MAURITIUS RESEARCH COUNCIL

INNOVATION FOR TECHNOLOGY

HYDROPONICS AND SEMI-PROTECTED ENVIRONMENT FOR THE PRODUCTION OF VEGETABLES IN RODRIGUES

Final Report

September 2006

MAURITIUS RESEARCH COUNCIL

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AGRICULTURAL RESEARCH AND EXTENSION UNIT

MRC FUNDED PROJECT

Hydroponics and Semi-protected environment for the production of vegetables in Rodrigues

END OF PROJECT REPORT

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1.0 Project title: Hydroponics and semi-protected environment for the production of vegetables in Rodrigues

2.0 Background information

Hydroponics or soilless culture is the technology of growing plants without soil. The plants are grown in a nutrient solution with or without the use of solid rooting medium. This technique of production has been successfully implemented and adopted in Mauritius since 2000. To date, in Mauritius, there are 190 hydroponic units occupying an area of 6.7 hectares and the main crops being cultivated are salad Tomato, Sweet Pepper and Cucumber, Melon, Lettuce.

In Rodrigues open-field vegetable production is still being practised by the majority of growers despite major constraints like scarcity of land, labour, water and adverse climatic conditions are major constraints in the production of vegetables. Moreover, with the growing Rodriguan population and tourist industry, there is definite need to increase production of high quality vegetables.

Hydroponic culture can be envisaged as an attractive solution for the production of vegetables. This technology also offers other advantages like elimination of soil-borne diseases, permits higher planting density, efficient use of water and fertiliser, eliminates use of herbicide, gives higher yield per unit area and enables production of quality vegetables.

3.0 Aim

The aim of the project was to evaluate new production techniques to increase vegetable production as well as producing high quality vegetables in Rodrigues.

4.0 Objectives

The objective of the project was to evaluate four different systems for vegetable production namely:

a. Semi-protected and hydroponics culture (GH1)
b. Semi-protected and fertigation (GH2)
c. Open-field and fertigation (Plot 3)
d. Open-field and conventional production (Plot 4)

Each system was implemented over an area of 100m^2 with a total area of 400 m^2 (4 x 100 m^2). In each unit, there were 4 planting beds each of length 15m and width 1m.

5.0 Funding agency: Mauritius Research Council (MRC)

6.0 Contract Number: MRC/RUN-0024

7.0 Principal Investigators: 1. Miss R.D Nowbuth
Principal Research Scientist (VOD)
VOD
2. Mr S Pandoo

Principal Agricultural Engineer
AREU

3. Mr V. Dooblad
Research Scientist
AREU
4. Mrs M. Nowbotsing
Research Scientist
AREU
5. Mr A. Ellapen
Assisitant Research Scientist
AREU

Rodriguan Collaborator: Mr Jérome Felicité
Scientific Officer
Agricultural Services
Rodrigues

Initial projected project duration: 2 years (June 2001-June 2003)

Project duration: 3 years

Project extension granted on grounds of

(a) Site identification was carried out in April 2002 instead of June 2001
(b) Structures which were to be installed by September 2001 were ready for use only in October 2003
(c) First transplantation of tomato which was scheduled for September 2001 was carried out in November 2003

Site: Baie aux Huitres Station of the Agricultural Services, Rodrigues

Project start date: April 2002

Project Ended: July 2005

Activities proposed: The project was dealt with 3 aspects:

Part 1: Mounting of tunnels/installation of fertigation and irrigation systems

This aspect of the project was closely monitored by Mr Pandoo through various visits, demonstrations and trainings.

Part 2: Crop Evaluation in different production systems

Four crops (tomato, cucumber, sweet pepper and melon) were evaluated under four different systems production

Part 3: Training

Several trainings were conducted for the Rodriguan collaborators in Rodrigues and Mauritius by the Agricultural Engineer and Research Scientists. The trainings offered were on

(i) Engineering aspects of hydroponics

(ii) Cultural practices for different crops grown in hydroponics

Responsibility of Officers:

The project was carried out jointly by officers of AREU and officers of Rodrigues Agricultural Services. The responsibilities of both parties were as listed below:

Table 1: Responsibility of Officers

Officers of AREU	Officers of Rodrigues Agricultural Services
1. Identification of potential sites for erection of greenhouse in collaboration of Rodriguan Officers	1. Selection of appropriate site
2. Purchase and shipment of greenhouse materials to Rodrigues	2. Proper storage of greenhouse materials
3. Training of Rodriguan Officer on engineering aspects with respect to mounting of tunnel and installation of fertigation system.	3. Land cleaning, levelling and preparation, excavation work and casting of concrete base for greenhouse structures and water tank platform
4. Supervision of: (i) mounting of tunnels and installation of irrigation and fertigation systems (ii) construction of nursery, pump house and store	4. Labour assistance in mounting of tunnel, construction of nursery, pump house and installation of fertigation system
5. Provide inputs (jiffy pellets, seeds and fertilizers) for crop production in greenhouses. Train Rodriguan Officers in: (i) production of healthy seedlings (ii) transplantation of seedlings in greenhouses	5. Provide labour for: (i) the raising of healthy seedlings (ii) transplantation of seedlings (iii) proper crop management in the four different techniques of crop production
6. Training of Rodriguan Officers on all aspects of hydroponic crop production	6. Provide labour and supervision of cultural practices for hydroponic vegetable production. Rodriguan Officers were also responsible for the proper management of crops production.

Materials and methods

Fertilizers/Fertigation/Irrigation

1.0 For conventional agriculture – fertiliser used was as per recommendation in the "Le Guide Agricole" and water was supplied to the plants via a drip irrigation system.

Fertilizer used for conventional agriculture (Plot 4): 13:13:20:2 and C.A.N.(Calcium Ammonium Nitrate)

2.0 For hydroponics culture (Greenhouse 1)– fertiliser used was hydroponics Nutrient Solution A and Solution B which were supplied to the plants via a drip irrigation system. Fertilisers used consisted of Potassium Nitrate, Monoammonium Phosphate, Magnesium Sulphate, Potassium Sulphate, Monopotassium Phosphate, Calcium Nitrate and Microelements (Kanieltra).

3.0 For fertigation (Greenhouse 2, Plot 3) – Fertilizers used were 16:07:07 and 11:11:22.

Planting materials

Seeds of the following crops and varieties were used.

(i) Tomato (Varieties: Cencara and Boa)
(ii) Sweet Pepper (Variety: Queen Star)
(iii) Green cucumber (Varieties: Spring Swallow and Merry Swallow)
(iv) Melon (Variety: Cezanne)

Rooting substrate

3.1.1 Conventional agriculture (Protected and Open-field): soil was used as rooting substrate
3.1.2 Hydroponics: 70% rocksand 0-6 mm and 30% rockchipping 8mm. This was later replaced by coconut coir due to incidence of Bacterial Wilt in gravel substrates.

Cropping Calendar

Four trials were carried out from 3rd November 2003 to 7th July 2005 as given in Table 2

Table 2: Cropping Calender

Crop	Variety	Start date	Ending date
Tomato	Cencara	November 2003	March 2004
Green Cucumber	Spring Swallow Merry Swallow	May 2004	June 2004
Sweet Pepper/Tomato	Queen Star/Boa	September 2004	January 2005
Melon	Cezanne	April 2005	July 2005

Part I: Mounting of Tunnel/installation of fertigation and irrigation system

(i) Identification of potential sites/ choice of substrates

The site for carrying out the project was identified at Baie aux Huitres Station of the Agricultural Services. Two types of water were available on that station for fertigation. These were collected and analysed to test for their suitability for use as irrigation water. The water samples were found to be alkaline and Nitric acid was used for pH adjustment of the hydroponic nutrient solution. The choice of the final substrate was a mixture of (70%) rocksand 0-6mm and (30%) rockchipping 8 mm available for use as substrate in Rodrigues.

(ii) Supervision of progress of work.

The safe unloading and proper storage of all greenhouse materials and accessories in Rodrigues were supervised by Mr Pandoo. These were checked and handed over to the Stores Officer from the Agricultural Services of Le Citronellle and they were stored at Baie aux Huitres Agricultural Station.

Monitoring of the progress work at Baie aux Huitres was carried out and the following work were supervised:

- Excavation work
- Casting of concrete base
- Site levelling and filling

Despite proper instructions were given for the right placement of reinforcement columns inside the base concrete, these were buried too deep inside the concrete and it could not be modified. Hence, risks of concrete cracking existed in event of strong cyclonic gusts striking the structural frames. However, for the remaining 60% base concrete to be cast, proper instructions were given to the Rodriguan officers so that the mistake is not repeated.

The construction of the pump house and fertigation room was completed and appropriate instructions were given on the design of the flooring.

Two tanks of capacity 2500 Litres each were installed on the roof of the pump house/fertigation room and not on a concrete platform as was initially planned. It was also decided that an additional concrete platform be constructed at the rear side of the pump house to accommodate additional water reservoirs in the future.

Since the soil in the two open-field plots was highly clayey they were filled with new top soil after ploughing.

Sixteen units of trellis frames required for the two open-field plots were constructed using galvanised pipes and other greenhouse materials. A wooden A-frame was constructed to serve as nursery.

(iii) Erection of greenhouse and fertigation System

The plastic tunnel was designed in such a way so as to cater for the production of a wide variety of crops including ornamentals under protected conditions. Moreover, the tunnel can be converted at a later stage, into a hydroponic unit after some modifications. It was also decided that the high and low tunnels be equipped with separate fertigation systems. Provision was made to unroll plastic sheet of the high tunnel during cyclonic conditions.

The following works were completed under the supervision of Mr Pandoo:

a) Fixing of plastic sheet and insect proof cloth on 2 greenhouse units
b) Fixing of plastic sheet and insect proof in wooden nursery of size 15 x 9m
c) Fixing and testing of fog system in both greenhouses
d) Testing of automated fertigation system inside pump house. Possibilities for leakage were also checked
e) Drip irrigation lines for all plots were prepared and assembled
f) The mulching film and growing troughs were placed inside the hydroponic greenhouses
g) Demonstration on how to remove plastic in the event of cyclonic period was carried in the presence of station labourers and one officer from the Agricultural Services
h) Demonstration was also given on how to fill the growing troughs
i) Installation of winding mechanism for shade cloth.

The following works were also completed:

- Installation and testing of winding mechanism and shade cloth on both greenhouses
- The water treadle pump was mounted and tested
- A demonstration was given on installation of family drip system

Following a request from the Scientific Officer, Mr Felicité, site visits were carried out to 3 growers at Grande Montagne, Baie aux Huitres and Rivière Banane regarding technical advice on the setting up of greenhouses. They were also advised on irrigation systems for small holdings.

Part II: Crop evaluation in different production systems

Activity 1: Evaluation of salad tomato in four different growing systems

Materials and Methods

The objective of this trial was to assess the performance of tomato in terms of yield when produced under four types of production systems namely: (i) semi-protected and hydroponics culture, (ii) semi-protected and fertigation, (iii) open-field and fertigation and (iv) open-field and conventional production. Fertilization/fertigation was carried out as follows:

	System	Fertilizers
(i)	Semi-protected and hydroponics	Hydoponic Nutrient Solution A and hydroponic nutrient solution B
(ii)	Semi-protected with fertigation	16:07:07 and 11:11:02
(iii)	Open-field and fertigation	16:07:07 and 11:11:22
(iv)	Open-field and conventional agriculture	as per recommendation in "Le Guide Agricole", i.e 13:13:20:2 and Calcium Ammonium Nitrate.

The trial was carried out at Baie-aux-Huitres Station of the Agricultural Services, Rodrigues using a completely randomised design without replication. The tomato (variety Cencara) seedlings were raised in jiffy pellets. Transplantation of tomato seedlings under protected structures was carried out on 3rd November 2003, while those under open-field and fertigation were transplanted on 4th November 2003 and finally those under open-field and conventional production were transplanted on 10th November 2003.

For tomato production under hydroponics, the seedlings were irrigated wiyh water for the first two days following transplantation and then they were fed with nutrient solution as from the 3rd day until last harvest. All cultural practices like trellising, de-suckering, defoliation, fruit thinning, pest and disease control, harvesting and sanitation were also carried out.

Harvest started on 30th December 2003 and ended on 23rd February 2004.

Results and discussion

Table 3: Results for tomato trial

System of production	Harvest period	Number of Harvests	Total weight (kg)
Semi-protected and hydroponics	30.12.03-15.01.04	2	1.00
Semi-protected and fertigation	30.12.03-23.02.04	10	135.20
Open-field and fertigation	-	Nil	-
Open-field and conventional production	15.01.04	1	0.55

The results show that highest yield was recorded in the semi-protected environment with fertigation with 10 harvest rounds and 135.2 kg of tomatoes. However, poor results were obtained in the other systems due to numerous constraints which were beyond control.

Constraints encountered and actions taken

The constraints experienced and actions were taken to counter-effect them. are:

(i) A high incidence of Bacterial Wilt was experienced in all systems of production. Hence all infested plants were uprooted and the growing substrate was replaced by coconut coir for the next trials.

(ii) The tomato crop under hydroponics production suffered from a high temperature build up and scarcity of water for irrigation led to high plant mortality. To lower the temperature inside the greenhouse, a woven shade cloth was placed on the plastic cover of the greenhouse.

Due to these constraints, the trial was not successful as reflected in the table of results.

Although the trial was highly affected by a high incidence of Bacterial Wilt, it is to be noted that harvest in the greenhouses started earlier than expected as compared to that in Mauritius. A shorter crop cycle was also experienced. However, this needs to be confirmed by carrying out more investigations.

Activity 2: Evaluation of cucumber in four different systems of production

Materials and method

The objective of this trial was to evaluate the performance of cucumber (varieties: Spring Swallow and Merry Swallow) in terms of yield when produced under four types of production systems namely: (i) semi-protected and hydroponics culture using hydroponic nutrient solutions A and B, (ii) semi-protected and fertigation using 16:07:07 as fertilizers, (iii) open-field and fertigation using 16:07:07 as fertilizers and (iv) open-field and conventional production using 13:13:20:2 and Calcium Ammonium Nitrate as per recommendation in "Le Guide Agricole". The experiment was set at Baie-aux-Huitres Station of the Agricultural Services, Rodrigues using a completely randomised design without replication. The cucumber seedlings were raised in jiffy pellets on 30th April 2004.Transplantation of cucumber seedlings in the four plots were carried as follows:

System of production	Date
Semi-protected and hydroponics (with coconut coir as substrate)	21 May 2004
Semi-protected and fertigation	20 May 2004
Open-field and fertigation	20 May 2004
Open-field and conventional production	23 may 2004

Transplantation in plot 3 was delayed for a few days due to heavy rainfall resulting in a muddy plot.
In both greenhouses the following cultural practices were regularly performed:

- Trellising and de-suckering at weekly interval
- Pollination 3 times per week

In the open-field plots only trellising and de-suckering were carried out.

Harvest started on 21st June 2004 and lasted up to 28th July 2004 with 17 harvest rounds for the hydroponic system of production and 15 harvest rounds for the production of cucumber under protected structures.

Results and discussion

Table 4: Results for cucumber trial

System of production	Harvest period	Number of Harvests	Total weight (kg)
Semi-protected and hydroponics	21.06.04-28.07.04	17	447.016 (1574 units)
Semi-protected and fertigation	21.06.04-28.07.04	15	208.925 (1525 units)
Open-field and fertigation	21.06.04-28.07.04	Nil	Nil
Open-field and conventional production	21.06.04-28.07.04	Nil	Nil

These results show that crop production under hydroponics and protected culture was better compared to the open-field production which was mainly affected by natural forces. However, proper management of pests and diseases in the greenhouses is very important so that yields can be maximized.

Remark:

All plants in the open – field with fertigation died by 17.06.04 and those in the open – field and conventional production died on 23.06.04 resulting in the termination of these trials.

Constraints and actions taken

The main problems encountered during this trial were:

(i) A high incidence of Powdery Mildew occurred in both greenhouses. Spraying of Microthiol Special @ 5g/L was carried out but still the disease could not be controlled.

(ii) The production of cucumber under protected structures with fertigation also suffered from Downy Mildew. Despite spraying of Ridomil Gold @ 2g/L, the disease could not be controlled.

(iii) For the open-field production of cucumber, constant wind accompanied by strong gusts of wind exerted severe stress on the plants. Hence the growth of the plants was very slow and many did not manage to take up from

transplanting. Although an artificial break was installed the situation did not improve.

(iv) Another problem encountered in the open-field with conventional production was heavy rainfall over a long period and this resulted in water-logged conditions in the plots leading to numerous plants death. In order to minimize the water-logged situation, irrigation was decreased.

Activity 3: Evaluation of Sweet Pepper and tomato in four different growing systems.

Materials and method

The objective of this trial was to evaluate the performance of sweet pepper (variety: Queen Star) and tomato (variety: Boa) in terms of yield when produced under four types of production systems namely: (i) semi-protected and hydroponics culture using hydroponic nutrient solutions A and B, (ii) semi-protected and fertigation using 16:07:07 as fertilizers, (iii) open-field and fertigation using 16:07:07 as fertilizers and (iv) open-field and conventional production using 13:13:20:2 and Calcium Ammonium Nitrate as per recommendation in "Le Guide Agricole". The experiment was set at Baie-aux-Huitres Station of the Agricultural Services, Rodrigues using a completely randomised design without replication. The sweet pepper and tomato seedlings were raised in jiffy pellets. Transplantation of the sweet pepper seedlings was carried out on 2nd September 2004 while tomato seedlings were transplanted 6th September 2004.

All cultural practices pertaining to sweet pepper and tomato productions were practised for the cultivation of these crops. These consisted of de-suckering, fruit tipping, trellising and regular pollination.

Tomato harvest started on 5th November 2004 and ended on 29th December 2004 with 20 harvest rounds while sweet pepper harvest started on 1st November 2004 and lasted up to 29th December 2004 with 16 harvest rounds.

Results and discussion

Table 5: Results for tomato and sweet pepper trial

System of production	Crop	Harvest period	Number of Harvests	Total weight (kg)
Semi-protected and hydroponics	Tomato (2 rows)	05.11.04 - 29.12.04	20	140.65
	Sweet Pepper (2 rows)	01.11.04 – 29.12.04	16	16
Semi-protected and fertigation	Tomato (2 rows)	19.11.04 – 26.11.04	3	3
	Sweet Pepper (2 rows)	N/A	8	N/A
Open-field and fertigation	Tomato (2 rows)	N/A	Nil	Nil
	Sweet Pepper (2 rows)	N/A	3	N/A
Open-field and conventional production	Tomato (2 rows)	N/A	Nil	Nil
	Sweet Pepper (2 rows)	N/A	Nil	N/A

This trial shows that the production of tomato and sweet pepper under hydroponic production has been more successful as compared to the production of these vegetables in soil which was highly affected by Bacterial Wilt

Constraints and actions taken

This trial also suffered from a high incidence of Bacterial Wilt, broad mites and red spider mites. The Bacterial Wilt was mainly prevalent in the open-field plots while broad mites and red spider mites were present in both greenhouses. The hydroponic production of sweet pepper and tomato also suffered from a high temperature build up and this was sorted out by covering the greenhouse with a woven shade cloth

Activity 4: Evaluation of melon in four different growing systems

Materials and method

The objective of this trial was to evaluate the performance of melon (variety: Cezanne) in terms of yield when produced under four types of production systems namely: (i) semi-protected and hydroponics culture using hydroponic nutrient solutions A and B, (ii) semi-protected and fertigation using 16:07:07 as fertilizers, (iii) open-field and fertigation using 16:07:07 as fertilizers and (iv) open-field and conventional production using 13:13:20:2 and Calcium Ammonium Nitrate as per recommendation in "Le Guide Agricole". The experiment was set at Baie-aux-Huitres Station of the Agricultural Services, Rodrigues using a completely randomised design without replication. The melon seeds were sown in jiffy pellets.

Transplantation of melon seedlings was carried out on 15th April 2005 and the crop cycle ended on 7th July 2005. Harvest started on 13th June 2005 and lasted up to 7th July 2005 with 12 harvest rounds. 212 melon units corresponding to 114.48 kg was harvested in the hydroponic system while 180 melon units corresponding to 102.61 kg was harvested in the protected system of production.

All cultural practices pertaining to sweet pepper and tomato productions were practised for the cultivation of these crops. These consisted of de-suckering, fruit tipping, trellising and regular pollination.

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Pollination in the greenhouses was carried out by bees. All cultural practices like trellising, de-suckering, defoliation, fruit thinning, pest and disease control, harvesting and sanitation were carried out by Rodriguan Officers.

Results and discussion

Table 6: Results for melon trial

System of production	Harvest period	Number of Harvests	Total weight (kg)
Semi-protected and hydroponics	13.06.05 – 07.07.05	12	114.48 (212 units)
Semi-protected and fertigation	13.06.05 – 07.07.05	12	102.61(180 units)
Open-field and fertigation	13.06.05 – 07.07.05	Nil	Nil
Open-field and conventional production	13.06.05 – 07.07.05	Nil	Nil

The results show that production of melon under protected structures is more promising than its open-field production since the crop is shielded against the damaging effect of wind.

Constraints and actions taken

The open-field production of melon was highly affected was strong gusts of wind but no action was action. It is to be noted that no such problem was reported in the production of melon under protected structures.

Overall Findings

The monitoring of on-going trials was mainly under the responsibility of officers in Rodrigues. However, the fact that the project was carried out in Rodrigues, it was not possible for officers of AREU to closely monitor the trials and interaction with the Rodriguan officers was quite difficult. For any major problems encountered, recommendations were given after discussion over the phone.

In addition, the trials suffered from quite a number of limitations such as:

(i) high incidence of Bacterial Wilt
(ii) strong gusts of wind
(iii) improper pests and diseases management.

This resulted in poor quality of trials and insufficient data collection. Hence, it has not been possible to carry out any statistical analysis.

Thus to avoid recurrence of such problems, the Rodriguan officers will need some more practices to properly monitor the hydroponic project.

Status of the greenhouses at the Rodrigues Agricultural Services

After completion of all trials in July 2005, the greenhouses have been used to carry out production of white cucumber varieties NS 46 and F1 Keisha. No other trial has been carried out afterwards due to unavailability of water but seeds of tomato and sweet pepper have been bought for future trials.

Project Outcome

By conducting this project in Rodrigues, hydroponic technique of crop production has been introduced to the officers and planting community in Rodrigues. This will enable the officers in Rodrigues to further promote this new technique of production to their growers.

To date there is only one hydroponic grower in Rodrigues who is cultivating mainly tomato. This grower is now launching into the production of sweet pepper and Rodriguan chilli and has requested support of AREU for identification of suitable varieties. Another two growers are also involved in flower production under protected structures.

Part III: Training

Training of Rodriguan Officers was a major component in this project. This was carried out both in Mauritius and in Rodrigues.

Training in Mauritius

Table 7: Trainings offered in Mauritius

Date	Trainer	Training offered
2 weeks training (August 2001)	Miss R. Nowbuth	Mr Mario Flore was given a two weeks training at Wooton CRS on on-going hydroponic projects. He also had the opportunity to visit on-going hydroponic projects of growers over the island.
2 weeks training (May 2002)	Miss R. Nowbuth Mr Dooblad Mr Pandoo	Two weeks training was organized for the Rodriguan officers, i.e. Mr J. Félicité, Mr. A. Law San, Mr M. Flore and Miss C. Jean. They had one week training on agronomic aspects of vegetable production in greenhouses (both at Wooton CRS and at grower's sites). They were also offered one week training on engineering aspects with Mr. Pandoo. A theoretical course on hydroponics including a video show on 'Tomato cultivation in hydroponics' was also organised for them.
August 2002	Trainers from Israel	Mr Law San and Mr M. Flore followed course on fertigation.
March 2005 (21st – 25th May 2005)	Mr Ellapen	Mr Jérome Félicité was given an in-depth training on melon production in greenhouses. The training covered the following aspects: 1. Trellising 2. De-suckering 3. Electrical conductivity monitoring 4. Water and fertigation management 5. Brix management 6. Pests and diseases management

Training in Rodrigues

Table 8: Trainings offered in Rodrigues

Date	Officer	Training offered TOMATO	Attended by
From 25th November to 19th December 2002	Mr Pandoo	Mounting of greenhouse, installation of fertigation system and construction of nursery Demonstration on how to remove plastic in the event of cyclonic period was carried out in presence and station labourers and one officer from the Agricultural Services. Demonstration of washing of rocksand and filling of growing troughs. Laying and fixing of irrigation lines on troughs. Construction of a drainage canal in order to collect drained nutrient solution on adjacent terrace. Burying of base plastic sheet on both sides into the soil. Spraying of ombraflex (2 layers) on roof plastic.	Officers from Rodrigues Agricultural Services
From 13th to 17th October 2003	Mr Dooblad	Rodriguan collaborators were trained in growing tomato crop in hydroponics and in operating of the hydroponics and fertigation system. A one day workshop on hydroponics was carried out with 15 farmers. The workshop comprised of a short talk on hydroponics including a video on 'Culture hors-sol de la tomate ' and a visit to the greenhouse at Oyster Bay. A radio programme on the importance of hydroponics and the development of hydroponics in Rodrigues was organised for the general Rodriguan public. This was done in collaboration with Mr Jerome Felicite. Materials submitted to Rodriguan officers: a) A video copy of 'Culture de la Tomate Hors-Sol'. b) CD on diseases of Tomato, diskettes on pests of tomato and nutritional deficiencies in tomato c) Checklist of activities to be carried out in plastic tunnel	Mr. J. Felicité, Mr. A. Law San, Mr. M. Flore and Miss C. Jean

Date	Officer	Training offered TOMATO	Attended by
From 3rd November to 4th November 2003	Mr Dooblad	Demonstration was given on preparation of hydroponic nutrient solutions A & B. Explanations were given to the Rodriguan officers on how and when to carry out different cultural practices: a) Monitoring volume of nutrient solution delivery at drippers b) Trellising and desuckering of plants one week after transplantation c) Pollination of flowers three times per week d) Monitoring of pH and E.C of nutrient solution on a daily basis e) Pests and diseases monitoring	Mr. J. Felicité, Mr. A. Law San, Mr. M. Flore and Miss C. Jean
From 19th May 2004 to 21st May 2004	Mr. Dooblad	Demonstration on preparation and expansion of coconut coir bags prior to transplantation of seedlings was done. The cucumber seedlings were transplanted in the different systems of production. Preparation of concentrated hydroponic nutrient solution A & B was carried out. The Agricultural Officers were shown how to programme the irrigation/fertigation schedule. Explanations on the following aspects were also given to the Rodriguan officers: a) Monitoring the volume of nutrient solution delivered to the plants with respect to stage of crop b) Trellising and desuckring c) Removal of flowers up to a height of 60 cm d) Checking pH and Electrical Conductivity of the nutrient solution e) Monitoring of pests and diseases	Mr J. Felicité, Mr. A. Law San, Mr. M. Flore and Miss C. Jean
From 16th August to 19th August 2004	Mr Pandoo	Rodriguan collaborators were trained on installation of family drip system. He also provided Technical advice were given to farmers concerning the setting up of greenhouses for growers and site visits were effected at Grande Montagne, Baie aux Huitres and Riviere Banane.	Officers from Rodrigues Agricultural Services and labourers

		Training offered SWEET PEPPER & TOMATO	
From 6th October 2004 to 8th October 2004	Mr Ellapen	Officers were given on in-depth training on cultural practices of sweet pepper and tomato as well. The training was focussed on the trellising of Sweet Pepper and tomato. However, officers were also offered a practical session on hydroponics cultivation of sweet pepper and tomato. Rodriguan officers were also given short lectures on sweet pepper and tomato cultivation. These lectures covered the following aspects: Electrical conductivity monitoring, desuckering of plants, monitoring of pests and diseases and detection and control of Blossom-end-Rot.	Mr. J. Félicité, Mr A. Law San, Mr M. Flore and Miss C. Jean

Conclusions

The results show that vegetable crop production in the open-field does suffer from several limitations which are beyond our control.
These are:

1. Bacterial Wilt
2. Strong gusts of wind
3. Excessive much rainfall leading to waterlogged conditions

With respect to these limitations both protected culture and hydroponic culture seem to be an alternative for vegetable production. However, for protected culture, Bacterial Wilt may still be a limiting factor. Though Bacterial Wilt may also occur in greenhouses, it should be pointed out that it is possible to minimize its effect through appropriate measures. These include:

1. Use of UV –lamp
2. Removal of infested plant and disinfection of substrates

However, two important aspects that may hinder for the adoption of this new technology are:

(i) High investment cost
(ii) Strong gusts of wind during cyclones

It should be noted that external factors such as strong gusts of wind and heavy rainfall are excluded in greenhouses and under protected structures.

Future Actions

Seeds of the following crops and varieties were given to the Rodriguan Agricultural Officers for further evaluation

1. Tomato (varieties: king Kong, Heinz, Efrat, Dynamite)
2. Melon seeds (Cezanne)
3. White Cucumber (Keisha F1)

Part IV: Budget estimate

Budget breakdown

Chemicals	23,101.46
Seeds/planting materials	49,914.45
Accessories	23,168.28
Airfare/Stipend	40,391.00
Fixed Assets	519,692.21
Total	680,996.99

Please see annexed document from Finance Section of AREU for detail of expenditure.

General conclusion

The hydroponic culture seems to be an attractive solution for the production of vegetables in Rodrigues especially for soil infested by Bacterial Wilt. The production of vegetables under protected culture also seems to work equally well provided that soil-borne diseases are controlled. This can be deduced from the results of all four trials whereby all trials carried out in the open-field have failed.

However, the yields for both hydroponic production and cultivation are rather low. Hence, more work has to be done so that these techniques of production can be mastered by the Rodriguan officers. But one aspect on which special consideration need to be focussed as well is temperature management in the greenhouse since too high temperatures affect vegetable production.