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**PROPOSAL FOR UPGRADING
THE GREENCASTLE PROPAGATION STATION**

MINISTRY OF AGRICULTURE

OF

ANTIGUA AND BARBUDA

St. John's

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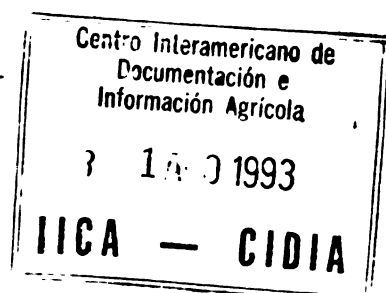


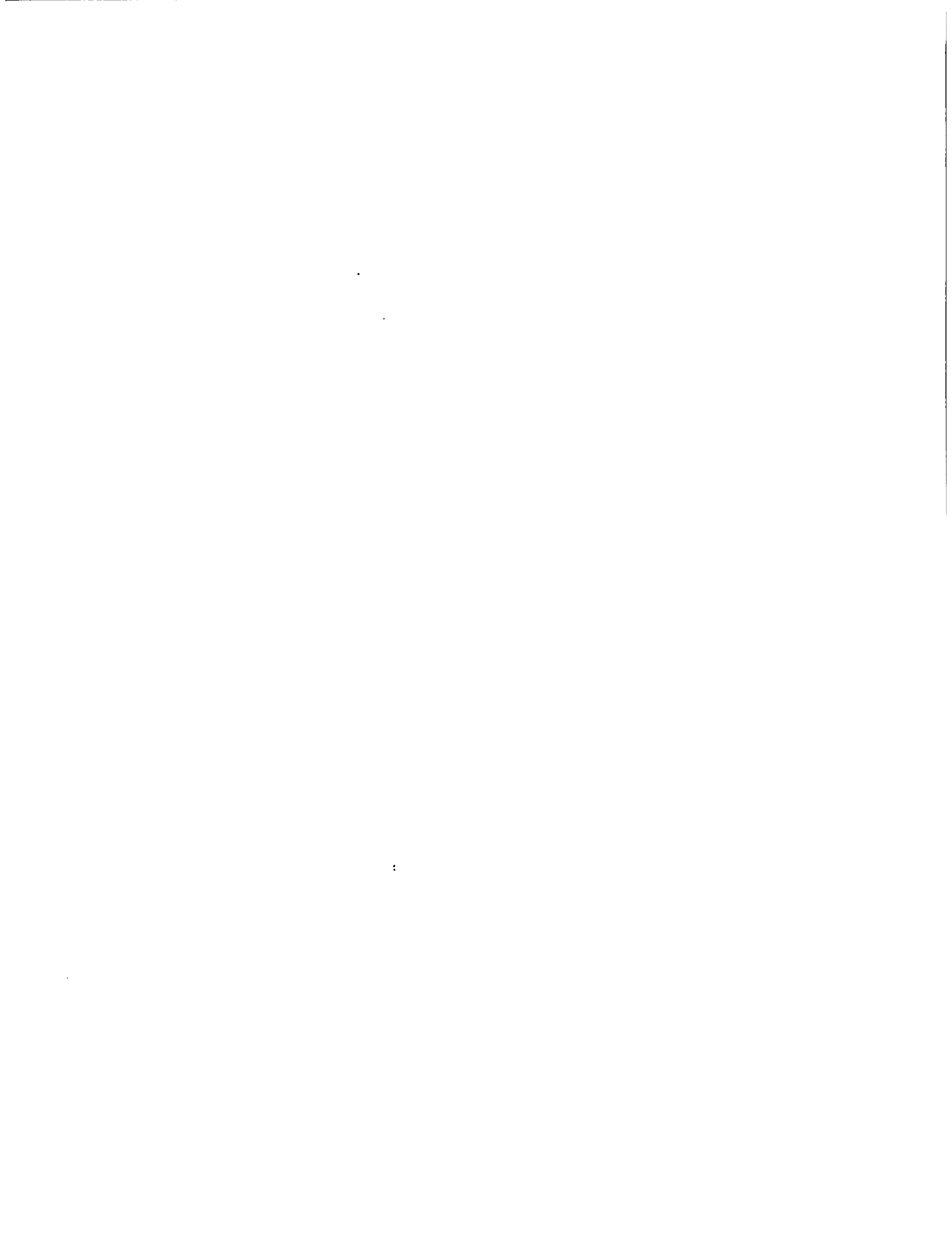
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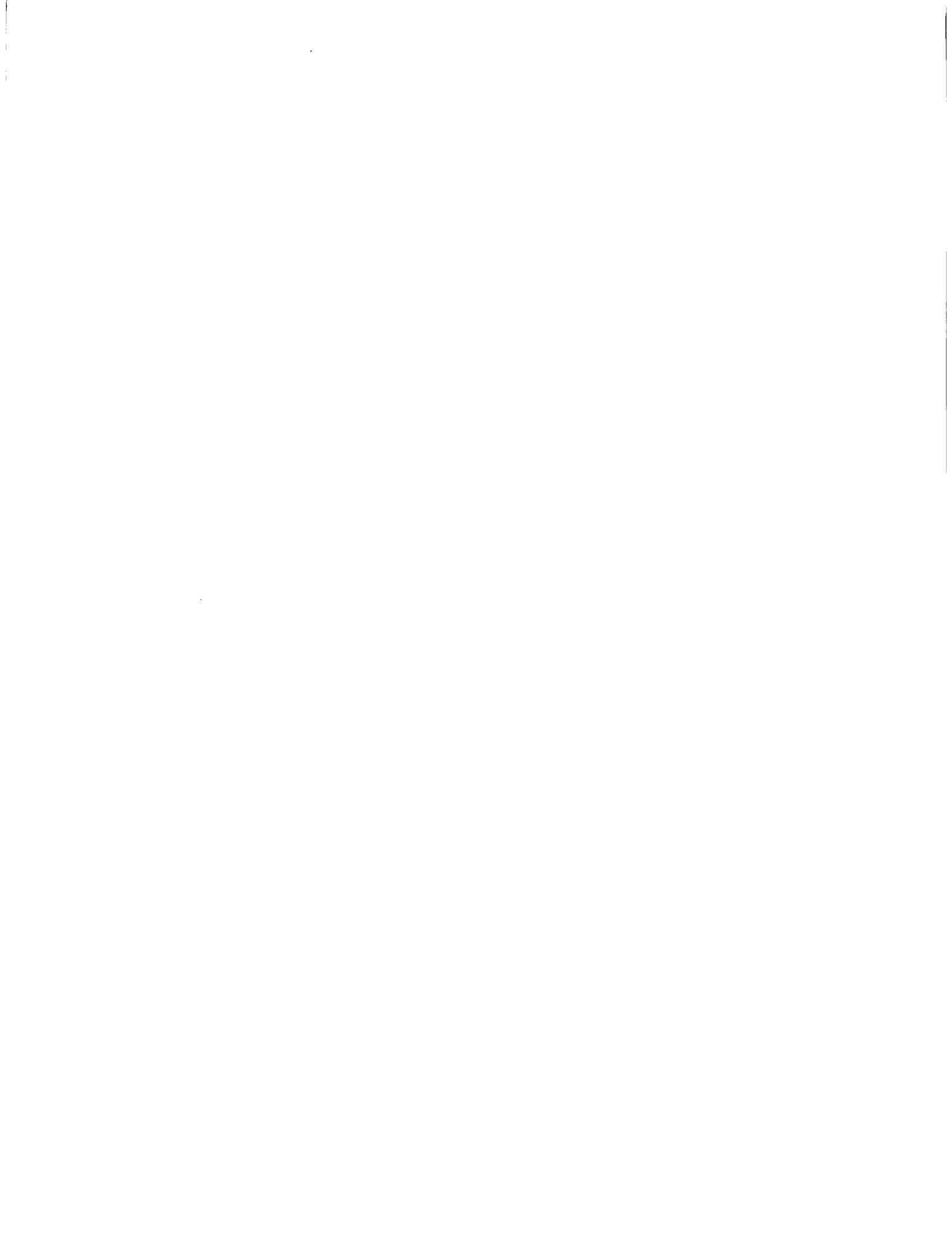
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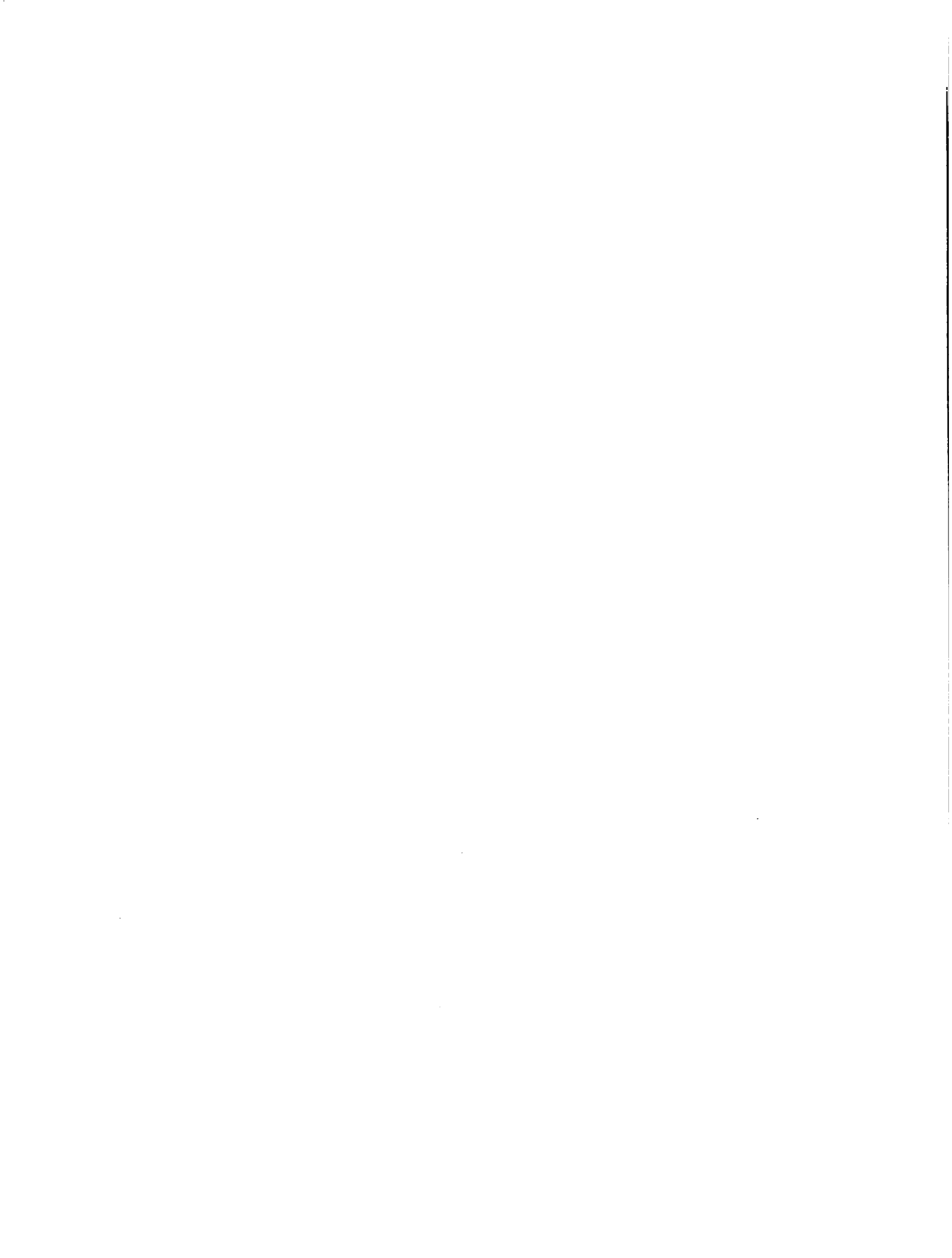
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EXECUTIVE SUMMARY

In response to a request from the Ministry of Agriculture of Antigua and Barbuda, IICA and CARDI provided technical assistance in upgrading the Greencastle Propagation Station.

The Director of Agriculture envisaged a dramatic increase in the demand for nursery plants mainly based on different projects such as the "forestry project", on pipeline. He anticipated a target of Fruit trees 29,000 plants, Forest trees 35,000 and ornamentals 40,000 plants. Additionally, vegetable seedlings would remain at the same level of 200,000 seedlings per year.

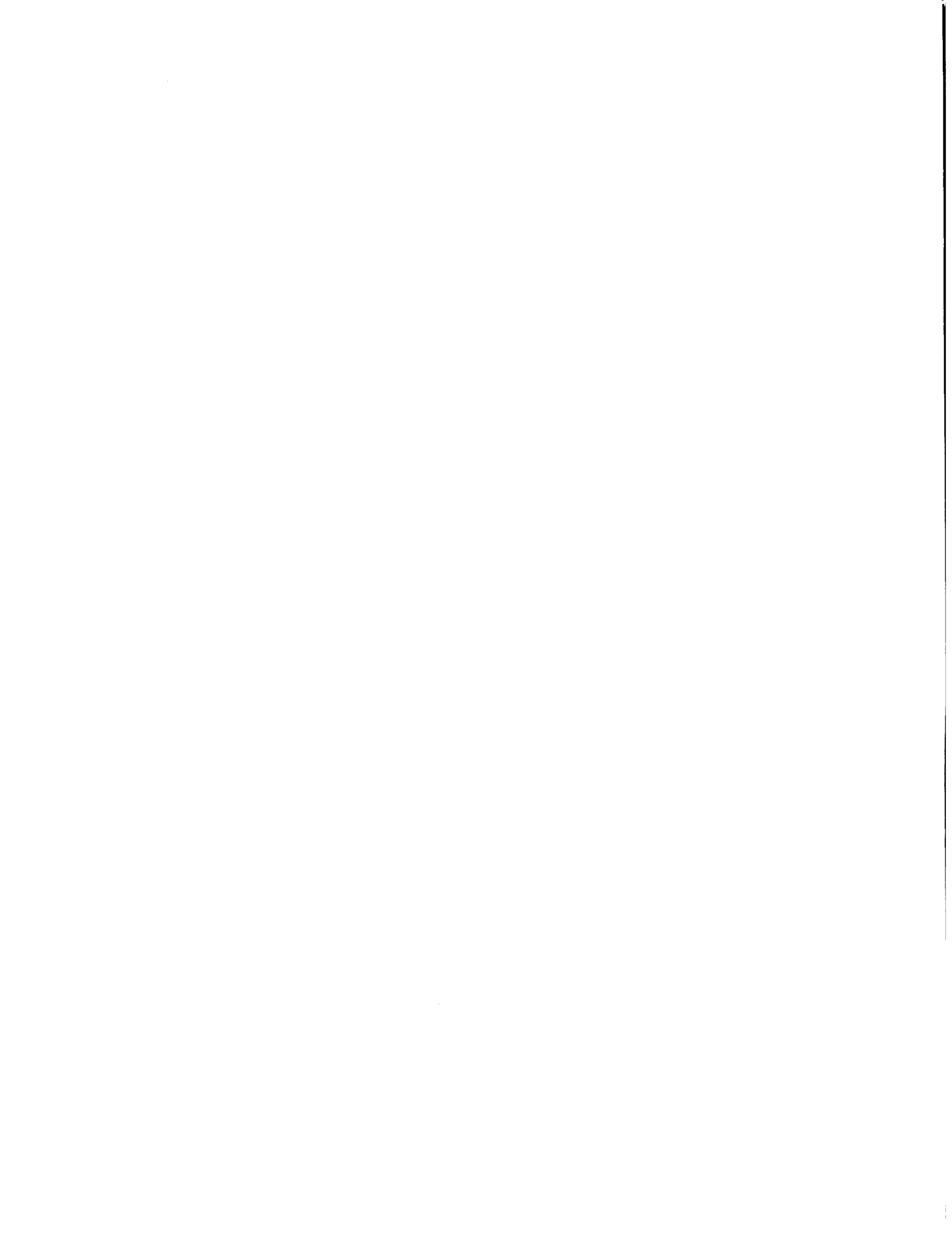
A technical mission took place from November 10-13, 1991 and a draft proposal was prepared. On January 27-28, 1992, an IICA/CARDI team visited Antigua, reviewed and completed that proposal in consultation with the Ministry of Agriculture.

In accordance with the terms of reference submitted by the Ministry of Agriculture of Antigua and Barbuda, the study covered the following areas:

- Infrastructure and equipment including water supply.
- Nursery Management.
- Technology (references, techniques, research and demonstration)
- Germplasm improvement.
- Training.
- Guidelines for budgeting, workplan and nursery standards for the release of plants.
- Implementation schedule and cost sharing.

Specific recommendations are made for each of the areas which include:

- the construction of a new building for mist propagation, storage of chemicals, soil, tools, fruits and vegetables, as well as a water tank.
- rehabilitation of existing infrastructure eg. office
- the construction of sheds for potted plants.
- rationalization for the use of space.
- improvement of on-station security and accessibility.
- the acquisition of necessary equipment and tools.
- staffing and functions
- management systems for nursery operation eg. data collection forms, cycle of activities.
- acquisition of reference documents.
- improvement of soil preparation, propagation techniques, irrigation system.
- on-farm testing of varieties, production systems, different inputs and material.

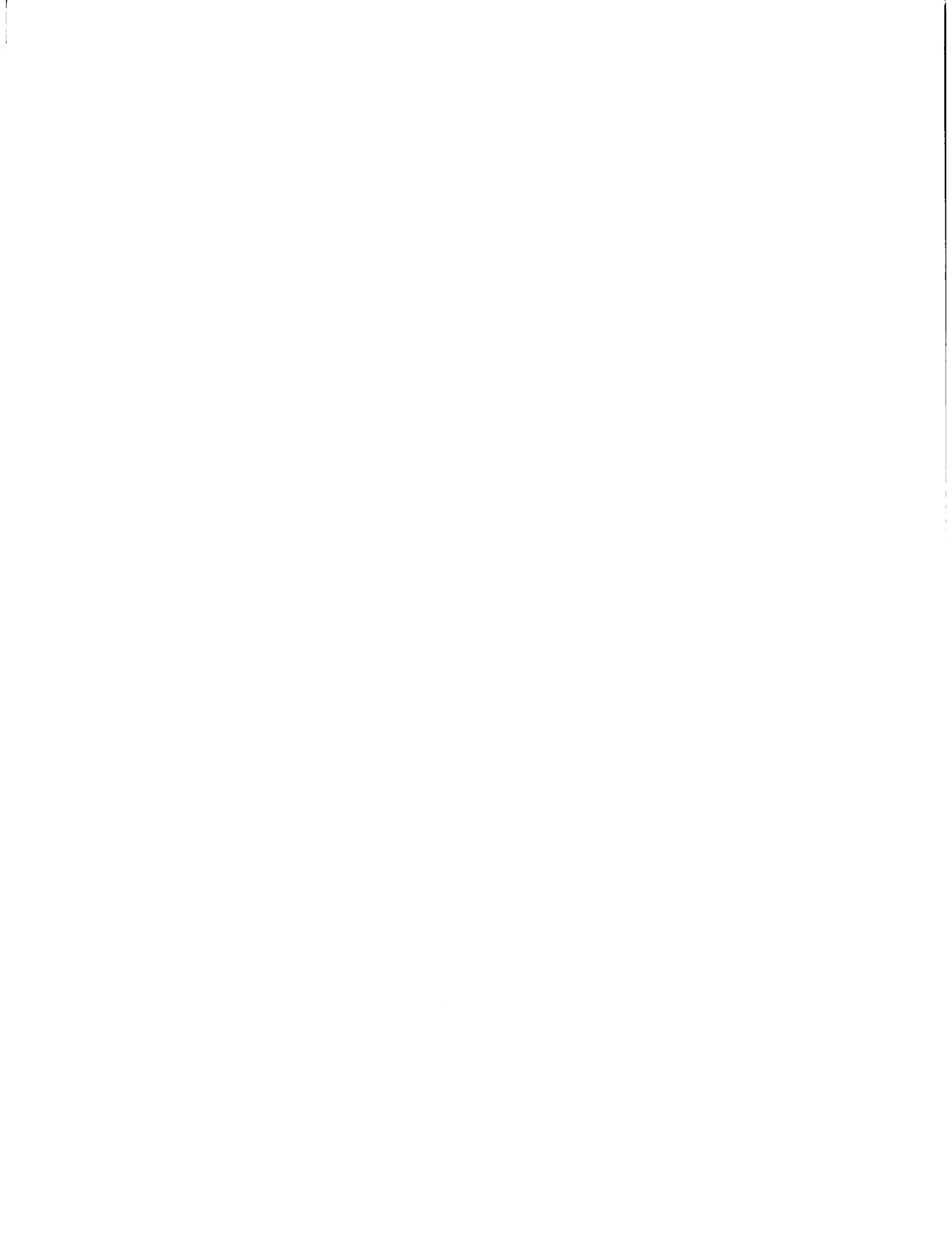


- demonstration of production system, production technology and new commodities.
- acquisition of superior species and varieties.
- rehabilitation of existing museums.
- training of staff in nursery management, propagation techniques, pest control, data collection and germplasm maintenance.
- guidelines for development of an annual work programme and monitoring system.
- other guidelines for nursery operation eg. development of nursery standards, introduction of planting material.
- scheduling of operations and sharing of costs.

Resources to implement the activities in this proposal would come from different sources, including:

- Vote within the Ministry of Agriculture budget for Capital investments:
 - . Capital investment for Greencastle Station
 - . Improvement of Washroom facilities
 - . Improvement of Agricultural Stations.
- Line of credit funds (Chinese Technical Mission)
- In kind cooperation of Regional and International Organizations eg. CARDI and IICA.

Recommendations are detailed in the main document which also includes proposed plans and designs.



I. ANALYSIS OF THE PRESENT SITUATION

Greencastle Station is located in the Central South-Western area of the Island of Antigua at Bendals. The whole superficies is about 25 acres, 13 of which are under cultivation in two locations (see map #1); on the left side of the road, the land is for food crops (plantain, banana, roots and tubers) and vegetables. The right side concentrates on fruit crops and ornamentals. The major purpose is to provide planting material for the farmers and the public in general.

1. Infrastructure and Equipment

1.1 Buildings

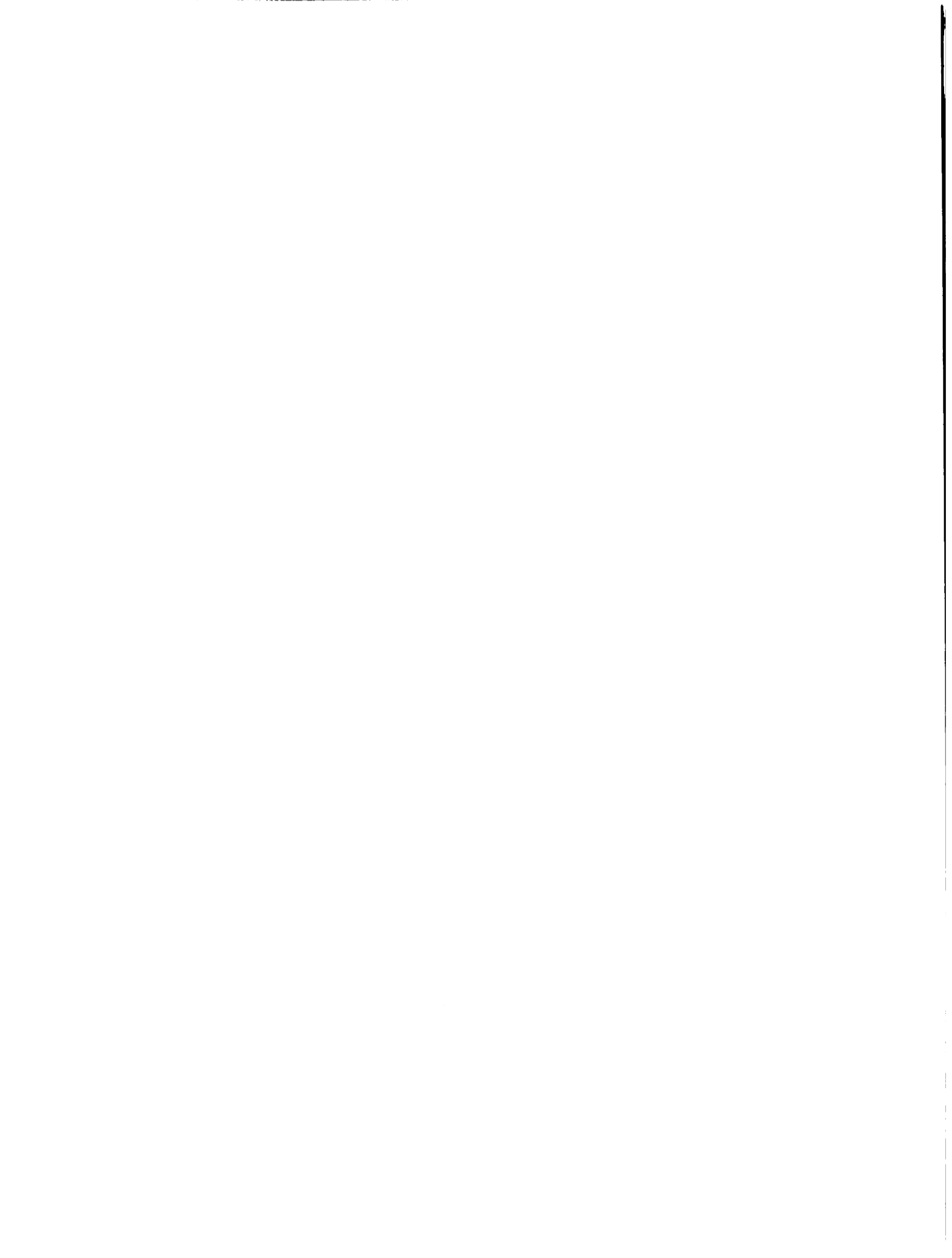
Presently, the station has one office building which is also used as a storage facility for chemicals and as a sales area for vegetables and fruits produced at the station. There is also an old garage and shed which are used as potting areas. There is no shed for plants or storage facilities for soil and equipment. On the food crops side, there is an installed 2" galvanized pipe shed structure (4x25m) which has never been used.

1.2 Water Supply

Irrigation is done by hand (hoses). Water comes from the domestic lines. There is no reserve tank. A public well is located on the station, but is out of service because it needs to be repaired. A stream runs along the station but its capacity is not sufficient for irrigation unless a dam is constructed. The issue of water is quite serious since it is not abundant in Antigua and the extension of the nursery cannot depend only on the public supply.

1.3 Equipment

Two motocultors (hand operated tractors) are used for minor land preparation. Heavy work is contracted to the Engineering Department of the Ministry of Agriculture. There is no equipment for soil disinfection, shredder, or even hand tools (secateurs, grafting knives, handsaws). The grafters have to use their own knives.



2. Nursery Management

2.1 Staff

The station staff consists of 18 permanent employees including the Manager, an Office Clerk, 2 Foremen and 2 Watchmen. One foreman is in charge of the nursery and supervises 5 workers. The average age group of the workers is a matter of concern since young people prefer to work for the easier and more lucrative tourism industry. The staff needs to be trained in different areas of nursery management and propagation techniques.

2.2 Utilization of Space

Available space at the propagation station is under-utilized and misused. Museum plots are invaded with bush and weeds. Some areas are not used at all and the area of plant propagation shows great disorder. There is no specific area for sale of plants. A new museum of ornamentals has been started almost in the middle of the plant propagation area (see map #2).

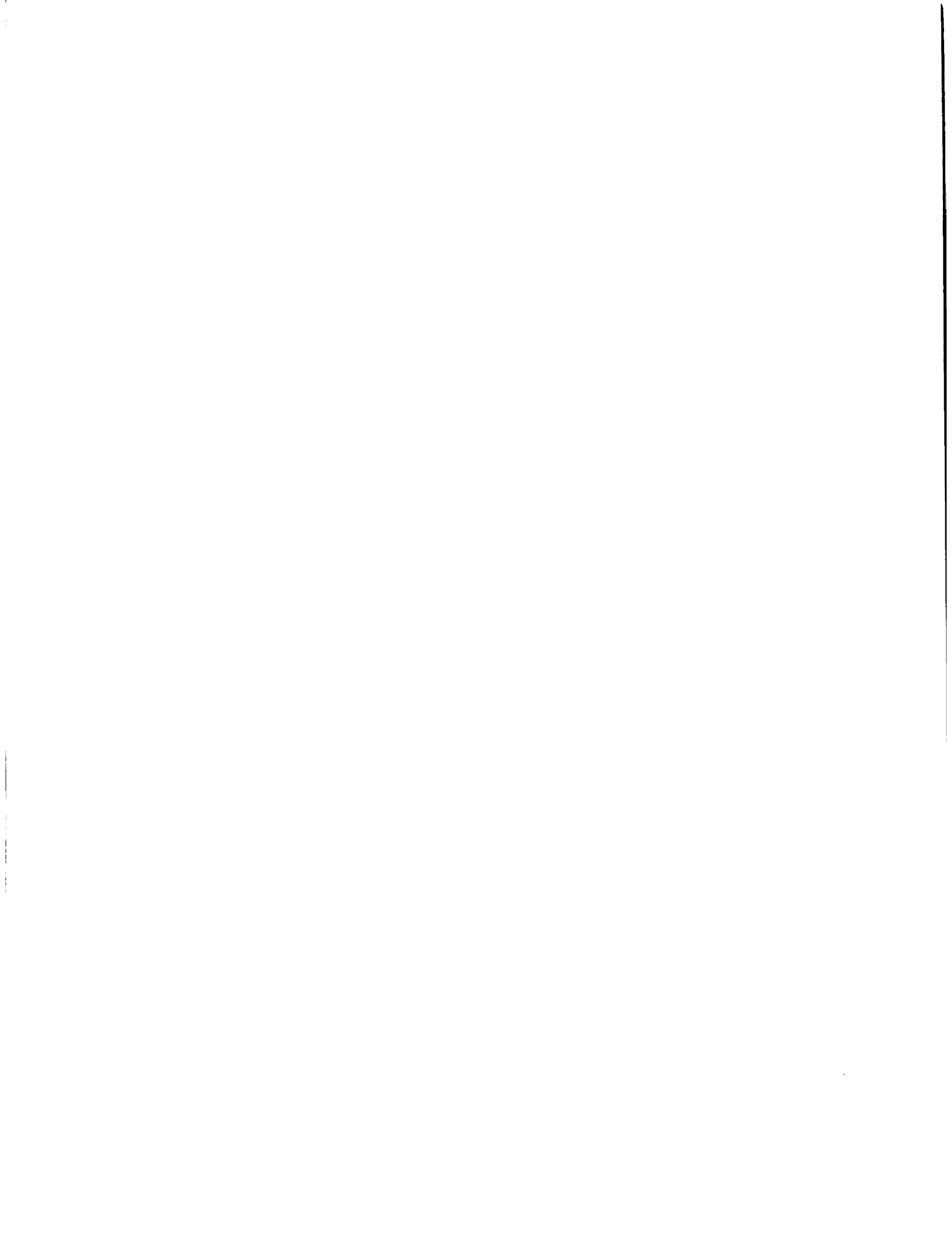
2.3 Planning

Targets for plant propagation are defined by the Station's Coordinator according to the results of the previous years and some feedback from the Extension Officers. It is in fact difficult to evaluate the quantities to be produced since there is no on-going project and customers only buy small amounts of plants. Some farmers sometimes try to book plants in advance but this is not relevant since only small quantities are involved.

Present production is about 4,000 fruit trees, 1,000 forest trees, 12,000 ornamentals and 200,000 seedlings of vegetable. Plants are produced to be sold all through the year and not in relation to the rainy season. The big argument is that some farmers have irrigation and are asking for plants at any time of the year. Lack of timing of the main operations results in bad management of physical resources and labour force. Some activities are not performed in a rational way, thus inducing waste of time and damage to the plants eg. unnecessary and excessive on-station movement of plants.

2.4 Monitoring

As far as we could see, the office clerk seems to have good control on the books used for record keeping at the station: movements of agrochemicals, bags, grafting tapes, plants etc. Control is done on a weekly basis. However, much time is wasted copying the headers of the pages throughout the books. However, other types of monitoring eg. propagation efficiency are not conducted.



2.5 Use of Standards

Although the most important standards are known, they are not used. This is quite noticeable by the inadequate size of the plants released to the public, as well as the inappropriate capacity of the bags used for citrus, mangoes and avocados.

3. **Technology**

3.1 Soil Preparation and Disinfection

Potting medium is prepared from top soil mixed with sand and manure. This is a manual operation. When disinfection takes place, only granulated insecticides and nematicides are used (Furadan). Primary ingredients and prepared soil are stored outside, thus allowing for proliferation of weeds.

3.2 Propagation Techniques

Budding and grafting are used for citrus, mangoes and avocados (inverse T-budding, wedge grafting and side grafting). We could notice that many rootstocks showed several marks of budding or grafting attempts, which may indicate that the techniques are not well dominated. Improved techniques such as chip-budding are scarcely used.

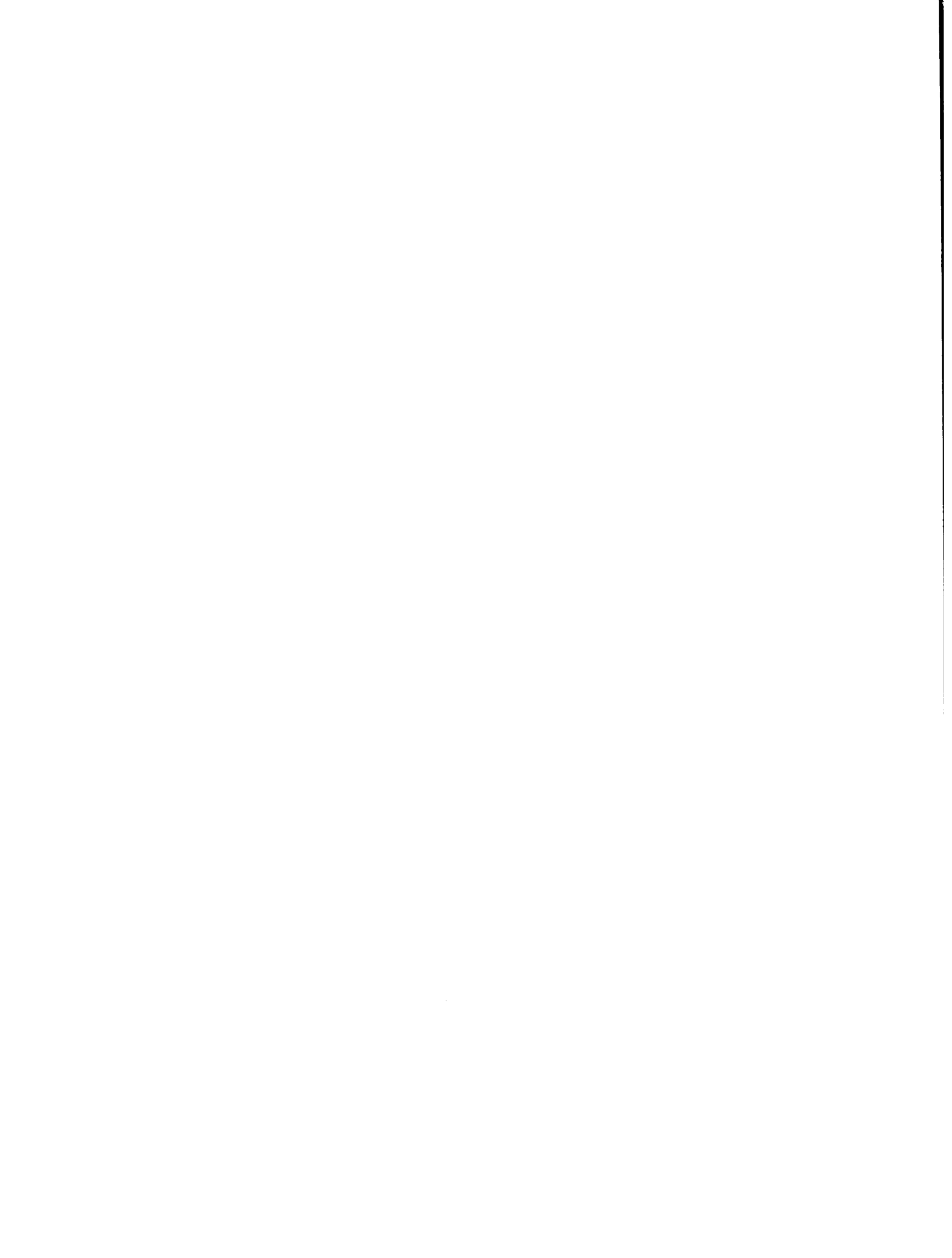
Other fruit species, as well as the forest plants are only propagated by seeds. Most of the ornamentals are propagated by cuttings, directly on the ground with a high percentage of failure.

There is also need for quick multiplication of pineapple since the lack of vegetative material is one of the major constraints to the expansion of this crop. The technique is known but has not been used because of lack of facilities.

Transplantation of bare rooted seedlings is performed without pruning the roots and leaves which often cause the plants to dehydrate and die. Care of potted plants is less than desirable; there seems to be a lack of initiative to solve simple problems like insufficient drainage in some bags or pest and disease infestation on fruit and vegetable nursery plants.

3.3 Germplasm

On the station there is a citrus museum and some scattered mango cultivars. Other fruit trees and ornamentals are located within an old museum North/East of the office. These mother plants lack maintenance. Floridian cultivars of mangoes and many species of fruit crops are not available on the station.



II. PROPOSAL TO UPGRADE THE GREENCASTLE PROPAGATION STATION

1. **Infrastructure, Space Management and Equipment**

1.1 Infrastructure

A new building was designed by Public Works to house 2 storage rooms for chemicals, a soil storage and working area, an office, a storage room for fruits, washrooms and showers for the workers (see plan #1):

We suggest that this building be modified as follows (see plan #2):

- moving the soil storage and working areas outside, East of the building.
- using this empty space to build 4 beds (5x1.20m) for rooting cuttings and 2 beds (5x1.00m) for germinating vegetable seeds during the rainy season. One of the four beds will be equipped as a humidity chamber for hard-to-root cuttings such as breadfruit, soursops, and pomerac. The other three are for conventional mist beds. Propagation of pineapple could be conducted alternatively to the vegetable seeds (see plan #2).
- modify the roof over the beds area, using transparent plexiglass alternated with galvanized sheets to provide light to the plants.
- moving the lockers along the wall of the storage room for chemicals.
- converting the fruit storage room into a training room.
- converting the office into a sales room for fruits and vegetables.
- constructing a water tank (10,000 gals) on the South/West side of the new building, which would receive water from the roof and from the connected water supply. Recommendations were made to have the well on the station rehabilitated. Once this is done, the well should be connected to the irrigation system. The proposed modifications appear in plan #2.
- storage facilities in place at the office building should be moved to the 2 storage rooms for chemicals in the new building.
- the 2 rooms in the existing office would be converted into additional office space.
- the galvanized pipe structure located in the food crops area should be transferred to the front of the new building to be used as part of the new shed house.
- hardening of tissue cultured plantlets that the

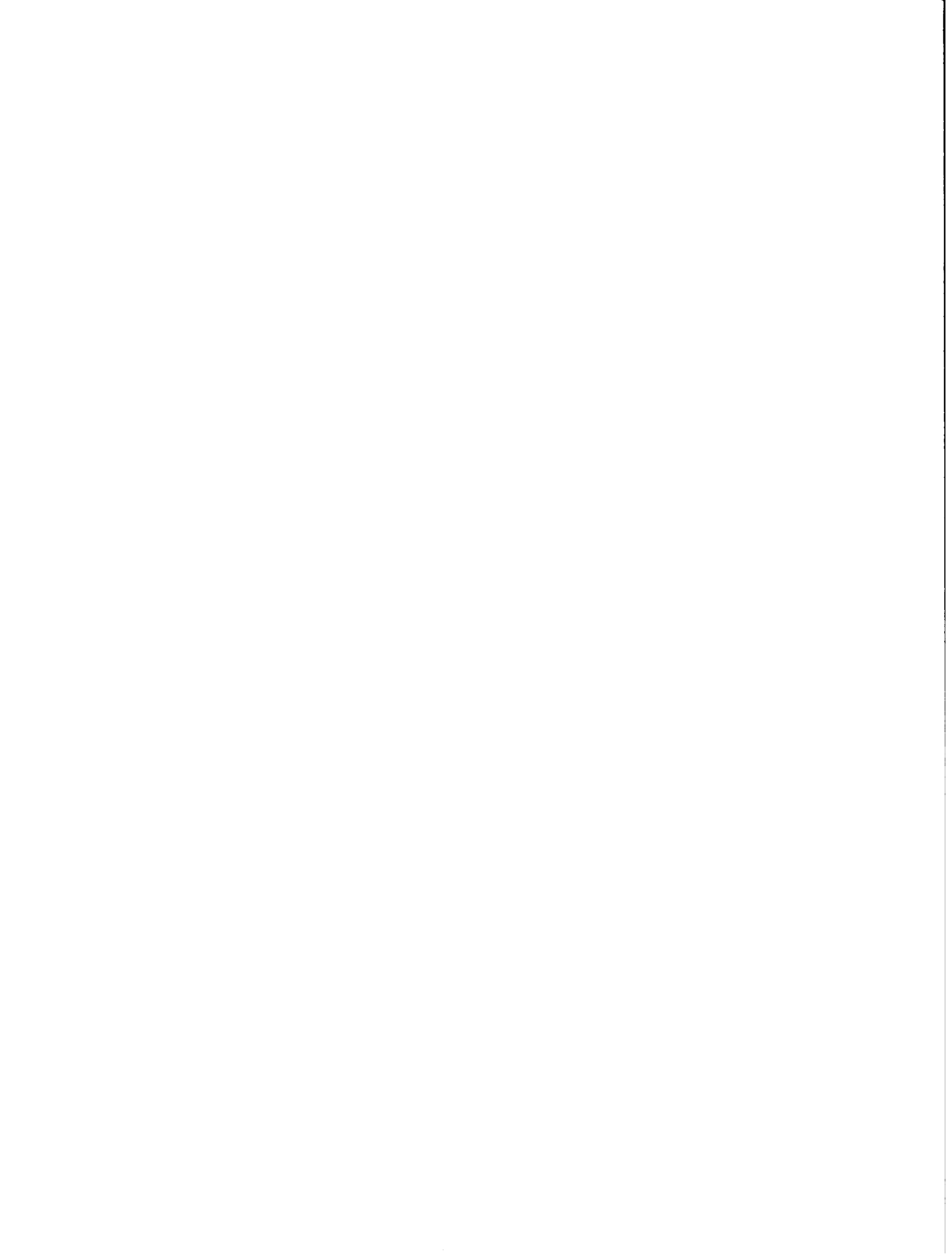
station may receive will be done in a modified and enclosed area under the shade house. This area will be equipped with separately controlled micro-sprinkler system.

- two seedbeds (10 x 1m) will be constructed in the new fruit tree area (see map #3). The seedbeds will have removable covers over a metal frame.

1.2 Space management

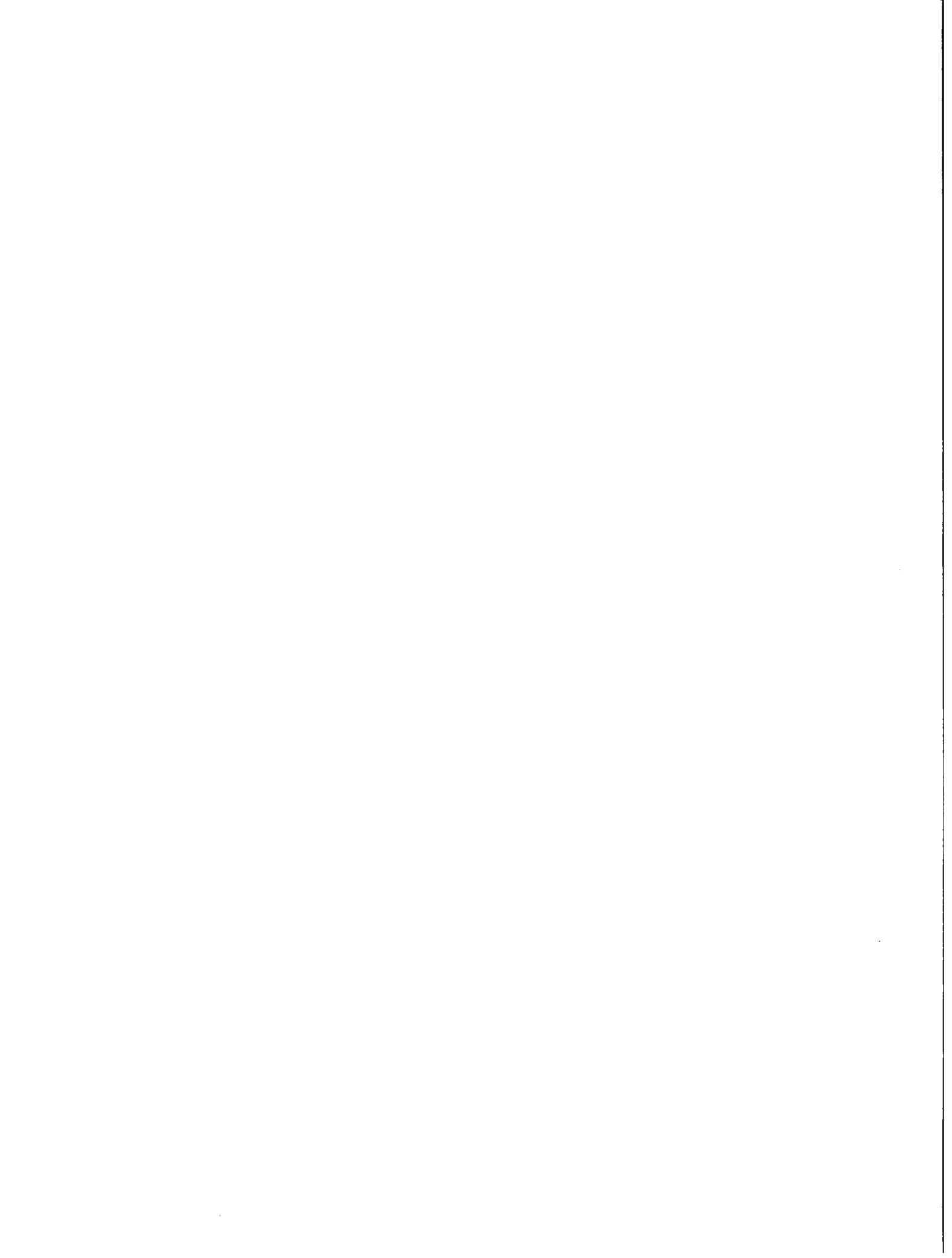
The construction of the new building and its shed house, will result in less space for the area of plant husbandry. Therefore, the space surrounding the nursery has to be redesigned (see map #3).

- the plant husbandry area should be extended up to the river and space will be allocated to fruit trees, forest trees and ornamentals. The spaces will be separated by paths (2.50m wide) allowing for tractor and trailer circulation.
- a special fenced area should be created for plants ready for sale. This area is under natural shade and is already used for plant propagation. Low branches will have to be removed. The floor in this area will be covered with thick permeable polypropilene sheets (specially designed for nurseries) to prevent weed growth and muddy conditions.
- the old fruit tree and ornamental museum would have to be rehabilitated so as to house more species and cultivars of ornamentals and secondary fruit trees.
- a small mango scion garden should be created North/West of the project, using the best Floridian and West Indian cultivars grown at Christian Valley Propagation Station.
- a part of the yard East of the new building should be used for soil mixing and treatment.
- Soil storage, soil disinfection and potting should take place in a new area built adjacent to the new building. This new area will be divided to accommodate storage of equipment (tractor, trailer, shredder, disinfection unit-boiler and others) in the other side (see plan #2).
- the cooking area should be moved closer to the office.



- the existing old garage, shed house and toilets should be demolished.

It is recommended to initiate the management of space as soon as possible in order not to stop or reduce activities during construction of the new building (see implementation schedule further on).



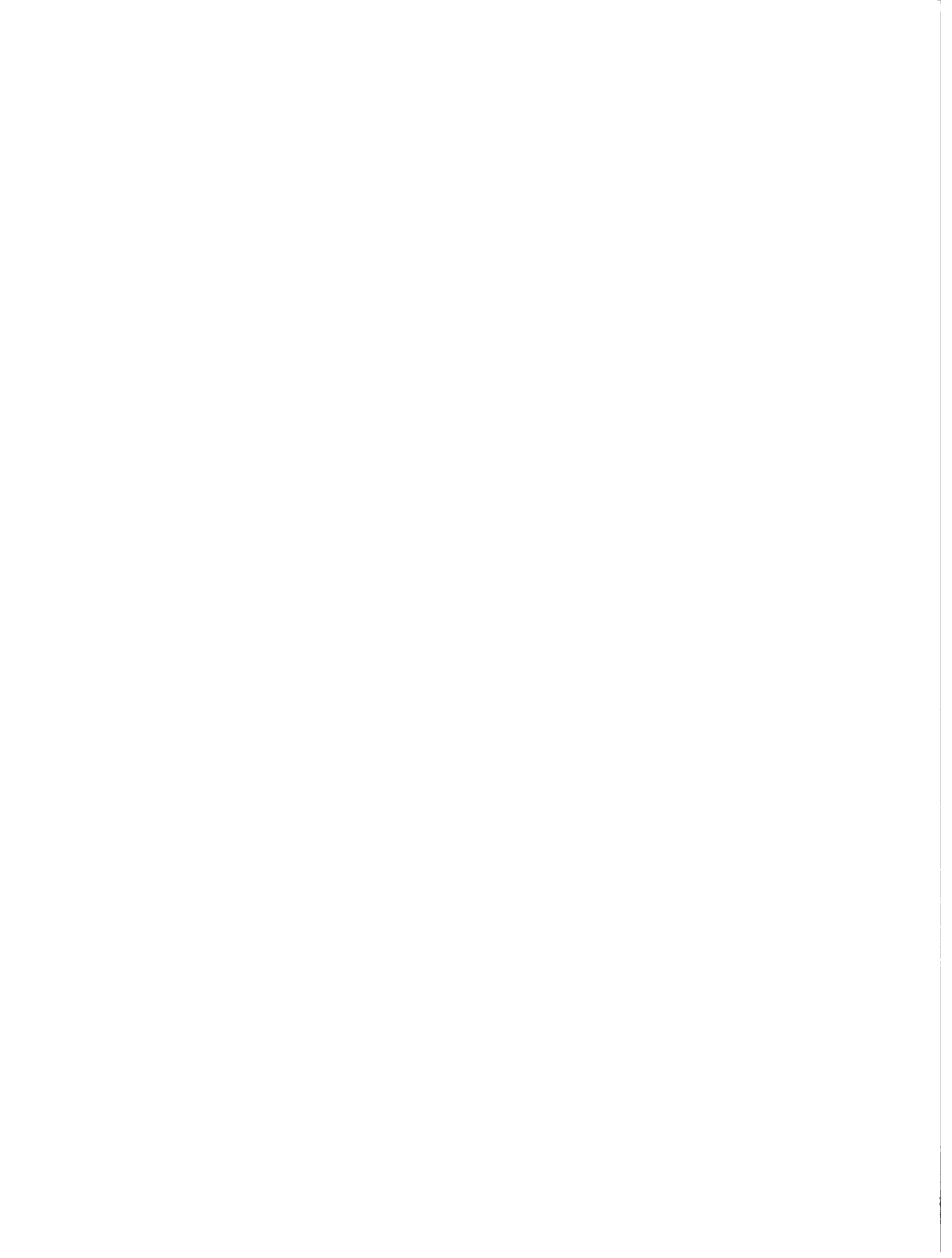
1.3 Equipment/Tools and Material

Table 1.

ITEMS	NUMBER/ QUANTITY	APPROX. COST IN US \$
Small tractor (15-20HP) equipped with a 1,000kg trailer and a frontal power shovel	1	15,000.00
Shredder	1	1,300.00
Soil disinfection unit (steam).	1	1,000.00
3 gallons motor sprayer	1	400.00
Wheel barrows	4	120.00
Computer for the office	1	3,000.00
Electric pump for the water tank	1	
Electric pump for the well	1	to
Mist system for 4 beds (5x1.20m) /building	1	be
Micro-sprinkler system for 40m ² under the shed	1	worked
Micro-sprinkler system for 2 beds (5x1m)/building	1	out
Sprinkler system in the growing area including the shed	1	by
Hoses for hand irrigation (20m long)	2	an
Saran net	500m ²	irrigation
Growing trays (12" x 20")	250	specialist
Grafting knives	20	
Secateurs	20	50.00
Hand saws	10	1,600.00
Pole saws	1	90.00
Rakes	4	300.00
Shovels	4	400.00
Cutlasses	10	100.00
1 gallon hand sprayers	4	120.00
Hand shovels (to transplant) ..	20	100.00
Protective glasses	10	100.00
Protective masks	10	100.00
Rubber boots	20 prs	400.00
Working gloves	20 prs	100.00
Sheep wire		
Galvanized wire #2	200lbs	100.00
Thick polypropilene impermeable sheets (pakground cover).....	200m ²	200.00

Potential Sources:

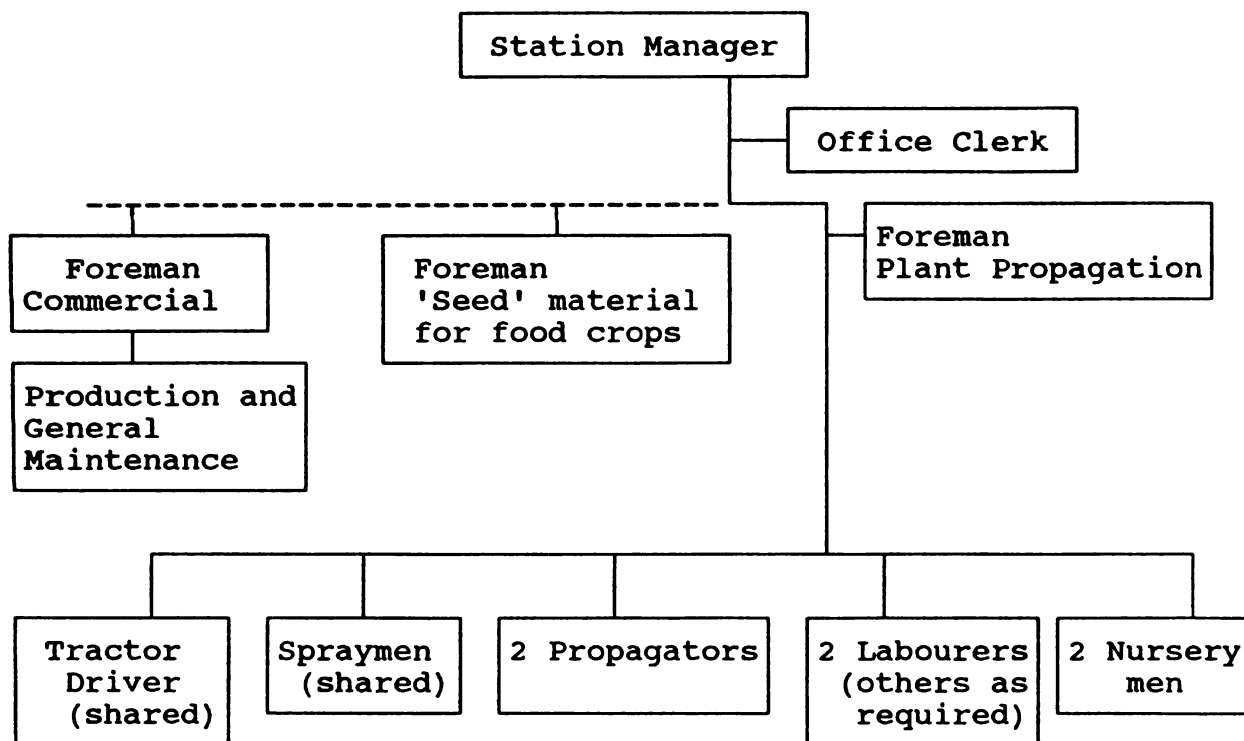
- Horticultural Supplies
- Gloeckner
- A.M. Leonard



2. Nursery Management

2.1 Staff and Duties

The nursery is located within an Agricultural Station managed by a Station Manager. The following is the organigram as proposed:

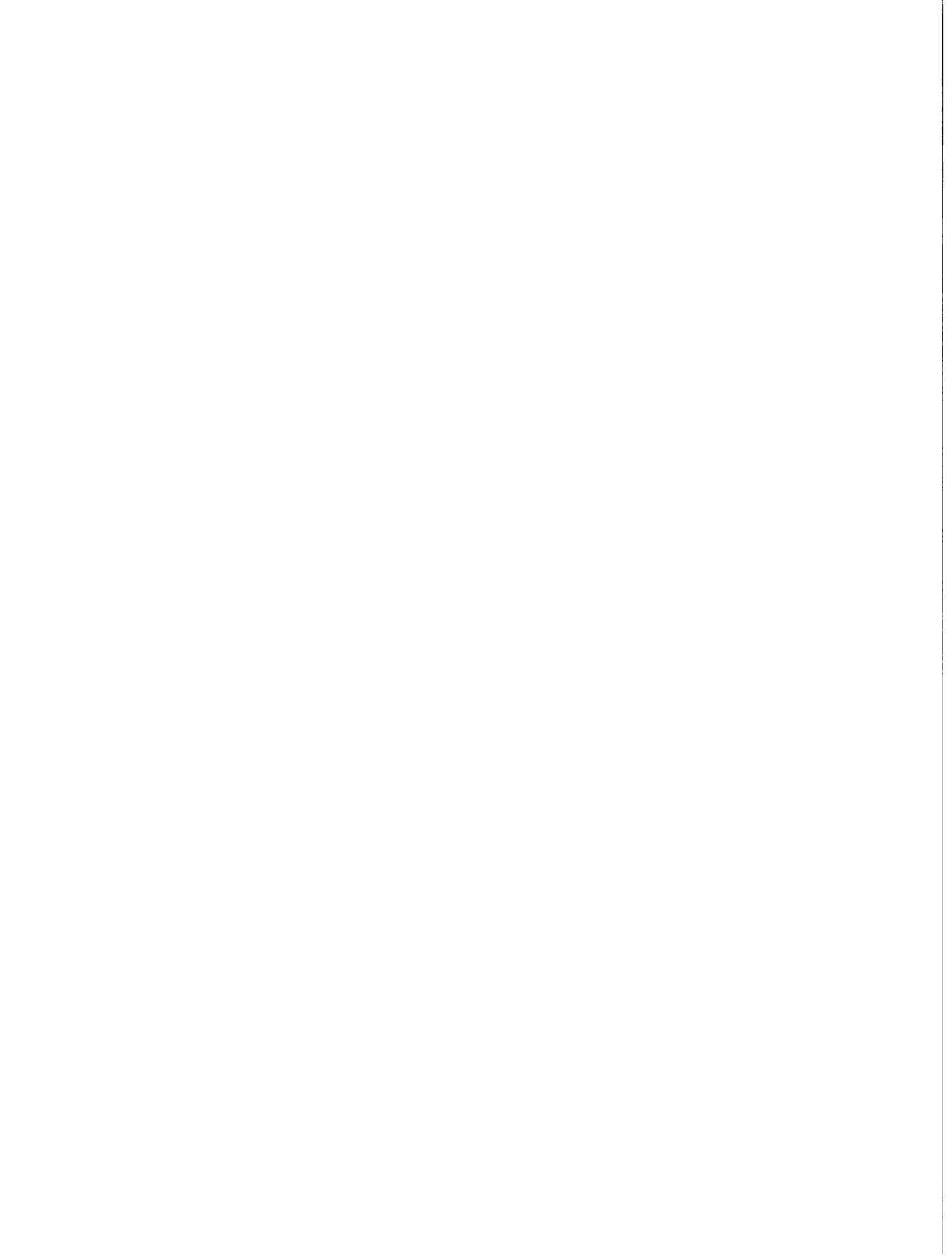


The services of sprayman, a machine operator and additional labourers will be accessed from a shared pool with the other sections within the station.

Management Structure

The management structure is designed to facilitate the performance of the functions to be conducted on the station. These are as follows:

- a) Commercial production and sale of produce eg. fruit.
- b) Production of food crop 'seed' material eg. plantain suckers.
- c) Production of other horticultural and forestry planting material for sale.
- d) General station maintenance.



e) **Research and Demonstrations.**

The organigram presented identifies the actors and areas of specialization considered optimal for station operation but details only the needs of the propagating unit. Duties and responsibilities of the main actors are included for clarification:

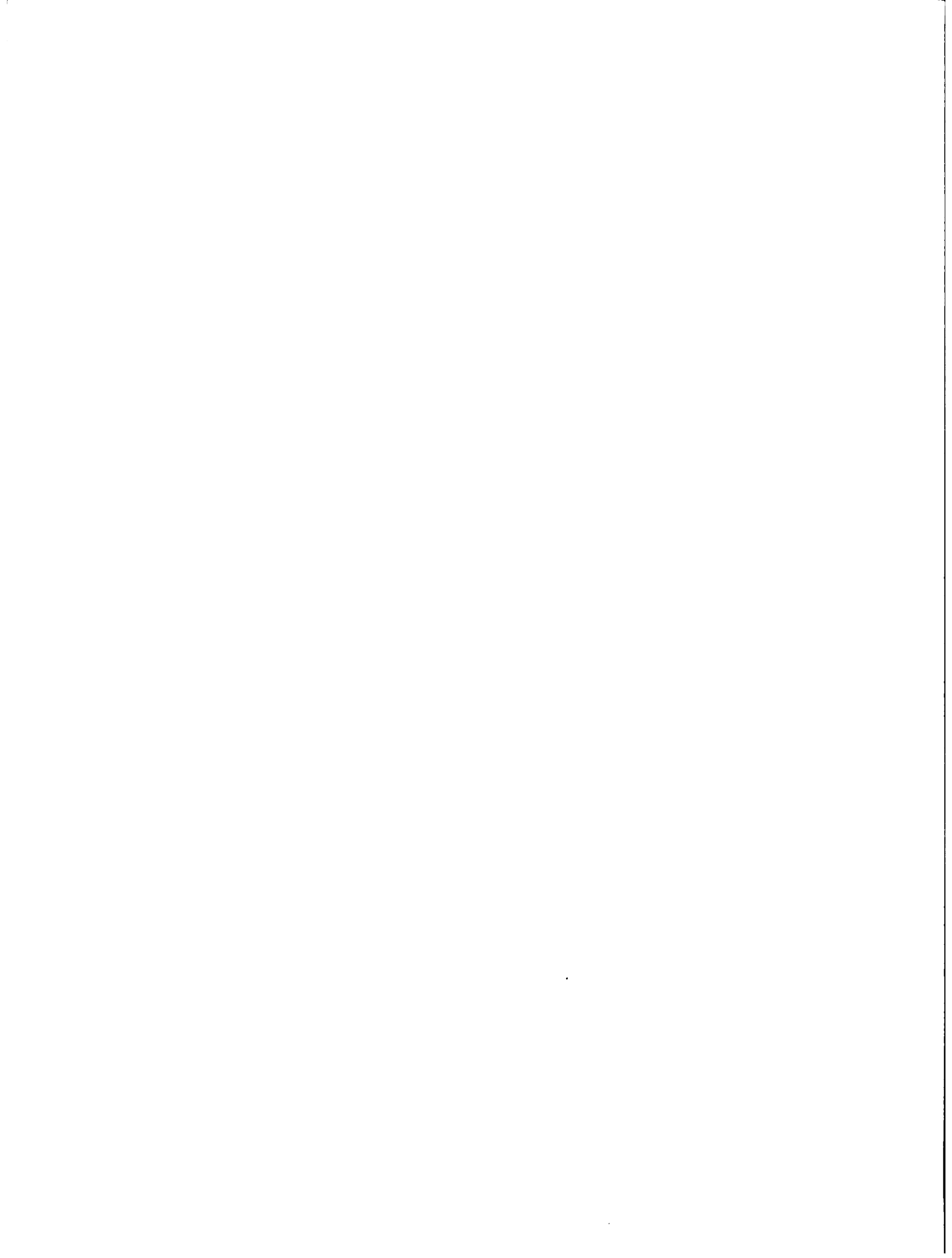
Station Manager	Annual planning and budgeting, acquisition of materials, technical direction of sub-ordinate staff, directing or collaborating.
Office Clerk	Maintenance of records (manually or on computer), wage sheets, filing, sales (cash receipts)
Foreman	Supervision and assigning of tasks to daily paid workers, dispensing of materials, plant sales (dispatch).
Propagators	Grafting, airlayering, setting of cuttings, pruning of scion trees and collection of cuttings eg. for grafting.
Nurseryman	Preparation of propagating media eg. mixing and sterilizing, seedling production (including rootstock seedlings).
Sprayman	Pesticide application, maintenance of spray equipment.

It is recommended that the staff directly involved with plant propagation be as follow:

- 1 Station Manager
- 1 office clerk
- 1 Foreman
- 6 permanent Workers
 - . 2 propagators
 - . 2 Nursery men
 - . 2 labourers

2.2 Management Systems for Nursery Operation

The successful production of quality plants is the result of a succession of inter-related activities which must be programmed in a rational manner: The nursery should have a calendar of general activities to assist the manager with the organization of tasks throughout the year (see table 2). Additionally, each crop has to follow a multiplication cycle based on activities such as collection of fruits, extraction of seeds all through the budding of the stocks and the final release of the plants. These cycles



can be prepared in a general format, where several species are involved (Annex 1), or specifically where more details for only one species at the time are given (Annex 2).

Table 2. Calendar of General Activities

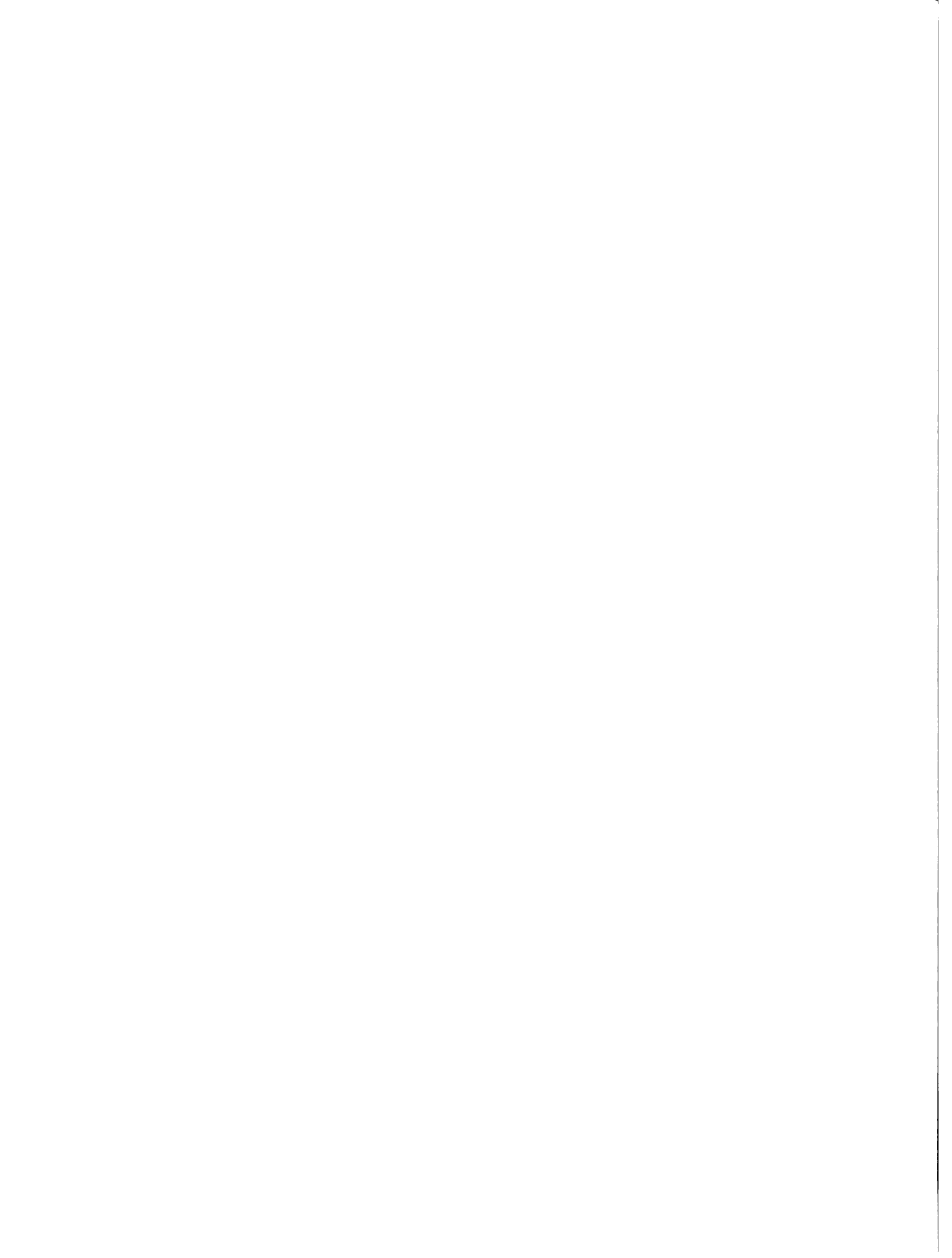
	J	F	M	A	M	J	J	A	S	O	N	D
Soil preparation									-----			
Potting soil												
Potting plants												
Sale of plants												
Rooting and cuttings:												
fruits												
ornamentals												
Vegetable seedlings in beds												
Pineapple stem cuttings												
Citrus seedlings												
Mango seedlings												
Avocado seedlings												

There are certain records that must be collected in order to facilitate the management and monitoring systems. Among these are:

- a) Sales/orders which includes name of purchaser, address, quantity, species, cultivar and others.
- b) Propagation efficiency as determined by percentage of germination, percentage of rooting, percentage of budding success.
- c) Rooting management data that include fertilizing, pruning, pest and disease control
- d) Inventory of species, scion and stock.
- e) Inventory of tools, equipment and consumable items

Example of forms to collect and keep these records are shown in annexes 3, 4, 5 and 6.

These records assist in detecting problems or bottleneck that may affect the achievement of the intended target. Moreover, they are useful in the planing of subsequent work programme including future targets.

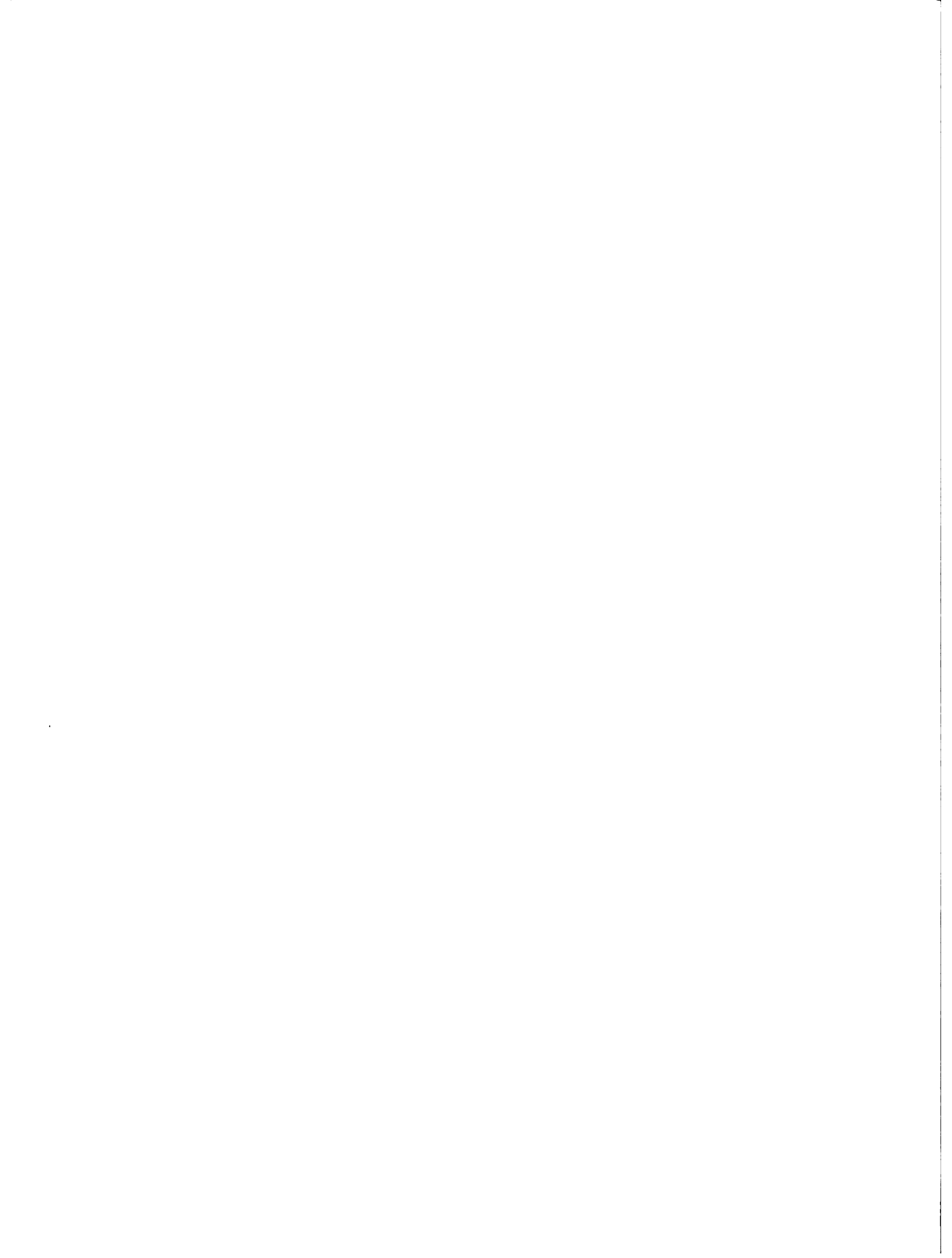


3. Technology

3.1 References

The following list is recommended for acquisition and housing at the station as reference material:

- a. Input suppliers price lists.
- b. Pesticide manual and pesticide compatibility charts.
- c. Horticultural supplies catalogues; seed, chemical, equipment.
- d. General texts for identification purposes eg:
 - i) The Citrus Industry - volume 1, Edited by Walter, Batchelor and Webber; University of California, Division of Agricultural Sciences.
 - ii) 'Tropica'- colour encyclopedia of exotic plants and trees, A.B. Graf, Roehrs Co.
- e. Texts on Pests and Disease and their control eg. Diseases of Tropical and Subtropical fruits and nuts by A. Cook, Hafner Press, a Division of Macmillan Publishing Company Incorporated.
- f. Propagation texts:
 - i) The Propagation of Tropical Fruit Trees by R.J. Garner and S.A. Chaudhri, Commonwealth Agricultural Bureau.
 - ii) Plant Propagation Principles and Practices by H.F. Hartmann and D. Kester, Prentice Hall Inc. Englewood Cliff N.J.
- g. Bulletins on plant propagation eg. Citrus Propagation Manual by R. Marte, IICA Barbados.
- h. Subscription to at least two general type journals eg. Agribusiness Worldwide and two horticultural type journals eg. Weeds and Turf.
- i. A photographic display of characteristic produce from the varieties of plants sold at the station.



3.2 Improvement of Techniques

The mechanization of the mixing of primary ingredients for soil media (top soil, sand, manure, fertilizers, solid chemicals) in an open area and its further storage under roof, will result in the saving of labour. Additionally, it will allow to collect these materials during the dry months (February to April and July to August) and ensure their ready availability during the rainy periods.

The acquisition and use of a shredder and a disinfection unit for the preparation of the growing medium, should increase considerably the ratio of rooting for cuttings and the germination of seeds reducing significantly the losses.

One of the major improvements on the technology side should come with the use of irrigation systems on the beds for propagation of cuttings and production of vegetable seedlings. A mist system will be installed on 4 beds for rooting of cuttings of fruit species eg. breadfruit, W.I. cherries, soursop, pomarac, and ornamentals eg. Hibiscus, Bougainvillea, Poinsettias, and Crotons. One of these beds will be convertible to a humidity bed for hard to root cuttings demanding etiolation. This bed will be equipped with a light removable structure supporting a polythene sheet (see plan #3). A micro sprinkler irrigation system is needed for the 2 additional beds, which will be used in the production of vegetable seedlings eg. tomatoes, peppers, and cabbages, in seedling trays during the wet season. During the dry season the same beds may be used for production of pineapple plants through the method of stem rings and short cuttings. These may also be used for seeds propagation of forest trees eg. mahogany, neem, eucalyptus and casuarina.

Rooted cuttings, pineapple and forest tree plantlets will be transplanted in bags and located under the shed for acclimatation before being grown outside in full sunlight.

Growth areas under the saran netting and under full sunlight will be fully equipped with sprinklers. However a section within the area covered by saran should be converted into a recuperation room equipped with a mist system where tissue cultured plantlets received by the Station would be initially hardened. The same area could alternatively be used in the hardening of cuttings recently transplanted.

The training of nursery staff in traditional and new propagation techniques eg. budding, grafting, cuttings, layering will contribute to improved efficiency thereby increasing the final nursery output.

The modification and construction of new infrastructure, the acquisition and use of additional equipment and the training of

nursery staff will represent a potential for an annual production of approximately:

- 25 to 30,000 budded and grafted fruit trees
- 20 to 25,000 cuttings of fruits and ornamental species.
- 16,000 pineapple or forest tree plantlets.
- 60,000 vegetable plantlets (under-cover).

These estimated targets are conditioned to the allocation of a real budget for operation and the on-time availability and disbursement of these funds.

3.3 Research and Demonstration

The conduct of these activities may be solely in the interest of plant propagation or may be collaborative in support of programmes originating in other departments eg. Extension. Examples of the former are:

- a. Testing and demonstration of new materials for use in the nursery.
- b. Testing of new methods of propagation.
- c. Survey of local germplasm.

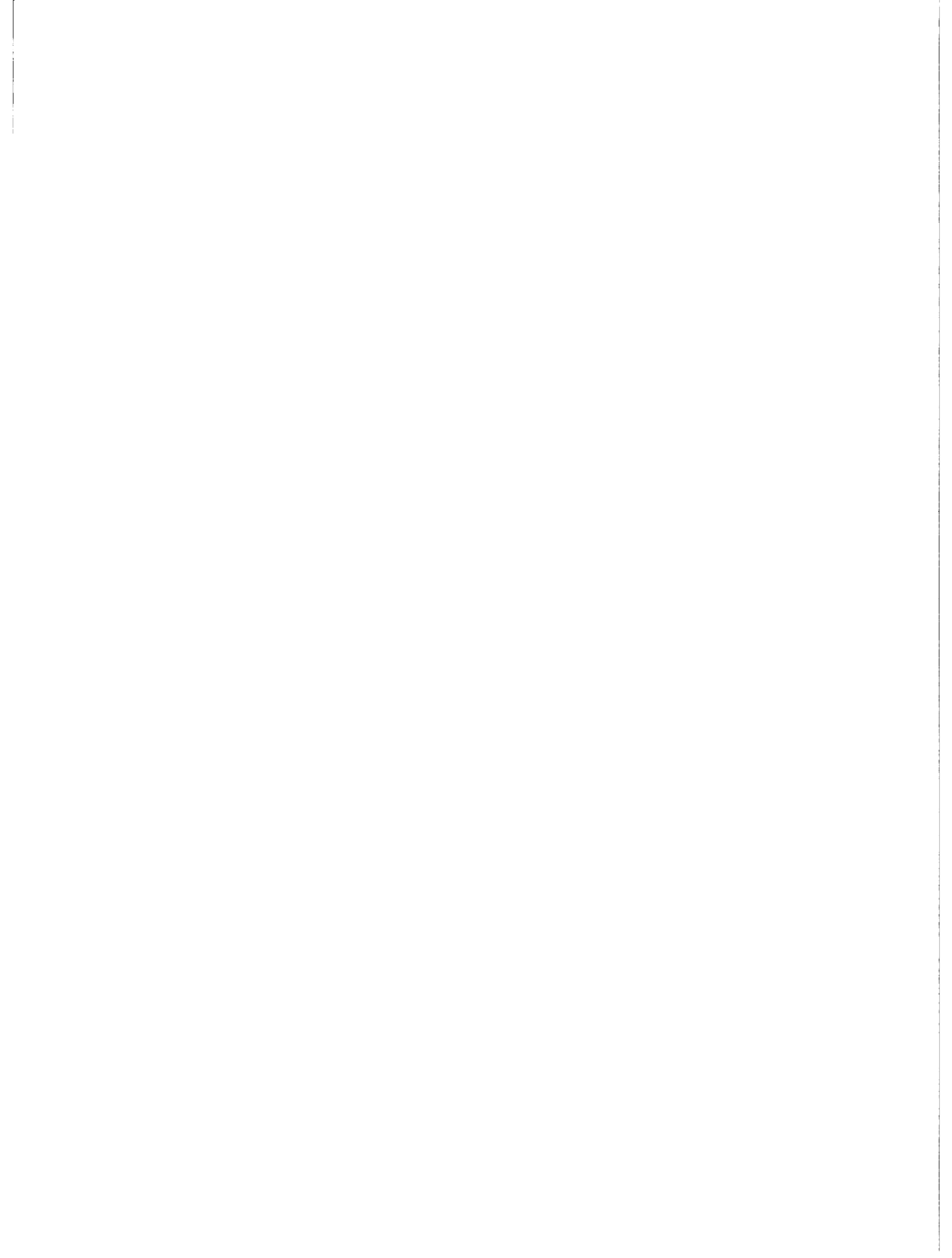
Examples of the latter are:

- a. Demonstration of trellis types for passion fruit growing.
- b. Performance testing of new cultivars eg. tomato cultivar testing in support of the Regional Vegetable Network.

Some testing and demonstration will be important to both executors. This is the case in the promotion of production of new commodities eg. growing of Pitahaya or agronomic practices on a crop commercially grown by the station eg. high density planting, flower induction for off season production and testing of new methods of weed control in mango.

High density plots can be established in the scion garden and/or the commercial growing area.

Additionally, some surveying of growers can be done when they come to the station to buy plants. The information collected is useful for planning at the station or at national levels.



4. Germplasm Improvement

Fruit and ornamental species available at Greencastle Station are quite limited. Dependence on Christian Valley Station for some fruit trees is not a convenient solution because of the distance. If Greencastle is to develop as a major nursery, its germplasm collections have to be improved.

4.1 Fruit Species

The citrus museum already in place, should be improved and completed, placing emphasis on new rootstocks resistant or tolerant to drought, calcareous soils and to some viruses eg. C. Volkameriana and Cleopatra mandarin. Also this plot should be limited to a scion garden where only the most important species and cultivars will be present. This should be based on the experience accumulated of performance and demand.

A small mango scion garden should be set up as designed in plan #3 including some of the best cultivars grown at Christian Valley: eg. 'Irwin', 'Sensation', 'Haden', 'Palmer', 'Kent', 'Keitt', 'Ruby', 'Tommy Atkins' as well as West Indian cultivars such as 'Julie', 'Imperial', 'Grahams' and 'Ceylon'.

The old mixed orchard located in the Eastern side of the office should be completed by introducing selected cultivars of other species such as carambola, sapodilla, W.I. cherries, etc. Trees of locally selected outstanding types of drought resistant fruit species such as tamarind, cashew and dunks are also recommended. These introductions and selections would be established in empty spaces at the present orchard.

For all the new trees to be established, it is recommended to adopt a high density planting system which will allow more plant per unit area an a more intensive production system.

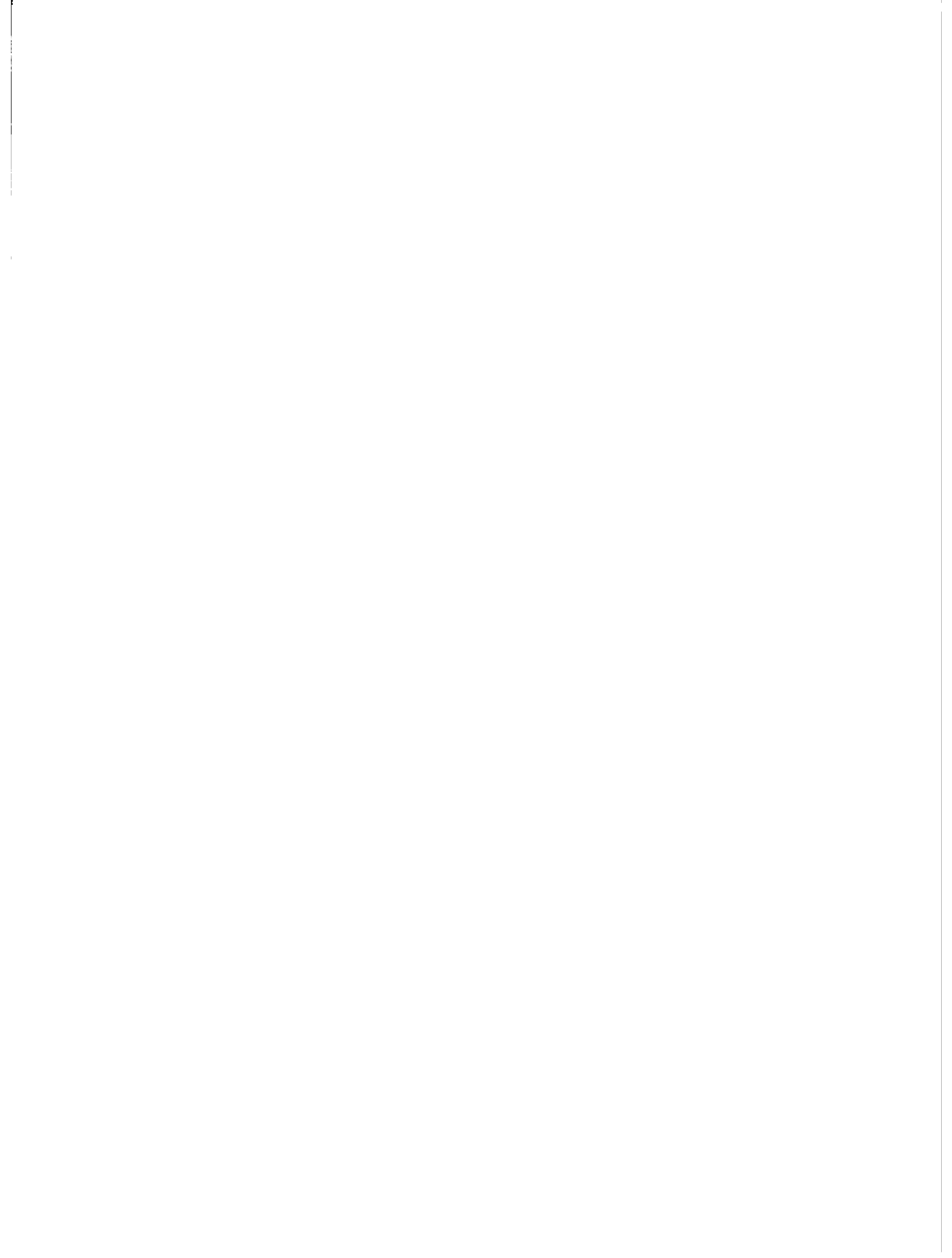
4.2 Ornamental Species/Herbal Nursery and Forest Trees

The small museum of ornamentals which is already being set up in the middle of the growing area for potted plants must be moved to empty spaces of the old museum, in the Eastern side of the office.

New varieties of Hibiscus, Bougainvillea, Palms and Cut Flowers (Ginger Lilies, Anthuriums, Heliconias, Orchids, Strelitzias) should be introduced to the same area.

The planned herbal nursery may occupy a small space within the growing area of the ornamentals (see map #3).

Forest species for seed production will be established



along the river side.

All movement of germplasm material should follow the protocol developed by FAO, IICA and CARDI for this purpose.

5. Training

A series of training are proposed to improve the efficiency of the staff of the Greencastle Station. These trainings are oriented to upgrade their capability in term of new and traditional plant propagation methods and techniques, nursery planning, nursery management, and nursery standards among others things. Table 3 outline the areas to be covered in each training, the kind of training and duration, the target group and the resource institutions to conduct the training:

Table 3. Proposed training for the Greencastle Propagation Station Staff

Area to cover	kind of training & duration	target group	Resource Institution.
Trad. Methods of Plant Prop.	Practical workshop (two days)	New Nur.Staff	IICA/CARDI
New Method in Plant Propag.	Practical workshop (three days)	Senior Propag.	IICA/CARDI
Nursery Management	Practical workshop (two days)	Nursery Staff	IICA/CARDI
Management of Germplasm	Practical workshop (two days)	Agric. Station Staff	IICA/CARDI
Pests Control in the nursery	Practical workshop (One day)	Nursery Staff	IICA/CARDI
Record keeping and data collect.	In-service Training (one day/two month)	Clerk and Foreman	IICA/CARDI

Additionally it is recommended to foster the participation of the Greencastle Staff on regional training being organized by IICA, CARDI and UWI, and to access additional funding or scholarships for overseas training tours to other islands with similar conditions.

It is recognized that many of the above trainings have been conducted over a period of time with participation of some of the Greencastle staff and yet the efficiency rather than to improve continued deteriorating. To ensure that the knowledge acquired is

being applied it is proposed that each of these training events be followed by specific assignments to the participants and further one-day evaluations over a reasonable period of time where the trainer will revise and advise on the problems encountered by the participants and supervisors.

6. Guidelines for Annual Workplan, Budgeting and Nursery Standards

6.1 Annual Workplan and Budgeting

The annual workplan and budget of the Greencastle Propagation Station should not be seen apart from the national programme of plant propagation for Antigua & Barbuda. The following ideas are presented as an example of how specific targets can be programmed for each propagation unit or for the national programme.

As proposed, activities at the Greencastle Propagation Station can be separated into 6 different categories:

- a) Commercial propagation & sales
- b) Propagation for special projects
- c) Commercial Production of crops & sales
- d) Maintenance of germplasm
- e) Research
- f) Demonstrations.

The extent to which each of these different categories can be implemented depends basically in the available budget and defined priorities. Therefore the programming and budgeting processes of the plant propagation unit are inter-dependent and must be done simultaneously. Figure 1 shows a diagram which provides the necessary information about the framework and the different steps to follow in an acceptable programming and budgeting exercise.

Application of this diagram in all its steps will avoid the normal shortcomings to which most nurseries in the Caribbean are normally subjected.

Defining the Propagation target

Unless the propagation targets respond to real needs the nursery will face problems such as:

- a) Slow or low sales and/or distribution of plants
- b) Overgrowing plants and increase percentages of discards.
- c) Deficits or occasional unavailability of planting material.
- d) Shortage of space.

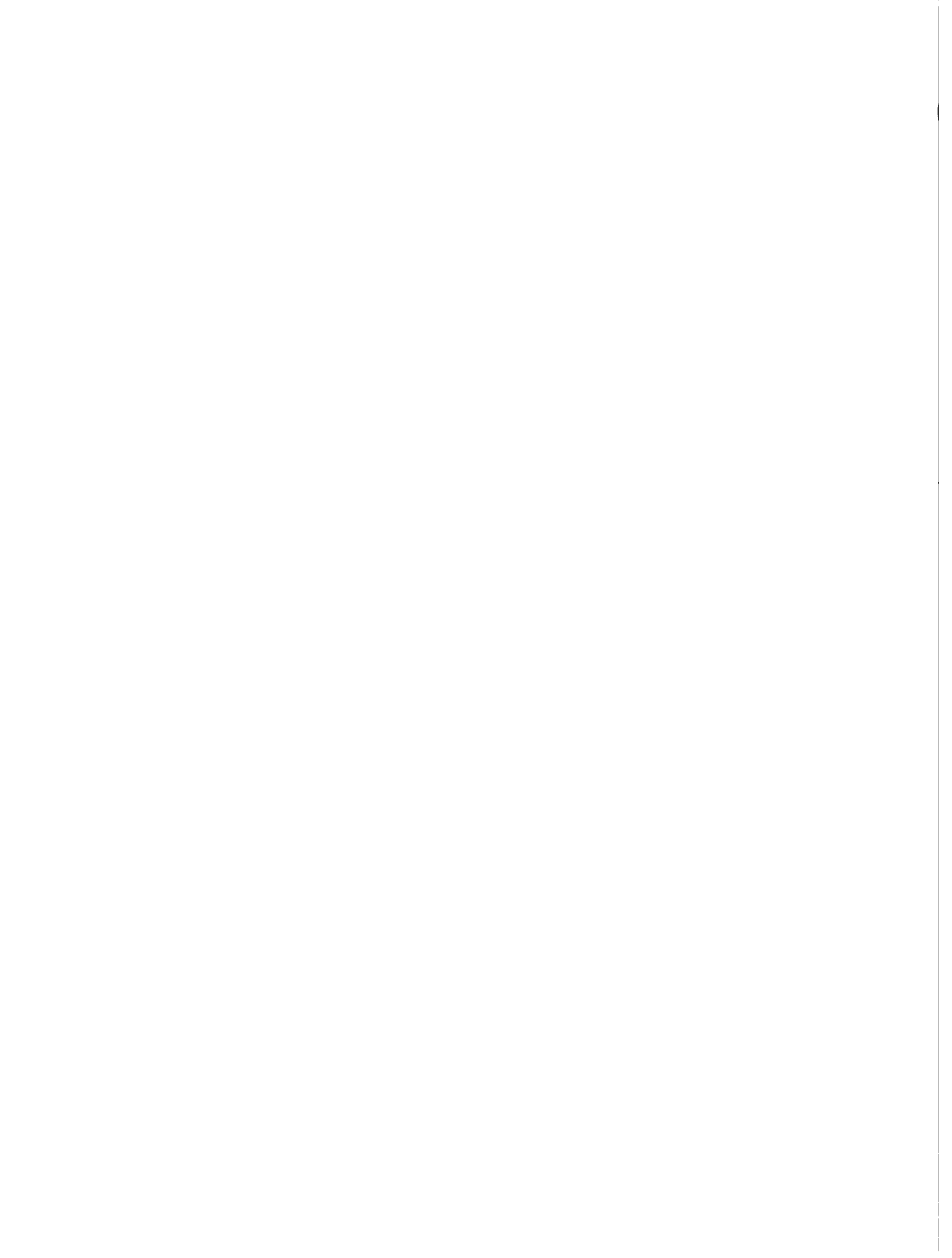
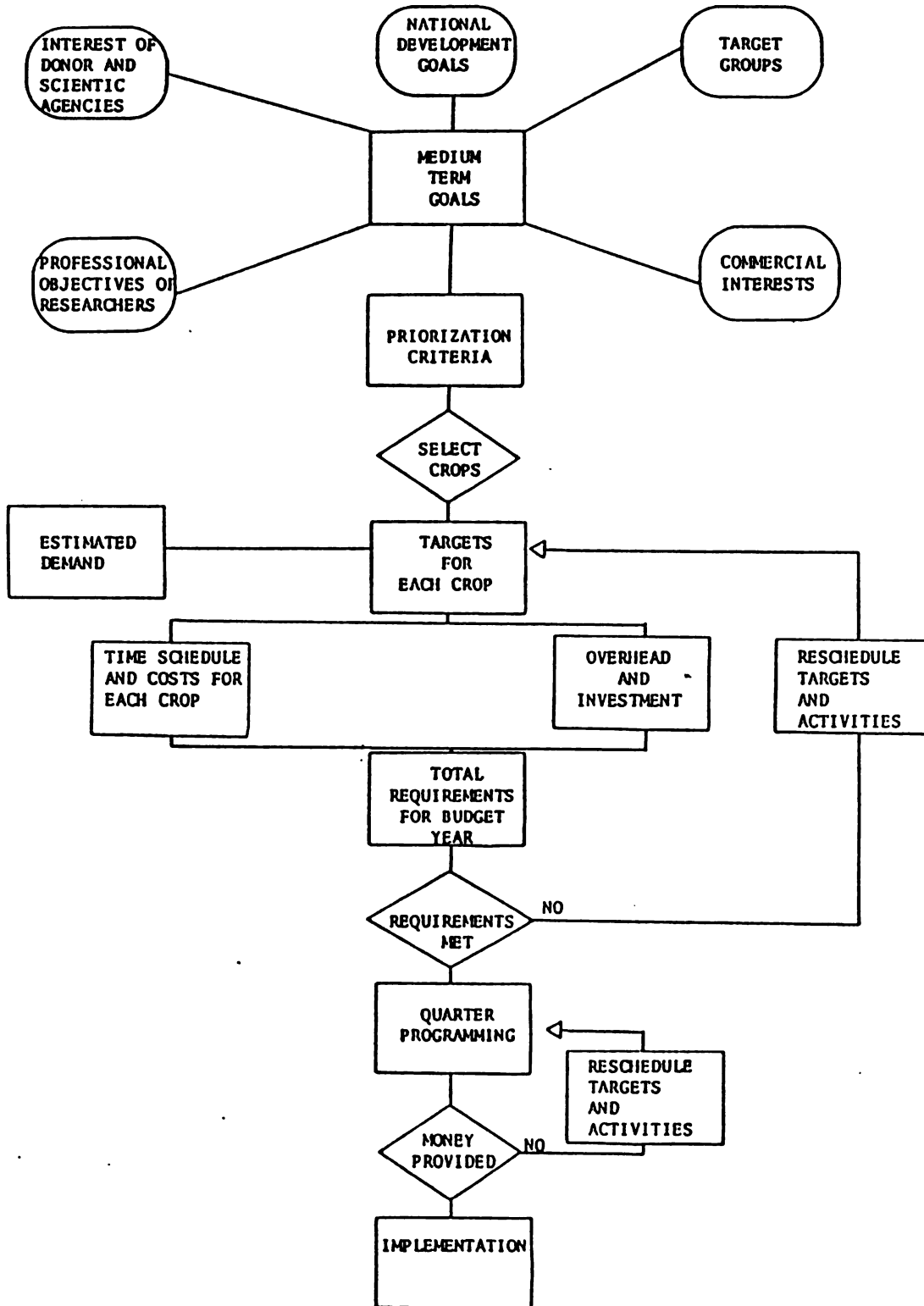


FIGURE 1

PROGRAMMING AND BUDGETING PROCESS OF THE P.P.U.



The number and kind of plants to be propagated should be determined by the combination of the following different factors:

- a) Crop priority established under the overall Agricultural Development Plan
- b) Demand levels determined by the extension service through direct contact with farmers.
- c) Direct booking of plants at the nurseries
- d) Experience of past years and/or historical pattern of plant sales.
- e) Available staff, infrastructure and equipment
- g) Operational Budget assigned.

The Propagation Plan for each of the nurseries should contain all the details necessary to direct the operation that involve its achievement and allow the monitoring of its progress. The target of plants propagated for commercial sales and those for special projects should appear separated in the plan. This plan is structured first as a proposal and modified accordingly to the budget obtained. An example of such a plan is presented in annex 7.

One of the most common problems facing nurseries in the Caribbean is the fact that although propagation plans with specific targets are developed, presented and approved, they are very rarely followed in term of implementation. Therefore a monitoring and evaluation system is required to ensure that the implementation of the plan goes accordingly to the target programmed.

6.2 Guidelines for nursery standards

In general, there should be emphasis on quality for planting material offered to the public. This becomes particularly important in the case of fruit tree crops which represent long term investment and therefore should begin with the best quality material available. Quality can be maintained and assured by the establishment of standards at the propagation stations. The enforcement of nursery standards at the Greencastle Propagation Station will result in a higher percentage of survival of plants in the field. Following are the main factors to consider in the definition of plant standards:

- a) Destination of the final plant (region and/or location where the trees are to be planted and their ecological characteristics.
- b) Species and cultivars to be propagated.

- c) Source of budwood
- d) Species used as rootstock
- e) Source of seeds for rootstock.
- f) Propagation method.
- g) Height of budding and/or grafting
- h) Training system ('Whip', 'headed' or 'free growth')
- i) Number and position of scaffold branches
- j) Delivery criteria
 - . General appearance
 - . Health
 - . Vigor
 - . Size
 - . Maturity
 - . Identification

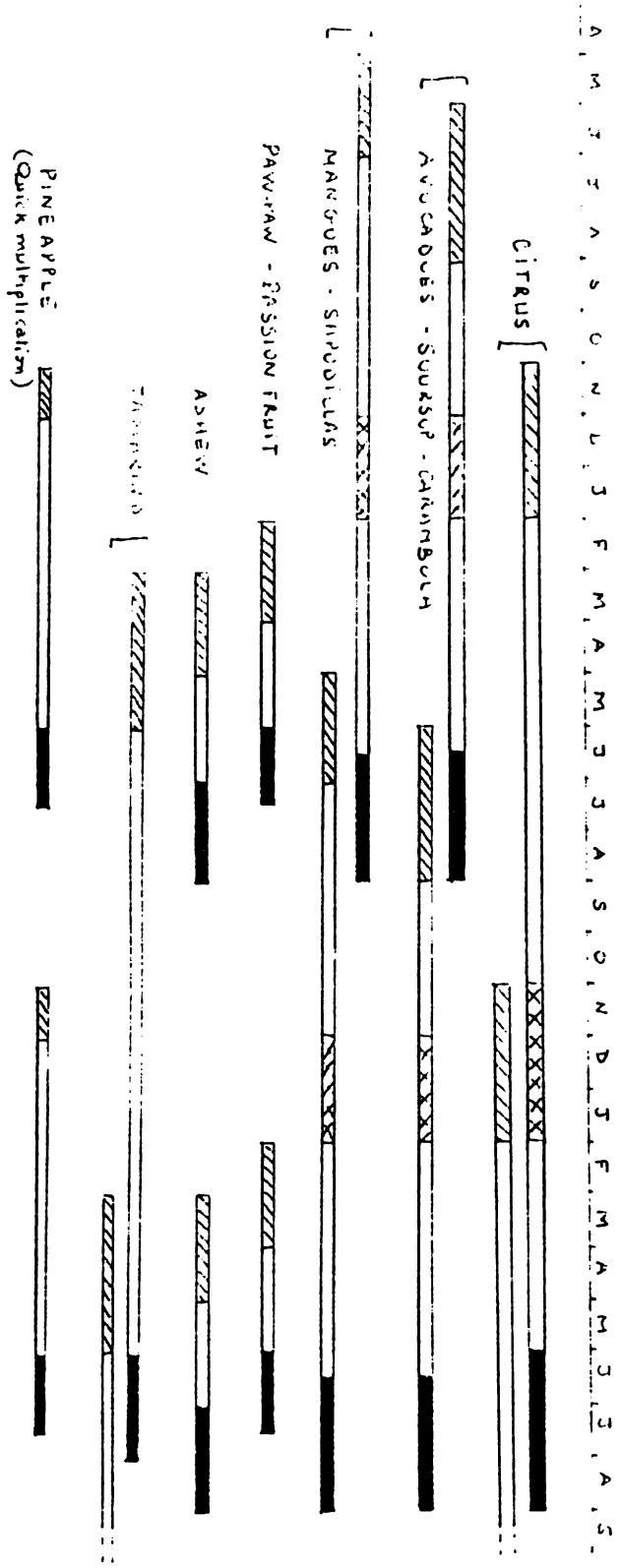
It is advisable to take additional precautions to safeguard the integrity of the planting material used. In this regard, IICA and CARDI can be called upon to assist in monitoring scion gardens to detect deviations such as mutations or virus infections.

III. PROPOSED IMPLEMENTATION SCHEDULE AND SHARING OF COSTS





	<u>Funding</u>		<u>Schedule</u>	
	<u>Donor Agencies</u>	<u>MoA</u>	<u>start</u>	<u>end</u>
1. <u>Space Management</u>			<u>(Month)</u>	
Land preparation		X	01	04
Moving fences		X	01	04
Construction of internal paths		X	03	04
2. <u>Infrastructure</u>				
Construction of new building		X	05	11
Demolition of old buildings		X	08	10
Moving infrastructure for shed		X	09	10

	Rehabilitation of existing office	X	11	12
3.	<u>Equipment</u>			
	Acquisition of tools	X	03	05
	Acquisition of equipment for soil preparation	X	03	05
	Acquisition of irrigation systems	X	06	09
	Installation of irrigation systems	X	10	11
4.	<u>In-service training</u>			
	Trad. methods/plant prop.	X	05	06
	Record keeping/data col.	X	05	06
	Pest control/nursery	X	08	09
	New methods/plant prop.	X	06	07
	Nursery Management	X	09	10
	Management of germplasm	X	10	11
5.	<u>Furbishing</u>			
	Moving shelves to the new building	X	11	12
	Refurbishing the new office rooms/old buil.	X	11	12
	Furbish salesroom and training rom/new building	X	13	14
6.	<u>Germplasm Improvement</u>			
	Introduction	X	05	24
	Establishment of local selections/outstanding cvs	X	18	48

MULTIPLICATION CALENDAR



LEGEND

-  Seed recollection and sowing
-  Growing period (pre and post grafting)
-  Grafting or grafting
-  Transplantation (sales period)

FRUIT CROP DEVELOPMENT PROJECT

MAFCA - IICA

CROP CITRUS

NURSERY OPERATION TIMETABLE

ACTIVITY	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
1. <u>Collecting the Fruits</u>												
2. <u>Extraction of Seeds</u>												
3. <u>Pretreatment of Seeds</u>												
4. <u>Medium Preparation</u>												
5. <u>Seedbed Preparation</u>												
6. <u>Planting the Seeds</u>												
7. <u>Transplanting to Plastic Bags</u>												
a) <u>Getting the Bags</u>												
b) <u>Preparing the Medium</u>												
c) <u>Filling the Bags</u>												
d) <u>Planting in the Bags</u>												
8. <u>Budding/Grafting</u>												
9. <u>Unrapping</u>												
10. <u>Forcing</u>												
11. <u>Rebudding/Regrafting</u>												
12. <u>Training the Plants</u>												
13. <u>Plants Ready to leave</u>												

FRUIT CROP DEMONSTRATION PROPAGATION UNIT

MOA-IICA

Distribution Control Form

1. GENERAL INFORMATION

- 1.1 Name:
- 1.2 Address:
.....
Phone No.
- 1.3 Farm Location:
- 1.4 Total Area: Area in Use:
- 1.5 Farming Activities:
.....

2. PLANTS REQUESTED AND DELIVERED

Species	Cultivar	No. Requested	No. Delivered
-----	-----	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----
-----	-----	-----	-----

3. If you have fruit trees on your farm, please complete the following:

3.1 Type (Species or Cultivar)	Area/Quantity	Age(s)
-----	-----	-----
-----	-----	-----
-----	-----	-----

3.2 Which are your main problems?

- Pest & Disease Management
- Poor Drainage
- Unavailability of inputs
- Praedial Larceny
- Lack of Market
- Lack of Transportation Facilities
- Inadequate Technical Assistance
- Lack of Credit

3.3 Are you planning to extend your orchard? Yes ()

No ()

If Yes: When _____
 Species _____
 Area/No. of Trees _____

SIGNATURE OF PERSON COMPLETING FORM:

DATE:

FORM

FRUIT CROP DEMONSTRATION PROPAGATION UNIT

MOA-IICA

Control of Seedlings Planted

Bin/Bed/Block No. _____ Area _____

Media: _____ Sterilized with: _____ Date _____

Fertilizer (s) added: _____ Date _____ Rate _____

Species: _____ From Bin No. _____

Transplant Date: _____ No. Transplanted _____

Second Fertilization: Due _____ Done _____

Third Fertilization: Due _____ Done _____

Date(s) of Weeding: _____

Date(s) of Budding: _____ No. Budded: _____ Cultivar: _____

Date(s) when ready for release: _____

Total number of plants for release: _____

Problems Encountered:* _____

Action taken:* _____

*Include dates

folms

PROPAGATION PLAN
1991 TARGET FOR "QUALITY FRUIT" NURSERY

<u>SPECIES</u>	<u>CULTIVARS</u>	<u>PROPOSED</u>	<u>APPROVED</u>
CITRUS			
Sweet Oranges		40000	20000
	Valencia		17500
	Hamlin		500
	Parson Brown		500
	W. Navel		500
	Pineapple		500
	Others		500
LIMES		16000	7000
	W.I. Limes		5000
	Tahiti (Bears)		2000
GRAPEFRUIT		3000	3000
	Marsh seedless		1500
	Duncan		300
	Thompson Pink		400
	Red Blush		400
	Ruby Red		400
MANDARINS AND MANDARIN-LIKE		6000	10000
	Satsuma		100
	Dancy		100
	Ortanique		100
	Murcott		100
	Orlando Tang		100
	Mineola Tang		100
	Ponkan		100
	Others		9200
		-----	-----
		65000	40000
		-----	-----

INVENTORY OF CITRUS BY JAN 1991

Plants budded and/or release.....	9153
Rootstock on hand	
Rough lemon	6247
Sour orange	688
Total number of stocks required	65000
Seeds required	130000
Fruits required	
Rough lemon	15000
Sour orange	10000

<u>SPECIES</u>	<u>CULTIVARS</u>	<u>PROPOSED</u>	<u>APPROVED</u>
Mangoes		8000	5000
	Julie		2300
	Buxton spice		2150
	Imperial		50
	Graham		50
	Ceylon		50
	Bombay		50
	Keitt		50
	Kent		50
	Tommy atkins		50
	Carrie		50
	Sabiana		50
	Irwin		50
	Palmer		50

INVENTORY OF MANGOES BY JAN 1991

Produced to date 67
 Number of stocks on hand
 Number of stocks required10000
 Number of seeds required15000
 Number of fruits required15000

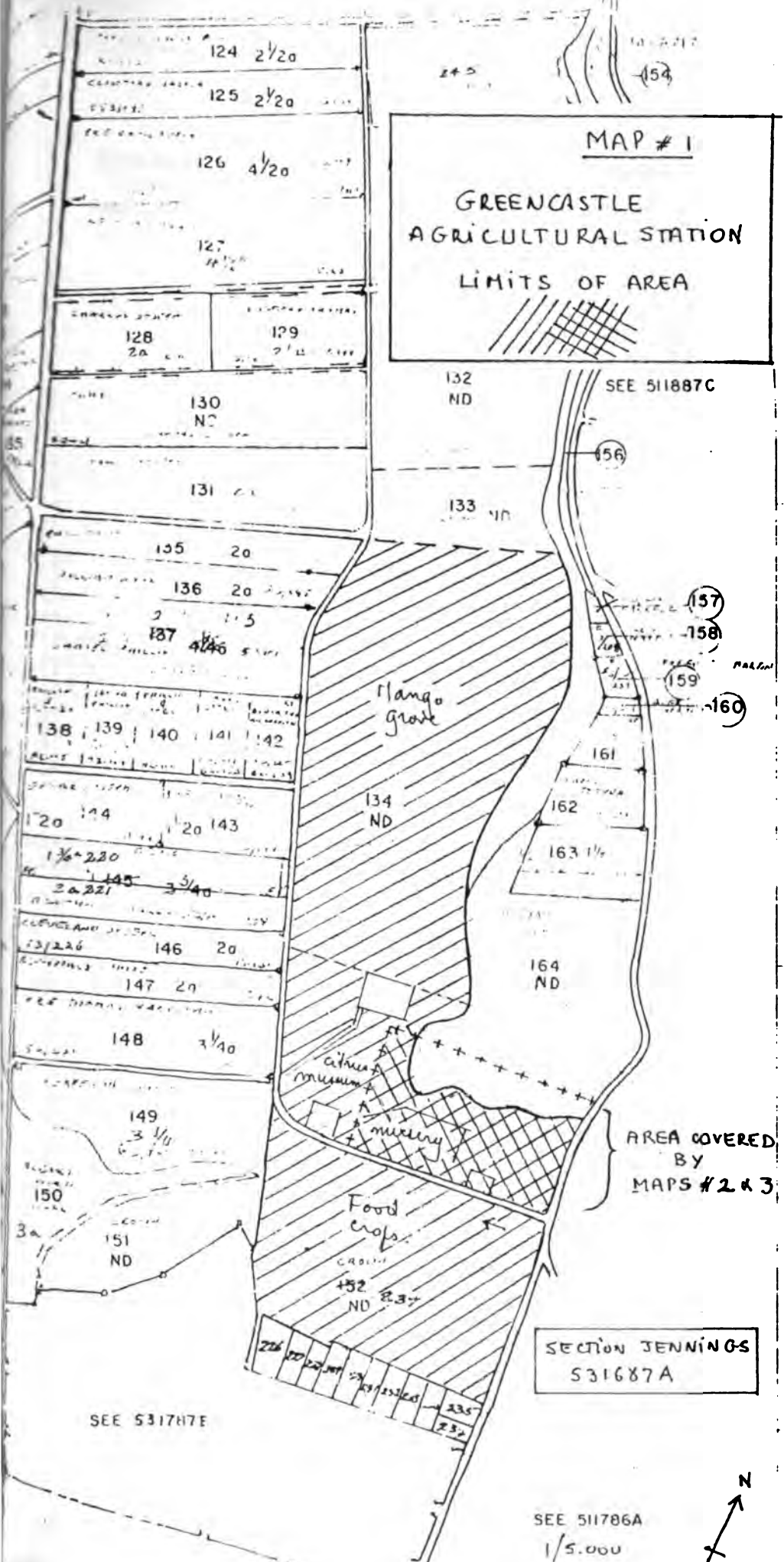
<u>SPECIES</u>	<u>CULTIVARS</u>	<u>PROPOSED</u>	<u>APPROVED</u>
AVOCADOS		8000	8000
	Lula		2000
	Simmonds		1000
	Choquette		1000
	Booth 7		500
	Booth 8		500
	Ruhle		500
	Pollock		300
	Semil 34		300
	Gripina		200
	Monroe		200
	Popenoe		200
	Hall		300
	Dade		500
	Others		500

INVENTORY OF AVOCADOS BY JAN 1991

Plants produced 479
 Stocks on hand
 Number of stocks required10000
 Number of seeds required13000
 Number of fruits required13000

<u>SPECIES</u>	<u>CULTIVARS</u>	<u>PROPOSED</u>	<u>APPROVED</u>
LESS TRADITIONAL			
CARAMBOLA		650	550
	Arkin	250	200
	Golden Star	250	200
	B-10	150	150
SAPODILLA		250	250
	Sugar brown	150	150
	Early	100	100
PAPAYA		2500	2300
	Sunrise	900	900
	Kapoho	900	900
	Cartagena	700	500
PASSION FRUIT		1900	1900
	Dominica 1	800	800
	Guyana 10-11	700	700
	Trinidad Sweet	400	400
W. I. CHERRIES		1000	1000
	B-17	800	800
	Florida Sweet	200	200
GUAVA		1120	950
	Supreme	300	250
	Patillo	320	200
	Centeno	500	500
SOURSOP		400	400
	Buris	200	200
	DR-15	200	200
BREADFRUIT		300	200
DUNKS		100	100
BILIMBI		100	100
TAMARIND		100	100
GOLDEN APPLE		100	100
ACKEES		100	100
OTHER FRUITS		1000	500
TOTALS			

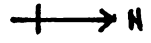
MAP # 1
 GREENCASTLE
 AGRICULTURAL STATION
 LIMITS OF AREA



SECTION JENNINGS
 531687A

SEE 511786A
 1/5.000





SEED BEDS FOR FRUIT TREES

AREA UNUSED

BEDS FOR ORNAMENTAL CUTTINGS AND ORNAMENTAL MUSEUM

NURSERY AREA (POTTED PLANTS)

AREA UNUSED

NURSERY AREA (POTTED PLANTS) UNDER SHADE

MAIN ENTRANCE

MAP # 2

PRESENT SITUATION

LEGEND

- 1 Office and sales' room
- 2 Old garage
- 3 Kitchen
- 4 Old shed
- 5 w.c.
- 6 well
- 7 Soil storage area
- 8 Water tank

--- Fence (sheep wire)

..... limits of areas

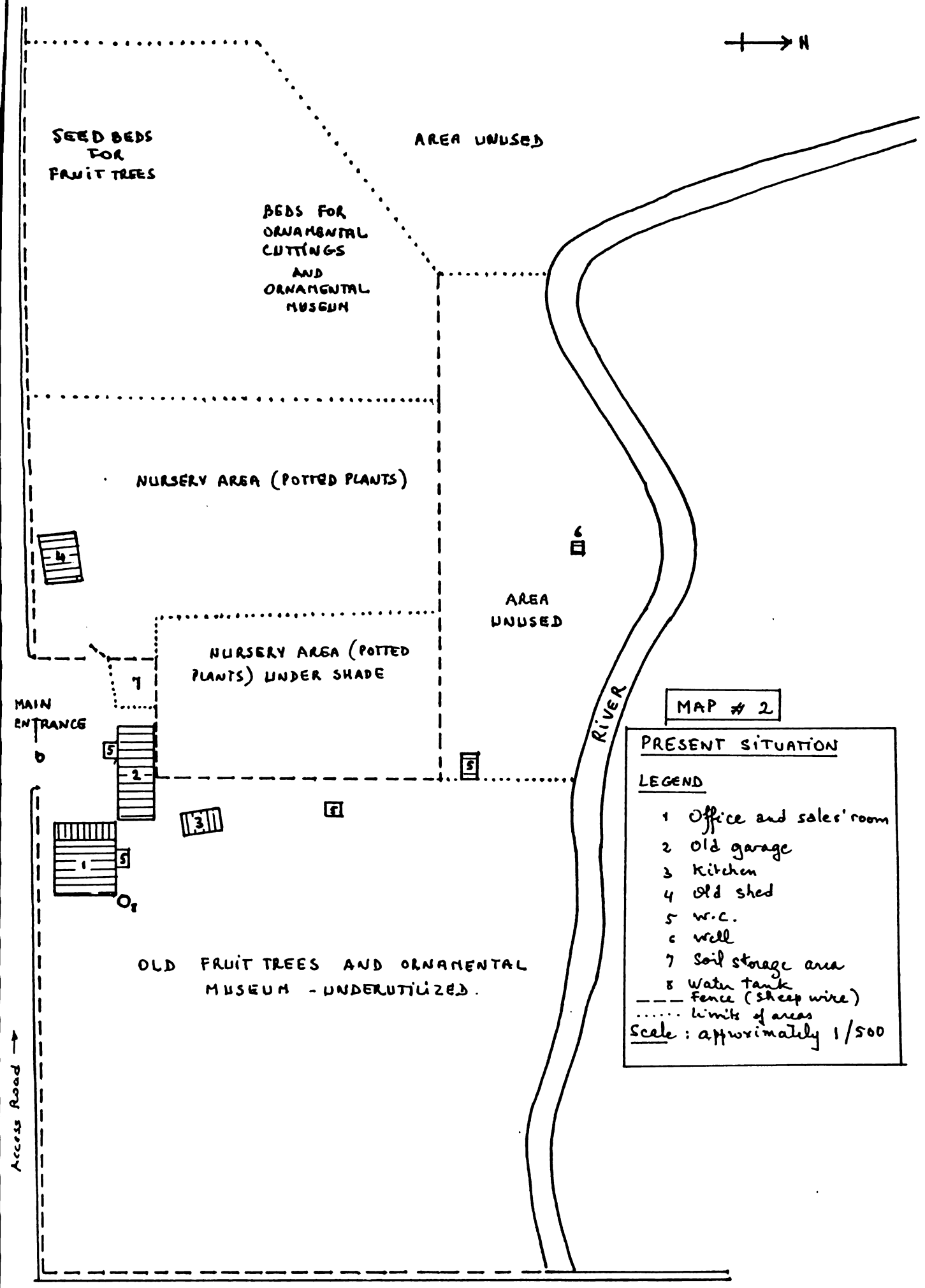
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OLD FRUIT TREES AND ORNAMENTAL MUSEUM - UNDERUTILIZED.

RIVER

Access Road →

← Access Road



11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35



CITRUS SCION GARDEN

MANGO SCION GARDEN

ORNAMENTALS

HERBAL MUSEUM

10

8

HARDENING AREA

2

4

SEED BEDS

10

FRUIT TREES

FOREST TREES

6

7

10

SALES AREA

MAP # 3

PROPOSAL FOR THE NURSERY AREA

LEGEND :

- 1 Offices
 - 2 New building
 - 3 kitchen
 - 4 Shed (mesh covering)
 - 5 w.c.
 - 6 well
 - 7 Soil mixing area
 - 8 water tanks
 - 9 Soil and equipment storage area
 - 10 path
- fence (sheep wire)

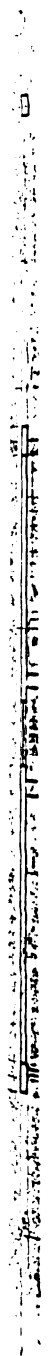
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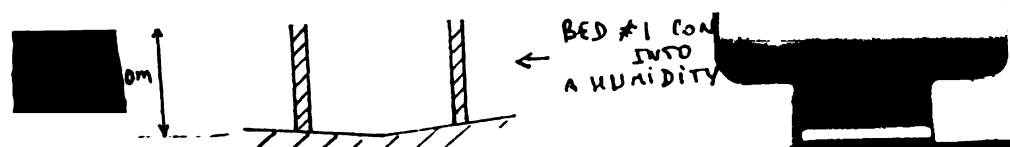
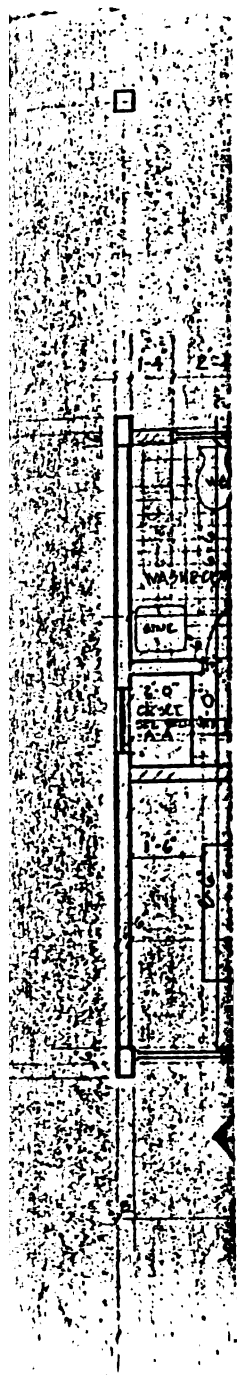
REHABILITATED FRUIT TREES AND ORNAMENTAL MUSEUM

RIVER

ACCESS ROAD

← ACCESS ROAD

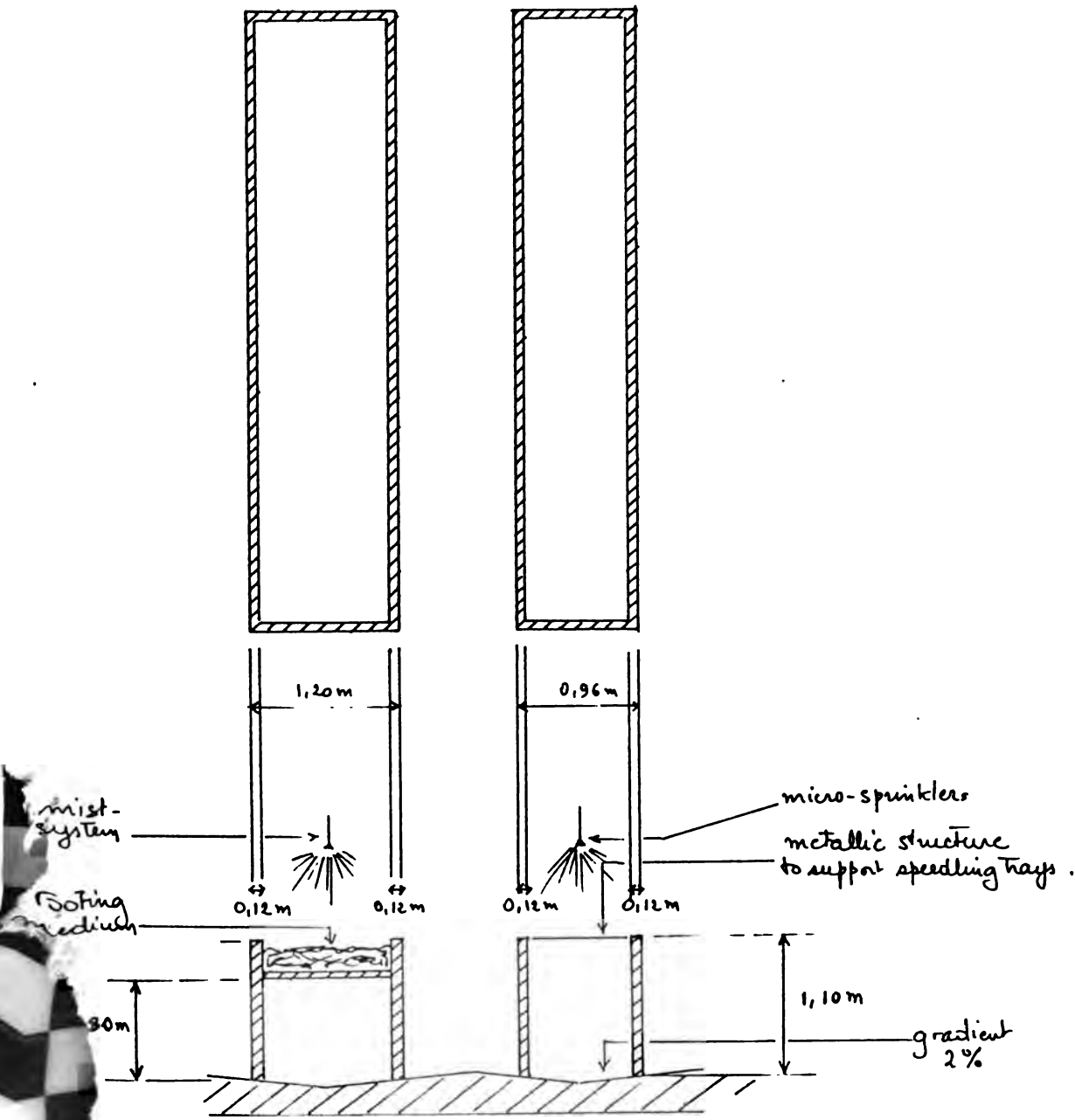






PROPAGATION BEDS.

PLAN # 3.
Approximate
scale: 1/50



BEDS # 1, 2, 3, 4

BEDS # 5 and 6

