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VEGETABLE SEEDLING MODULE CONSULTANCY IN SRI LANKA

by

David Parsons
HIGH VALUE HORTICULTURE

MARD PROJECT
PIMBURATTAWA

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SRI LANKA.

DAVID PARSONS,
HIGH VALUE HORTICULTURE,

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Abbreviations.

CTC	Ceylon Tobacco Company
FO	Farmer Organisation.
MARD	Mahaweli Agricultural and Rural Development Project.
MEA	Mahaweli Economic Agency
OC	Other Crops.
RARC	Regional Agricultural Research Centre.
wp	Wettable powder.

All US dollars and UK pound conversions in the text are calculated from the following rates of exchange:

US$ 1.00 = Rs 50/-
GBP 1.00 = Rs 70/-

Cents in the text refer to one hundredth of a Sri Lanka Rupee.

Executive Summary.

The purpose of the seedling block module consultancy was to design and recommend ways in which a containerized vegetable seedling system could be used by settlers in System B of the Mahaweli Agricultural Rural Development Project (MARD). The containerized seedling method involves the use of plant trays or modules.

Apart from a few private sector nurseries, there is no modular seedling production experience in Sri Lanka. A few farmers in the intensive vegetable production areas have utilized soil blocking methods.

The vegetable seedling transplant requirement in System B during the 1991/92 wet and dry seasons was approximately 70 million seedlings. The seedling numbers broken down were, 70 million onions and seven million of other vegetables that included chillies, peppers, eggplant, tomatoes and cabbage.

It is envisaged that, at present, System B could support three vegetable seedling propagation units. An individual unit would have a capacity of producing 350,000 salable seedling four times a year.

The overall dimensions of such a unit will be 1,600 m2. The seedlings will be sown in 240 cell modules and grown under shade.

A shade area of 625 m2 is recommended that is capable of growing 1,800 trays at any one planting. The substrate will be sieved and steam sterilized coir. Coir substrate is ideal for seedling production.

The cost of raising 1,400,000 saleable seedlings would, in the first year be Rs 445,834/-. The production cost assumes that there is a 20% seedling wastage rate and that a farmer acquires a bank loan at 22% interest. In this model, the price of producing one seedling is calculated at being 32 cents (Sri Lankan rupees).

Two alternatives to the model given above are presented in the report.

> Model two, where the propagation unit is run by a Farmer Organization (FO) and the capital equipment is granted to the organization. The FO manager would run the nursery and labor is contracted. The unit seedling price is calculated at being 13 cents per plant.
>
> Model three, where the propagation unit is run by a settler family and the capital equipment is granted to the settler. The settler and his/her family manage and work on the nursery, with no outside contracted labor. In the first year the price per seedling will be six cents per plant.

In comparison to other countries there are a number of constraints that would affect System B vegetable seedling production: -

The majority of the nursery equipment needs importing which will incur a 40% import duty, thus adding to the cost of a seedling unit.

A disincentive for potential entrepreneurs, to establish a vegetable seedling unit, is the 22% interest rate for a loan.

Farmers in System B purchase vegetable seedlings between 0.8 - 10 cents, consumer resistance to higher prices is envisaged.

Yields in System B are comparatively low and net returns are lower than in other regions of Sri Lanka and the world. Farmers have little income to buy relatively expensive plants. Seed prices are comparatively low, a high wastage and a high seed rate are accepted.

After use, returning the plant trays to the nursery from the farm will be a problem.

On the other hand there is a number positive advantages with respect to raising vegetable seedlings in System B:-

The labor force, especially the women workers are very capable at doing meticulous and intricate work. Labor rates are low in relation to many other countries.

Tray transportation to the field is usually a problem in other countries. With the two wheeled tractors many farmers have access to an economical and efficient form of transporting the plant trays.

Inland coir is freely available and is an excellent substrate, provided it is prepared correctly.

The recently introduced gradual import ban of onions and chillies will signify higher returns. Farmers will not be adverse to paying higher prices for quality seedlings.

With the establishment of the TESS packhouse, forward contracts and crop programming will encourage farmers to purchase module grown transplants.

Recommendations.

In the first instance, it is recommended that MARD establish a vegetable seedling nursery to supply the packhouse contract growers. At the end of the second production season two private nurseries should be established with MARD/MEA assistance.

That a project technician is given the responsibility for modular vegetable seedling production.

Initially, until suppliers can be found in Sri Lanka, 240 cell injection molded cells will need to be imported.

Initially, until suppliers can be found in Sri Lanka, 240 cell injection molded cells will need to be imported.

Further evaluations of seedling raising techniques are required namely:-

Comparing various forms of shade.

Assessing the coir substrate in conjunction with the mini bags for cucurbit transplanting.

Testing multi seeded onion cells in the lighter soils of System B.

Module sown seedlings need to be demonstrated on farmers fields in conjunction with the field officers.

In the medium term, the eventual vegetable seedling producers will require a study tour, to observe more intensive production units overseas.

Acknowledgements.

I would like to express my sincere gratitude to Mr Bruce Spake, Chief of Party (MARD) and all his staff, for their assistance and hospitality given to me during my stay in Sri lanka.

A special thank you must go to my assigned counterpart Mr WG Dayawansa who guided and assisted me throughout the mission.

1.0 INTRODUCTION.

The Seedling Block Module consultancy is part of the horticultural component within the Mahaweli Agricultural and Research Development Project (MARD).

The objective of MARD is to develop and promote new technology (crops, varieties and techniques) to enable System B farmers to grow export quality high value crops. Modular vegetable seedling production fits in nicely within the parameters of the horticultural component. With the above in mind the aims, results and recommendations of the consultancy are detailed below.

The consultant was in country for 26 days between April 23 and May 18, 1993. A list of activities and people met is given in appendix 2.

1.1 The Consultancy.

The purpose of the mission was to introduce a method of growing containerized vegetable seedlings (see appendix 1).

The rationale behind the activity was to devise a method that will mass produce vigorous and uniform seedlings at the correct stage of growth for transplanting. The need for such vegetable seedlings arises owing to the fact the MARD is promoting vegetable production as an export crop.

An important factor in order to achieve success in exporting vegetable crops is the requirement to have a programmed production. A programmed production signifies continuity of vegetable seedling and therefore vegetable supply.

Vegetables that are designated for export have a number of production pre-requisites, as follows:-

A uniform higher yielding crop, that can be harvested within a specific time period, the harvest window.

Crops that are planted sequentially during the optimum growing period of the year.

1.2 Consultancy Methodology.

Based on the consultant's vegetable seedling raising experience in other countries, the material and equipment available in Sri Lanka and the skills and resources of the settlers in System B, a systematic programme was devised.

The programme consisted of:-

The assessment of the existing methods of vegetable seedlin raising and reviewing any previous work that had been carrie out.

The identification of ways in which intensive vegetabl seedling production units could be established, bearing i mind the climatic conditions that prevail and the material that are available locally.

The recommended equipment and structures applicable to th skills and resources of the small farmers or farme organizations.

The economic evaluation of a vegetable seedling productio unit depending on the target group.

2.0 VEGETABLE AND VEGETABLE SEEDLING PRODUCTION.

2.1 Sri Lanka.

The species of vegetables produced in a particular region in Sri Lanka, will depend on the agro-ecological zone that prevails in any one geographic location.

Basically the zones are divided between wet, intermediate and dry areas at altitudes that vary between 0 - 2,000 meters above sea level.

In the lower areas only heat tolerant crops can be grown, such crops as the cucurbits, eggplant, chilies, sweet corn (baby corn) and to some extent onions (see figure 1 for optimum vegetable planting times in System B). Other crops, such as tomatoes and cabbage, can be grown but yields of 10 Mt and 5 Mt per ha respectively , are appreciably lower in comparison to growing the same crop species at higher elevations (tomatoes 25 MT and Cabbage 50 MT per hectare), where the temperature influence is moderated.

A greater range of vegetable crops can be grown in Sri Lanka at altitudes above 1,500 meters above sea level (m.a.s.l) whereby the maximum temperatures will not reach extremes of 33^0 C and over. The major intensive vegetable production area is situated in and around Nuwara Eliya (altitude 1,520 m.a.s.l). Of all areas visited Nuwara Eliya had the highest concentration of specialist vegetable growers.

The growers in Nuwara Eliya on average farmed between 0.2 to 0.4 of a hectare. The farming is intensive with all the year round production. In the need to achieve maximum production out of the small farm unit, no land is left uncultivated for more than a week.

Along with intensive production goes the over utilization of Farm Yard Manure, FYM and a great dependance on pesticides.

2.1.1 Transplant Technology.(see appendix 3)

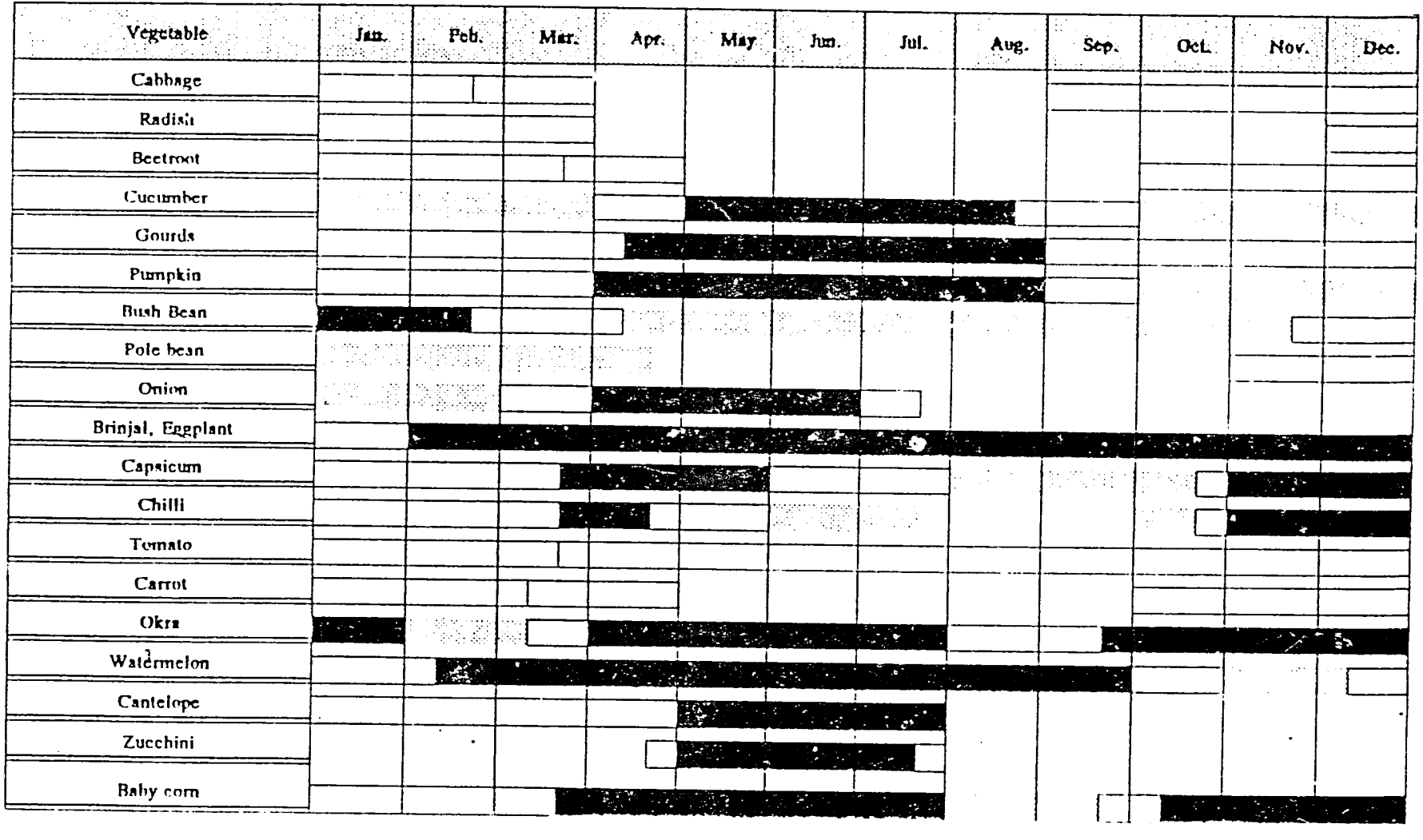
Growers in traditional vegetable production areas, like Nuwara Eliya, are accustomed to producing vegetable seedlings in raised nurseries and to bare root transplanting the seedlings. The bare root transplant method is the most popular method of growing on the crops.

Some advanced farmers will grow vegetables in blocks based on the Nandoko system. The aforementioned system is Japanese in origin and is specifically for small farmers.

Other containerized system utilized by a few farmers are growing

Vegetable Crop Planting Time Table: Mahaweli Low Country Dry Zone, System 'B'

Figure 1



seedlings in rolled banana leaves, coconut shells, tins and paper/plastic cups.

As a general comment the standard of the seedling beds and nurseries viewed was variable. Farmers that had listened to advice with respect to sowing in rows and correct seedling densities had good crops. Whereas farmers that were still broadcasting seed and not properly preparing the beds, had high seedling mortality with resultant plants of low vigor.

It was observed that no farmers grew uniform seedlings for programmed production.

2.1.2 Vegetable Nurserymen.

In the Nuwara Eliya area vegetable nurserymen do exist, that is to say growers that grow vegetable seedlings to sell to third parties. Such individuals can be categorized into three groups:

Category 1. A nurseryman that produces only vegetable seedlings to sell to the farmers and does not grow vegetables.

Category 2. A vegetable farmer that also grows seedlings to sell to farmers.

Category 3. A vegetable farmers that happens to have excess plants that could be sold on.

At this juncture it is worth mentioning that very few specialist nurserymen exist.

Seedlings that are sold are not delivered, the customer arrives and takes away his or her plants. If the customer is buying a bed of plants he or she will dig up the plants, a type of "dig your own".

2.1.3 Seedling Prices.

From the information gathered in the field it is apparent that there is a wide variance in the price of seedlings. There is therefore no preset ideas with respect to the price of a crop species at one particular planting time Price is wholly dependant on consumer demand. What does vary is the prices that plants from the various categories(see Vegetable Nurserymen, above) of nurseryman can command, as follows:-

Category 1 nurserymen gained the higher prices per plants between 25 to 50 cents per plant.

Category 2 nurserymen sell their plants between 15 to 30 cents per plant or sell the whole bed. The price is agreed on, which is according to a mutual (vendor/purchaser) plant count.

Category 3 nurserymen will offer plants at between 15 to 20 cents per plant or as above sell the nursery beds complete.

2.2 Mahaweli System B.

In comparison to other areas and systems, the farmers or settlers in System B are comparatively new to vegetable production. In fact, many settlers are new to farming. The farmers were and are growing paddy rice as their staple crop. To increase settler incomes, crop diversification is being promoted by MARD.

Farmers in system B are being encouraged to grow other crops (OC) which includes vegetables that are transplanted onions, chilli, pepper, eggplant and crops that could be transplanted such as melons, cucumber and squashes.

The vegetable crop planting time table can be referred to in figure 1. The type of crop to be planted is wholly dependant on daytime maximum temperatures and precipitation during a particular time of the year. The cropping year is divided into two:

Maha the wet season.
Yala the dry season.

Climate.

Comparatively high temperatures predominate in System B with 10 of the 12 months having an average maximum temperature above 30° C. There is little diurnal range in temperature (see figure 2).

With respect to rainfall there is a dry season (Yala) which coincides with the months of May, June, July and August (see figure 3).

From the above only heat tolerant crops can be commercially grown in the project areas.

2.2.1 Transplant Technology.

Bearing in mind the growers are new to vegetable production the nurseries visited by the consultant in Dammina and Wijayabapura blocks were not as bad as anticipated. It was clear that farmers did follow extension advice such as:

* Planting on raised beds.
* Sowing the seed in well spaced rows.
* Covering the bed to protect the seedlings from rainfall or sun as the case may be.
* Dressing farm save seed.

All transplanting is carried out using bare rooted seedlings. No

Figure 2

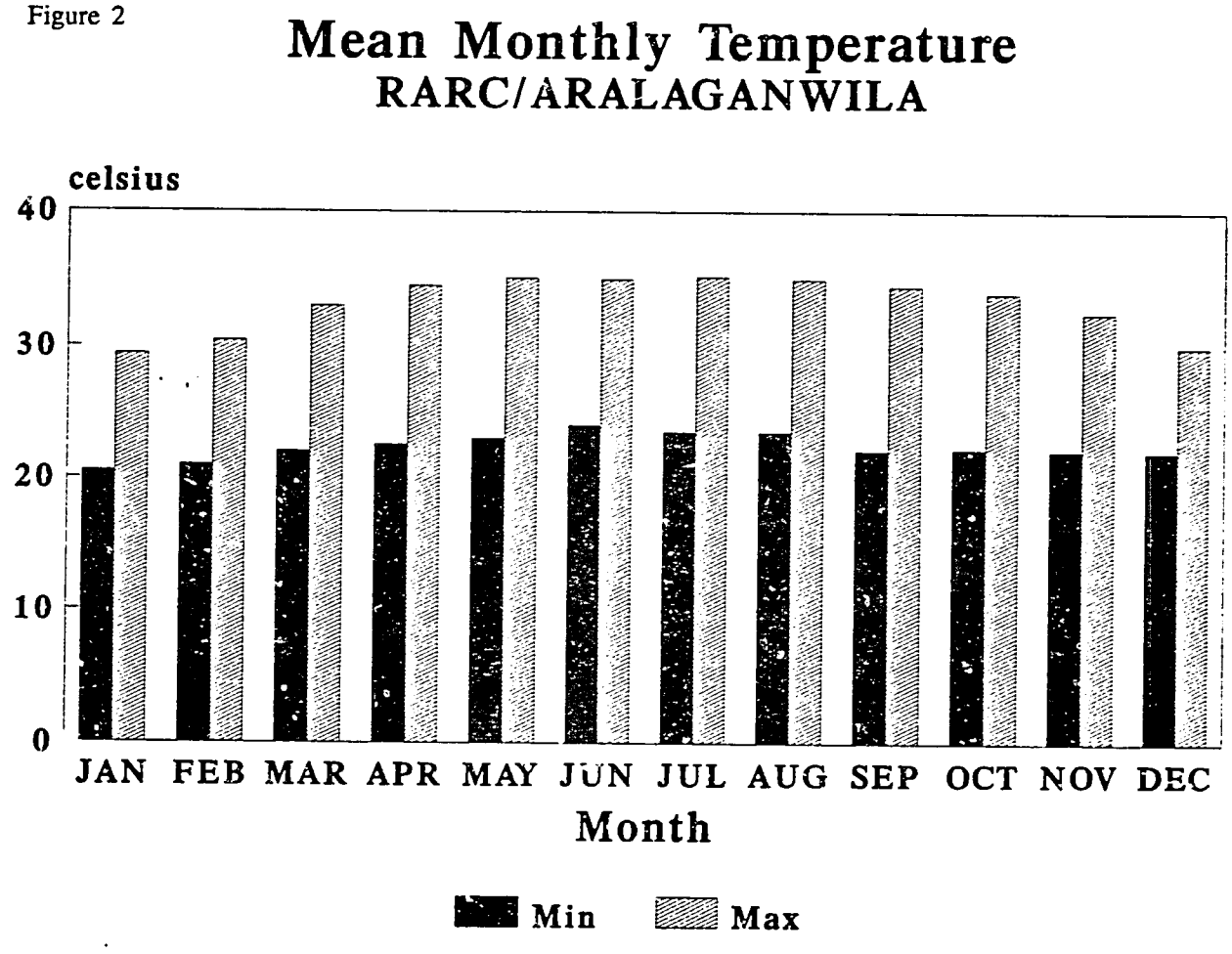
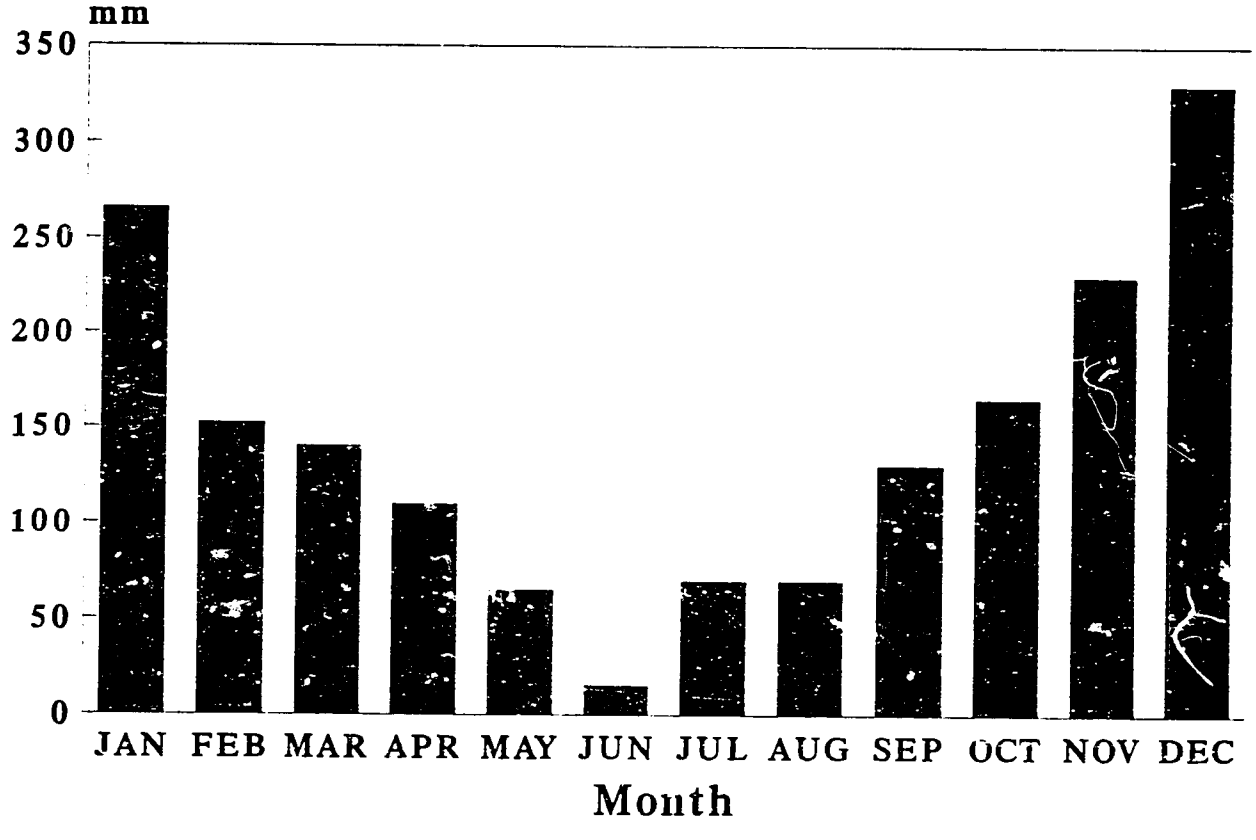

Mean Monthly Temperature
RARC/ARALAGANWILA
celsius
40
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Month
Min
Max

Figure 3

Mean Monthly Rainfall
RARC/ARALAGANWILA



modules or blocks are utilized,(the MARD project horticulturist did distribute chillies in 2 inch clear plastic liners with limited success in Maha 1992/92).

Specialist vegetable nurserymen do not exist in System B although farmers sell their excess plants. In Yala 1992 the MARD project contracted a number of growers to grow bulb onion seed to produce bare rooted transplants, for onward distribution and sale to other farmers. The contract nurserymen had intensive extension supervision, but still had numerous difficulties.

2.2.2 Seedling Prices.

The prices of vegetable seedlings in System B are very low in comparison to the prices cited from Nuwara Eliya.

There appears an ingrained opinion in the farming community that 10 cents (Sri Lanka rupees) is the price for seedlings in System B. Only one farmer stated that he could sell his plants for more than 10 cents, but only at a price of 15 cents each.

Farmers in System B do not, at present, value seedlings as an important commodity that is worth paying extra for quality. This has to change before a specialist vegetable nursery unit can become an economical viable enterprise.

2.3 The Florida Vegetable Transplant Industry.

As an insight into what is occurring in other countries below is a description of the Florida vegetable transplant industry, one of the most important transplant industries in the USA.

Containers.

Growers of containerized production utilize a wide variety of tray or container styles, such as Cell Pack, Speedling (Todd), Blackmore and Tray Master. The Speedling type tray, and copies of the design, is most commonly used. Very few growers are using containers that they have designed themselves.

Substrate.

Most of the nurserymen used an "off the shelf" mix, which is prepared by the supplier, from such manufacturers as Asgrow, Grace, and Verlite.

Some nurserymen prepare their own substrate which consists of one of the following proportions:

40% peat, 60% bark.
60% peat, 15% polystyrene, 5% sand, 20% composted bark.
50% peat, 5% polystyrene, 45% vermiculite.

Where there is a bark component in the mix, this will usually signify that the grower is producing non vegetable seedlings, for example nursery stock plants as well as vegetable transplants.

Sowing.

The majority of nurserymen seed directly into containerized flats. Nevertheless some growers, usually the smaller producers, still sow in non containerized flats and then prick out into containerized flats in order to obtain single plants in individual cells.

In Florida about 20% of the smaller operators still employ bare rooted transplants (cole and Solanaceous crops only).

All nurserymen used pre-treated seed or fungicide treated their seed.

Fertilizers.

The fertilizer regime that nurserymen utilize varies widely. Growers use one of the following N-P-K ratios:-

10-10-10, 20-10-20, 20-20-20, 12-48-8, 9-45-15 and 10-20-20.

Growers apply additional secondary and micronutrients as the need arises.

The frequency of applying the fertilizer is just as varied, ranging from a base dressing and constant fertigation to 2 applications over the 6 week period of the containerized crop.

Equipment.

A whole range of equipment exists for semi automatic seedling production, from compost mixers, tray fillers, dibbing and seeding machines.

Costs.

Bearing in mind every nursery unit is different, the approximate cost breakdown as a percentage of the overall vegetable seedling raising enterprise is:-

Production (buildings, machinery, trays, compost sterilization and shipping) 40%

Seed costs 24%

Labor costs 36%

The average cost of a tray of vegetable seedlings is US$26 or 10 13

US cents a plant, depending on the number of cells per tray.

Problems.

The Florida nurserymen encounter a number of problems, in order of priority, they are:-

1. Insect pest problems which included leaf minor on watermelon and tomato, whitefly on tomatoes, aphids on Capsicums, diamond back moth on the cole crops. Insects pests of minor importance were pinworm, looper and leaf eating beetles.

2. Poor germination was a problem with Capsicums, tomato, cole crops and celery.

3. Heat stress with the above mentioned crop species.

4. Damping off and other seedling diseases (bacterial spot, downy mildew and Alternaria).

5. Other problems encountered were water stress, fertilizer burn, nematodes and seedling damage through improper handling.

3.0 THE VEGETABLE SEEDLING PROPAGATION UNIT.

Within the Terms of Reference it was proposed that "private sector seedling production centers should be established". The target groups for such are vegetable seedling propagation unit are settlers, farmer organizations or entrepreneurs.

In this chapter the individual structures, equipment, inputs, methods and outputs to suit a generalized unit are discussed.

3.1 The Mahaweli System B Vegetable Seedling Requirement.

The number of propagation units is directly proportional to, initially, the number of hectares of transplanted vegetables grown in System B and in the future the estimated increase in vegetable production within System B and its surrounding areas.

With respect to the 1991 dry season (Yala), the following transplanted crops were grown in system B:-

Chilli 187 hectares.
Onions 76 hectares.
Other vegetables (which includes eggplant, cabbage & tomato) 55 hectares.

In the 1991/92 wet season (Maha), the following transplanted crops were grown in system B.

Chilli 77 hectares.
Onion 6 hectares.
Other vegetables 26 hectares.

In the 1991/92 cropping year there was approximately a vegetable transplant requirement for:-

7 million chilli, eggplant, cabbage and tomato seedlings.
70 million onion seedlings.

At 1991/92 production levels it would be possible to justify a less than a tenth of the 77 million seedlings produced in modules. It is the consultants opinion that many farmers will show caution in buying/using module grown seedlings.

Bearing in mind a unit output size of 1,400,000 plants described below, the project area could sustain 5 units. Nevertheless it is the consultants opinion that **3 vegetable seedling units would be a realistic target.**

3.2 The Unit Output.

A unit that would produce a 350,000 saleable plants, at a single seeding, is the maximum output that a small producer can handle, bearing in mind no automatic dibbers or seeders will be utilized. In order to produce quality plants, it is envisaged that under the System B climatic conditions a vegetable seedling producer could sow 4 times (4 x 1,800 trays) in any one year. Each sowing would be a 4 to six week schedule. The total nursery output would be 1,400,000 seedlings. This figure assumes a 20% wastage rate of unsold, weak, diseased and damaged plants.

The seedling producers could possibly sow another 2 schedules of "off season" seedlings, but he would not sell the crop. The nurseryman would have to break down the farmer idea that some crops can only be planted at a specific season and time of the year.

At present there is no incentive to produce "off season" seedlings as farmers will not buy them.

3.3 The Unit Layout.

Due to the intense heat that prevails in the project area, all the seedlings need to be grown under shade. To produce 350,000 plants in modules a shade area of 625 m2 is required.

Other structures on the nursery would be a simple storage shed, a water tank with a base. The shed would be used to store the hand tools, nursery inputs and two steam sterilizers.

The nursery requires fencing and wind break trees will be planted.

The overall dimensions of the unit can be 1,600 m2. The extra space is required for a plant acclimatization area and the shed.

3.4 The Shade.

The practical work carried out by the consultant was at the shade structure located at the MARD nursery. The shade was 30% and although, very good for mango propagation it is not suitable for vegetable seedling production. A reduction in the ambient temperature is necessary and 30% shade is not sufficient for such a reduction. Lower temperatures are very important to not only to reduce the internal ambient temperature of the shade house but also to prevent the substrate from obtaining temperatures in excess of 40^0 C. At high temperatures, onion, chilli and eggplant will not germinate.

Another problem with 30% shade is that during the times of high rainfall, large droplets can pass through the netted plastic. The droplets are capable of hitting the modules with such a force that substrate and seed or plants are displaced.

An alternative netting should be utilized. Such a netting is located at the seed farm, which has a shade house with a thicker weave of 40% shade. When as rainfall hits a denser weave it is converted into mist.

In the seedling units in Mexico open sided canopies of opaque light green perspex roofing are used. Unfortunately in Sri Lanka, such a unit is too expensive. To cover an area of 625 m2 a perspex roofed shade house would cost Rs 1,930,000/- (in comparison to the net shade house of Rs 72,000/-).

3.5 The Module.

Local Module Production.

A number of modules or plant trays are available throughout the world of all shapes and sizes. After searching for such modules in Sri Lanka there are no locally made plant trays. The project may have to import the appropriate tray at an approximate landed price of US$ 5 per tray.

In Pakistan the consultant designed a 200 cell module made from tin for a cost of US$ 8. A 240 cell tray was made by a blacksmith in Polonaruwa, the cost for the tray is inhibitive. To produce 200 tin trays the unit cost would be US$ 28.

For plastic or polystyrene trays, the manufacture of a module involves the preparation of the mold for injection plastic or the design of a template for pressing polystyrene.

Further to discussing module production and design with various plastic industries, two companies were interested and willing to quote the project for a plant tray (See appendix 11 with regard to the faxes sent).

For a 200 cell polystyrene tray - Regnis Lanka Ltd, Ratmalana. (Mr B Fernanado, tel:. 635408). This company makes refrigerators, in the manufacturing process Regnis handles and presses polystyrene.

For a 240 cell plastic injection molded tray - ARPICO, Richard Pieris Distributors Ltd (Mr M Weerasinghe, tel: 687165). ARPICO manufactures a wide range of household plastic items.

Module Materials.

The modules can be made in three ways, from polystyrene, vacuum formed plastic and injection molded plastic.

Polystyrene trays are cheap and easy to use, they break very easily and after a few years look very shabby. After a number of uses cracks form in the individual cells, seedling roots enter the cracks and the plants are difficult to pull out of the cells, The

difficult plant removal defeats the object of using a plant tray. In order to alleviate the problem of plants sticking in polystyrene trays they need to be treated with a product like Styrodip (a solution based on copper carbonate).

Because they are economical in price polystyrene trays are still widely used in the USA.

Vacuum formed trays are economical but are not long lasting and made out of a thin plastic, the tray is not rigid enough. The non rigid vacuum trays bend on benching or in the transport bins. When vacuum formed trays are bent under the load of substrate they have a tendency to break. Vacuum formed trays will only last two seasons.

Injection molded trays are the more expensive but longer lasting product, up to 10 seasons. The trays are made of strong plastic. They do not bend and can be stacked easily for chitting or storage purposes. Unlike polystyrene and vacuum formed plastic, the trays can be pressure washed and steam sterilized, without detriment to the material.

If MARD has to import trays, it is recommended that the project imports quality, that will last a long time. There is little point in importing products that will only last a few seasons. Bearing in mind the probable rough use by the local farming community, trays made out of injection molded plastic are the best products to import or have them made locally if costs are reasonable.

Module Dimensions.

The module dimensions, i.e. the number of cells per module, and the size of the cell varies widely. For vegetable production in the UK, trays with up to 336 cells are used with 19-22 cc of substrate. Seedlings grown in such cells need to be planted out in the optimum field conditions.

An ideal tray is a module with 240 cells with 25 cc cell substrate volume. This type of module will give the seedlings more substrate/compost to withstand harsh conditions but will give a planting density to fully utilize the shade house area.

3.6 The Substrate.

The main constituent of the modular substrate in the developed countries is peat. Peat is used because of its lightness, good water holding capacity and its high cation exchange capacity (see appendix 6 for analysis). The use of a finite resource as peat is not environmentally sound.

Coconut coir is an alternative infinite, renewable form of plant

substrate. Coir is being used more and more in Europe as a peat alternative.

Coir (see appendix 5) is comparatively inert with respect to the plant nutrients that it contains. In comparison to peat High Value Horticulture's experience of the product is that it has the following advantages:-

Its cation exchange capacity is excellent.

The product is easier to wet if it dries out.

The product has a greater water holding capacity.

Speed of germination is faster in coir.

Coir is a "warmer" medium (not an advantage in Sri Lanka).

Five problems that do and can occur with coir is:-

1. Salinity. if the coir is washed in sea water, salinity will be high, affecting seedling development. Coir should be purchased from factories that wash their material in fresh water tanks. The project obtained coir from a factory situated at Kurunegala 50 kilometers from the sea.

2. Green coir. If green or fresh coir is used as the substrate, a proportion of the nitrogen that is added to the material is "locked up" by the bacteria that breaks down organic matter. The full nutrient value of the base mix is not efficiently utilized owing to the bacteria using fertilizer that should have been used by the vegetable seedlings.

If fresh coir cannot be avoided then the material can be composted by adding ammonium sulphate and lime. The mushroom fungus *Pleurotus* sp can also be used in the composting process.

3. Fibers. The coir cannot be used without sieving, the material contains many threads which are detrimental to the settling of the compost in the cells. Threads will form "bridges" in the cells, when watered the bridges collapse and the nurseryman is left with a number of half empty cells in the module.

4. Microbe contamination. Recently, in the UK, there has been a lot of reports in the press regarding the contamination of coir by bacteria that may give rise to enteric diseases. It is the consultants opinion that these rumors were circulated by the peat distributors to avoid loosing substrate market share to coir. From the coir analysis carried out for High Value Horticulture (see appendix 7), neither sample contained E.

coli, the internationally recognized indicator of faecal contamination. Salmonella was also absent in the substrate. Bacteriologically speaking the results indicate that there is little enteric disease risk.

If bacteria do exist it has been shown that chemical fumigation will not control the problem. Heat sterilization or the use of UV radiation will kill any harmful bacteria.

5. Dust. In coir dust thermophilic actinomycetes can be present, these organisms can cause severe respiratory allergies (including a condition termed Farmers Lung). One sample (see appendix 7) had a high actinomycete count, such levels would not be expected in peat but are not unusual in composted products. If the product is kept in the open and is moistened before use, as it is done in Sri lanka, dust levels are significantly reduced.

As previously mentioned the coir is practically inert, it is recommended that a base dressing of N.P.K 10.20.20, be incorporated into the substrate at a rate of 3.5 kilograms per cubic meter. The quantity of base dressing assumes once the seedling pass the cotyledon/one true leaf stage that they are foliar fed (Libspray) with a 20.10.20 formula, at a rate of 3 gm in 1 liter of water applied through a knapsack sprayer.

The Kurunegala coir pH was tested by the consultant and was found to be 6.8. the pH value was high in comparison to the maximum value of pH 6.4 found in sample 3 of appendix 5. The high value may be due to the fact that the water used for irrigation has a value of pH 7.2.

3.7 Substrate Sterilization.

Damping off, a complex of Pythium, Rhizoctonia and Fusarium fungi is endemic in the seedbeds in System B. Therefore any substrate used requires a fungicide treatment but preferably sterilization.

The consultant designed and made a simple steam sterilizer that can be used to sterilize 140 liters of compost (sufficient for 23 plantraiser 240 trays). Bearing in mind that in any one season 50 m3 of substrate needs to be sterilized two sterilizer units need to be employed on every 1,800 tray nursery unit.

Certain optimum temperatures are required to destroy substrate organism, listed below are the temperatures that correspond for eradicating the various groups of soil borne plant pest and diseases:-

Organism	Temperature Required to Sterilize.(30 minutes @ ^0C)
Nematodes	50
Damping off fungi	55
Most pathogenic bacteria & fungi	65
Soil insects and most viruses	75
Most weed seeds	80
Resistant weed seed and viruses	100

Steam is the ideal medium for sterilizing coir. Other methods of sterilization do occur:-

Direct heat using fire.

Solarization employing the suns rays.

"Partial sterilization" a term used in Sri Lanka, refers to the use fungicide drenches with Captan or a similar compound.

Direct heat sterilization is not efficient for two reasons:-

If not carried out correctly parts of the compost may not be sterilized, especially if the compost is uneven in consistency and texture, "cool spots" may well have formed.

Direct heat tends to de-nature the nutrients which reduces the limited nutrient value of the coir even more.

The use of Captan appears to be extreme, not only have the seeds to be dressed using Captan but also some of the traditional nursery beds are drenched up to 3 times. Captan will only prevent fungal problems.

Solarization is impractical as this method is not effective or rapid enough to be used for sterilizing module substrates.

3.8 Staging.

The modular system requires that the trays are placed on staging, which implies beneath the tray there is air and light, root pruning occurs. Root pruning is the phenomenon when roots die or are inhibited from emerging as they attempt to grow through the individual cell's drainage hole. All roots stay in the cell and the plants are then easier to pull out of the cells.

In the consultant's nursery the staging is provided by concrete blocks over a plastic sheeting. The modules rest on the blocks, 3 blocks for two trays with a 50 cm path between the lines of two trays.

A 1000 gauge plastic sheet is utilized on the floor of the nursery.

The plastic isolates the trays from the bare soil floor of the unit, thus preventing water splash from unsterilized floor dirt to the tray.

Other more costly alternatives can be concrete or dexion/angle iron staging 1 meter from the ground.

3.9 Plant Material.

It is proposed that initially, chilies, peppers, eggplant and onions are raised in modules.

One of the major advantages of the modular vegetable seedling production is that the use of seed is reduced in comparison with traditional direct sowing and seedbed raising methods.

The reduction in seed usage is particularly important when farmers in system B use hybrid seed. Hybrid seed is an expensive commodity and should be used in conjunction with modules. In the table below the comparison in seed rates between different methods of sowing is shown.

	Modular seed requirement.	Traditional seedbed requirement	Direct seed requirement
Peppers	280 gm	1,750 gm	2,200 gm
Tomato	140 gm	350 gm	2,200 gm
Eggplant	280 gm	375 gm	2,200 gm
Cabbage	280 gm	225 gm	2,300 gm
Onion	2,500 gm	4,000 gm	6,000 gm

Assuming a 240 module tray, the grower would need the following number of trays according to the crop species and the plant density per hectare:-

Crop.	No. of trays	Spacing.*
Sweet peppers	220	40 x 40 cm
Chili	100	60 x 60 cm
Eggplant	100	60 x 60 cm
Onion	3,541	10 x 10 cm

* taken from Sri lankan extension guidelines.

In some ways, using modules for onion transplants appears impractical owing to the fact that a 625 m2 shade unit would only produce sufficient onion seedlings for half a hectare.

The spacing of 10 x 10 cm appears very close, bulb onions are usually grown at spacings between 5 - 10 cm between plants and 20 - 45 cm between rows. Nevertheless Sri Lankan plant density in conjunction with reducing the tray requirement per hectare could be achieved by using multi seeded plugs.

3.9.1 Onion Multi-seeded Plugs.

Multi seeded cells or plugs were pioneered by Dr Mirons in the UK, whereby up to six onion seeds are sown in an individual cell and the onions are then transplanted as a number of plants in the multi plant cell.

The advantage of multi seeded plugs are an earlier harvest, a higher yield, a more uniform bulb size and less modules are required per unit area.

Using the Sri lankan plant population requirement of 850,000 onion seedlings per hectare, which requires 3,541 trays (1 seedling per cell) an alternative to achieve the same population density would be multi-seeded plugs (6 seedlings per cell) thus requiring 593 trays. It is obvious this method cannot be recommended until trials are carried out within System B.

3.9.2 Cucurbits in Modules.

Traditionally cucurbits (cucumbers, watermelons, melons and squashes) are direct sown into the field. Cucurbits were not transplanted because of the seed size, they do not tolerate being bare root transplanted and the seedlings do not resist rough handling.

With the onset of containerized planting methods some cucurbits (watermelons and to some extent melons) are transplanted out of containers. In Florida over 23 million watermelon and 4.5 million melon seedlings were grown in containers during 1990. In fact seedless watermelons are difficult to germinate and containerized production is a criteria for this particular crop.

In System B rats are a problem in the melon crop, the rodents go along the lines of freshly planted melons dig up the seed and eat them. There is a case for containerized planting of melons.

If melons are to be planted in containers different modules will need to be used. A module with at least 150 cc of substrate per cell which would be a 72 cell tray. The melon seedlings will be ready for transplanting within three weeks. Transplanting should be carried out before there is any appreciable elongation of the stem.

Leaving the plant too long in the module will be detrimental to the crops survival rate in the field, heavy losses due to sunburn can occur, therefore the planting out time has to be more precise.

Cucurbit Mini Bag Production.

If trays are not available melons can be grown in mini bags, 3 inches deep by 2 inches in diameter, MARD has produced such bags for growing chillies. With the use of sterilized coir compost the mini bag is ideal for growing individual melon plants.

The filling of the mini bag with substrate is completed comfortably in 20 seconds. Therefore during an 8 hour shift a worker can fill and sow approximately 1,500 mini bags, at an in field plant density of one plant in a 0.65 m2 area the two designated workers can prepare sufficient plants for a fifth of a hectare per day.

The 63 sown mini bags can be put into ordinary household trays 35 x 45 cm and placed on staging.

3.10 Seedling Acclimatization.

Seedling acclimatization or "hardening off" is the process of preparing the tender vegetable seedling for transplanting into the field. Acclimatization is necessary in order to adapt the seedling from a controlled "soft" environment under shade to a harsh field environment.

The method of acclimatization is a combination of the following methods:-

Restricting irrigation, by reducing the frequency of watering, a week before transplanting .

By exposing the plants to the outside ambient temperatures, the operation of placing the trays outside the shade in the acclimatization area.

By not foliar feeding the seedlings a week before transplanting.

On the other hand in the UK, if the plants were to be planted out in ideal conditions, some nurserymen would over feed the seedlings two days before planting out. The rich nutrient regime gives the plants a boost and they will grow very quickly, right from the day of transplanting. In System B this method is not recommended, as it is doubtful whether conditions would be optimal for transplanting.

3.11 Water.

For efficient watering in a nursery, the unit requires an over head tank. Water should be pumped up to a 500 liter tank at a height to give sufficient pressure for irrigation through a spray nozzle at the end of a hose pipe. Four meters is an appropriate height for irrigation purposes.

Tank storage is required instead of pumping direct into the hose line. Water storage is always advisable just in case there is an electricity failure during peak watering times. A water tank of five hundred liter capacity is sufficient to water the plants for a number of days without pumping.

Assuming the water is pumped out of the canal the quality of the irrigation water, that is available, is good. The salinity, sodium and calcium levels are low and would not affect the tender young seedlings.

The water analysis commissioned by MARD revealed the following:-

pH 7.2,		
EC (salinity)	0.4	mmhos/cm.
Calcium	0.82	meq/1
Sodium	0.31	meq/1

Another potential harmful element iron, was not measured in the analysis. The color and smell of the water would not indicate a high iron content.

4.0 THE COST OF SEEDLING PRODUCTION

The costs of producing vegetable seedlings using three models or scenarios are discussed below. The nursery is as the specifications described above, 1800 trays on a four sowing turn around.

4.1 The Full Cost Model Nursery.

Over leaf, in figure 4, is the cost breakdown of a nursery that assumes an individual entrepreneur takes out a five year loan of Rs 925,000 at 22% interest and establishes a nursery of a 1,800 module capacity on 4 crop cycles. The overall assumptions of the model can be seen in appendix 8.

The model assumes that the nurseryman not only services his 22% loan but he pays back a fifth of his principal borrowed every year over a five year period.

From the model it is clear that the production cost of the individual seedlings, in comparison to the local selling rates is high from 32 cents in year 1 to 18 cents in year 6, at current rupee prices. For the nurseryman to make a reasonable profit he would have to sell the seedlings for at least 50 cents each.

After the fifth year when the loan had been repaid the nurseryman could reduce the price of his plant material by approximately 10 cents.

Under the present circumstances, with the fact that farmers pay around 10 cents for each seedling, the nurseryman would find it very difficult to sell his plants.

<u>Seedling wastage.</u>

It is worth noting that a wastage rate of 20% was assumed in the model. For such a wastage rate the seed has to be good seed with a high germination percentage. Nevertheless, the wastage rate caters for poor germination, diseased and weak plants that the grower cannot sell.

If the nurseryman was highly efficient and achieves a 5% wastage rate in year one, each seedling would cost 27 cents and in the sixth year 15 cents to produce. A five percent wastage rate is only possible if the grower were to sow two seeds in each cell.

The nurseryman could reduce the price of his seedlings in the sixth year to 30 cents a plant and still make a profit of Rs 250,000.

Figure 4

FULL COST MODEL NURSERY

Seedling Nursery Costs
625 m2 shade area)

ITEM	Total cost (Rs)	Years	Year 1 (Rs)	Year 2 (Rs)	Year 3 (Rs)	Year 4 (Rs)	Year 5 (Rs)	Year 6 (Rs)
Land rent	0	1	0	0	0	0	0	0
Fencing (160 meters)	41600	8	5200	5200	5200	5200	5200	5200
Plastic sheet(1000 guage)	21875	4	5468.75	5468.75	5468.75	5468.75	5468.75	5468.75
Shade house (structure)	50000	8	6250	6250	6250	6250	6250	6250
New shade	28125	3	9375	9375	9375	9375	9375	9375
Staging bricks	24000	10	2400	2400	2400	2400	2400	2400
Steam steriliser/stove x 2	5000	5	1000	1000	1000	1000	1000	1000
Modules (2000)	500000	10	50000	50000	50000	50000	50000	50000
Knapsack sprayer	3500	5	700	700	700	700	700	700
Overhead water tank/base	35000	10	3500	3500	3500	3500	3500	3500
Water pump	7000	7	1000	1000	1000	1000	1000	1000
water piping + hoses	8000	5	400	400	400	400	400	400
Equipment shed	10000	10	1000	1000	1000	1000	1000	1000
Substrate 50 m3	30000	1	30000	30000	30000	30000	30000	30000
Kerosene	10065	1	10065	10065	10065	10065	10065	10065
Fertiliser	6830	1	6830	6830	6830	6830	6830	6830
Pesticides	1000	1	1000	1000	1000	1000	1000	1000
Onion seed	600	1	600	600	600	600	600	600
Chilli seed	5500	1	5500	5500	5500	5500	5500	5500
Pepper seed	2250	1	2250	2250	2250	2250	2250	2250
Brinjal seed	5500	1	5500	5500	5500	5500	5500	5500
Hand tools	2000	2	1000	1000	1000	1000	1000	1000
Watchman	28000		28000	28000	28000	28000	28000	28000
Laborers (420 mandays)	54000		54000	54000	54000	54000	54000	54000
Sub total costs	879845		231038.75	231038.75	231038.75	231038.75	231038.75	231038.75
Contingency	5.00%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Contingency costs	43992.25		11551.9375	11551.9375	11551.9375	11551.9375	11551.9375	11551.9375
Sub total	923837.25		242590.687	242590.6875	242590.6875	242590.6875	242590.6875	242590.6875
Loan servicing	22.00%		203244.195	162595.356	121946.517	81297.678	40648.839	0
TOTAL PRODUCTION COST			445834.882	405186.0435	364537.2045	323888.3655	283239.5265	242590.6875

Full cost continued:

Seedlings numbers	1728000	1728000	1728000	1728000	1728000	1728000	1728000
Wastage rate	20.00%	345600	345600	345600	345600	345600	345600
Revenue earning production		1382400	1382400	1382400	1382400	1382400	1382400
Price per seedling		0.32	0.29	0.26	0.23	0.20	0.18
Retail price.		$0.50	$0.50	$0.50	$0.50	$0.50	$0.50
Revenue		245365.117	286013.9565	326662.7955	367311.6345	407960.4735	448609.3125
Principal repayment		184767.45	184767.45	184767.45	184767.45	184767.45	0
Profit		60597.6675	101246.5065	141895.3455	182544.1845	223193.0235	448609.3125

4.2 The Farmer Organization Nursery Unit.

In figure 5 the costs are presented for a nursery that is part of a farmers organization (FO). The organization would manage the nursery using the FO manager, whereby part of the manager's salary would be allocated to him from the nursery revenues.

The model also assumes that the project or MEA, as a development cost, grants the FO the capital equipment required to establish a nursery.

The cost of the individual seedlings will be between 13 cents in year one to 11 cents in year 5 onwards, at current rupee prices. To make some profit the FO would have to sell its seedlings for at least 17 cents.

Seedling Wastage

As in the full cost model if the FO nursery reduced the wastage level to 5%, in the first year the production cost of a seedling would be 11 cents per plant and 9 cents per plant during the sixth year.

Figure 5

FARMER ORGANISATION

Seedling Nursery Costs
(625 m2 shade area)

ITEM	Total cost (Rs)	Years	Year 1 (Rs)	Year 2 (Rs)	Year 3 (Rs)	Year 4 (Rs)	Year 5 (Rs)	Year 6 (Rs)
Land rent	0	1	0	0	0	0	0	0
Substrate 50 m3	30000	1	30000	30000	30000	30000	30000	30000
Kerosene	10065	1	10065	10065	10065	10065	10065	10065
Fertiliser	6830	1	6830	6830	6830	6830	6830	6830
Pesticides	1000	1	1000	1000	1000	1000	1000	1000
Onion seed	600	1	600	600	600	600	600	600
Chilli seed	5500	1	5500	5500	5500	5500	5500	5500
Pepper seed	2250	1	2250	2250	2250	2250	2250	2250
Brinjal seed	5500	1	5500	5500	5500	5500	5500	5500
Hand tools	2000	2	1000	1000	1000	1000	1000	1000
Watchman	28000		28000	28000	28000	28000	28000	28000
Labor (420 Mandays)	50400		50400	50400	50400	50400	50400	50400
Management (Salary + Com.)	24000		24000	24000	24000	24000	24000	24000
Sub total costs	142145		141145	141145	141145	141145	141145	141145
Contingency	5.00%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Contingency costs	7107.25		7057.25	7057.25	7057.25	7057.25	7057.25	7057.25
Sub total	149252.25		148202.25	148202.2	148202.2	148202.2	148202.2	148202.2
Loan servicing	22.00%		32835.495	26268.39	19701.29	13134.19	6567.099	0
TOTAL PRODUCTION COST			181037.74	174470.6	167903.5	161336.4	154769.3	148202.2
Seedlings numbers	1728000		1728000	1728000	1728000	1728000	1728000	1728000
Wastage rate	20.00%		345600	345600	345600	345600	345600	345600
Revenue earning production			1382400	1382400	1382400	1382400	1382400	1382400
Price per seedling			0.13	0.13	0.12	0.12	0.11	0.11
Retail price.			0.18	0.18	0.18	0.18	0.18	0.18
Revenue			67794.255	74361.35	80928.45	87495.55	94062.65	100629.7
Principal repayment			29850.45	29850.45	29850.45	29850.45	29850.45	0
Profit			37943.805	44510.90	51078.00	57645.10	64212.20	100629.7

4.3 The Settler Nursery Unit.

In figure 6 the costs are presented for a settler nursery unit. In this particular case, as in the FO model, the capital cost equipment is granted to the settler. All the labor inputs in the enterprise will be taken care of by the farmer and his family. No outside labor will be hired.

The production cost of individual seedlings will be from 6 cents in year 1 to 5 cents from year 6 onwards, at current rupee prices. The low prices signify that if the settler can command a premium for modular produced plants over the existing bare root transplants, the settler family can make a reasonable living out of the enterprise.

Seedling Wastage.

Like the other two models the settler nursery could reduce its wastage rate in this case it would be possible for the nursery to reduce the wastage rate to 10% and not 5% as is given in the other two examples. Nevertheless if the wastage was reduced to 10% then the family could produce plants at a price 5 cents in the first year and 4 cents in the sixth year.

Figure 6

SETTLER NURSERY

Seedling Nursery Costs
(625 m2 shade area)

ITEM	Total cost (Rs)	Years	Year 1 (Rs)	Year 2 (Rs)	Year 3 (Rs)	Year 4 (Rs)	Year 5 (Rs)	Year 6 (Rs)
Land rent	0	1	0	0	0	0	0	0
Suustrate 50 m3	30000	1	30000	30000	30000	30000	30000	30000
Kerosene	10065	1	10065	10065	10065	10065	10065	10065
Fertiliser	6830	1	6830	6830	6830	6830	6830	6830
Pesticides	1000	1	1000	1000	1000	1000	1000	1000
Onion seed	600	1	600	600	600	600	600	600
Chilli seed	5500	1	5500	5500	5500	5500	5500	5500
Pepper seed	2250	1	2250	2250	2250	2250	2250	2250
Brinjal seed	5500	1	5500	5500	5500	5500	5500	5500
Hand tools	2000	2	1000	1000	1000	1000	1000	1000
Family Labor	0		0	0	0	0	0	0
Sub total costs	63745		62745	62745	62745	62745	62745	62745
Contingency	5.00%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Contingency costs	3187.25		3137.25	3137.25	3137.25	3137.25	3137.25	3137.25
Sub total	66932.25		65882.25	65882.25	65882.25	65882.25	65882.25	65882.25
Loan servicing	22.00%		14725.095	11780.076	8835.057	5890.038	2945.019	0
TOTAL PRODUCTION COST			80607.345	77662.326	74717.307	71772.288	68827.269	65882.25
Seedlings numbers	1728000		1728000	1728000	1728000	1728000	1728000	1728000
Wastage rate	20.00%		345600	345600	345600	345600	345600	345600
Revenue earning production			1382400	1382400	1382400	1382400	1382400	1382400
Price per seedling			0.06	0.06	0.05	0.05	0.05	0.05
Retail price.			0.15	0.15	0.15	0.15	0.15	0.15
Revenue			126752.655	129697.67	132642.693	135587.71	138532.73	141477.75
Principal repayment			13386.45	13386.45	13386.45	13386.45	13386.45	0
Profit			113366.205	116311.22	119256.243	122201.26	125146.28	141477.75

5.0 MODULE PRODUCTION IN SRI LANKA & SYSTEM B.

5.1 The constraints.

In the consultants opinion a number of constraints exist that will effect the successful adoption of the modular method of vegetable seedling production, such constraints as:-

1. The limited equipment available on the local market.

2. The vegetable seedling market and current vegetable average yields.

3. The high interest rates.

4. Tray return from the farm.

5.1.1. Vegetable Seedling Equipment.

Apart from the pipes for the irrigation lines, the shade house structure, the steam sterilizer and hand tools, all specialist equipment has to be imported.

In the 1,800 module seedling unit described above, the only imported equipment was the modules and the shade netting. If, to cater for a higher demand, the nurseries were expanded equipment would need to be imported. The automatic and semi automatic machinery to be imported, would be subject to a 40% import duty. The comparatively high duty rate is disadvantageous to the grower in comparison to other countries. In many countries there is no import duty on agricultural equipment.

The use of intermediate technology is important and in the long term it is wiser for the agribusiness sector to devise simple devises that can be used locally by adapting equipment to suit local conditions. Such equipment that needs to be adapted are the dibble board, the soil master foot operated pegging machine or a hand operated multi seed sower (see appendix 9).

5.1.2 Seedling Price and Yields.

As mentioned earlier farmers in System B have the idea that vegetable seedlings are worth 10 cents each. The farmers made no reference to the crop, the seed origin, the plant size and the quality of the seedling.

In other parts of the world prices of plants are higher and more realistic. At this juncture it is worth mentioning, that in other countries, yields are higher and cropping is programmed to suit the market conditions and processing.

For example the equivalent rupee cost of seedlings in other parts

of the world are as follows:-

United Kingdom between 2.0 to 5.0 rupees per plant.

USA (Florida) An average price of 5 rupees per plant.

Mexico between 0.8 to 1.20 rupees a plant.

In Nuwara Eliya, Sri Lanka, seedling prices range from RS 0.15 to Rs 0.5.

From the above if Sri Lankan prices were comparable to even Mexican levels, an entrepreneur in the fully costed model would be able to make a good return.

To put the System B perceived seedling price into perspective, one only has to compare yields of the crops grown in System B, with up country and those yields from abroad, see below.

Crop	USA*	Mexico**	Up Area+	System B++
	(metric tons per hectare)			
Eggplant	26	22	20	9.3
Bulb onion	41	22	--	6.0
Chilli	-	3	--	1.0

* USDA
** Secretaria de Agricultura y Recursos Hidraulicos, Mexico.
\+ Department of Agricultural Economics and Planning.
++ MARD Yala 1992 report.

With respect to System B the settlers, they are novices when it comes to growing vegetables. From the crops observed the plant population is low with many plants missing. The majority of missing plants are due to transplant failure and soil borne diseases.

To improve plant population and therefore increase yield a module grown plant could assist the settler in achieving such improvements. The farmer needs to be shown such module techniques can improve his yield and raise his profitability.

If yields in System B were higher then there would be less resistance from the settlers to purchase seedlings for more than 10 cents.

At present vegetable seeds are not that expensive. If seed prices rose farmers would be aware of seed wastage and would more readily buy seedlings in modules.

5.1.3 Interest Rates.

An interest rate of 22% is a major constraint when trying to establish a fledgling industry, especially when the enterprise is novel.

As can be seen from the full cost model figure 4, an entrepreneur would have to pay Rs 1.25 million over a five year period to service the loan. The farmer also needs to pay back the principal, another Rs 923,000.

5.1.4 Tray Return.

One problem encountered in other countries is the return of the trays by the farmers after use. In an ideal world farmers should send the trays back to the nurseryman once they are empty. With out much of problem tray return is effective in the USA and Europe.

In other parts of the world the nurseryman's confidence in farmers returning trays is not so solid. In Mexico, farmers come to the nursery with boxes and empty the trays at the nursery. Damage to the plants invariably occurs in transit, some farmers can travel as much as 100 kilometers to purchase seedlings.

If MARD imports plantraiser trays farmers will realize that they are valuable items and keep the trays for themselves (personal communication).

Work is required to devise a means of ensuring tray return. A number alternatives do exist:-

1. The farmer pays a deposit for the tray. Unfortunately a full deposit would be 250 rupees which is impractical.

2. The nurseryman or a worker delivers the trays to the farmers and waits for the trays to be emptied. This ties up the nurseryman or his employees time.

3. The nurseryman could operate a contract service, whereby he plants the seedlings in the farmers field, thus ensuring tray return.

4. Farmer organizations could own the trays on behalf of their members. The trays are color coded according to which group they belong to. It would be then the responsibility of the FO to ensure tray return.

5.2 Possible Comparative Advantages.

In Sri Lanka there are a number of positive benefits with respect to the various facets of module vegetable seedling production. The advantages are detailed in the individual sections below:-

5.2.1 Labor.

Modular vegetable seedling production is an intensive and time consuming vocation. Many of the jobs, if done manually are intricate, especially dibbing and sowing the seed.

For intricate work women show a higher skill level and are more patient than men, the female worker has more subtle hands. Many women work on the land and do not shy from hard and tedious work.

Women are readily available as a work force and as such be utilized for seedling work.

In comparison to other countries the Sri Lankan salary levels are comparatively low, which is a distinct advantage. The salary comparison is detailed below:-

Sri Lanka	US$ 2.40 per day.*
Mexico	US$ 3.50 per day.
Brazil	US$ 4.50 per day.
India	US$ 2.30 per day.*
Pakistan	US$ 2.50 per day.*
USA	US$ 32.00 per day

* includes food.

It should be noted that in Sri lanka, with respect to the above rates, **the daily salary for women is usually 25% less than for men.**

5.2.2 Coir.

As previously mentioned, provided it is sieved and sterilized, coir is an ideal substrate for module work. The substrate is a waste product from the coir fibre factories and it is freely available to anybody that wants to collect it.

The only cost incurred by the nurseryman is the coir haulage charge.

5.2.3 Tray Transport.

One major factor that affects the adoption and acceptance of vegetable module is the transport of the trays, to the farm.

Farmers in many countries have to hire tractor and trailers, pickups and, on a larger scale, articulated lorries. Many small farmers can not afford the luxury of hiring such vehicles.

In System B the average area of vegetable production per farm unit is between 600 to 2,000 m2. Such small production areas would require between 20 to 60 trays (onions is the notable exception of 700 trays for 2,000 m2 cultivated).

In Sri Lanka, for transportation settlers have at their disposal the Kubuta type two wheel tractors and the locally made trailer adaption, an ideal piece of equipment for transportation. The flat bed of the trailer (1.90 x 1.05 meters) will take 7 trays (240 cells). With a simple 6 layer staging frame work that fits into the trailer boards, the small tractor can carry up to 42 trays comfortably.

5.2.4 Import Ban.

A decision was made by the Sri Lankan cabinet to progressively ban the import of certain agricultural commodities. The list of crops include onions and chillies which will be banned over a period of one year. In theory farm gate prices should rise and there will be a need for farmers to grown such crops throughout the year. The farmer needs to time his production to fill the demand gaps created by the import ban.

Module production of seedlings lends itself to programmed production.

5.2.5 The Packhouse.

An added advantage that System B has is that there is a packhouse located in the project area. A packhouse negotiates forward contracts with growers and encourages farmers to schedule the cropping to suit the packhouse demands. Modular seedling production will help the farmer grow his crops to suit specific production times.

The farmers that grow for the packhouse will be more conducive to adopt modular seedling technology.

6. 0 FIELD COMMENTS

In order to obtain some feedback on the vegetable seedling module system, the consultants counterpart Mr Dyawansa discussed the principles of the method with System B extension staff (20 Field Assistants and 3 Agricultural Officers), below are their ideas and comments on the method:-

The Method. The module system was liked by all, one person had seen modules at the Asian Vegetable Research and Development Center in Taiwan.

The Substrate. The coir substrate is good and was thought ideal, but getting the material from a distance of 100 kilometers from Kurunegala may be expensive.

The Sterilizer. They thought the sterilizer would be more efficient using firewood (not environmentally sound) rather than using a kerosene stove.

The Seedling Price. The seedling price is between 8 to 12 cents per plant, perhaps module produced seedlings could sell for up to 20 cents per plant.

The Vendor. It is doubtful that farmers will buy plants from other farmers, they mistrust each other. There would be some demand for Farmer Organization raised seedlings," but it is better that MARD produces the plants".

Tray Return. Farmers will not return the tray, a method of tray return will need to be devised.

Module Adoption. For the module system to be adopted by settlers, the individuals have to see trays sold in the farm supply shops. Once trays are for general sale the method would be accepted, there is a little hesitance on the farmers to be the first one to try a particular system.

The Loan. No farmer would borrow nearly a million rupees to establish a vegetable seedling unit.

The Crops. The type of crops to use for module transplants would be peppers, eggplant and cabbage, perhaps chilli? Onions would not be accepted and cucurbits transplants should be grown in larger containers like coconut shells, banana leaves etc.

7.0 RECOMMENDATIONS.

7.1 Action Required.

Farmers in System B need to be aware of the advantages of using module grown transplants. The sooner that such transplants are available in System B the sooner the technology will be adopted.

The first farmers to target are those that are now supplying produce to the System B packhouse. The growers would be getting used to programming their crops to suit packhouse schedules and modules help the programmed production.

It is recommended MARD to:-

Obtain a supply of modules of either locally (tin) or Colombo made (plastic/polystyrene) or imported modules of 240 cells with cell volumes of between 25 - 50 cc of substrate.

Initially module production will be located at the fruit nursery or the shade at the seed farm.

In the first season, MARD produces modules for certain select innovative farmers.

As the module system of production is new, a project technician is required to take charge of such an operation. Although not a project officer, Mr Dayawansa who accompanied the consultant throughout the mission would be an obvious choice. Another possibility would be an Agricultural Officer from MEA, who could develop a vegetable seedling unit not only in System B but also in other Systems.

7.2 The Packhouse.

In many foreign production areas the packhouses and freezing plants are not only the focus of produce purchasing but also they supply (sell) the plants to be grown to their suppliers. The supply of transplants ensures that the packhouse receives a known variety, standard product and that the planting dates and therefore harvest dates are programmed.

In the long turn the System B packhouse has to be involved directly or indirectly with seedling supply to its out growers.

Directly by producing the plants by themselves, which at present appears impractical as TESS is very preoccupied with establishing the packhouse.

Indirectly by working closely with a registered nurseryman to supply the packhouse out growers with specified plants, at the correct stage of growth and the right time of the year.

7.3 Equipment Importation.

At present it is not advisable to import automatic tray fillers, dibbers and seeders. The importation of semi-automatic machinery (examples given in appendix 9), may take place at a later date if a nursery is expanded to above a 4,000 tray capacity.

A soil shredder, to cut coir fibers, as shown in appendix 10 is worth testing. The shredder will reduce the 20 - 40% wastage percentage caused by the long unusable fibers.

If suppliers/manufacturers cannot be found in Sri Lanka a tray will have to be imported. An ideal tray is a module with 240 cells with 25 cc cell substrate volume. This type of module will give the seedlings more substrate/compost to withstand harsh conditions but will give a planting density to fully utilize the shade house area.

A module with the above specifications would be a plantraiser tray. An extra advantage of the plantraiser tray is the design of the individual cells. The cell shape will give the nurseryman more compost per tray unit area in comparison to other tray designs.

The tray is made from injection molded plastic and is very sturdy signifying it can take a lot of misuse without damage.

The design is patented and can only be bought through Plantway.

7.4 Further Work.

The module system of vegetable production is new not only for System B but for Sri Lanka. A lot more work with respect to testing systems and equipment is required, such work recommended is:-

The evaluation of sequential planting, to grow off season crops and achieve programmed production

Comparing the use of 50% open sided shade houses instead of 30% enclosed shade houses. An alternative would be to test local shading materials.

Testing multi seeded onion cells in the lighter soils of System B.

Assessing the coir substrate in conjunction with the mini bags for cucurbit transplanting.

7.5 Training and Demonstration.

The MARD Unit. Once the MARD vegetable seedling unit is established the system has to be demonstrated to farmers and potential nurserymen. In the first year the MARD unit will be testing the technology and the economics of the unit. The unit will also act as a demonstration site for potential nurserymen.

At a later stage, when the system is perfected, the training will commence. Training will fall into a number of categories:-

For nurserymen on how to grow the seedlings, from establishment of a unit, substrate preparation, seed sowing, growing, pre transplant preparation, seedling transportation and the economics of the enterprise.

For the settlers how to calculate their requirements, programme production, transport and plant seedlings. This would require demonstrations in specific areas or with certain farmer groups, as well as farmer visits to the unit.

For the Field Assistants. The field staff need to be trained with respect to the above but also, the officers will have to set out demonstrations in their areas of influence. The demonstrations will show:

1. How to transport seedlings to the field.

2. Methods of transplanting seedlings and post transplant care.

3. The comparison of plant populations between module grown transplants and bare rooted transplants.

4. To measure the difference in growth rate between cell and bare root transplants and the differences in yield.

If the system becomes a reality, when cell transplants begin to be in demand and production is projected to increase, an overseas study tour is recommend for the vegetable seedling coordinator and committed private sector nurserymen.

At present the consultant has designed a small unit, if the unit is to expand, semi automatic or automatic machinery will be required, such equipment needs to be viewed and if possible operated by the participants of the tour.

7.6 Medium Term Recommendations.

The successful adoption of the vegetable seedling unit will depend on the private sector being involved. It is proposed that at the

end of the second season a number of private nurseries could be established. The nursery owner will be granted the capital equipment by MARD and the project will guarantee vegetable seedling sales on a buy back scheme.

An alternative to the above is that the existing MARD nursery be sold at a discounted price to a nurseryman.

By the end of the third season a second and possibly third nursery would need to be established. The nurseries could be run by settlers and their families or Farmer Organizations under the financial guidelines laid out under section 4.2 and 4.3.

APPENDICES.

Appendix 1

TERMS OF REFERENCE.
SEEDLING BLOCK MODULE EXPERT.

BACKGROUND.
Following the establishment of a cold chain facility for export crops, it is necessary to produce and time the production of various crop varieties. It is believed that the efficient production of seedlings of the correct varieties will give the settlers in Mahaweli System B an opportunity to produce these crops and give continuity and quality to the markets.

GOAL.
To establish a private sector seedling production center in Mahaweli System B.

OBJECTIVES.
1. Generate information on a suitable seedling system which will help the settler farmer grow timed production for the export market.

2. Create a suitable system that uses expensive hybrid seed in the most economic way possible, therefore broadening the range of germplasm available to the settler farmers in system B.

TASKS.
1. Review relevant information available on seedling production in Sri Lanka.

2. Upon arrival in Colombo, meet the coordinator, System B, MEA and Senior Agronomist MEA to review terms of reference.

3. Upon arrival in System B meet the Resident Project Manager, the Deputy Resident Project Manager and MARD acting Director to review the Terms of Reference.

4. Report on two or three options of module transplant systems that might be suitable to Mahaweli System B. This information should include:

a) Module design and source.
b) Medium types and composition.
c) Some estimated costing of the above.
d) Size and estimated facilities required for system B.

5. Arrange a training scheme that would be suitable for use by the private sector when the module system is in place.

6. Work with a Sri Lankan expert to investigate and recommend sustainable local adaption to the suggested module including any adaption to the medium to be used etc. Report any cost advantages

found in Sri Lanka compared with other countries.

7. With the cropping information from Mahaweli Authority and the MARD project, design and cost a seedling production system for a private investor in System B.

8. Prior to the end of the consultancy, prepare and present a report on the activities under the terms of reference. The report shall include and not be limited to, activities and problems encountered.

9. A draft report must be submitted three days before the end of the mission.

Appendix 2

MISSION CONTACTS.

In the UK.

Gamini Atukorale M.P.	Minister of Lands, Irrigation and Mahaweli Development.
Charley Jayawardana BA. FEDI.	Secretary, Ministry of Lands and Land Alienation

DAI/MARD/MDS personnel.

Bruce Spake	Chief of Party.
Martin West	Horticulturist.
Henry Harmon	Marketing Specialist
Chilliah John	Grape Consultant.
T.C. Welikala	Training Coordinator.
Y.P. de Silva	Extension Agronomist.
K. Santhgunasigham	Civil Engineer.
Mrs I Padmasira	Tree Crops Specialist

USAID Colombo.

Mr G Alex	Project Officer.

Private Sector Agribusiness and Industry Personnel.

Mr L. Disanayake	OIC, CTC Potato Farm, Ambewela.
Mr S. Muthu	Muthu Stores, Nuwara Eliya.
Dilshan Fernando	Tess Agro (Pvt) Ltd.
Mr M R Hassandeen	Phoenix Industries (Pvt) Ltd.
Mr Rabindranath	Forbes Agricultural Services.
Mr B Fernando	Regnis (Lanka) Ltd.
Mr M Weerasinghe	ARPICO,Richard Pieris Distributors Ltd.

Government Agricultural Personnel.

I.B. Herath	Ass. Dir. Agriculture, Nuwara Eliya.
I.Ranatunga	A.D.A (training),ISTI, Badarawala.
.P. Karunasckra	Agrarian Supervisor, Nuwara Eliya.
Dr J. Fernando	D.D. Research (quarantine)
Mr A. Lecamwasam	D.D. Research RARC Aralaganwila.

Farmers and Nurserymen.

Many farmers from System B.

.M. Jayesekara.	Nuwara Eliya.
. Nanayakare.	Nuwara Eliya.
. Sundaraaja.	Nuwara Eliya.
.M. Jayantha.	Nuwara Eliya.

Others.

r Bob Nissen	Moroochy Horticultural Research Station.

Appendix 3.

VEGETABLE SEEDLING PRODUCTION METHODS IN SRI LANKA.

Vegetable crops.

The following transplanted vegetable crops are grown within the region:-
Tomatoes.
Chilies and peppers (capsicums)
Onion.
Eggplant (brinjal)
The cole crops (cabbage and cauliflower)
Lettuce.

With respect to the crop species cited above only chilies, peppers and onions can be grown with success in system B. The prevailing ambient temperature is too high for cole crops to grow successfully and for the efficient pollination of the tomato crop.

The Methods of seedling production.

Seedling beds.
At present the majority of transplanted crops are grown in seedling nurseries. The resultant plants are bare root transplanted.

The nursery beds are raised to between 15-20 cm. Only a few farmers produce vegetable seedlings on sunken beds.

Seeds are either sown in rows or broadcast. Valuable high priced seed is sown in rows.

Container growing.
Some vegetable farmers grow seedling in containers either boxes, coconut shells, plastic cups or plant leaves (banana leaves), the latter method was introduced from Malaysia and Indonesia.

Nandoko.
Nandoko is a substrate blocking system that was adopted from a method that Japanese farmers utilize and is used by a few farmers in the Bandarawala/Nuwara Eliya region. The "nandoko" system, consists of compressing a moistened plant substrate. Blocks are formed by placing the wet mixture in a frame and compressing it using a plant, the blocks are then cut out using a knife to produce individual plant cells. The blocks are a cube of 5 x 5 x 5 cm dimension or 125 cm 3 of substrate,

Substrates.
The farmers use a variety of substrate mixes the main constituents utilized are:

One part manure (cow)/one part top soil.

One part Manure (cow)/one part top soil/one part sand.

Before block preparation the substrate fractions and sieved to produce a consistent fine material.

Seed Bed Preparation Equipment.
Farmers use the following hand tools /equipment for raising seedlings:

A Mamoty (a local hoe/digger).
A Watering can.
A Bucket.
A wooden board.

Seed treatments.
Farm saved/produced seed is dressed with either Captan or thiram

Captan.
Orthocide 50 wp 6 gm per 1 kg of seed.
Captan 80 wp 4 gm per 1 kg of seed.

Thiram.
Pomarsol Forte 80 wp or Thiotox 4.5 gm per kg of seed.
Fernasan 40.

Seedbed Treatments.
Farmers will burn crop straw on top of the seedbed to heat treat the area. The method is usually ineffective owing to the quick burn of the material and the heat not penetrating the soil. The recommended method is:-

> Wet the seedbed, then spread a 3-5 cm layer of paddy straw on the soil, followed by 3-5 cm of paddy husk and another 3-5 cm of paddy straw.

An alternative method is soil solarization, covering a wet seedbed with clear polythene for approximately 2 weeks.

Damping off is problematic in the vegetable seedbeds, a novel non chemical approach to the control of this disease is using charred rice husks scattered on top of the seedbed. The rice husks appear to regulate the moisture/humidity content of the bed microclimate thus reducing excessive humidity which does not favor the proliferation of the disease.

Mulches.
The seedbeds are covered with straw or gunny bags. To control the bed humidity it is best to use roasted paddy husks, as described above.

Plant Removal.
Plants are dug up out of the seedbed and transported to the field either in boxes or wrapped in leaves.

Appendix 4.

ENVIRONMENTAL RESPONSES OF SOME MODULAR SOWN CROPS.

Cauliflower.
Both low and high temperatures effect the flowering of cauliflower, in general the optimum temperature for cauliflower production is in the range of 15-25^0 C. A number of conditions occur when the temperatures varies widely, they are buttoning, bracting, riciness and pinking.

Cucumber.
The crop responds well to growing temperatures between 25-33^0 C. Low temperatures at planting will retard seedling growth.

Eggplant.
The eggplant is a vegetable species that will grow in relatively high temperatures, 25-30^0 C are the optimum temperature but the plant will tolerate much higher temperatures.

Garlic.
Relatively high temperatures are required for bulb formation up to 30^0 C, but cooler conditions for vegetative growth. The more vegetative growth that occurs in the cooler period of the year the larger the bulb size.

Onion.
Although warm temperatures promote bulb development, the vegetative stage must be completed in a relatively cold period with temperatures of 18- 20^0 C. Some cultivars requir. temperatures of between 7-12^0 C for a four week period. The change from vegetative growth to bulb formation is stimulated by a rise in temperature. At ripening a dry period is required.

Capsicum.

Peppers: Peppers grow in moderately warm climates with optimum growing temperatures of 21-25^0 C. High temperatures kills pollen and reduces fruit set, temperatures of 32^0 C, and above causes temporary wilt, fruit abscision and sun scald.

Chilies: Chilies are more tolerant to higher temperatures than peppers.

Tomato.
Low soil temperatures retard seedling growth and the uptake of minerals. High air temperatures + 27^0 C can induce pollen sterility and high night temperatures adversely affect flower initiation. Night temperatures of 16-20^0 C are considered adequate for most cultivars. Temperatures below 13^0 C affect pollination and fertilization.

Watermelon.
Watermelons are hot climate plants and will grow in temperatures of 21-30^0 C. Temperatures higher than 35^0 C and lower than 10^0 C will delay growth.

Appendix 5.

Raw Coir Pith Analysis.
(not composted)

Component	Sample 1	Sample 2	Sample 3
pH	4.3	5.4	5.8 - 6.4
Organic C %	25.75	29.10	46.00
Lignin %	--	29.00	69.00
Cellulose %	--	26.18	8.00
Carbon/N ratio	--	112:1	80:1
Nitrogen %	0.7	0.26	0.3
Phosphorous %	0.02	0.01	0.2
Potassium %	0.65	0.73	0.26
Magnesium %	0.21	0.36	0.51
Calcium %	0.39	0.42	0.11
Iron ppm	--	6.0	4.1
Copper ppm	--	3.1	0.14
Zinc ppm	--	7.49	1.11
EC mmhos/cm	1.50	---	.315

Analysis carried out for High Value Horticulture by various Sri Lanka coir suppliers.

Appendix 6.

Peat Analysis According to Origin.

	Sphagnum Canada	Sphagnum N. England	Sedge S.W. England
pH	3-3.5	3.5-4	4.8-5.2
Nitrogen	0.97%	1.12%	1.20-1.5%
Phosphorous	0.04%	0.01%	0.03-0.05%
Potassium	0.05%	0.015%	0.02-0.04%
Calcium	0.36%	0.11%	1.2%
Magnesium	0.1%	0.25%	0.25%

Appendix 7.

MICROBIOLOGICAL ANALYSIS OF COIR.

	Sample 1	Sample 2
Moulds 37° C	560,000	24,000
Yeasts 37° C	0	0
Moulds 25° C	700,000	240,000
Yeasts 25° C	150,000	13,000
Actinomycetes 55° C	640	109,000
Predominant moulds @ 37° C	*Aspergillus niger* *Penicillium* sp	*Aspergillus fumigatus* -----
Predominant moulds @ 25° C	*Aspergillus tamarii* *Penicillium* sp.	*Penicillium* sp. ----
Coliforms MPN	11,000	2,000
E. coli	Absent	Absent
Salmonella	Absent	Absent
pH	5.24	5.31

(numbers expressed as counts per gram)

Analysis carried out for High Value Horticulture by the Ministry of Agriculture, Fisheries and Food, UK.

Appendix 8

Assumptions Vegetable Seedling Unit Cost Analysis.

Overall Assumptions. US$ 1 = 50 Sri lankan Rupees.

All costs calculated at constant Sri lankan Rupees.

A five year loan is given at the current Sri lankan rate of 22%.

The nursery has a surface area of 1,600 m2 of which 625 m2 is a shaded area.

The nursery will produce 1,800 trays (240 cells) four times a year.

The nursery will produce a mix of onion, capsicum (chilli & peppers) and eggplant seedlings.

The coir is free of charge from the factory, a transport charge is incurred from the factory at Kurunegala. It is estimated that 9 m3 of coir can be transported in a ten ton truck. After sieving 5 m3 of compost is usable.

Three liters of kerosene is required to sterilize 140 liters of compost.

The substrate will have 3.5 kg of 10.20.20 per 1 cm3 incorporated into the mix. The plants are foliar fed with a 20.10.20 foliar feed twice a week for 4 weeks.

The modules used are imported at a price of US$ 5 landed Sri Lanka.

Forty percent import duty is not included in the price of the shade netting and modules.

No automatic or semi automatic dibbing and seeding machinery have be calculated in the costs.

A 5% contingency cost is included in the overall costs to cover incidentals that may have been overlooked.

Pesticide costs are low assuming the use of propriety dressed seed and sterilized compost.

Appendix 8i

Individual Model Assumptions.

A. The Fully Costed Nursery.

This model assumes that:-

All capital costs are incurred.

Water is pumped from a canal up into a 500 liter storage tank.

A watchman is employed and 420 labor man days are required with the loanee managing the unit.

B. The Farmer Organization Nursery.

This model assumes that:-

The loan is taken out to purchase the inputs only. A development cost is incurred by the project to support the nursery.

The labor requirement is as in the fully costed model, but the manager of the farmers organization handles the day to day running of the unit. Part of the managers salary will be paid for by the nursery.

C. The Settler Nursery.

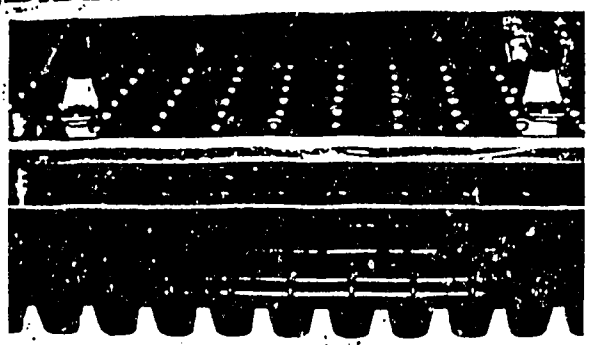
This model assumes that:-

As in the Farmer Organization model only a loan for the inputs is arranged for the recipient.

No outside labor is employed, the settler utilizes his and his families labor.

Appendix 9

DIBBLE BOARD



Operation: Simply align the board over the flat and press down firmly. The NYLON pegs penetrate the soil easily and provide uniformly-spaced identical cavities for rapid transplanting.

Construction: The pegs are securely mounted to the strong reinforced plywood base board. Two comfortable wood handles are provided. The spring loaded aluminum self acting stripper plate automatically removes clinging soil from the pegs when the board is withdrawn. The tapped NYLON pegs are individually fastened to the board with machine screws. Two styles of pegs are available:

Pointed Easy to punch and withdraw.

Blunt Nosed to provide more root space for larger seedlings.

Boards are available with 16-96 pegs, designed to peg all of the popular CELL PAKS. When ordering, state number and style of pegs desired, peg spacing and outside dimensions of flat other than 11 and 21 size.

39-4050-1	SOILMASTER DIBBLE BOARD	$ 99.50
39-4052-1	ADDER PRICE: LARGER THAN 11" x 22"	22.75

Adder prices also apply to complete Soilmasters.

SOILMASTER FOOT OPERATED PEGGING MACHINE

The flat is placed under the peg board. A slight pressure on the foot bar brings the peg board down to the flat, pegs enter the soil easily and springs return the peg board to up position. The stripper plate automatically cleans all soil from pegs as the photo on the right illustrates, and you will have a perfectly pegged flat every time. The end result will be evenly spaced holes in the plastic or fiber packs. "Soilmaster" is designed to accept flats of all sizes within dimensions from 11 x 20 up to and including 15 x 24. Most growers are now transplanting directly into the popular Market or Cell Packs. We suggest when ordering, mail us your flat with paks advising the number of seedlings you want in each pak. We will do the rest.

SOILMASTER (Includes one custom designed Peg Board and Stripper Plate) **F.O.B. OHIO**

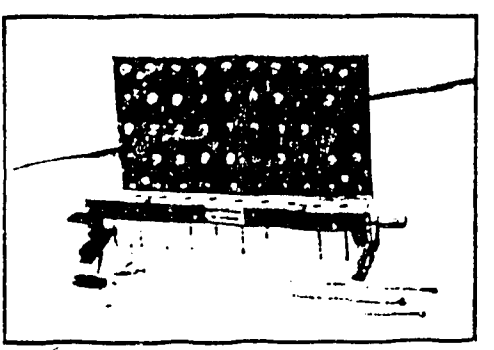
39-3050-1	SOILMASTER (each)	$ 358.60
39-3055-1	EXTRA PEG BOARD WITH STRIPPER PLATE	99.50

THE SMALLEY HAND OPERATED MULTI SEED SOWER

ed by a practical grower for the acing of seed in a range of trays.

available for:
pack 5 section tray
tpak P 5 section tray
tpak 576 Plug tray.
Seeder for Hassey Trays.
ivalents to the above.

eder comes complete with 4 rods and its own specific marker



OPERATION

Press the marker board on a filled tray to make impressions.

Select required rod to suit seed.

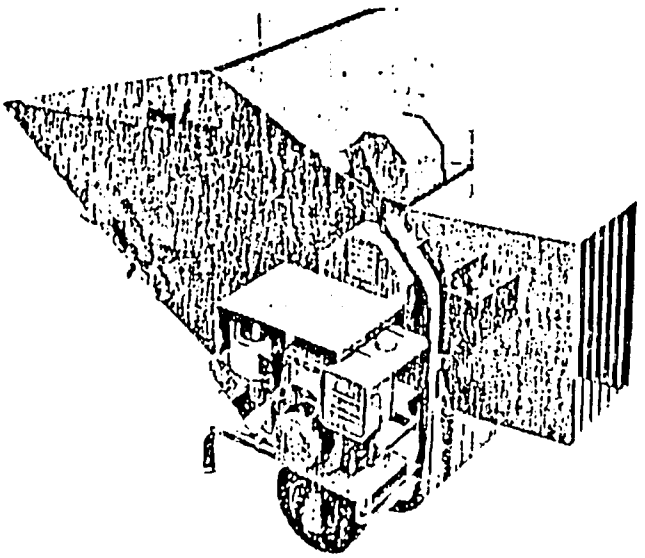
Push the rod in and secure by spring to the anchor pin.

Place the coloured tube on the opposite end.

Now you are ready to sow by turning the handle anti clockwise.

Release handle letting the spring return, in doing so the seed is sown.

Swiss soil shredder



Malvan Group has introduced the Swiss-manufactured Roxor soil shredder into the UK.

The shredder, designed to shred or mix soil, compost, humus and manure, is available in four models that process 6, 8, 16 and 32cu m/hour. The machines can be loaded manually or mechanically and are powered by electric or petrol motors.

MALVAN GROUP

Appendix 11 i

MARD PROJECT
DAI
Pimburattewa
Sri Lanka
Tel: 027 - 2174 (94 - 27 - 2174)
Telex: 21979 SALAKA CE.
Fax: 027 - 2174 (94 - 27 - 2174) 698315

Two Page Fax to 01 699626.

Mr Mithra Weerasinghe,
Marketing/Merchandising Manager,
ARPICO,
69 Hyde Park Corner,
Colombo 2.

May 14, 1993.

VEGETABLE SEEDLING TRAY.

Dear Mr Weerasinghe

Further to our meeting of Tuesday last, regarding your companies possible production of vegetable seedling trays, below are the specifications of such a tray:-

Material: Injection moulded plastic.

Tray Dimensions: Length 66 cm, width 40.4 cm and depth 5 cm.
The tray exterior (sides and base) should be made from 1 cm thick plastic.

The Cell: The tray should be sub divided into 240 individual cells of size, 3 x 3 cm and 5 cm deep. At the base of each cell is a 1 cm diameter drainage hole.

The thickness of the plastic that divides the cells should be 0.2 cm thick.

In conjunction with this fax I am transmitting a rough drawing of what is required.

Please could you give the above project an estimate with respect to the mould and the cost of a tray for an expected production run of between 4,000 to 10,000 trays.

As I will have left the country by the end of next week, your contact within the MARD project is Mr Martin West, at the above address and phone number. If you have any queries please don't hesitate to contact Martin.

May I take this opportunity to thank you for taking the time to see me at very short notice. The project looks forward to hearing from you in due course.

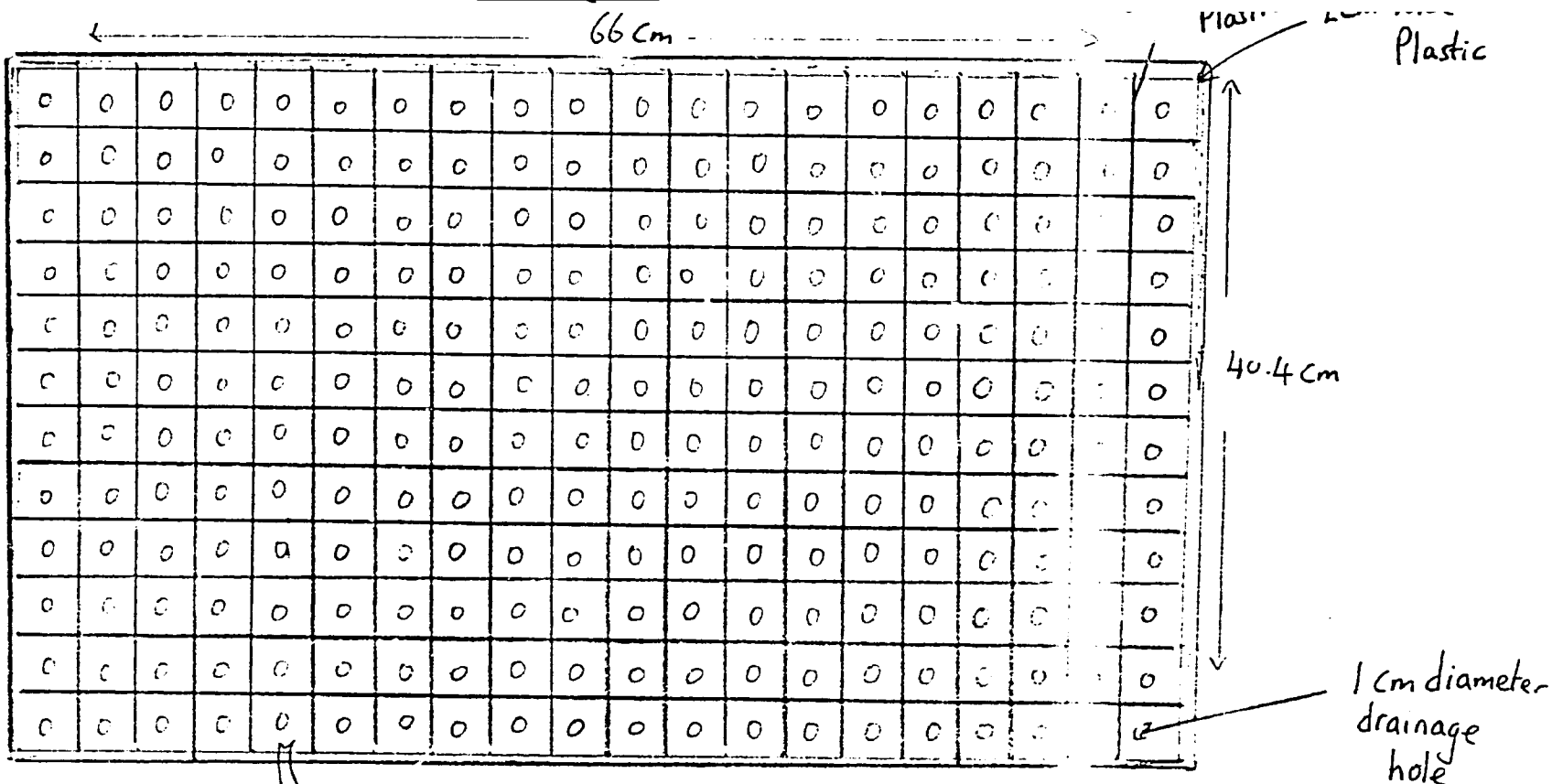
Yours sincerely,

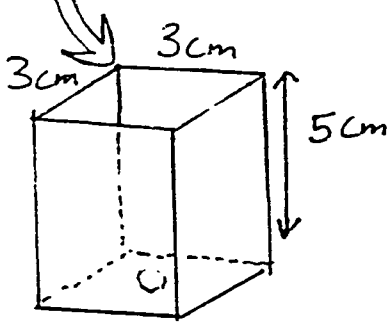
David Parsons.

DAI
Development Alternatives, Inc

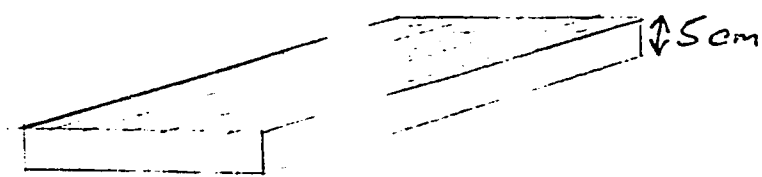
Address: 7250 Woodmont Avenue, Suite 200, Bethesda, MD 20814
Telephone: (301) 718 - 8699 Telex: 424822 DAI UI Telecopier: (301) 718 -7968

Consultants to the Mahaweli Authority of Sri Lanka and USAID


66 Cm
Plastic
40.4 Cm
1 Cm diameter drainage hole


3cm
3cm
5cm

The Cell.


5cm

Appendix 11 ii

MARD PROJECT
DAI
Pimburattewa
Sri Lanka
Tel: 027 - 2174 (94 - 27 - 2174)
Telex: 21979 SALAKA CE.
Fax 027 - 2174 (94 - 27 - 2174) 698315

Two Page Fax to 01 622032 or 01637151.

Mr B Fernando,
Regnis (Lanka) Ltd,
52 Ferry Road,
Telawala,
Borupana Road,
Ratmalana.

May 14, 1993.

VEGETABLE SEEDLING TRAY.

Dear Mr Fernando,

Further to our meeting of Tuesday last, regarding your companies possible production of vegetable seedling trays, below are the specifications of such a tray:-

Material: Polystyrene.

Tray Dimensions: Length 61.5 cm, width 31.5 cm and depth 5 cm. The tray exterior (sides and base) should be made from 1 cm thick polystyrene.

The Cell: The tray should be sub divided into 200 individual cells of size, 2.5 X 2.5 cm and 5 cm deep. At the base of each cell is a 0.5 cm drainage hole.

The thickness of the polystyrene that divides the cells should be 0.5 cm thick.

In conjunction with this fax I am transmitting a rough drawing of what is required.

Please could you give the above project an estimate with respect to the mould for the press and the cost of a tray for an expected production run of between 4,000 to 10,000 trays.

As I will have left the country by the end of next week, your contact within the MARD project is Mr Martin West, at the above address and phone number. If you have any queries please don't hesitate to contact Martin.

May I take this opportunity to thank you for taking the time to see me at very short notice. The project looks forward to hearing from you in due course.

Yours sincerely,

David Parsons.

DAI
Development Alternatives, Inc

Address: 7250 Woodmont Avenue, Suite 200, Bethesda, MD 20814
Telephone (301) 718 - 8699 Telex: 424822 DAI UI Telecopier (301) 718 -7968

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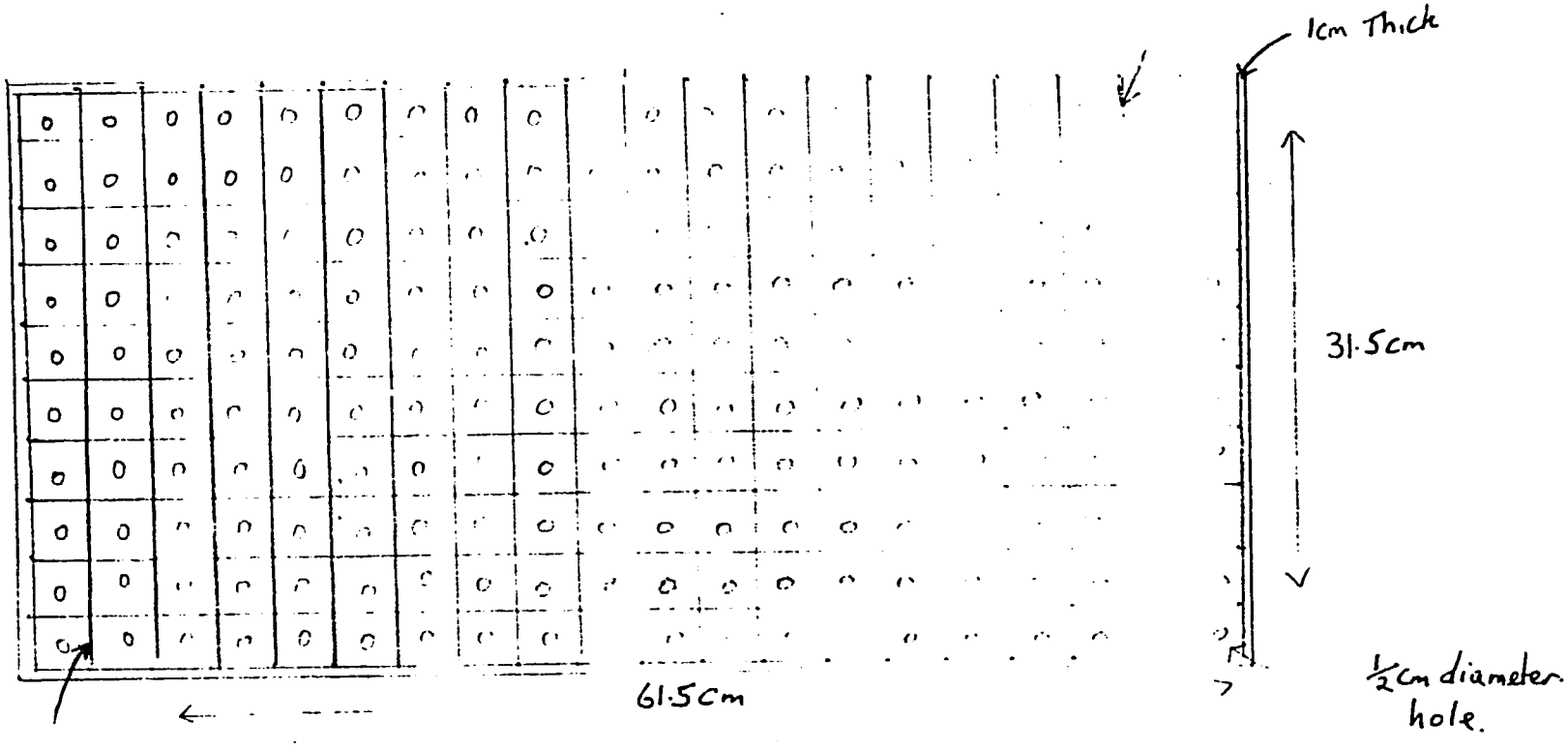
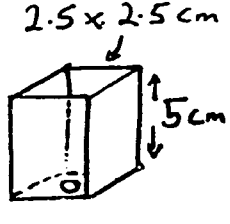
Polystyrene Tray 200 Cells



Cell Size