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**TRAINING IN PLANT PROPAGATION
PROCEDURES AND NURSERY MANAGEMENT**

By

R J Nissen
Horticulture Consultant
and
M E R Pinto
Horticulture Consultant

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P O Box 57, Peradeniya.

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ACRONYMS

ADD	- Additional Deputy Director
ARTI	- Agrarian Research and Training Institute
DAI	- Development Alternatives Incorporated
DARP	- Diversified Agriculture Research Project
DOA	- Department of Agriculture
DD/R	- Deputy Director of Agriculture, Research
DD/SC&P	- Deputy Director of Seed Certification and Plant Protection
DD/S&PM	- Deputy Director of Seeds & Planting Material
DD/TT	- Deputy Director of Technology Transfer
EDB	- Export Development Board
GCEC	- Greater Colombo Economic Commission
GOSL	- Government of Sri Lanka
IBPGR	- International Board for Plant Genetic Resources
KVS	- Agricultural Field Assistants (Krushi Viyaptha Sevaka)
MARD	- Mahaweli Agricultural and Rural Development Project
PGRC	- Plant Genetic Resources Centre
R&D	- Research and Development
RD	- Research Division
SCS	- Seed Certification Service
SC&PP	- Seed Certification and Plant Protection
S&PM	- Seed and Planting Material
USAID	- United States Agency for International Development

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R J Nissen
Horticulture Consultant
Queensland Department of Primary Industries
PO Box 5083
Sunshine Coast Mail Centre
Nambour 4560 QLD. Queensland, Australia.

M E R Pinto
Horticulture Consultant
256A, Aratenne Road
Edanduwana, Peradeniya, Sri Lanka.

1. INTRODUCTION

Until recently, horticulture has not been given high priority by the Government of Sri Lanka. Research and development strategies for horticulture were not clearly defined, and consequently staff were unable to make significant contributions to improve horticultural crops.

Introduction of fruit tree crops under various projects has resulted in the establishment of some tree fruit varieties on government and Department of Agriculture farms. But very little propagation and distribution to the private sector of these varieties has occurred. However with renewed interest in horticultural crops, the need for rapid multiplication and improved nursery management procedures is evident. Recent introductions of banana, mango, citrus rambutan, durian, guava and avocado cultivars all need rapid multiplication and distribution to mother tree orchards.

Significant improvement in the Sri Lankan horticultural industry can be achieved through activities such as labelling plant material, establishing mother tree orchards, upgrading nursery facilities, improving nursery management systems, applying proper propagation techniques and rapidly distributing plant material of known fruit varieties to the private sector. The propagation of these internationally known fruit varieties and subsequent production of export quality fruit with the correct marketing approach could provide income and employment opportunities in rural areas of Sri Lanka.

With these factors in mind, the following actions were recommended:

- 1) Improved fruit cultivars from introductions from overseas, especially those with international acceptance.
- 2) Continued selection of fruits from seedlings and clones already in Sri Lanka through the improvement of the Plant Genetic Resources Centre of the Department of Agriculture.
- 3) The need for rapid multiplication of desirable cultivars and distribution to mother tree orchards for private sector production.

The Scope of Work for the present technical assistance assignment on Plant Propagation and Nursery Management was developed by the Diversified Agriculture Research Project (DARP), including the Sri Lanka Department of Agriculture (DOA), the United States Agency for International Development (USAID), and Development Alternatives Incorporated (DAI).

2. BACKGROUND AND OBJECTIVES

The technical assistance assignment was conceived of as having three separate parts. The first of these, carried out in 1992 by Mr Keith Chapman and Mr Rufus Pinto, resulted in an action plan. The second was to conduct training, and the third to expand mother tree orchards and budwood gardens. The DOA action plan, titled "Perennial Tropical Fruit Development in Sri Lanka: Plant Cultivar Collection, Mother Tree Orchards, and Plant Propagation" was published by DARP in August, 1992. This document set out the specific objectives for the current assignment, which focuses on training of nurserymen:

Prior to this assignment, Mr Nissen conducted a special study tour in Queensland, Australia for six officers of the DOA, funded under the DAR Project. One of the primary objectives of the study tour was to identify fruit varieties that might perform well under Sri Lankan conditions and to collect the plant materials on the spot. The transport of the collections back to Sri Lanka was personally arranged by the Deputy Director of Agriculture (Research), Dr Sarath Amarasiri. The introduction was supervised carefully by the plant quarantine service.

Objectives of this technical assistance assignment were to conduct five courses in nursery management and perennial tropical fruit tree propagation. Selected nurserymen would participate along with DOA officers.

3. WORKSHOP ORGANIZATIONAL ACTIVITIES UNDERTAKEN

Organization of venue, setting of training workshop dates, equipment, props, displays, plant material availability and selection of participants was undertaken by Mr. B A S S Padmalal, Additional Deputy Director (Seeds & Planting Material) and staff of the DOA Seeds and Planting Material Division with consultation of Messrs. Nissen and Pinto.

Visit to Bibile Research Farm: Inspection of plant nursery stock and training centre by Mr. Nissen, accompanied by Mr. Padmalal and Mr. Srikanthan, revealed that nursery stock plants were in condition to be used for training purposes. The training centre was suitable for conducting lectures and demonstrations for the training of participants. Discussions on equipment requirements and workshop details were undertaken with assistance of Mr. Harischandra. Availability of nursery plants was also discussed with the farm manager Mr. Wijesundara.

The purchase of demonstration props and equipment was undertaken utilizing locally available material to show participants the ease at which plant propagation equipment can be gained at a reasonable cost.

3.1 SUBJECT AREAS OF REFERENCE NOTES AND SUMMARY

3.1.1 Workshop Notes Provided at Nursery Management and Plant Propagation Workshops

Workshop Reference Notes were supplied by Mr. Nissen in English, consisting of some 560 pages covering all aspects of plant propagation and nursery management practices. A total of 200 copies were published and distributed by DARP to workshop participants and other interested parties around the country.

Subject areas covered are as follows:

Nursery Infrastructure

Greenhouses

- Greenhouse structure
- Greenhouse coverings
- Greenhouse environment
- Greenhouse design
- Benches and trolleys for greenhouses

Types and Characteristics of Shade Cloth

Heating and misting systems for hot bed propagation of plants

Automatic watering systems

Nursery Hygiene

Factors

- Propagation media
- Plant source material
- Personnel
- Containers
- Work area
- Growing surfaces
- Water
- Growing on
- Maintenance
- Reuse of propagating mixtures
- Weed control
- Disposal of waste material
- Attention to potting on

Summary of approved hygiene practices and apparatus needed

Nursery Crop Protection

Diseases in nurseries

Disease symptoms

Pests in nurseries

Control of pests and diseases

Safety precautions for users

Nursery Management

A dozen things you should know about plants

Production system for nursery management

Identification system for recording nursery plant production and labelling of stock

Potting mix ingredients

Physical properties of potting mixtures

Chemical properties of potting media

Plant containers

Water management in nurseries and gardens

An introduction to plant nutrition

Fertilizer use in nurseries

Weed control in nurseries in Australia

Principals in Propagation

Scion selection and treatment

Seedling rootstock production

Propagation by grafting and budding

Air layering

Propagation by cuttings

Procedures for Successful Importation of Fruit and Nut Trees

Importation guidelines

Potting mixtures

Potting and watering

Defoliation and cutting back

Environmental control

Fertilizing

Plant protection

Rootstock and scion import

Propagation

Preparation of plant material in country of origin

Propagation Methods for Subtropical/Tropical Fruits

Avocado, citrus, custard apple, fig, jackfruit, logan, loquat, low chill stonefruit, lychee, macadamia, passion fruit, persimmon

Top-working, Inarching and Tree Planting

Top working

Inarching

Planting and establishment of fruit and nut tree

3.1.2 Workshop Summary Notes

A set of summary notes was prepared by the consultants on subject areas of introduction to plants:

- Greenhouse infrastructure and nursery design
- Seed extraction, treatment and propagation
- Raising of seedling rootstocks
- After-care of propagated plants
- Fertilizer use in nurseries
- Introduction of new varieties

- Methods of vegetative propagation
- Specific methods of propagation of selected crops
- Training and pruning of grafted plants
- Establishment and maintenance of mother plants
- Record keeping and labelling of nursery plants

Three staff members of Department of Agriculture also produced summary notes on three selected subject areas:

- Mr. Heenkenda - Setting up a nursery, use of pots and potting mixtures.
- Mr. Iddagoda - Pests in nurseries and their control.
- Mr. G Zoysa - Diseases in nurseries and their control.

Translation of workshop summary notes into Sinhala was undertaken by Mr. Pinto and Mr. Karadawela of Department of Agriculture, and copies were distributed to each participant of the three workshops on plant propagation and nursery management. This enabled the full comprehension of concepts being shown and taught at each workshop.

4. TRAINING ACTIVITIES UNDERTAKEN

Five training workshops of three and a half days period on nursery management and plant propagation were undertaken with approximately 30 participants attending each workshop. The first three workshops were held at Bibile Research Station and District Training Centre Provincial Council. The fourth was held at Maha Illupalama, and the fifth workshop at Walpitia.

First training workshop:	20 April - 23 April 1993
Second training workshop:	27 April - 30 April 1993
Third training workshop:	11 May - 14 May 1993
Fourth training workshop:	25 May - 27 May 1993
Fifth training workshop:	15 June - 17 June 1993

4.1 FIRST TRAINING WORKSHOP

It was decided that the first workshop for Department of Agriculture officers should contain in depth technical information on plant propagation and nursery management procedures. Detailed information was presented as well as demonstrations and practicals on all aspects of plant propagation and nursery management, allowing Department of Agriculture staff to become familiar with technical terms and up-to-date information. English was predominantly used for this workshop with interpretation in Sinhala so that complete understanding of course lectures, demonstrations and practicals could be achieved.

First workshop was attended by thirty-four agricultural officers from a large number of districts and provinces. Names of officers, address, districts and provinces are presented in Appendix I. The program used for the first training workshop on Nursery Management and plant propagation is presented in Appendix II.

Department of Agriculture officers who are stationed at district training centres were asked to include plant propagation and nursery management programs in their individual centre's training schedules. It was impressed upon other Departmental officers who were not stationed at district training centres to provide advice and training for local nursery personnel unable to attend workshops.

4.2 SECOND TRAINING WORKSHOP

The second workshop for Department of Agriculture budders and nursery caretakers was based mostly on practical training. Short lectures were prepared. Time of practicals and demonstrations were greatly increased to allow participants to be fully conversant and to increase their experience with plant propagation techniques and basic skills needed in nursery management.

Sinhala was predominantly used for this second workshop. Lectures in English were translated into Sinhala.

The second workshop was attended by thirty-three budders and nursery caretakers of the Department of Agriculture. Names of participants, addresses, districts and provinces are presented in Appendix III.

Program used for the second training workshop on nursery management and plant propagation was based on the first workshop program timetable. Adjustments were made to allow increased practicals and demonstrations where and participant skills were insufficient.

Nineteen persons prepared three written questions each on various fruit crops grown or propagated by them. These were as follows:

- 1) Death after topping - 9 questions
- 2) Drying after removal of shade - 1 question
- 3) Method of budding and grafting 27 questions
- 4) Diseases - 3 questions
- 5) Pests - 3 questions
- 6) Method of nursery preparation - 2 questions
- 7) Methods of rooting of cutting - 1 question
- 8) Casualties after grafting - 6 questions
- 9) Casualties after potting - 5 questions
- 10) Nursery disorders - 2 questions

All these were attended to and covered during the training course.

4.3 THIRD - FIFTH TRAINING WORKSHOPS

The three workshops for private nurserymen were also based primarily on practical training. Lectures were prepared and times of practicals and demonstrations were increased or shortened to give participants the opportunity to fully understand what the instructors were teaching and demonstrating to increase their experience in plant propagation techniques and skill in nursery management.

Sinhala was predominantly used for these workshops. It is reported that there are 278 registered private nurseries in Sri Lanka. Twenty-six nursery personnel attended the third workshop held at Bibile Research Farm in the Uva province. One training class of approximately twenty eight students presently studying agriculture production at Bibile research farm training centre who also attended the third workshop participated in discussions and asked questions.

The fourth workshop which was held at Maha Iluppallama for private nurserymen was attended by nineteen participants, while the fifth workshop held at Walpita and was attended by twenty five participants.

Names and addresses of the participants who attended these three workshops are presented in Appendix IV and V. Some DOA official were also accommodated at these workshops.

4.4 SEMINAR

A Seminar was presented on 14 May to Department of Agriculture officers on Development of Horticultural Industries in Queensland, Australia.

5. NOTES AND COMMENTS ON VISITS TO GOVERNMENT AND PROJECT FARMS

5.1 BIBILE RESEARCH FARM

General

This farm was earlier known as a Horticultural Research Farm and is presently under the Research Division, operated from Bandarawela. The Department of Agriculture Seeds and Planting Material Division finances the operation of the nursery. This nursery and Research Station and Training Centre is where three workshops on plant propagation and nursery management were held. The farm manager Mr. Wijesundara must be congratulated on a well managed nursery which is producing good quality plants and the maintenance of mother tree orchards.

Nursery

- a) Land is sufficient and there is land for expansion. Nursery beds have been established.
- b) Access to all shade houses and propagation house is good.
- c) Excellent use is being made of three shade houses and one propagation house. The propagation house roof shows signs of wear and repairs will have to be effected so maximum benefit may be obtained from this house.
- d) Benches to place plants could be constructed to eliminate the risk of spreading disease. If benches are not possible then the placement of 3/4" gravel to a depth of 4" to 6" should be sufficient to allow good pot drainage and not allow contact between soil or propagation house floor and pots. This will reduce the risk of disease infection of pots or potting medium and plants.

If plants are infected with disease and distributed by departmental nurseries, then the Government may be liable. Therefore, all precautions should be taken to eliminate any improper practices carried out in nurseries.
- e) Covered potting media bins should be constructed for storage of potting medium to reduce risk of contamination of potting mediums by diseases or pests.
- f) Construction of a pasteurization unit should be undertaken to allow for disease and pest free potting medium to be used.

- g) This particular nursery would benefit greatly with the construction of a mist propagation unit for the striking and raising of cuttings.
- h) Water is adequate for nursery.
- i) Very few tools and materials are available. Grafting knives, secateurs, pruning saws, grafting tape should be obtained.

Mother Tree Orchards

Mango block and orange blocks have been established and are well maintained. Trees in these blocks should be identified and labelled. Irrigation of these blocks is essential if trees are to be used as a budwood source. Water supply has to be improved. The renovation of an existing storage tank situated at the top of a hill would supply gravity irrigation to nursery and mother tree orchards. The purchase of an irrigation system, supply line and pump are necessary.

Nursery Propagation Methods Used

The propagation methods adopted for mango is mostly patch budding with the rate of success proving to be high. The rate of take is estimated to be around 75 to 80 percent. In the failed buds, the gap between the patch and stock cambium layers appeared to be too great. The manufacturing of a double bladed knife would overcome much of these problems and greater success rates could be achieved.

Citrus propagation is mainly by chip budding, and "T" budding is sometimes used. These methods appear to be quite successful.

Field equipment such as a tractor and slasher would simplify the management of orchards.

5.2 PLANT GENETIC RESOURCE CENTRE

Visit to glass houses of the Plant Genetic Resource Centre with Mr. H P Ariyaratne was undertaken by consultants to inspect plant material condition which was imported from Australia by the Sri Lankan study tour group.

Inspection of citrus species, mango, durian, jack-fruit, pomegranate, sapodilla, guava and lychee showed that they are all progressing well with many showing signs of bud swelling with a few sprouting new growth.

One mango variety was incorrectly labelled and consultants pointed out the mistake. Identifying and correct labelling of variety was made under supervision of the consultants.

Mr. H P Ariyaratne and staff should be congratulated for efforts in establishing species of internationally important varieties imported into Sri Lanka and which show excellent results.

5.3 MAHA ILLUPPALLAMA SEED FARM AND RESEARCH FARM

General

This farm, formerly known as School Farm is administered by S&PM Division of DOA. Consultants visited the farm on the 17th April. Discussions and visits to field and nursery with farm manager Mr. Rambukwella. Discussions on nursery practices and propagation works also a held with Mrs. Rambukwella, assistant farm manager, who is in charge of the nursery. This nursery is well managed and maintained. Plants inspected were healthy and growing vigorously. Mango and guava produced looked especially healthy. Both Mr. Rambukwella and Mrs. Rambukwella should be congratulated on work being carried out.

Propagation Methods Employed

The propagation method adopted for mango is mostly the wedge graft with the rate of success proving to be high. This is probably due to the long thin wedge graft union being used. There appears to be no incompatibility at this stage between root-stock and scion. Seeds are sown directly into pots and grafting completed in about four months after sowing. Nucellar seedlings are removed before grafting. A very small percentage of mango plants were showing slight signs of nutrient deficiencies. Darkening of leaf veins and intervinal chlorous is appearing. This may be an indication of zinc deficiency. The growth rate and health appearance of these mango plants is excellent.

With propagation of guava the method mostly used is patch budding. Success rate is reported to be high. Plants inspected were growing vigorously and in very healthy condition. Growth from the patch bud is about two feet to three feet. Plants will soon be hardened and off ready for planting in mother tree blocks.

Citrus propagation is mainly completed by "T" budding. This method appears to be quite successful. Plants inspected were growing well. Very few plants were showing signs of a nutrient deficiency and a small number were quite stunted. Stunting may be an indication of a virus. It was noted that these plants had been placed at the end of this citrus block of grafted plants and advice was given to destroy the plants. The percentage of plants affected appeared to be less than one per cent. The nutrient deficiency appear to be zinc and effected only a very few plants. Advice was given on how to correct this with the use of zinc sulphate. Leaf minor was also evident in some plants and control measures will be implemented.

It was noted that coir dust was used on top of each pot and this practice should be recommended for all nurseries. Use of coir dust reduces the loss of moisture

from the potting medium and is useful in reducing weed growth. A good layer of about 1" to 1 1/2" should be sufficient to enable weed control and moisture retention.

Nursery Management Practices

Labelling of all plants in the nursery is of vital importance and was pleasing to see this in use. Methods of labelling varied according to material available. Advice was given on various aspects of recording information about grafting times, stages of rootstock growth, scion material condition and environmental conditions. Also the development of an operational flow chart which lists work practices linked to time period. This will enable management strategies and coordination of seedling production, grafting, potting on, hardening off and finally sale of product so that costs can be attributed to each operational procedure.

Nursery Infrastructure and Requirements

- a) Land - adequate, but needs expansion. As plant numbers increase, room to expand is required.
- b) Access - is limited up to all shade houses for either vehicles or trolleys. This needs considering to facilitate the movement of plants and save on costs. Double or triple handling of grafted plants may damage grafts with each move made.
- c) Structures - one shade house (shade net house) is giving excellent results to the propagator. More shade houses should be constructed to accommodate all plant material. Netting has been purchased and a structure is under construction which will be made into a shade house. The improvisation must be commended in construction of temporary shade house used for raising of seedlings. But these temporary structures must become permanent structures and upgraded.
- d) Benches to place plants could be constructed to eliminate the risk of spreading diseases to areas and sites of planting.
- e) Covered potting media bins need to be constructed for storage of mediums as this will enable mixing of different mediums during rain periods and prevention of disease and pest contamination.
- f) Construction of a pasteurization unit should be undertaken to allow for disease free potting mediums to be used.
- g) This farm could benefit by the provision of a mist propagator unit.
- h) Irrigation facilities area available, but an additional water tank should be constructed as envisaged. The mother orchard programme is to be

correctly implemented. There is a need for a 2" or 3" pump together with the piping and spray irrigation equipment.

- i) Very few pieces of equipment are available; grafting knives, secateurs are necessary. Also, a tractor and a slasher and other field equipment should be provided.

Mother Plant Orchards

Inspection of very old mango selections planted along roadside and other mango blocks inspected showed the need for pruning and manuring of trees. Correct labelling and identification of trees is needed, as a few trees appeared to have incorrect labels. Plans of these blocks need to be upgraded and placed in farm files with corrections.

One newly established citrus mother tree block where plants are beginning to take hold and grow was inspected along with one mango block.

Irrigation facilities and farm equipment such as tractors, sprayers, slashers should be provided to maintain trees in good health.

Fertilizing of mother tree blocks is essential to allow healthy plant material to be used for propagation.

The Farm Manager, Assistant Farm Manager and nursery helpers should be complimented for the excellent job in production of good plant material.

5.4 BANDARAWELA RESEARCH FARM

General

Mr. Nissen visited this farm with Mr. Heenkenda. Discussions on horticultural cross were held with DD/R, Bandarawela, Dr. L G Herath. Discussions were also held with Plant Pathologist Dr. D B Kelaniyangoda, Entomologist Mr. Dhanapala and Horticulturist Mr. Dharmaratna who established some of the original tree plants on this research farm. This farm was originally a tea farm but now a potato farm and to a minor degree a horticulture farm.

Nursery

There are no nursery facilities; a small section of a garage is being utilized as a nursery and plant propagation area. There is a very small partly constructed nursery shed but funds are not available for its completion.

There is a vital need for the establishment of plant propagation and nursery facilities to enable the multiplication and distribution of plant material for horticultural tree

fruit industries. Funds should be made available for nursery construction and equipment purchased.

Research Fruit Tree Blocks

Inspection of research blocks was undertaken with Mr. Heenkenda. New research blocks of citrus, mango, and passionfruit are establishing well. Old blocks of pears, guava, citrus and apples were also inspected. Advice was given on training systems and disease control measures.

Land for expansion is limited. Most fruit tree blocks are established on terraced blocks of land. Trees are watered by hand-held hoses which are supplied by a gravity feed storage tank located on the highest point on the research farm. The purchasing of a gravity feed irrigation system which could be connected to storage tank would significantly reduce the hand watering, and therefore more time could be allocated to collecting vital research trial data on individual crops.

It is suggested that the old apple block which is diseased be removed and a new block of apples of imported cultivars be established. A regular pest and disease spray program should be carried out and data collected on performance in fruit yield, quality, tree growth and flowering patterns. The old guava block of trees should be rejuvenated by heavy pruning and a regular pest and disease program should be maintained.

If spray equipment is not available then the purchasing equipment is essential to maintain research trials as well as mother tree plants.

There is a good collection of mother plant material, tree training trials, research trials which all need maintaining at the highest possible standard.

The addition of at least one more horticulturist and several technical assistants would greatly enhance the excellent work being carried out under trying circumstances.

Mr. Heenkenda is to be congratulated for his work and persistence in carrying on planting and maintaining research trials under difficult circumstances.

5.5 RAHANGALA RESEARCH FARM

General

Mr. Nissen visited this farm on the 25 April 1993 with Mr. Heenkenda. Inspection of nursery and plant collections were undertaken.

Nursery

- a) Land - one propagation house on limited area of land.

- b) Access - access too house door is limited but access for vehicle to an area of close proximity is available.
- c) Structures - the propagation house is producing good quality plants. the construction of a shade house would provide facilities for rapid propagation and distribution of plant material.
- d) Water is available for nursery.
- e) Benches are provided in propagation house.
- f) Construction of a pasteurization unit would benefit in the production of disease from potting medium.
- g) Construction of a mist propagation unit would be very beneficial in the rapid multiplication of plant material for distribution.
- h) Very few tools and materials are available. A tractor or walk-behind slasher would also be beneficial in simplifying management problems.

Plant Cultivar Collections

A good collection of apples, peaches and pears have been made and established. Inspection of recent introductions of apples, pears and peaches was undertaken. Plants have been top worked and the scion material is moving and growing. So establishment of these recent introductions look promising.

Recent Apple

cultivars are: Anna and Dorsett golden

Recent Pear

cultivars are: Hood, Floridahome, Shinsui, Tsuli, Kosui and Yali

Recent Peach

cultivars are: Floridastar 8-1, Newbell, Floridadawn 9-1, and Florida Prince

Recent Nectarine

cultivars are: Sunwright 81-17, Sunblaze 9-15, 9-12 and Sunpower

Recent Plum

cultivars are: Gulfruby and Pollinator 8-1

Florida prince peach plant when inspected had set fruit and nearing maturity. With correct plant training and fruit thinning low chill peaches can be successfully grown on the research farm. Advice was given on correct pruning and thinning techniques to enable production of fruit each season.

5.6

GANNORUWA RESEARCH FARM

General

This farm is under Research Division of Department of Agriculture. The consultants visited this farm on the 1st of May 1993 with Mr. D Diynaseous. There are many tropical and sub-tropical fruit tree species at this centre.

Nursery

- a) Land is adequate and present land for plant cultivar pollution is used to maximum.
- b) Access to all shade houses and propagation houses is possible with a vehicle except for one propagation house which is in need of repair. A road should be constructed.
- c) Two shade houses are giving good results and one propagation house is fully used. One other propagation house is not used and should be utilized. Money should be made available for replacement of roofing on both propagation houses.

The construction of a fully enclosed mini glasshouse should be undertaken and would be useful in helping propagation of several plant species.

- d) Water is available for nursery and adequate.
- e) Benches to place plants could be constructed to eliminate the risk of spreading diseases to areas and sites where plant material may be distributed.
- f) Covered potting media bins should be provided for storage of potting medium.
- g) Construction of a pasteurisation unit need to be undertaken to allow disease free potting medium to be used.
- h) Construction of a mist propagation unit would be beneficial to this farm in producing plant material.
- i) Since very few tools and materials are available, sprayers are necessary and a walk behind slasher or mower would simplify management.
- j) Problems with seedling propagation of rambutan are being encountered and advice was given by the consultants.

Plant Cultivar Collections

Upon inspection cultivar collection seemed well maintained. There is a diverse collection of plant material and the need for duplication on another farm needs considering.

The purchasing of an irrigation system is essential for maintenance of budwood plant collections and should be undertaken as soon as possible.

Summary

Propagated plant produced from this nursery seem to be of good quality. This nursery is in a prime location close to Plant Quarantine and the Plant Genetic Research Centre. With this location this nursery should be made into one of the major nurseries where plant material is multiplied and released to government and private sectors.

5.7 ANGUNAKOLAPELESSA RESEARCH FARM

Mr. Nissen visited this Research farm on the 4th and 5th of April 1993 in the company of Mr. H P Ariyaratne. This farm is a regional agriculture research station. Discussions held with Deputy Director Dr. N Senanayake, and also with research officer Mr. J A Sirisena followed by a field visit.

Plant Cultivar Collections

Banana Variety Collection

Inspection of this block was undertaken with Mr. H P Ariyaratne and Mr. J A Sirisena. This block is well maintained and all varieties inspected were growing well.

Desert Type Varieties Planted are:

Ambul (sour)
Kolikuttu (silk)
Poowalu (similar to Australian Lady Finger)
Watupalu (similar to Australian Lady Finger)
Suwandel (Similar to silk banana with thinner skin)
Muwanethi Kesel (type without bell)
Seenikesel (Rubber kesel) Elastic Banana

Cooking type varieties planted are:

Ash plantain (also a type without the ash)
Alu Mundan (Ash colour, fruit larger)
Di Mundan (without ash)

Advice was given on methods in collecting research data. Data can be collected in stages on varieties without having to grow to bunch maturity.

Citrus

Citrus blocks have been grafted on to woodapple. It was reported that with better management trees last up to seven years and produce large crop.

Mango

Old trees on mango cultivar collection were inspected. Advice was given on old large collection block of Willard, Neelan, Karthakolomban and Vellaikolomban. Advice was to select the best five types on fruit quality and yield of each variety and top work. Other trees to these type in a replicated trial. Collect data on fruit quality and yield of better selections and publish data on this research work for the particular environmental conditions.

Dr. N Senanayake and Research Officer Mr. J A Sirisena should be congratulated for the excellent work being done under trying conditions.

5.8 DIARMASOMA VINE FARM

Grape Plantation Field Visit

The consultants visited this farm on the 8th of May 1993 with Mr. C John and Mrs. I Padmasiri.

Cultivars inspected were: Cardinal, Black Muscat, Italia, Ribera, Flame, Seedless, Sultana, Purple Cormition. Vines are growing well on a "Pagola Trellis" system with cultivars, Ribera, Black Muscat, Italia and Cardinal reported be fruiting well and out performing the other cultivars.

Different pruning times and systems with different bud spur numbers are being tried. Spray applications of Thio Urea Hydrogen Cyanamide and GA dipping of fruit bunches at varying rates are also being tried. Advice was given on pruning system and timing.

5.9 ARALAGANWILA RESEARCH STATION

The consultants visited this farm on the 8th May 1993 with Mr. C John and Mrs. Padmasiri. Discussions and field visits were undertaken with Mr. S Peiris, research officer.

Grapes

Grapes inspected in field planted block were growing well. Drainage was a problem in the past with the death of some vines. But the insulation of drainage pipe has eliminated the problem and vine deaths have ceased.

Cultivars such as black muscat and riber were reported to be the best cultivars to date. Trellising system in use is a pagola but a fence system is under construction. Different pruning times and bud spur systems are also being tried. Discussions and advice was given on grape cultural practices.

Citrus

Citrus variety rootstock trial was reported to be progressing well and trees inspected were in excellent shape. Difference in rootstock effects are starting to appear and data collected.

Old block of citrus grafted on woodapple was inspected. Trees are starting to die out. Trees have been fruiting two times each year in April and September.

A few trees have produced 100 fruits but this is rare. Normal fruit production is about 20 to 40 fruits per plant.

Mr. S Peiris should be congratulated for the excellent work and condition of the grape and citrus block at this research station.

5.10 GIRANDURUKOTTE RESEARCH FARM

The consultants with Mrs. Padmasiri visited this farm on the 8th May 1993. Discussions were held and visited field plantings. Inspection of Mango selections planted revealed tree work in excellent condition. Last season's fruit was reported to be spoilt by a pest or disease attack. Fruits were reported to have had large cracks in the skin which penetrated into the flesh. Also a severe infestation of leaf hopper attacked trees and control measures were undertaken. Trees inspected still show some signs of the damage but have been regenerated to a healthy growth. Advice was given on pruning and tree size control measures. Advice was also given on guava pruning and training to regenerate trees back to fruiting and manageable conditions.

5.11 ALUTHARAMA SEED PRODUCTION FARM

This farm is under the Seeds and Planting Material Division of Department of Agriculture. The consultants visited this farm on the 8th May 1993 with the farm manager Mr. Abeykoon. Discussions were held and visit to nursery were undertaken with the farm manager.

Nursery

- a) Land is adequate at the moment but as plant numbers increase room to expand is needed.
- b) Access is limited. Only four wheel drive vehicles can go up to the nursery. Road needs to be constructed to allow access for vehicles.
- c) One propagation house is in use and one covered area is used to the full extent. More shade houses should be constructed to accommodate all plant material.
- d) Benches to place plants could be constructed to eliminate the risk of spreading disease.
- e) Covered potting media bins be constructed for safe storage of medium.
- f) Construction of a pasteurization unit should be undertaken to allow disease from potting medium to be used.
- g) This farm could benefit by the provision of a mist propagation unit.
- h) Very few pieces of equipment are available. Sprayers are necessary.

Nursery Propagation Method Used

The propagation method adopted for mango is mostly wedge graft with the success rate reported to be high. This is probably due to the long thin wedge graft union being used. There appears to be no incompatibility at this stage between root stock and scion.

Citrus propagation of seedling rootstocks is being undertaken. Problems have been encountered in growth of some plants. A small percentage of plants were dying from over-watering and exposure to direct sun.

Advice was given by consultants on potting methods and watering rates. A new site for construction of a shade house was inspected and advice was also given by consultants on drainage, construction and types of benches or raised gravel beds.

The quality of mango plant being produced is good and Mr. Abeykoon and staff should be congratulated for production of such plant under trying conditions.

5.12 MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT

General

The consultants visited the project site on the 7th and 8th of May 1993 with Mrs. Padmasiri.

Discussions and visits to field plantings, packing shed, nursery with Mr. Wett, Mr. D Parsons, Mr. Henry, Mr. C John and Mrs. Padmasiri were undertaken. Discussions were also held with Mr. Bruce Spake and Mr. Y P de Silva of MARD project.

Nursery

- a) Land is sufficient for expansion.
- b) Access to shade houses is limited. This may need consideration to facilitate the movement of plants in wet periods by trolleys or vehicles within and outside the shade house.
- c) One newly completed shade house is about to be used for production of fruit trees. Side netting on house may be modified to move up and down if ventilation or high temperature problems emerge.

Relative humidity, maximum and minimum temperature data should be collected and recorded in various locations in the shade house. This information may help identify stress factors which can effect plant growth and also help to determine locations for different propagation practices.

- d) Plant growing areas inside shade house and outside should allow water drainage away from the site.
- e) The poly bags presently in use are of excellent depth and size but holes need to be placed in the bottom of the bags to allow for drainage. A small quantity of gravel about 1/4" placed in the bottom of each bag will give excellent drainage in periods of heavy or prolonged rains.
- f) A pasteurization unit should be constructed for disease free potting medium.
- g) Covered rotting media bins should be constructed for storage of mediums. This will enable mixing of different mediums during rain periods and freedom from pest and disease contamination.
- h) Overhead mini sprinklers could be installed in shade house. But plant density will have to be carefully monitored. If plants are stacked too close over 75 per cent of water applied can be shed by the leaf surface.

Field Visits

Inspection of Nursery Mother Plants was undertaken, demonstrations of pruning methods systems for mango and carambola were given by Mr. Nissen. Discussions were held on plant spacing and mounding of tree rows. Trees inspected showed signs of revealing wind damage. Advice was given on construction of artificial or natural tree wind breakers.

The drip irrigation system should be replaced by low delivery mini sprinklers to increase humidity in tree canopy. These sprinklers could be fitted to the present drip irrigation lines.

Packing Shed

A short visit to the packing house was undertaken. Baby corn was being packed for shipment to overseas markets. These excellent facilities are capable of handling a wide variety of fruit types.

6. TENTATIVE RECOMMENDATIONS

6.1 GERMLASM

1. Catalogue present varieties, characterize and check with international characters for name, identification characteristics, etc. (PGRC)

Sources:

- a) Proceedings of international symposiums,
 - b) Catalogues of mango from the Australian Mango Association, and
 - c) IBPGR.
2. Collect any varieties not introduced yet. (PGRC)
 3. Discuss establishing genetic material centres, possibly at MI, Peradeniya, and Horana as suggested by DD/R and mentioned in Chapman and Pinto Report. (Deputy Director Research DD/R, DD/S&PM and DD/SC&PP.)
 4. Maintain all stations which have germplasm. (RD and S&PM)
 5. Continue collection of local germplasm. (PGRC).

6.2 BUDWOOD GARDENS

1. Maintain all present budwood gardens, and permanent records. (S&PM)
2. Characterize all mother plants in DOA and private nurseries and register these for issuing to nurserymen. Provide best mother plants available for use. (SC&PP, S&PM)
3. Prepare manuals on maintenance (fertilising, irrigation) and pruning for budwood production for each plant species in budwood gardens.

6.3 TRAINING

1. Continue training of officers, budders, nurserymen and private nurserymen. Initially take the persons not trained during this consultancy. Re-training should be done later at least yearly.
2. Carry out training for new private nurserymen.
3. Consider variety, diseases and pest damage rather than other aspects, such as height at which plants have been grafted. (Plant inspectors)

4. Give publicity to training programme. Use video produced and other news stories on plant propagation.
5. Prepare a team of trainers for undertaking training programmes on nurseries as well as cultivation techniques of fruit trees. (TTD, with assistance of RD, S&PM and SC&PP)
6. Participate in international training programmes on horticulture. (Trainers)

6.4 SURVEY

Recommend a survey to be undertaken to complete a list of registered and non registered nurseries, plant species, numbers of plant propagated, sold and areas where plantings have occurred (home garden, commercial). Part of this information is already compiled by S&PM Division.

7. PROGRAM OF VISITS

- 06 April 1993 - Depart Nambour/Arrive Brisbane (R J Nissen)
Depart Nambour/Arrive Singapore (R J Nissen)
- 07 April 1993 - Depart Singapore/Arrive Sri Lanka, Colombo Airport.
Depart Colombo Airport/Arrive Kandy.
- 08 April 1993 - Briefing with Dr. Pattie, Chief of Party/DARP.
Briefing with Mr. Padmalal (S&PM)/DOA at DARP.
Meeting with DARP Staff.
Continued briefing and arrangements with Mr. Padmalal at DOA Head office.
- 09 April 1993 - Briefings and discussions with Dr. S P R Weerasinghe - Director of Agriculture and Dr. Preston Pattie, Chief of Party/DARP.
Arrangement of programme and discussion on training programme. Preparation of lecture notes.
- 10 April 1993 - Visit to Bibile Research Station, inspection of nursery cultivar collections and training facilities.
Briefing and discussions with:
Mr. P Wijesundara - Farm Manager
Mr. J Harishchandra - Manager, District Training Centre /Provincial Council.
- 11 April 1993 - Arrangements and discussions on training program and visits with:
Mr. B A S S Padmalal (S&PM) DOA.
- 12 April 1993 - Briefing and discussions with:
Mr. P L E Pannila, DD/S&PM.
Dr. S L Amarasiri, DD/R.
Inspection of plant material collected and imported from Australia with:
Mr. H P Ariyaratne - PGRC, Gannoruwa
RO, Germplasm Exploration and Collection.
Discussion with:
Dr. H Somapala, Deputy Director Research, CARI Gannoruwa.
Mrs. I Padmasiri, Coordinator for fruit crops.
Instructions on nursery and cultivar collections at CARI, Research farm.
- 13 April 1993 - Preparation of lectures, notes, slides, overhead projections, design and purchasing of course materials.
- 14 April 1993 - Preparation of lectures, notes, slides, overhead projections,

- design and purchasing of course materials.
- 15 April 1993 - Preparation of lectures, notes, slides, overhead projections, design and purchasing of course materials.
- 16 April 1993 - Preparation of lectures, notes, slides, overhead projections, design and purchasing of course materials.
- 17 April 1993 - Visit to Maha Iluppallama Government Farm.
Discussions and inspections of nursery and cultivar collections.
Mr. Rambukwella - Farm Manager
Mrs. Rambukwella - Assistant Farm Manager
- 18 April 1993 - Preparation of lecture notes, slides, overhead projections, design of lecture structures and purchasing of course materials.

DARP OFFICE

- 19 April 1993 - Preparation of lecture notes, slides, overhead projections, purchasing of equipment and organization of filming of lectures.
Travel to Girandurukotte; overnight at Girandurukotte Circuit Bungalow.
- 20 April 1993 - Travel to Bibile Research Farm.
1st day First Training programme.
Travel to Badulla.
- 21 April 1993 - Travel to Bibile Research Farm.
2nd day First Training programme.
Travel to Badulla.
- 22 April 1993 - Travel to Bibile Research Farm.
3rd day First Training programme.
Travel to Badulla.
- 23 April 1993 - Travel to Bibile Research Farm.
4th day First Training programme.
Travel to Bandarawela Research Farm with Mr. Heenkenda.
Discussions with Dr. L. C. Herath.
Discussions with Dr. Kelaniyangoda.
Discussions with Mr. Dhanapala.
- 24 April 1993 - Inspection of Bandarawela Research Farm with Dr. Heenkenda.
Discussions with Dr. LC Herath.
Discussions with Dr. Kelaniyangoda.
Discussions with Mr. Dhanapala.

- Travel to Rahangala Research Farm with Mr. Heenkenda.
Inspection of tree crops and imported plant material.
Travel to Kandy.
- 25 April 1993 - Kandy. Writing report of farm visits and inspections.
- 26 April 1993 - DARP. Meeting with Dr. Preston Pattie.
DOA/S&PM division meeting with Mr. Padmalal.
Travel to Bibile.
- 27 April 1993 - Day 1 : Second Training Programme
- Bibile Research Farm
- 28 April 1993 - Day 2 : Second Training Programme.
- Bibile Research Farm
- 29 April 1993 - Day 3 : Second Training Workshop.
- Bibile Research Farm
- 30 April 1993 - Day 4 : Second Training Workshop.
- Bibile Research Farm
Travel to Kandy.
- 1 May 1993 - Visit Peradeniya Botanical Gardens and recourse nursery.
Visit to Gannoruwa Research Farm and Nursery.
Report writing.
- 2 May 1993 - Visit to Kandy city area.
Report writing.
- 3 May 1993 - Visit to PGRC, tissue culture lab and seed lab.
DARP - discussion with Dr. Preston Pattie.
Travel to Angunakolapelessa Research Farm; Visit to Research Farm.
Discussions with Deputy Director Dr. N. Senanayake.
Discussions and field visits with Research Officer, Mr. SA Sirisena.
- 4 May 1993 - Visit Angunakolapelessa Research Farm.
Travel to Yala National Park.
Travel to Angunakolapelessa Research Farm.
Travel to Bandarawela.
- 5 May 1993 - Travel to Nuwara-eliya.
Visit to Strawberry Farm.
Visit to Horton Planes National Park.
Travel to Kandy.

- 6 May 1993 - DARP.
Meeting with Dr. Preston Pattie, Chief of Party.
Report writing.
- 7 May 1993 - Visit to Dambulla.
Visit to Sigiriya.
Visit to Polonnaruwa.
Travel to Mahaweli Agriculture and Rural Development Project.
Discussions with Mr. Martin West, Horticulturist.
- 8 May 1993 - Visits to field, nursery and packhouse (MARD).
Discussions with Mr. Bruce Spake, Chief of Party.
Discussions with Mr. Martin West.
Discussions with Mr. Y P de Silva.
Discussions with Mr. Davis Parson.
Travel to Dharmasana Vine Yard.
Travel to Aralaganvila Research Station.
Field visits and discussions with Mr. S Peiris (Research-Officer).
Field visits and discussion with Mr. John.
Travel to Girandurukotte Research Station.
Travel to Alutharama Research Station.
Nursery visits with Mr. Abeykoon.
Travel to Kandy.
- 9 May 1993 - Report writing Kandy.
Discussions with Mr. H P Ariyaratne (Research Officer)
Discussions with Mr. Diyanesius.
- 10 May 1993 - Meeting and discussions with Dr. Preston Pattie at DARP.
Debriefing meetings and discussions with Dr. SPR Weerasinghe
Director of Agriculture, Dr. S L Amarasiri/Deputy Director
(Research), Mr. P L E Pannila/Deputy Director (Seeds & Planting
Material), Mr. B A S S Padmalal, Dr. Pattie and Mr. Pinto.
Travel to Bibile.
- 11 May 1993 - Day 1 - Third Training Programme.
Bibile Research Farm
- 12 May 1993 - Day 2 - Third Training Programme.
Bibile Research Farm
Visit to Bibile estate
- 13 May 1993 - Day 3 - Third Training Programme.
Bibile Research Farm
Travel to Kandy

- 14 May 1993 Discussions and provided seminar to Dept. of Agriculture, Directors and Deputy Directors.
Report writing.
- 15 May 1993 - DARP office report writing.
Travel to Colombo; debriefing with Dr. Preston Pattie.
Discussions and meeting with Mr. Richard Hurelbrink, Chief of Party/Ag-Ent Project.
Debriefing.
- 16 May 1993 - Depart Colombo.
Arrive Bangkok - R S Nissen.
- 17 May 1993 - Depart Bangkok - R S Nissen.
- 18 May 1993 - Arrive Brisbane
Depart Brisbane
Arrive Nambour - R S Nissen.
(Home Base)

APPENDIX I

**DEPARTMENT OF AGRICULTURE OFFICERS ATTENDANCE AT FIRST
WORKSHOP HELD AT BIBILE TRAINING CENTRE
FROM 20 APRIL - 23 APRIL 1993**

NAME	ADDRESS	DISTRICT	PROVINCE
1. W Kusumalatha	Govt. Farm, Kundasale	Kandy	Central
2. K M W Wijebandara	Hort. Research Farm, Gannoruwa	Kandy	Central
3. K Vincent	C A R I, Gannoruwa	Kandy	Central
4. I R Amarapala	Dist. Training Centre, Ambepussa	Gampaha	Western
5. R H Chitra Rajapakse	Govt. Farm, Ambepussa	Gampaha	Western
6. S A Premathilaka	Dist. Training Centre, Walpita	Gampaha	Western
7. K N K Jayathilaka	Hort. Research Farm, Horana	Kalutara	Western
8. Upasena Weerakoon	Inservice Centre, Bombuwela	Kalutara	Western
9. P Weerasinha	Hort. Research Farm, Bandaragama	Kalutara	Western
10. A K Gamage	Dist. Training Centre, Homagama	Colombo	Western
11. Dharmadasa Sagara	Dist. Training Centre, Tellitawila	Matara	Southern
12. Nihal Weerakoon	Dist. Agric. Office, Matara	Matara	Southern
13. D D Weerakkody	Govt. Farm, Middeniya	Hambantota	Southern
14. P P Bandusiri	Hort. Research Farm		Southern
15. W R E Kodithuwakku	Dist. Training Centre	Galle	Southern
16. N J Liyanage	Res. Centre, Angunukolapelessa	Hambantota	Southern
17. J A Sirisena	Res. Centre, Angunukolapelessa	Hambantota	Southern
18. U W K Jayasighe	Govt. Farm, Malwatta	Ampara	Eastern
19. M Abeykoon	Govt. Farm, Aluththarama	Badulla	Uva
20. H M Wickramasinha	Hort. Res. Farm, Bibile	Moneragala	Uva
21. A M Perera	Bibile Group	Moneragala	Uva
22. P Wijesundara	Hort. Res. Farm, Bibile	Moneragala	Uva
23. N Premachandra	Citrus Res. Centre, Bibile	Moneragala	Uva
24. C Pathmakumari	Govt. Farm, Bibile	Moneragala	Uva
25. G M Rathanapala	Govt. Frm, Bibile	Moneragala	Uva
26. R M Gunaratne	Dist. Training Centre, Bibile	Moneragala	Uva
27. W B Rambukwella	Govt. Farm, Maha Iluppallama	Anuradhapura	North Central
28. P Hulegalle	Govt. Farm, Maha Iluppallama	Anuradhapura	North Central
29. W M Abeywickrama	Govt. Farm, Pelwehera	Matale	Central

**DEPARTMENT OF AGRICULTURE OFFICERS ATTENDANCE AT FIRST
WORKSHOP HELD AT BIBILE TRAINING CENTRE
FROM 20 APRIL - 23 APRIL 1993**

NAME	ADDRESS	DISTRICT	PROVINCE
30. M A Wimalaweera	Provincial DA Office, Kurunegala	Kurunegala	North Western
31. H M S Heenkenda	RARC, Bandarawela	Badulla	Uva
32. A B Hapuhinne	Seed Division, Peradeniya	Kandy	Central
33. B A S S Padmalal	Seed Division, Peradeniya	Kandy	Central
34. I S Padmasiri	MARD, Pimburattewa	Polonnaruwa	North Central

APPENDIX II

TRAINING WORKSHOPS PROGRAM ON NURSERY MANAGEMENT
AND PLANT PROPAGATION HELD AT BIBILE

	<u>Topic</u>	<u>Presenter</u>		
1st Day	8.30 - 8.45	Welcome Address		
	8.45 - 9.45	Introduction and scope of training	Mr. Nissen	
	9.15 - 10.15	Introduction to plants		
	10.15 - 10.30	Tea Break		
	10.30 - 12.00	Greenhouse Infrastructure and Nursery Design	Mr. Nissen	
	12.00 - 13.00	Setting up a nursery, use of pot and potting mixes		
	13.00 - 14.00	Lunch Interval		
	14.00 - 15.00	Seed extraction, treatment and propagation		
	15.00 - 16.00	Raising and after care of stock plants		
	16.00 - 17.00	Nutrition of Nursery Plants	Mr. Nissen	
	17.00 - 17.30	Discussion		
	18.30 - 19.00	Film show		
	2nd Day	8.00 - 9.30	Methods of vegetative propagation	
		9.30 - 10.30	Specific Methods of propagation of individually selected crops	Mr. Pinto and Mr. Nissen
10.30 - 10.45		Tea Break		
10.45 - 12.00		After care of grafted plants	Mr. Nissen	
12.00 - 13.00		Training and Pruning of grafted plants	Mr. Pinto	
13.00 - 14.00		Lunch interval		
14.00 - 15.30		Pests in Nurseries and their control	Mr. Iddagoda and Mr. Nissen	
15.30 - 17.00		Diseases in Nurseries and their control	Mr. G Zoysa and Mr. Nissen	
18.30 - 19.00		Film show		
3rd Day	8.00 - 9.30	Establishment and Maintenance of Mother plants	Mr. Pinto and Mr. Nissen	
	9.30 - 10.30	Record Keeping and labelling of nursery plants	Mr. Pinto and Mr. Nissen	
	10.30 - 10.45	Tea break		
	10.45 - 12.00	Introduction of New Plant varieties	Mr. Nissen	
	12.00 - 12.30	Discussion		
	12.30 - 13.30	Lunch Interval		
	13.30 - 15.30	Practical Training I, II, III)	Mr. Pinto	
	15.30 - 15.45	Tea Break)	Mr. Nissen	
	15.45 - 17.00	Practical Training I, II, III)	Mr. Heenkenda	
4th Day	8.00 - 10.00	Practical Training		
	10.00 - 10.15	Tea Break		
	10.15 - 11.30	Discussion		
	12.00 -	Lunch and close down programme		

**DEPARTMENT OF AGRICULTURE BUDDERS AND NURSERY CARETAKERS ATTENDANCE
SECOND WORKSHOP HELD AT BIBILE TRAINING CENTRE
FROM 27 APRIL - 30 APRIL 1993**

NAME	ADDRESS	DISTRICT	PROVINCE
1. W A Amarapala	Govt. Farm, Bataata	Hambantota	Southern
2. S H Gunapala	Govt. Farm, Middeniya	Hambantota	Southern
3. K G Siripala	Dist. Training Centre, Teliggawila	Matara	Southern
4. B A E Abeyssekera	Dist. Training Centre, Labuduwa	Galle	Southern
5. S A Sonny	Agric. Research Centre, Makandura	Kurunegala	North Western
6. M W Siripala	Govt. Farm, Pasyala	Gampaha	Western
7. D P Somatissa	Dist. Training Centre, Ambepussa	Gampaha	Western
8. E D Jinadasa	Govt. Farm, Ambepussa	Gampaha	Western
9. B P Gunatillaka	Dist. Training Centre, Walpita	Gampaha	Western
10. W M Ariyapala	Agric. Research Centre, Bandarawela	Badulla	Uva
11. I Velusamy	Agriculture School, Vavuniya	Vavuniya	North
12. A G Nandasena	Agriculture School, Kundasale	Kandy	Central
13. K G Gunasena	CARI, Gannoruwa	Kandy	Central
14. S P Gunadasa	Agric. Research Station, Gannoruwa	Kandy	Central
15. N S Rupasena	Hort. Research Farm, Ulpathagama	Kandy	Central
16. G D Nandasena	Government Farm, Malwatta	Ampara	Eastern
17. B G Sirisena	Govt. Farm Minuwangoda	Polonnaruwa	North Central
18. L A B Upali	Dist. Training Centre, Bibile	Moneragala	Uva
19. K M Chandrawathi	Govt. Farm, Bibile	Moneragala	Uva
20. W M Samaranyake	Dist. Training Centre, Bibile	Moneragala	Uva
21. W M Abeyratne	Hort. Research Station, Bibile	Moneragala	Uva
22. L P Leelaratne	Agric. Research Station, Maha Iluppallama	Anuradhapura	North Central
23. A P Jayasekera	Govt. Farm, Pelwehera	Matale	Central
24. K A D Mahipala	Govt. Farm, Bandaragama	Kalutara	Western
25. A D P Chandrasekera	IST, Bombuwela	Kalutara	Western
26. H M Piyadasa	Govt. Farm Maha Iluppallama	Anuradhapura	North Central
27. A Sirisena	Agric. Research Station, Angunukolapelessa	Hambantota	Southern
28. W A Dhanapala	Hort. Research Station, Walpita	Gampaha	Western
29. W Premachandara	Govt. Farm, Aluththarama	Badulla	Uva
30. P M Chandrawathie	Dist. Training Centre, Bibile	Moneragala	Uva

**ATTENDANCE AT THE THIRD WORKSHOP FOR
PRIVATE NURSERYMEN - BIBILE TRAINING CENTRE
11.5.93 - 14.5.93**

NAME	ADDRESS	PROVINCE
1. WGSK Warawatta	Keselwatte, Meegahakula	Uva
2. JJ Jayalath	Jayalath Nursery, Udawela, Barawardana Oya	Central
3. DM Samarapala	"Sisila", Taldena, Badulla	Uva
4. DM Jayasundera Banda	Kahataruppa, Badulla	Uva
5. PM Gunapala de Silva	No.7, Jayabima Nursery, Demodara	Eastern
6. GL Sisira Jayatissa	C56, Sisira Nursery, Dadayantalawa	Eastern
7. YMS Abeysingha	No.8, Gemunupura, Amapara	Eastern
8. GGD Samaranayake	"Amitha", Bolana, Ambalantota	Southern
9. WP Gunaratne	"Leelani", Imbulgoda, Badulla	Uva
10. L Jayasooriya	"Suriyawasa", Danture	Central
11. HL Kulatunga	Moragaswatte, Koslande	Uva
12. HMW Herath	Galbedde, Monaragala	Uva
13. WMS Weerasekera	Kebellawela, Bandarawela	Uva
14. KM Ratnawcera	Egodawatte, Galabedde	Uva
15. JD Ratnepala	S C S, Bibile	Uva
16. Ranjini Premaratne	Mallehewa, Bibile	Uva
17. KM Jayatilaka	Galbedda, Monaragala	Uva
18. KG Anulawathie	A R S, Bandarawela	Uva
19. WS Perera	Kuruwitawatte, Moneragala	Uva
20. R Rajakaruna	Wegama, Bibile	Uva
21. LB Hapuhinna	Rajagiri, Haliela	Uva
22. AM Bandusena Bandara	Nanapurana	Uva

3rd workshop attendees contd/..11.5.93 - 14.5.93

NAME	ADDRESS	PROVINCE
23. HMJ Kumari	No.3, Wegama, Bibile	Uva
24. KB Jayasinghe	Kolongalla, Monaragala	Uva
25. MB Ekanayake	Siriwijayapura, Monaragala	Uva
26. MRM Wijekoon	Gallabedda, Monaragala	Uva

and 28 Nos. youth trainees.

**ATTENDANCE AT THE FOURTH WORKSHOP
FOR PRIVATE NURSERYMEN
MAHA ILUPPALLAMA I.S.T.I 25.5.93 - 27.5.93**

NAME	ADDRESS
1. Mr. DMPB Wijeratne	Konaragama, Maneruwa, Negampaya
2. Mr. DMK Dissanayake	Disapaya, Kulcepitiya, Polgahawela
3. Mr. DG Gunaratne	"Tharanga" Anuradhapura
4. Mr. DTK Koranelis	1st Mile Post, Padaviya
5. Mr. HM Piyaratne	7/29, Devahuva
6. Mr. DE Samarasinghe	Ubaya Plant Nursery, Polonnaruwa
7. Ms. Indrani Dharmasiri	3rd Lane, Udavilla, Kurunegala
8. Mr. KJA Gunasinghe	Mahakonwea, Tabbowa, Puttalam
9. Mr. HB Weerasinghe	Sampath Plant Nursery, Ibbagamuwa
10. Mr. GB Sugathapala	No.500, Siyaya, Padavi Parakramapura
11. Mr. IB Ukkubanda	Dangaswea
12. Mr. PW Gunatunga	Rajanganaya, Yata 2, Saliya-Asokapura
13. Mr. NM Kirimudiyanse	Sanasuma, Pathiniwatta, Lokahettiya
14. Mr. YN Avusadahamy	Unagolla, Heelogama
15. Mr. HM Herath	Seeds Farm, Maha Iluppallama
16. Mr. HM Jayaratne	Plant Nursery, Boraluwa, Kumbukgate
17. Mr. CS Jayaweera	Unit of University, Maha Iluppallama
18. Mr. BM Wijeratne Banda	Kandewatte. Plant Nursery, Galabadagama, Uhumiya
19. Mr. SBMCK Wijesundara	Disna, Plant Nursery, Kudagalgamuwa

**ATTENDANCE AT THE FIFTH WORKSHOP FOR PRIVATE
NURSERYMEN WALPITA I.S.T.I. 15.6.93 - 17.6.93**

NAME	ADDRESS
1. Mr. DN Atukorala	41A, Situmina Plant Nursery, West Elamulla, Panadura
2. Mr. SA Nisantha Tilakasiri	Agnugurubichchiya, Walgammulla
3. Mr. Sriyantha Wijetunga	Wijaya Plant Nursery, Padukka
4. Mr. K Mahnidadasa	Meeegahakotuwa, Kalvana, Aranayake
5. Mr. ADH Devasinghe	Utuwana, Utuwankanda, Mawanella
6. Mr. WGS Perera	Research Assistant, ARM, Bombuwela
7. Mr. D Wilson	Research Assistant, ARM, Bombuwela
8. Mr. WA Somaratne	Danduwawa, Debehara, Nittambuwa
9. Mr. GGS Ratnasekera	286, Makola Road, Kiribathgoda
10. Mr. G Gamini Jayasinghe	Vijitha Plant Nursery, Ballantudawa, Bandarawela
11. Mr. HR Wijeratne	C/o. Ranjith Simbalapitiya, Wandala, Ruwanwella
12. Mr. AAK Perera	18, Polwatte, Pannipitiya
13. Ms. JWK Dayawathie	Govt. Farm, Walpita
14. Ms. Padmalatha	DTC, Walpita
15. Ms. Leena Ratnayake	Govt. Farm, Weerapana
16. Mr. WP Siriratne	573/3, Nadungamuwa
17. Mr. HW Karunaratne	Thusara Gaspe, Banduragoda
18. Mr. C Nanayakkara	Nirmana Nursery, Banduragoda
19. Mr. WA Siripala	210, Ihalagama, Gampaha
20. Mr. WP Wijeweera	Kudawewa, Polonnaruwa
21. Mr. GH Tilakaratne	Govt. Farm, Walpita
22. Ms. NMW Sakalasoosua	ADA, (S&PM), Colombo
23. Mr. KKG Jayakody	ADA's Office, Colombo
24. Mr. SC Wijesooriya	Govt. Farm, Walpita
25. Ms. IAPW Indurana	Govt. Farm, Walpita

REFERENCES AND TEXT ON PLANT PROPAGATION
AND NURSERY MANAGEMENT

- Anon. (1982). 'Make Your Own Potting Mix'. (Dept. of Agric. Hobart, Tasmania).
- Anon. Stonefruit - Budding Trees. (Queensland Department of Primary Industries Farm Note AGDEX 214/24 F75/Sept 86).
- Anon. Citrus Growing in Queensland. (Queensland Department Primary Industries AGDEX 220/11 July 1971).
- Anon. Propagating Fruit Trees. (New South Wales Department of Agriculture Series 1 Horticulture in N.S.W.)
- Anon. Propagation of Fruit Trees. (Queensland Department of Agriculture and Stock Division of Plant Industry Advisory Leaflet No. 264).
- Anon. Propagation of Deciduous Fruit Trees. (Department of Agriculture, South Australia Special Bulletin No. 8/74).
- Anon. Reworking Avocado Trees. (New South Wales Department of Agriculture, Division of Horticulture Series 6, Tropical Fruits Bulletin H.6.3.5.).
- Anon. Propagation of Fruit Trees. (Queensland Department of Primary Industries Advisory Leaflet).
- Anon. Planting and Establishment of Fruit Trees and Vines. (Queensland Department of Primary Industries Advisory Leaflet).
- Anon. Proceedings of Nursery Crops Workshop. (Redlands Horticultural Research Station, Queensland Department of Primary Industries, 1986).
- Barry, G. (1986). Physical Properties of Potting Media. (Proceedings of Nursery Crop Workshop R.H.R.S. April/May '86. p. 29-36).
- Bass, T. (1983). Potting Mixtures (South Australian Department of Agriculture, Loxton Research Centre).
- Black, N. (1982). Potting Mixes - A Common Sense Approach. (Australian Horticulture, July 1982 p 8-11).
- Baker, K.F. (1979). The U.C. System for Producing Healthy Container Grown Plants (Calf. Agricultural Experimental Station Extension Service, Australian Edition).
- Beardsell, D. and Nichols, D. (1985). Toxic Pinebark in Potting Mixtures (Australian Horticultural, October 1985 p 67-70).

- Bose, T.K., Mitea, S.K., Sadhu, M.K. Propagation of Tropical and Subtropical Horticultural Crops (Published 1986).
- Baker, J.A. Propagation of Plants. (Queensland Department of Primary Industries Advisory Leaflet).
- Browne, B., Murison, J., Baker, J. Choosing Coll-Type Container Systems for Seedlings. (Agricultural Gazette of N.S.W. June 1981 AGDEX 207/21)
- Baker, J.A. propagation of Fruit Trees. (Queensland Department of Primary Industries Advisory Leaflet).
- Bondi, H. et al. The Life of Plants. (Marshall Cavendish, London).
- Chapman, J.C. Citrus Rootstock Recommendations. (Queensland Department of Primary Industries Farm Note AGDEX 220/36 F148/Oct 87).
- Coe, R.G. Avocados Grafting Young Trees. (Queensland Department of Primary Industries Farm Note AGDEX 275/24 F50/May 82).
- Cassidy, N.G. Guide to Soils and Plant Nutrition.
- Fuller, H.J., Carothers. The Plant World (Holt, Rinehart and Winston New York).
- Goss, O.M. Practical Guidelines for Nursery Hygiene. (Published 1983)
- Garner, R.J., Chaudhri, S.H. The Propagation of Tropical Fruit Trees (Horticultural Review No. 4, Commonwealth Bureau of Horticulture and Plantation Crops Published 1976).
- Goodwin, P.B., Kantzow, D.D.E. Greenhouses for Horticulture (A.I.A.S. Symposium Series No. 4 May 1982).
- Gordon, I. Nursery Production System on Analysis. (Australian Horticulture 1982).
- George, A.P., Nissen, R.J. The Persimmon as a Subtropical Fruit Crop. (Queensland Agricultural Journal, May, June 1985 pp 133-140).
- Handreck, K.A. and Black, N.D. (1984) Growing Media for Ornamental Plants of Turf. (NSW University Press; Sydney).
- Hockings, D. (1986) Potting Media Selection. (Proceedings of Nursery Crop Worksh R.H.R.S. April May 1986 p 37-42).
- Hassan, E. (1977). Major Insect and Mite Pests of Australian Crops (Ento Press: Gatton, Queensland).

- Hely, P.C., Pasfield, G. and Gellatley, J.G. (1982). *Insect Pests of Fruit and Vegetables in N.S.W.* (Inkata Press, Melbourne).
- Hocking, F.D. (1980). *Friends and Foes of Australian Gardens* (A.H. and A.W. Reed Pty Ltd, Sydney).
- Handreck, K.A. (1985). *Poting Media for Plant Production. Mixes for Outdoor Plants* (Australian Horticulture, October 1985 p. 48-75),
- Hughes, I.K. *Plant Nurseries - Water Treatment to Control Pathogens - use of Ultra Violet Light.* (Queensland Department of Primary Industries Farm Note F 61/July 85).
- Hesse, B. *Automatic Watering Systems for Plant Nurseries and Horticultural Crops* (S.E.Q.E.B. Advisory Leaflet).
- Hesse, B. *Glasshouse Environment Control.* (S.E.Q.E.B. Advisory Leaflet).
- Hesse, B. *Heating and Misting System for Mist Propagation of Plants.* (S.E.Q.E.B. Advisory Leaflet).
- Hartman, H.T., Kester, D.E. *Plant Propagation Principles and Practices.* (Third Edition 1975 Prentice-Hall, New Jersey).
- Jalisbury, F.B., Parke, P.V., *Vascular Plants Form and Function* (Macmillan and Co., London).
- McKay, M.E. (1981) *Growing Media for Potted Plants* (Q.D.P.I. Brisbane).
- McKay, M.E. *Greenhouse* (Queensland Department of Primary Industries Advisory Leaflet).
- Kitagawa, H., Glucina, P.G. *Persimmon Culture in New Zealand.* (New Zealand Department of Scientific and Industrial Research Information Series No. 159 1984).
- Lee, A.E., Heimsch, C. *Development and Structure of Plants* (Holt Rinehart and Winston New York).
- Mrurant, V.N. *Mango Grafting* (Queensland Department Primary Industries Farm Note AGDEX 234/24 F160/Oct 84).
- Menzel, C.M., Watson, B.J., Simpson, D.R. *Longan - Its Place in Queensland's Horticulture.* (In press).
- Murison, A. *Propagating Avocados.* (New South Wales Department of Agriculture, Division of Horticulture Series 6 Bulletin H6.2.3. First Edition 1976).

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- McMaugh, J. (1985). What Garden Pest or Disease is That? (Landsdowne Press, Sydney).
- Menzel, C.M., Simpson, D.R. Methods of Propagating Lychee (In press).
- McMaugh, J. (1986) Attend to the Basics and Save Time and Money. (Australian Horticulture Jan '86, p 30-32).
- Owen-Turner, J.C., Shaw, R.G. Citrus Propagation in Containers. (Queensland Department of Primary Industries Information Series Q184023, 1984).
- Robbins, W.W., Weier, T.E., Stocking, C.R. Botany - An introduction to Plant Science (Wiley International, New York).
- Rose, P., Twenty Man, L. Control Systems for Propagation (Unknown).
- Read, J.C. Propagation of Deciduous Fruits Trees on Rootstocks. (Government of Victoria Ag Note Department of Agriculture June 1985 AGDEX 210/24.)
- Robinson, P.W. Simple Passionfruit Grafts (Queensland Fruit and Vegetable News, March 1971).
- Randhawa, G.S., Singh, R.K.N. The Loquat in India. (Indian Council of Agricultural Research Technical Bulletin (Agric.) No. 24.
- Read, J.C. Budding Deciduous Fruit Trees. (Government of Victoria Ag Note Department of Agriculture December 1984 Agdex 210/30.
- Rochecoste, J.F.C. Plant Nurseries - Chlorinating Water for Disease Control. (Queensland Department of Primary Industries Farm Note F29/April 85).
- Stephenson, R.A. Grafting Macadamias. (Queensland Department of Primary Industries Advisory Leaflet).
- Sanewski, G.M. Low-chill Stonefruit - Propagation. (Queensland Department of Primary Industries Farm Note Agdex 214/17 F36 Mar 87).
- Sweedman, R. Fig Growing. (Department of Agriculture New South Wales Division of Plant Industries Bulletin H3.1.19 First Edition 1981).
- Sanewski, G.M. Propagation Custard Apple Fact Sheet. (Queensland Department of Primary Industries NMH7-Mar, 85).
- Swaine, G. Ironside, D.A. and Yarrow, W.H.T. (1985). Insect Pests of Fruit and Vegetables in Colour (Q.D.P.I., Brisbane).
- Thomas, R. et al. Botany - A brief Introduction to Plant Biology.

- Thomson, L., Bagshaw, J. and Cummins, T. (1984). A Comparison of Composted and Fresh Hardwood Sawdust for Use as a Component of Nursery Potting Mixes (Q.A.C. Gatton).
- Vock, N.T., Greer, G.N. The Science Behind the Art Notes for A Series of Basic Training Seminars for Sunshine Coast Nurserymen and Their Staff. (Queensland Department of Primary Industries 1986).
- Williams, D.W. (1986). Pest Management in the Nursery and Ornamental Industries (Australian Horticultural Jan 86 p 40-45).
- Willmott, W.F and Warrell, L.A. (1984). Investigation of Peat Materials, Sunshine Coast District. (Geological Survey of Queensland Record Series).
- Worrall, R.C. (1985). Composting Wood Wastes for Potting Mixes. (Australian Horticulture, Oct'85 p 34-36).
- Whitcomb, C.E. Plant Propagation in Containers. (Published 1984).
- Wilkinson, I. Growth - Regulators a New Management Skill (Australian Horticulture March 1985).
- Young, P.J. Propagation of Grafted Passionfruit. (Queensland Department of Primary Industries Advisory Leaflet).