |
| TWO SPOTTED SPIDER MITE | Vendex 50 WP<br>Pental Aqua Flow | 8-14 oz.<br>4 oz. | 3 week intervals, if necessary.<br>Re-apply 8-10 weeks if necessary. |

(Some wettable powders will leave unsightly residue on foliage, grower discretion is advised.

Saturate foliage to point just prior to run-off.)

(Refer to temperature recommendations on Label for all above.)

## 11. NUTRITION

To achieve optimal growth rates and consistent quality of product, a well balanced fertilization program must be implemented. Organic and inorganic regimes of varying types are available to an infinite degree, however, the basic requirements are the same.

| | | |
|---|---|---|
| | CARBON<br>HYDROGEN<br>OXYGEN | Supplied from the Atmosphere and Water. |
| MAJOR ELEMENTS | NITROGEN<br>PHOSPHORUS<br>POTASSIUM<br>CALCIUM<br>MAGNESIUM<br>SULFUR<br>IRON | Supplied from the soil |
| MINOR ELEMENTS | MANGANESE<br>ZINC<br>COPPER<br>BORON<br>MOLYBDENUM<br>CHLORINE | |

Primary concern for growers are the elements of; Nitrogen, Phosphorus and Potassium. This group is referred to as "complete".

A good approach to fertility for Sri Lankan growers is a slow release granule form that will supply on a constant basis, the "complete" fertilization needs. Three trade manufactured products which are available in Sri Lanka are "Magamp", "Osmocote" and "Nutriform" or "Nutricoat".

Micro nutrients should be fortified on a need-be basis. All are in supply to varying degrees through the origin of soil mediums and as a result of decomposition.

Soil-less mediums have a far greater nutritional need for replenishment as there is typically less organic material available by volume.

Following is an example of a dry formulation for 1 cubic yard of soil:

| | |
|---|---|
| 4 oz. Potassium Nitrate ) | |
| 4 oz. Potassium Sulfate ) | Contingent on soil make up |
| 2.5 lb. Single Superphosphate ) | and analysis and target |
| 4.5 lb. Dolomite Lime ) | plant variety. |
| 2.5 lb. Calcium Carbonate Lime) | |

This is sufficient for a period of 12 - 16 months. (Applicable to growing beds and containers for finished product.)
Organic applications are limited and more costly to handle and require closer scrutiny to truly be value competitive. This process should be considered on a one-to-one basis at the nursery site.

The disadvantage of organic versus inorganic is the rate of proportions; 100 lb. of inorganic 10-5-10 is equivalent in formula to 2,000 lb. of cow manure. The disadvantages are cost, storage, delivery, application, labor, soluble salts and the need for repeated applications.

## 12. POST-HARVEST HANDLING AND PACKAGING

All packaging preparations should be set up in advance of harvest.

### Air Ship

Materials selected for air shipment need to be consolidated preferably in the cool early hours of the morning.

Cut foliage and unrooted plants need maximum sanitation precautions employed with minimal handling. Any extraneous and foreign material should be washed off with relative ease or discarded. Specifications should be adhered to as close as possible; Leaf size, shape, color, petiole length, caliper, number of leaves, overall height, percent of variegation per leaf, degree of variegation color, sturdy in appearance and all typical characteristics of the species or variety need be represented.

When bundling plants together, the individual leaves should lay in a complimentary order. Any bent, folded or creased foliage will result in damaged condition at the receiving end. Even alignment of basal ends guarantees uniform packaging and consistent overall professional appearance.

Individual bundles and total bundles per box need to be uniform and preferably of even numbers. The direction the plants lay in relation to the box design further aid in an overall professional appearance.

All plant parts and packaging components must be free of excess water. This usually occurs in the time it take to put an order together. It may be necessary to have a

blower or fan available during the rainy season while irrigation schedules should be altered 24 - 72 hours prior to harvest and packaging. Either wax impregnated or polyethylene-lined cartons are necessary to maintain an even temperature and isolate the environment. A layer of absorbent paper is used as a barrier between plants (if not fully bundled) and polyethylene-lined cartons.

Box construction should be designed to withstand anticipated weight factors (stacking) and mechanized handling.

Finished plant material should be individually sleeved or netted (specimens) and packaged tightly but not crushed, to minimize any movement during shipment. All specifications outlined for cut foliage and unrooted plants apply to finished material and rooted plants or cuttings and cut flowers as well.

**Refrigeration**

Refrigeration is required for cut foliage, unrooted and rooted plants when extended time in handling is anticipated. Any lengthy layover at air freight terminals is especially important. Unfortunately there is no real facility available at this time at the freight terminal.

**Sea Freight Shipment**

Sea freight cargo has a competitive edge against Air Freight in terms of cost per cubic measure. However, the advantages are specific to a lesser varietal mix and size range.

Closed sea containers are available in three sizes; 8' x 8 ' 20' = 1,280 cubic feet, 8' x 8' x 40' = 2,560 cubic feet and 8' x 8' x 45' = 2,880 cubic feet. The cost comparison to air freight is roughly 60% less. This is dependent upon availability and individual carriers. Other factors that dictate sea cargo shipments and rates are spot market fuel cost which can fluctuate weekly (and extended to each container while en route) and seasonal and climatic constraints that can affect delivery schedules.

Plant varieties and non-traditional plant materials that lend themselves to closed sea container shipments are

typically, but not limited to; palm specimens, caudaceous mid-size plants and caudaceous specimens, non-herbaceous ornamental shrubs and trees, cut lengths of unrooted and rooted herbaceous cane and varying species of cacti and bamboo.

Temperature requirements for closed sea containers will vary according to varietal mix, seasonal harvest and procurement type; unrooted, rooted, divisional stage and development. Forty five to fifty five degrees F is optimal for much of the material mentioned but is calculated to endure not more than 24 days. It is imperative to consider all plant characteristics, degree of foliation and the compatibility range of each individual load. Under no circumstances should there be any bud set, flowers or fruit in accompaniment.

All portions of plants or plants that can be sleeved or netted, should be. All precautions must be taken to tightly secure the entire shipment as there is constant movement while in route. Any contact with any surface (plant or otherwise) will experience abrasion and thus limit the value of those pieces. Trial and control of species are advised.

**Open Top Sea Containers**

Open Sea Containers are limited to mid-to-large exterior landscape plant materials. This applies in general to plant containers ranging from 5 gallons to 92" boxed specimens.

Cubic foot utilization is less efficient than any other form of shipping due primarily to branching structure and the need to suspend the larger pieces mid-way and in a horizontal position within the container.

Larger trees (20" - 92" boxes) need extensive rigging / positioning and support to secure them against the continual movement characteristics of sea transport and negative environmental sea conditions.

Growing boxes need to be totally self contained. Carpet remnants / coco fiber matting or equivalent should be secured at soil level to a height of one foot around the trunk. The soil mass should then be completely enclosed by wood construction, nailed and secured with the aid of metal strap banding.

Pliable rope is used to "pull-in" the main branching structure of the tree to approximately the same dimensions of the width and depth of the sea cargo box or container. Minimal pruning is essential but must be done carefully as to not seriously alter the shape and form of the piece.

Considerations must be given to:

1. Length of voyage / route.
2. Seasonal constraints / weather.
3. Growing season / Deciduous, Dormant
4. Sea exposure and temporary effects.
5. Client expectations / recovery period.

Irrigation en route:

Each box must be drilled (top side only) and fitted with an emitter device to a point of 20% of overall depth (i.e. 20" box, emitter 4" deep. 36" box, emitter 7.2" deep) emitter tubes should be connected to a manifold system which is mounted or suspended from shade cloth covering and terminated with a female adaptor on top of container door and facilitated with a 90 degree coupling, pointed downward. The diameter of the tube going over the door must not exceed 3/4" (gantry cranes and dock swing crane machinery have 1-1/4" variance between container top and underside of crane assembly). One hundred foot hoses must accom- pany each container to facilitate watering while en route. Hoses are bundled tightly to front side of container and are only released while at sea for irrigation purposes.

Arrangements must be made with carrier for a separate fresh water supply of 1,200 gallons per week, per container. The volume of water needed is dependent upon: number of units, varietal mix, weather, route, and security concerns at point of destination. (This is especially pertinent going into Middle Eastern countries.)

General sea cargo concerns for open top/perishable cargo.

1. Advance requisition for open top container - months.

2. Escort en route (1 man).

3. Transportation at importer destination - dock to site.

4. Telescopic crane for loading and off-loading trees.

5. Scheduling; time and number of employees:

   a. Dependent on variety and sizes (4 - 10 men).
   b. Preparation and set-up; one hour and a half, to one day, per container.

Miscellaneous material for handling;

a. 2 - 25'-30' chains, 4 ton capacity.
b. 2 - 25'-30' x 8" soft nylon straps.
c. Lead rope - 100'.
d. 3 each Hammers, crow bars
e. Blocking material, loading and off-loading and inside structural support while in transit, 2" x 8" x 60' or as much as 200' of lumber (per container).

## 13. VARIETAL SELECTIONS AND TRENDS

There are roughly two hundred varieties (species and cultivars) of tropical foliage plants currently under production around the world.

As trends come and go and interior designers, homeowners and plant scapers create new and exciting schemes to please the esthetics of home, office and industrial work places, new varieties will emerge and broaden the applications of tropical foliage plant uses.

There are no "fast cash" or quick plant production schemes. Diligence, commitment, market awareness, and sound nursery management are all elements to building a successful business.

Capital strengths and strategies allow for creative innovations and research and development. On occasion timely introductions of new varieties / cultivars will generate a flurry of business but these high points of activities are typically short lived.

Following is a list of fifty or so popular interior plants geared for high volume production. These are bread and butter / staple items that have historically maintained their position in spite of trends, fads and other influences - (95% of these are tropicals):

| | | | |
|---|---|---|---|
| 1. | AGLAONEMA | commutatum | |
| 2. | " | commutatum | "silver queen" |
| 3. | " | roebelinii | |
| 4. | ASPIDISTRA | elatior | |
| 5. | ASPLENIUM | nidus | |
| 6. | BEGONIA | rex (cultivars) | |
| 7. | BRASSAIA | actinophylla | |
| 8. | BRASSAIA | arboricola | |
| 9. | CHAMAEDOREA | elegans | |
| 10. | " | erumpens | |
| 11. | " | siefritzii | |
| 12. | CHLOROPHYTUM | comosum | "variegatum" |
| 13. | CHRYSALIDOCARPUS | lutescens | |
| 14. | CISSUS | rhombifolia | |
| 15. | " | " Ellen Dania" | |
| 16. | " | "mandiatum" | |
| 17. | CODIAEUM | (cultivars) | |
| 18. | CORDYLINE | terminalis | |
| 19. | DIEFFENBACHIA | amoena | |
| 20. | " | | "exotic perfection" |
| 21. | " | "camalle" | |
| 22. | " | "tropic snow" | |
| 23. | DRACAENA | deremensis | "janet craig" |
| 24. | " | " | "warneckii" |
| 25. | " | fragrens | "massangeana" |
| 26. | " | marginata | |
| 27. | " | " | "tri color" |
| 28. | " | " | "color rama" |
| 29. | " | sanderana | |
| 30. | EPIPREMNUM | aureum | |
| 31. | FICUS | benjamina | |
| 32. | " | " | "variegated" |
| 33. | " | lyrata | |
| 34. | HOWEA | forsterana & balfouri | |
| 35. | HOYA | carnosa | |
| 36. | " | " | "variegata" |
| 37. | MARANTA | leuconeura | "kerchoviana" |
| 38. | MONSTERA | deliciosa | |
| 39. | NEPHROLEPIS | exaltata | "bostoniensis" |
| 40. | PHILODENDRON | "emerald queen" | |
| 41. | " | scandens oxycardium | |
| 42. | " | selloum | |
| 43. | POLYSCIAS | balfouriana | "marginata" variegated |
| 44. | " | fruiticosa | |
| 45. | SPATHIPHYLLUM | "mauna loa" | |
| 46. | " | "tasson" | |
| 47. | SYNGONIUM | podophyllum | "white butterfly" |
| 48. | PHOENIX | roebelinii | |
| 49. | RHAPIS | humilus | |
| 50. | BROMELIADS | | |

## 14. EXECUTIVE SUMMARY PRODUCTION

The export floriculture industry in general terms is much stronger and more well fortified than potential import countries' perceptions indicate.

Many previous attempts to generate and sustain business relationships have failed in part as a result of the following:

1. Poor communications.
2. Unprofessional approach and follow up.
3. Inconsistent performances.
4. Inconsistent product.
5. Poor product representation.
6. Flight delays.
7. Misunderstanding of product descriptions.
8. Poor product mix.
9. Unsynchronized container sizes.
10. Too eager to sell product / cultivates market manipulation.
11. Poor box construction and design / poor logo.
12. Lack of credibility regarding production.
13. Hearsay/perceptions of tropically located shade growers.
14. Weak collection practices.
15. Non-aggressive business practices.
16. Post harvest handling techniques.

Many of the observations mentioned are valid while others are due in part to logistical problems and direct production and marketing deficiencies.

Implementation of improved image and production credibility is needed. This must be synchronized with a well-organized plan that will tie together a public relations blitz along with real, large volume and top quality inventories.

Co-operation amongst producers must be established by mutual efforts to achieve higher standards and to capitalize on diversity of product in quantities of massive volume.

Enormous progress could be achieved through the Export Floriculture Association, which until now is virtually operating in name-sake only.

The diversity available to the "green industry" has not moved beyond the "tropical species" segment. Many specialized sectors within the "green industry" could

develop in equal terms to that which is currently being generated and projected for "tropical species" alone.

There exist a void in mid-management personnel which is a threat to real expansion. The "competitive climate" in import countries has a zero tolerance range for product inconsistency and non-professional marketing performances.

Strong mid-management personnel are critically needed at all levels throughout the industry.

The opportunity to increase Sri lankan floriculture exports is ripe, but the road ahead is an arduous path; yet the rewards remain consistent and in clear view.

# G L O S S A R Y

| | | |
|---|---|---|
| * | Copper Napthanate | Surface disinfectant, wood preservative |
| * | "Hoop" style propagation bed | Polythene film laid over p.v.c pipes to form miniature greenhouse (18"-36" high) |
| * | Semi woody and woody | With cambium |
| * | Soilless mediums | Wood chips, vermkulite, perlite, rice hulls, saw dust, foam particles, oasis root cube (porous foam cube) |
| * | Biotic | Infectious organism |
| * | Abiotic | Non living / non infectious |
| * | Chlorosis | Failure of the development of chlorophyll<br><br>Fading of plant tissue from green to light green, yellow and white |
| * | Petioles | Stem from leaf axle to leaf base |
| * | "Lithop" | Small succulent-like plant from Africa |
| * | Formaldehyde<br>Methyl bromide<br>Chloropicrin<br>Vapona | Chemical soil sterilizers |
| * | Tissue culture | In vitro / in glass |
| * | Air layering | Procurement of plants from mature shrubs and trees |
| * | Pathogen | Organism or biotic agent that causes disease in another organism |
| * | Caudaceous | Swollen at base. |

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