IMPROVING LIVES THROUGH AGRICULTURAL RESEARCH

CARDI

SL/003/10

Country Highlights

St. Lucia

2010

Improving lives through agricultural research

Caribbean Agricultural Research and Development Institute

St Lucia Country Highlights 2010

CARDI's contribution to
agricultural research and development,
food production and the reduction of poverty and hunger

CARDI Office in St. Lucia

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ACRONYMS AND ABBREVIATIONS

BAM	Banana Adjustment Measures Programme
BAS	Beausejour Agricultural Station
BIT	Banana Industry Trust
CARDI	Caribbean Agricultural Research and Development Institute
CTV	Citrus Tristeza Virus
DTC	Demonstration and Training Centre
EC $	Eastern Caribbean Dollar
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
IICA	Inter-American Institute for Cooperation on Agriculture
MALFF	Ministry of Agriculture, Lands, Forestry and Fisheries
NCCARD	National Coordinating Committee for Agricultural Research and Development
SLMB	St. Lucia Marketing Board
OPSR	Office of the Private Sector Relations
PPCS	Pineapple Producers Cooperative Society
PA	Protected Agriculture
POW	Programme of Work
SFA	Special Framework of Assistance
OF	Open Field
TSS	Total Soluble Solids
TTA	Total Titratable Acidity
US$	United States Dollar
WIR	West Indies Red (hot pepper variety)

1.0 FOREWORD

The Caribbean Agricultural Research and Development Institute (CARDI) St. Lucia Unit would like to thank all farmers and farmer organisations for their participation and collaboration in the successful execution of its 2010 work programme. The Unit gives special thanks to the staff of the Ministry of Agriculture, Lands, Forestry and Fisheries (MALFF), other local agricultural institutions particularly the Inter-American Institute for Cooperation on Agriculture (IICA) and other stakeholders that provided financial and technical assistance throughout the year. The Unit also extends sincere thanks to members of staff who contributed arduously throughout the year, towards the satisfactory delivering its programme outputs under such trying times. This report was written in an atmosphere of chaos, due to the devastation of most the agricultural sector by Tropical Storm Tomas, which struck the island on October 30th 2010. It is estimated that the total cost of recovery is in the region of over US$500 million. CARDI takes this opportunity to extend its sympathy to the farmers, the rest of the agricultural community and to all those that have been affected by the passage of the storm, hoping that you have a speedy recovery.

Ronald Pilgrim
Country Representative

2.0 EXECUTIVE SUMMARY

The 2010 Country Highlights covers the Unit's Programme of Work (POW) for the period 1st January to 31st October 2010, which marks the end of the 2008 - 2010 Medium Term Plan. This section is a summary of country activities/priority actions for 2010.

Extreme weather conditions dominated the period under review, and severe drought conditions reduced crop production during the early part of the year. In the month of February the lowest rainfall (2.8 mm) was recorded at the Demonstration and Training Centre (DTC). High monthly rainfall was recorded at the DTC during the period April to October 2010 and monthly rainfall figures over this period varied from 164.9 mm to 374.4 mm. Heavy flooding interrupted agricultural activity during that period, and on 30th October Tropical Storm Tomas hit the island devastating the agricultural sector.

The unavailability of planting material for the sustainable production of root crops (sweet potato, sweet cassava, tannia and yams) has resulted in shortages for local consumption and exports. This situation has resulted in increased prices for planting material, thereby increasing the cost of root crop production and prices of the produce on the local market. To alleviate these problems, multiplication of root crop planting material for farmers was conducted at the CARDI DTC. Plots consisted of 0.17 ha of sweet potato, 0.21 ha of sweet cassava, 0.17 ha of tannia and 0.32 ha of yam. Planting material consisting of 300 kg of yams, 310 kg tannia, 48 bags of sweet potato slips and 8000 sticks of sweet cassava were distributed to 57 farmers. Sweet cassava planting material was also given to the Belle Vue Famers' Cooperative for establishing 1ha of cassava under the Vige Cassava Revitalisation Project.

There is a great potential for increasing the export of hot peppers to the Miami market. Over the last 5 years, exports of hot peppers to the USA have shown an upward trend. However, market reports from Miami, indicate that peppers exported do not consistently meet the quality requirements of the market. Also due the shortfall in production from traditional overseas producers, imports of pepper mash by local pepper sauce processors has decreased, creating a large local market with better prices for local pepper producers. To facilitate the local production effort, the CARDI St. Lucia Unit facilitated the importation of 1 kg of seed from the Antigua CARDI Unit for the St. Lucia Marketing Board (SLMB). The SLMB distributed the seeds to farmers. CARDI also conducted field training sessions for 20 farmers in production and post-harvest handling of peppers.

A wide range of passion fruit production information has been produced by CARDI, Ministry of Agriculture, and other regional organisations. This information needs to be refined, standardised and made more user friendly for farmers and should be aided by demonstration plots to improve passion fruit production and marketing systems. An improved passion fruit production system was established at CARDI DTC as a demonstration. The plot utilised local material for the construction of trellises to reduce cost of production and was also used to demonstrate the application of control pruning. Eleven farmers and five Extension Officers

from the Ministry of Agriculture, Lands Forestry and Fisheries (MALFF) visited the DTC to observe the low cost passion fruit production demonstration plot. Also an updated and refined "Passion fruit production Guide" was produced and circulated to farmers.

Passion fruit validation trials, comparing the farmer's system and the improved production system were conducted on two farms. The improved production system involved the application of proper management practices such as pruning, training of vines, timely application of fertiliser, pest and disease control as opposed to the farmer's system which does not apply these practices. Analysis of the data collected at the end of October for both farms, showed, that the improved production system out yielded the farmer's system on both farms by 97.5 % and 72.7 % respectively.

Pineapples are produced by small scale farmers in St. Lucia mainly for local consumption. The main cultivars grown are the Smooth Cayenne, Antigua Black and some "unimproved" cultivars. Recently small farmers' interest in pineapple production has grown and a Pineapple Producers Cooperative Society has been formed, as farmers recognised that the crop is a sustainable revenue earner. A germplasm plot consisting of five locally grown varieties (Antigua Black, Smooth Cayenne, TN# 4, TN #11 and local Cayenne) was established in 2009 at the DTC. The plot is a source of planting material for farmers and explants are also provided to the tissue culture laboratory of MALFF at the Union Agricultural Station, for rapid multiplication for sale to farmers.

A large number of pineapple varieties exist which do not meet the quality requirement of selected markets such as the hotel industry. The need to screen varieties that are acceptable will allow farmers and marketers to better satisfy market demands and obtain better prices for their fruit. A trial consisting of a randomised block design was conducted at the DTC to assess the productivity of five (Antigua Black, Smooth Cayenne, Local Cayenne, TN # 4 and TN # 11) existing pineapple varieties. Significant differences were observed between fruit weight and yield ($P < 0.05$). Among the varieties, Smooth Cayenne (2.5 kg) and Local Smooth cayenne (1.9 kg) produced the heaviest fruit and the highest yields of 30.35 kg and 28.75 kg respectively. TN#11 produced the lowest fruit weight and yield. Smooth cayenne varieties were the most susceptible to the Pineapple Mealy Bug *Dysmicoccusbrevipes* (Cockerell) which was controlled with frequent applications of pesticide. Antigua Black was the least affected.

The "Revitalisation of the fresh water nut (coconut) industry" project funded by IICA, started in December 2006, ended in June 2010. The project attempted to satisfy the demand for fresh water nuts, as tall varieties were old, no longer productive and infested with the red palm mite. As the demand for fresh water nut increases, the need to increase production through sustainable propagation of dwarf coconut seedlings for farmers also increased. Seven thousand Malayan dwarf coconut seedlings (green, red and yellow cultivars) from selected trees were propagated in 2009/2010 at the DTC. During 2010, over 2,000 coconut seedlings (equivalent to 15.7 ha) were distributed to 15 farmers.

The CARDI Unit over the years has maintained and multiplied germplasm (mango, soursop, dwarf plantain, pomerac, breadfruit, dwarf golden apple, pineapple, pomegranate, red tannia, sweet cassava etc.) at its DTC for supplying to the farming community. Planting material was sold to farmers and mango scions were provided to the Propagation Unit of MALFF. The sale of fruit crop seedlings and produce from existing germplasm generated revenues of EC$11,169.00.

The CARDI Unit continued its research re evaluating Protected Agriculture vs. Open Field vegetable production systems, by conducting economic analyses on tomato, cucumber and sweet pepper produced during the dry season (January to May) and wet season (June to December). Economic analyses comparing protected vs. open field tomato production during the dry season, showed that the PA system had a higher cost of production of $197,462.00/ha but a lower net return of $46,982.00/ha, as compared to the open field system which had a production cost of $120,864 and a net return of $184,691. This lower rate of return under the PA system may be attributed to Tomato Leaf Curl Virus which severely affected the tomato crop. This disease which affected both production systems was found to be more prevalent under the protected system.

The control of Citrus Tristeza Virus (CTV) disease on existing citrus plantings is difficult. In new citrus plantings control of the disease can be achieved by the use of tolerant/resistant rootstocks. The presence of Citrus Triteza Virus has been observed on a few locations by the Ministry of Agriculture. CARDI has established at its DTC a germplasm bank of three CTV-tolerant lemon rootstock varieties (Volkameriana, Swingle citremelo and Carrizzo citrange. Seeds (1.5 kg) were extracted from CTV-tolerant lemon rootstock varieties and handed over to the Propagation Unit of the Ministry of Agriculture for propagation of CTV tolerant rootstocks.

CARDI provided sweet cassava (M Col 22) roots to the Ministry of Agriculture to promote the consumption of cassava as a staple at World Food Day exhibition on 16 October 2010. This was done as part of a concerted effort to promote the consumption of local agricultural produce, in order to reduce the increasing food import bill.

Various meetings were held with individual members (collaborators and stake holders) of the National Coordinating Committee for Agricultural Research and Development (NCCARD). These meetings were used to conceptualise and develop the Units Programme of work for 2010. However, due to the small critical mass of the NCCARD, it seldom met as a "body" during 2010.

A 3 hour lecture in post harvest technology of fruits vegetables and root crops was presented by Ronald Pilgrim to 35 agricultural students of the Sir Arthur Lewis Community College.

Technical assistance was provided by the CARDI Unit to the Banana Industry Trust (BIT) for the "Assessment of Pineapple Maturity in St. Lucia". The technical assistance was provided through a short term consultancy funded by the European Union (EU). The objective was to

provide registered pineapple farmers and related stakeholders with information that would assist them in the determining all stages of maturity of the main pineapple varieties (Victoria Sweet, Antigua Black, Boutielle, and Smooth Cayenne) grown commercially in St. Lucia. Pictorial descriptors were developed for determining pineapple maturity stages for the main varieties. A workshop was also conducted in collaboration with the Ministry of Agriculture to train 40 members of the Pineapple Producers Cooperative Society (PPCS) in the determination and use of pineapple maturity indices for various market outlets.

The CARDI Unit is also providing technical assistance to Ministry of Agriculture Lands Forestry and Fisheries (MALFF) by undertaking a water nut (coconut) production project at its DTC. This project will greatly assist in sustaining coconut seedling production which was initiated by the CARDI Unit that ended in June 2010. It is expected that the project will last 2.5 years and will cost EC$200,000. EC$40,000 will be provided in each of five phases and 8,000 coconut seedlings will be produced in each phase. Since the 1980's, coconut production has continued to decline primarily as a result of aged trees that are low yielding, abandoned banana farms that were inter-planted with coconuts, mite infestation and the general lack of management practices. Also the strong and growing popularity and demand for fresh water (jelly nut) nuts, which continues to fetch an attractive price, has impacted on coconut production in St. Lucia. The project seeks to rehabilitate the coconut industry in St. Lucia through the provision and establishment of improved dwarf cultivars that are high yielding, disease (lethal yellowing) resistant and of good tasting quality (water / jelly). During the completed first phase of the project, the coconut nursery was established and 1,000 coconut seedlings were distributed to seven farmers. An additional 8,000 seedlings are ready for distribution.

CARDI in an effort to generate much needed revenue initiated an income generating activity at the DTC through the production of selected food crops (pumpkin, spinach, amaranth and okra) on 0.30 ha for sale on the local market. Produce from these crops was sold mainly to the St. Lucia Marketing Board (SLMB) and generated a net profit of EC$ 3,269.

3.0 REVIEW AND UPDATE OF THE AGRICULTURAL AND RURAL SECTORS[1]

The Government of St. Lucia in its effort to expand the agricultural sector and improve rural livelihoods has outlined a number of initiatives for the Financial Year 2010/2011 that are envisaged will impact positively on the sector.

Government provided EC$5 million to support the promotion of domestic produce; agro-enterprise development, and technology adaptation.The provision of funds for these activities will avert the negative effects caused by the EU cutting its import tariff on bananas from Latin America.

Government continued to enhance the existing partnerships between leading economic sectors under an Agro-Eco Tourism Programme valued at €4.3 million. The objective of this project is to increase consumption of domestically produced food. This programme is expected to create alternative economic activity, thus generating employment, increasing incomes, facilitating competitiveness, reduce poverty and ensure adequate social protection for rural communities. The impact of the project is expected to be reflected in an improvement in diet-related lifestyles, manifested in a reduction in the level of non-communicable diseases and the increased consumption of locally produced agricultural products. The Dennery/Mabouya region has been identified as the pilot community for the implementation of this programme.

Under the programme of Agro-enterprise Development, the objective is to generate rural income and employment, promote entrepreneurship (especially among the youth), encourage linkages between the agro-processing, craft and tourism sectors and to enhance the competitiveness and market opportunities for foods produced in St. Lucia; thereby creating employment and opportunities for the youth and people in the rural communities.

Through the Technology Adaptation project two main components were pursued, namely: Improvement of Agricultural Production and Productivity and Strengthening of Plant Health Services.

Continued support will be provided to improve productivity in the banana sector as Government recognises its importance to the economy and job creation. Therefore, under the SFA 2005 Programme, Government intends to establish a Scheduling and Forecasting Production System to enable farmers to maximise their production at the times when the market price is at its peak.

Non traditional crops will be targeted during the year, as Government will be making a concerted effort to diversify the agricultural sector, generate employment and foster growth

[1]*Source: Prime Minister's Budget Address, 2010*

in the sector by providing support to four key agricultural commodities (cocoa, pineapple, cut-flowers and cassava).

Under the Banana Commercialisation and Agricultural Diversification Programme, the European Union has pledged support to the banana industry under a new Financing Instrument called the Banana Adjustment Measures Programme (BAM). The objective of this EU funded programme is to help countries to adjust to new market conditions resulting from trade liberalisation.

The new clearing house facility (National Marketing Infrastructure) at Cul-de-Sac will come into being during this fiscal year. The new company will be restructured as a one-stop service centre for Saint Lucian enterprises engaged in the production, manufacturing and sale of non-banana (agricultural) commodities. The total cost of the facility is estimated at EC$3.5 million.

Government has started to enhance the capacity of the Beausejour Agricultural Station (BAS) to effectively service the agriculture community. Emphasis will be placed on the livestock sub-sector. The first phase of the project has been completed. The second phase of the project, will be undertaken during the new financial year 2011, at an estimated cost of EC$2 million.

The establishment of the Agricultural Diagnostic Facility at Roseau is expected to promote agricultural development, through the provision of services to address major needs of stakeholders and other production sectors (agro-processing, tourism, and manufacturing). The project costs approximately EC$3.5 million.

The Government of the Republic of China on Taiwan is financing a state of the art meat processing facility costing approximately EC$12.5 million. Work has commenced on the facility in Vieux Fort. When completed, the facility will revolutionise the livestock sector and result in a reduction in the food import bill. The facility will also enhance livestock producers' ability to supply hotels, supermarkets and community-based distribution outlets. The overall impact will be the economic recovery and growth within the livestock sub-sector, and by extension, the national economy.

The establishment of an agro-processing plant in this financial year 2010/2011 is expected to create at least 32 jobs, increase foreign export earnings by 10% and generate over $EC2-3 million annually. To date the Taiwanese government has pledged EC$1.5 million to rehabilitate and construct the facility. The Food and Agriculture Organization (FAO), under SFA 2006, has agreed to provide the necessary equipment and to train the staff, which will operate the plant. The total cost of the project is approximately EC$3.5 Million.

Government has recognised the importance of the participation of youth in economic activities in all sectors and has promoted economic recovery and sustained growth, through the agric-enterprise development initiative. This initiative seeks to increase output that would lead to employment generation, agri-business development, income generation within the

farming community, particularly young displaced persons in the rural areas, and to a lesser extent, the urban areas. It is anticipated that with the implementation of this project at least 450 jobs will be created, and the linkage between agriculture and tourism will be strengthened through a consistent and reliable supply of agricultural commodities.

4.0 Implementation of Medium Term Plan, 2008/2010

4.1 Development of sustainable industries

4.1.1 Commodity development - crops

4.1.1.1 CARDI sustains root crop production through provision of planting material

Objective

To increase and sustain the production of root crops (yam, tannia, sweet potato and sweet cassava) for local consumption and export.

Shortages of root crop planting material have seriously affected local production. This has caused increases in the cost of planting material, cost of production and higher prices for local consumers. In an effort to increase and sustain production, CARDI established root crop planting material multiplication plots at its Demonstration and Training Centre (DTC). These plots consisted of 0.15 ha of sweet potato, 0.20 ha of sweet cassava, 0.16 ha of tannia and 0.30 ha of yam. The plots are a source of plant material for farmers.

During the year planting material was distributed to 57 farmers (Table 1 and Plate 1).

Table 1: Number of farmers and quantity of root crop planting material distributed

Planting material	No. of farmers	Quantity
Yam	12	300 kg
Tannia	6	310 kg
Sweet potato	24	48 bags
Sweet cassava	15	6000 sticks
Total	**57**	

Sweet cassava planting material (10,000 sticks) was also distributed to the Belle Vue Famers Cooperative (Plate 2) for establishing 1 acre (0.4 ha) of cassava under the Vige Cassava Revitalisation Project being funded by the Office of Private Sector Relations (OPSR). CARDI will provide most of the planting material for the establishment of 5 acres (2 ha) of cassava next year.

Plate 1: Farmer inspecting a sweet potato tuber from a field established using planting material received from CARDI

Plate 2: Members of the Belle Vue Farmers Cooperative collecting cassava planting material at CARDI DTC

4.1.1.2 Improving hot pepper production and quality

Over the last 5 years, exports of hot peppers to the USA particularly the Miami market have shown an upward trend (for example 27.4 tonnes in 2006 and 32.7 tonnes in 2008) which is expected to continue for some time. The West Indies Red (WIR), Scotch Bonnet and CARDI Green are the major varieties grown in St Lucia. Market reports from Miami indicate that peppers exported do not consistently meet the quality requirements of the market. The shortfall in production from traditional mash producers has caused a reduction in imports of pepper mash by local pepper sauce processors. This has created a large local market for hot pepper and better prices for local pepper producers.

The above post-harvest concerns has caused the CARDI Unit to focused on training farmers in production and post-harvest handling of hot peppers,with the intention of increasing the quantity and improving the quality of berries for both the processing and export markets. Training was conducted at the field level for 20 farmers (Plate 3). It is expected that by the time production comes on stream in November and December 2010, farmers will be trained in all aspects of post harvest handling of peppers for both the processing and export markets. The CARDI Unit through the St. Lucia Marketing Board (SLMB) facilitated the importation of 1.0 kg of West Indies Red hot pepper seeds from CARDI Antigua Unit in June 2010 for sale to farmers.

Plate 3: Training in hot pepper production at the field level

4.1.1.3 Improving and reducing the cost of passion fruit production

Passion fruit production information produced by CARDI, Ministry of Agriculture, and other regional organisations over the years was refined, standardised and made more user friendly, and with the aid of demonstration plots used to transfer technology to extension officers and farmers. The CARDI Unit demonstrated to farmers the improved methods for passion fruit production and also documented the improved production practices for reducing the cost of production. The 0.25 ha demonstration plot at CARDI's DTC reduced establishment costs by utilising local material (indigenous posts and discarded telephone cable wire) for the construction of trellises. The application of control pruning techniques for maximising production was also demonstrated. The plants were spaced 2.4 m apart between rows and 2.4 m apart along rows.

During the year 11 farmers and five Extension Officers of MALFF visited the DTC demonstration plot (Plate 4). An updated and refined "Passion Fruit Production Guide" for farmers will be published for distribution to farmers.

Plate 4: Low cost passion fruit production demonstration plot

4.1.1.4 Validation of improved passion fruit production system

Two validation trials were established on two farmers' holdings in December 2009 (Plate 5). The trials compared two methods of passion fruit production: the farmer's system vs. improved production system. Each system of production was replicated three times on each farmers' holding. The improved production system involved the application of proper management practices such as low-cost trellis, pruning, training of vines, timely application of fertiliser, pest and disease control as opposed to the farmer's system which did not apply these practices. Collection of yield data from the validation plots is on-going. Analysis of the yield data collected from both farms for the first part of the production cycle (up to the end of October 2010) showed that the improved production system out yielded the farmer's system on both farms by 97.5 % and 72.7 % respectively (Table 2).

Table 2: Yield comparisons between farmers vs. improved passion fruit production system

Farm No.	Farmer's system	Improved system	% increase
	Mean yield/plot (kg)	Mean yield/plot (kg)	
1	40	79	97.5
2	55	95	72.7

Plate 5: Farmer collecting fruit from validation plot on his farm

4.1.1.5 Locally identified pineapple germplasm maintained at the DTC

A range of pineapple cultivars including the Antigua Black and the Smooth Cayenne with some "unimproved" cultivars are grown by small farmers in St. Lucia. CARDI has in the past validated the performance of the Taiwanese varieties TN # 4 and TN # 11 and small quantities of these varieties were distributed to farmers. Recognising that the crop is a sustainable earner, the number of pineapple producers has increased, thus necessitating the need for a Pineapple Producers Cooperative Society.

A pineapple germplasm plot consisting of five locally grown varieties (Antigua Black, Smooth Cayenne, TN# 4, TN #11 and local Cayenne) was established and maintained at the DTC in 2009 (Plate 6). During the year planting material (suckers) from the pineapple germplasm plot were distributed to 11 farmers and explants were provided to the tissue culture laboratory at the Union Agricultural Station for rapid multiplication and sale to farmers (Plates 7 and 8).

Plate 6: Pineapple germplasm plot at DTC

Plate 7: Tissue cultured ex-plants

Plate 8: Advanced tissue cultured plants for sale to farmers

4.1.1.6 Assessing the productivity of existing pineapple varieties grown in St. Lucia

The existence of various pineapple varieties in St. Lucia necessitates the need for screening varieties that are acceptable and productive, so that farmers can better satisfy market demands and obtain better prices for their fruit.

A randomised block trial with five randomised treatments (Antigua Black, Smooth Cayenne, Local Cayenne, TN # 4 and TN # 11), was replicated four times. Each plot was made up of 3 rows spaced 45.0 cm apart and each row contained 15 plants spaced at 45 cm along the row, giving a total of 45 plants per plot. Plot size was 20.25 m^2. Yield data (mean fruit weight and mean plot yields) were analysed to determine the most productive varieties (Table 3).

Significant differences were observed between fruit weight and yield ($P < 0.05$). Both Smooth Cayenne and the Local Cayenne produced the heaviest fruit 2.025 kg and 1.925 kg respectively and the highest plot yield 30.35 kg and 28.75 kg respectively. TN#11 producing the lowest fruit weight and yield.

The yields per hectare of all the cultivated varieties used in the trial were high with a minimum yield of 12,148 kg/ha. Farmer and consumer preferences will determine which variety best suits their needs.

Table 3: Mealy bug infestation, fruit weight, plot and per hectare yield of four locally cultivated pineapple varieties

Varieties	Level of mealybug infestation	Mean weight/fruit (kg)	Mean Yield /plot (kg)	Yield/Hectare (kg)
Antigua Black	Low	1.725	26.03	12,854
Smooth Cayenne	High	2.025	30.35	14,987
Local Cayenne	High	1.925	28.75	14,197
TN# 4	Low	1.700	25.52	12,602
TN# 11	Low	1.600	24.60	12,148
LSD (5% level)		0.3259	4.683	
df		12	12	

The Pineapple Mealy Bug is known to be the vector for transmitting Pineapple Wilt which can seriously affect pineapple production. Varieties that are susceptible to the pest face serious problems and may be adversely affected by the wilt if the pest if not adequately controlled. The Smooth Cayenne and the Local Smooth Cayenne varieties were highly infested with the Pineapple Mealybug *Dysmicoccus brevipes* (Cockerell) warranting the frequent application of pesticide for effective control of the pest. Antigua Black variety was the least affected.

4.1.2 Development of seeds and seedling banks

4.1.2.1 Revitalisation of the fresh water nut (coconut) industry

Fresh coconut water is in great demand, but coconut production is on the decline, because the traditional tall trees (Jamaica Tall) are very old, infested with the red palm mite and are no longer productive. A project funded by IICA, aimed at increasing and sustaining year-

round production of water nuts was initiated in December 2006. The project replaced unproductive old trees with the more productive dwarf varieties. The project came to an end in June 2010.

During the final year of the project 7,000 Malayan dwarf coconut seed nuts (green, red and yellow cultivars) from selected trees were propagated at the DTC. Over 2,000 seedlings (equivalent to 15.7 ha) were distributed to 15 farmers (Plate 9). Farmers were monitored by MALFF Extension Officers to ensure that seedlings were properly established and managed, following the recommended management practices provided by the CARDI Unit.

Plate 9: Farmer collecting the final batch of coconut seedlings at CARDI DTC

4.1.2.2 Fruit and food crop germplasm maintenance

This is an on-going activity for providing service to the farming community. Over the years there has been a loss of germplasm of various indigenous fruit and food crop species, as new market driven crop types are introduced. This has resulted in the loss of local crop species thereby reducing the island's crop biodiversity. Initiatives have been taken by the CARDI Unit over the years to maintain and multiply the germplasm of a number of local fruit (mango, soursop, dwarf plantain, pomerac, breadfruit, dwarf golden apple, pineapple, pomegranate etc.) and food crop species such asred tannia, sweet cassava, dwarf plantain, and breadfruit at the DTC. This activity ensures that these species are available for future research and the Unit generates revenues from the sale of planting material and produce.

Planting material was sold to farmers and mango propagation material (scion) provided to the Propagation Unit of MALFF. The sale of fruit crop seedlings and produce harvested from existing germplasm were sold generating revenue of EC$11,169. The quantity and revenue received from such sales are shown in Tables 4 and 5 respectively.

Table 4: Quantity and revenue from fruit and other crop germplasm

Crop	Quantity of planting material	Revenue ($EC)
Passion fruit	296 seedlings	465
Golden apple	8 seedlings	40
Pineapple	50 slips	100
Plantain	465 suckers	580
Coconut	440 seedlings	595
Cassava	2000 setts	120
Tannia	120 suckers	200
Total		**2,100**

Table 5: Quantity and revenue for produce generated from germplasm

Crop produce	Quantity (kg)	Revenue ($EC)
Golden apple	125	110
Passion fruit	1181	3,882
Mango	180	227
Plantain	468	465
Wax apple	366	817
Pineapple	115	508
Sweet pepper	22	51
Tomato	81	382
Tannia	157	695
Watermelon	117	450
Cassava	558	1,230
Chinese yam	2	10
Avocado	55	242
Total		**9,069**

4.1.3 Emerging issues

4.1.3.1 Validation of Open Field (OF) vs. Protected Agriculture (PA) for vegetable production

This is an on-going project that began in 2008. The project aims to evaluate yields and cost of production of selected vegetables (cucumber, sweet pepper and tomato) grown under Protected Agriculture and Open Field production systems.

Traditionally, vegetables are grown by small farmers in Saint Lucia in the Open Field system during the months of January to May (the dry season), when the incidents of pest and disease are low. Some cultivation also takes place in the rainy season (June to December) but production during this period is severely affected by pests and diseases.

Protected Agriculture ("greenhouse") technology was first introduced to Saint Lucia through the Ministry of Agriculture in 1990 by the French Technical Mission. The Ministry saw the need for this type of protected system due to the high year-round demand for vegetables, such as sweet pepper, tomato, cucumber and lettuce particularly during the wet months of the year (June to December). These crops were not only demanded by the local consumers but also by the hospitality industry. To supplement local production short falls during the wet season, large quantities of vegetable are imported to satisfy consumer demand.

In an attempt to realise its mandate, of substantially reducing the importation of vegetables which are in high demand, through appropriate technological interventions, the Ministry of Agriculture in collaboration with the Taiwanese Mission is assisting with the establishment of Protected Agriculture systems to help stabilise and sustain adequate levels of local vegetable production.

Protected Agriculture technology as it is envisaged could help solve the problem of seasonal variation in vegetable supply. The project also takes into consideration a noticeable shift towards smaller farm size and the need to engage in more intensive forms of agriculture. The role of the "PA" systems could be seen therefore as an attempt to even out production levels especially during periods of scarcity during the rainy season. It provides an avenue for the intensification of production of certain vegetable types and can target farmers with scarce land resources.

Though production of vegetables using Protected Agriculture systems has been on-going, the evaluation of productivity under these systems compared to that in OF systems is limited.

From 2004-2008, the value of vegetable imports and fruits increased from EC$ 33.2M in 2004 to EC$ 46M in 2008 as shown in Table 6.

Table 6: Value of imports of vegetables and fruits to St Lucia, 2004-2008

Year	2004	2005	2006	2007	2008
Value (EC$'000)	33,265	40,267	43,864	41,657	46,026

Source: Planning and Statistical, Ministry of Agriculture & the Foreign Trade Report 2010

Estimated local production of cucumber has fluctuated and sweet pepper and tomato has increased throughout the years (Table 7).

Table 7: Estimated crop production and value (EC$'000) for cucumber, sweet pepper and tomato in St Lucia, 2004-2008

Crop	2004		2005		2006		2007		2008	
	Tonnes	Value	Tonnes	Value	Tonnes	Value	Tonnes	Value	Tonnes	Value
Cucumber	557	1,110	508	1,088	583	1,215	566	1,401	504	1,435
Sweet pepper	73	429	54	395	77	558	92	761	149	1,100
Tomato	218	1,479	192	1,396	307	1,887	328	2,204	346	2,177

Source: Planning and Statistical, Ministry of Agriculture & the Foreign Trade Report 2009

In this study the Protected Agriculture structure consisted of galvanise steel frames, with support for climbing crops, aluminium side clips and anchors. It covers an area of 18 m x 9.3 m (168 m^2) with an area cultivated underneath of 108 m^2. There is a celloclim anti heat 200 mic plastic cover which has a life span of 5 years. The system comes with 12 drip irrigation lines of 16 mm round drip line 0.30 / 2 L/h with a valve on each line. The drip irrigation system also consists of a pressure regulator 19 mm / disc filter 19 mm with main valve 19 mm, and manifold PET 25 mm. Surrounding the front, back and sides of the structure is an anti-bird netting (Plate 10).

Plate 10: Protected Agriculture system established at the CARDI Demonstration and Training Centre

The Open Field system consisted of an unprotected area with the same dimension as that used for the PA system (18 m x 9.3 m). The land was mulched (polypropylene fabric) as a weed control measure. A drip irrigation system similar to the protected agriculture system was also established (Plate 11).

Plate 11: Layout of the Open Field system, CARDI St Lucia Demonstration and Training Centre

Prior to land preparation the sites (Protected Agriculture and Open Field systems) were allowed to fallow for a period of 2 months to allow the land to recuperate from previous intensive cropping as it was difficult to relocate the sites. Lime in the form of dolomitic limestone was broadcast at a rate of 500 kg/ha then both areas were disc ploughed and rotor tilled.

Crops of tomato (Caribe Improved) and cucumber (Tropic Cuke 11) were grown during 2010. Seeds were sown and raised in seedling trays. A starter solution (Miracle Grow) was applied to the seedlings at a rate of 2 ml/L of water.

Tomato seedlings were transplanted 8 weeks after sowing (Plates 12 and 13) and cucumber seedlings 10 days after sowing. A standard crop spacing of 60 cm x 60 cm was used at transplanting giving a total plant population of 270 plants per system (108 m^2). At transplanting compost (114g) was applied to each planting hole. NPK fertilizer (12:16:24+2) and urea were applied alternatively at a rate of 114g per plant every 21 days during the life of the crop.

Pests and diseases were controlled using various pesticides at the manufacturer recommended rates when the first signs of pest and disease appeared on the crop. The crops were irrigated for half an hour per day on a daily basis under the PA system and whenever required under the Open Field system

A support system comprising of two parallel lengths of twin running along either side of each plant row was used to support tomato plants under both production systems. A trellis system was used for cucumber only for the protected agriculture system. It consisted of twin tied to the base of each plant and tied upright to horizontal crop support structures above

the plants. Plants were trained to climb established trellises during their early growth phase. Under the open field system plants grew along the ground.

Data was collected on rainfall, temperature, yield, material and labour inputs throughout the production period, for each crop cultivated under both production systems. Costs of production were calculated and comparisons made for both production systems.

Plate 12: Transplanted tomato seedlings under the PA system

Plate 13: Transplanted tomato seedlings under Open Field system

The tomato crops grown in both PA and Open Field systems were severely affected by a viral disease, which was identified by Plant Pathologist of the Ministry of Agriculture as Tomato Yellow Leaf Curl Virus (Plate 14). The disease is usually spread by white flies and aphids. Attempts to control the disease using chemicals have been unsuccessful. The disease has recently been affecting tomato production throughout the island. The mean temperatures recorded for the Protected and Open systems were 30 ^{0}C was 28 ^{0}C respectively.

Plate 14: Tomato plant affected by Tomato Yellow Leaf Curl Virus

The tomato and cucumber crops were each harvested over a 30-day period. Economic analyses comparing Protected vs. Open Field tomato production systems during the dry season showed that the Protected system had a higher cost of production (EC$197,462 / hectare) and a lower net return (EC$46,982 / hectare), when compared to the open field system which had a production cost of $120,864/ hectare and a net return of $184,691 (Tables 8 and 9 below). This lower rate of return under the protected system may be attributed to Tomato Leaf Curl Virus which severely affected tomato crop. This disease which affected both production systems was found to be more prevalent under the protected system.

Table 8: Economic analysis for dry season tomato production under Protected Agriculture system

ACTIVITY	Unit	Qty	Unit cost	Total (EC$)
Costs				
Land preparation				
Ploughing & rotavating	man days	0.5	60.00	30.00
Drainage	man days	1.5	50.00	75.00
Planting material				
Seed	no.	300	0.04	12.00
Seedling trays	trays	3	12.00	36.00
Peat moss	kg	2	3.00	6.00
Fertilising & plant applications				
Manure	bags	2	10.00	20.00
Fertiliser NPK 16:8:24+2	kg	20	4.00	80.00
Urea	kg	10	4.60	46.00
Miracle Grow	gm	8	0.12	0.96
Cytokin	gm	80	0.15	12.00
Insecticide				
Pronto	ml	75	0.35	26.25
New Mectin	ml	24	0.64	15.36
Fungicides				
Rizolex	gm	10	0.50	5.00
Banrot	gm	120	0.38	45.60
Maintenance labour				
Planting	man days	0.25	40.00	10.00
Trellising	man days	0.50	40.00	20.00
Fertilising	man days	0.25	40.00	10.00
Spraying	man days	0.25	50.00	12.50
Weeding (manual)	man days	1	40.00	40.00
Harvesting				
Harvesting	man days	2.5	40.00	100.00
Transportation				
Inputs	Trips	1	50	50.00
Marketing	Trips	12	50	600.00
Total operating expenses				**1252.67**
***Fixed expenses (per crop)**				
*Protected Agriculture structure & equipment	1 (9.30 x 18.0 m)	1	13,118	874.50
Twine for trellis	roll	1	66.00	5.42
Total cost of production				**2132.59**
Returns				
Plants	270			
Production (kg) / 108m^2	530			
Marketable yield (kg) /108 m^2	400			
Kg / plant	2.0			
Average price/kg	$6.60			
Cost of production/ha	**$197,462**			
Net returns/ha	**$46,982**			

* Approximate life span of Protected Agriculture structure = 5 yrs. Number of crops/yr = 3
Cost of protected Agriculture structure/crop = (13,118/5/3) = $874.50

Table 9: Economic analysis for dry season tomato production under Open Field system

ACTIVITY	Unit	Qty	Unit cost	Total (EC$)
Costs				
Land preparation				
Ploughing & rotavating	man days	0.5	60.00	30.00
Drainage	man days	1.5	50.00	75.00
Planting material				
Seed	gm	300	0.04	12.00
Seedling trays	trays	3	12.00	36.00
Peat moss	kg	2	3.00	6.00
Fertilising & plant applications				
Manure	bags	2	10.00	20.00
Fertiliser NPK 16:8:24+2	kg	20	4.00	80.00
Urea	kg	10	4.60	46.00
Miracle Grow	gm	8	0.12	7.20
Cytokin	ml	80	0.15	12.00
Insecticide				
Pronto	ml	75	0.35	26.25
New Mectin	ml	24	0.64	15.36
Fungicides				
Rizolex	gm	180	0.20	36.00
Banrot	gm	120	0.38	45.60
Maintenance labour				
Planting	man days	0.25	40.00	10.00
Trellising	man days	0.50		20.00
Fertilising	man days	0.25	40.00	10.00
Spraying	man days	0.25	50.00	12.50
Harvesting				
Harvesting	man days	2.5	40.00	100.00
Transportation				
Inputs	Trips	1	50.00	50.00
Marketing	Trips	10	50.00	500.00
Total operating expenses				1149.91
Fixed Expenses (per crop)				
*Ground cover	roll	1/4 roll	1800.00	150.00
Twin for trellising	roll	1	66.00	5.42
Total cost of production				**1305.33**
Returns				
Plants	270			
Production (kg) /108m^2	670			
Marketable yield (kg) /108 m^2	500			
Kg / plant	2.5			
Average price/kg	$6.60			
Revenue	$3,300			
Average cost/kg	$2.60			
Margin	$4.00			
Cost of production/ha	**$120,864**			
Net returns/ha	**$184,691**			

*Cost of ground cover/crop = ($450/3 crops per year) = $150.00

No yield data was obtained for the cucumber production systems, as the crop was totally devastated by Tropical Storm Tomas. Trials using cucumber will be repeated during dry season in 2011.

4.1.4 Invasive species initiatives

4.1.4.1 Seed production for Citrus Tristeza Virus tolerant rootstock

Tristeza is primarily a disease of citrus trees. It is usually transmitted by the brown citrus aphid and affects the budding or grafting on susceptible sour orange rootstocks. The presence of CTV has been observed by the Ministry of Agriculture at a few locations on the island. Control of the disease on existing plantings is difficult. In new citrus plantings, control of the disease can be achieved by the use of tolerant/resistantrootstocks.

CARDI continues to maintain in its germplasm bank three CTV-tolerant lemon rootstock varieties (Volkameriana, Swingle citremelo and Carrizzo citrange). One and half kilograms of seeds were extracted (Plate 15) from these tolerant rootstock varieties and supplied to the MALFF for their propagation programme.

Plate 15: Seed extraction from fruits produced by CTV resistant varieties

4.2 Development of strategic sinkages

The Unit continued to improve the Institute's image through a number of initiatives. This year, activities that supported developing CARDI's strategic linkages with its collaborators and stakeholders included the following:

4.2.1 Exhibitions

CARDI provided sweet cassava (M Col 22) tubers to the Ministry of Agriculture to promote the consumption of cassava as a "mainstay" of the local diet. This was done as part of a concerted effort to promote the consumption of local agricultural produce and reduce the increasing food import bill. This activity, called the 2010 Cassava Festival "Knowing Cassava" was organised by the Ministry of Agriculture as part of World Food Day. Other activities included in-store promotions and samplings at various supermarket outlets. The activities were financed by the FAO SFA 2006 Project and OPSR.

4.2.2 Training

The Country Representative gave a 3 hour lecture in Post Harvest Technology of fruits vegetables and root crops to 35 agricultural students of the Sir Arthur Lewis Community College (Plate 16).

Plate 16: Lecturing agricultural students of Sir Arthur Lewis Community College

4.3 Institutional strengthening

4.3.1 Technical assistance

4.3.1.1 Assessment of pineapple maturity in St. Lucia

Technical assistance was provided to the Banana Industry Trust (BIT) in the form of a short term consultancy funded by the European Union (EU) for a period of 4 months. The main objective of the consultancy was to provide registered pineapple farmers and related stakeholders, with information that would assist them in the determining the maturity stages (indices) of the main pineapple varieties (Victoria Sweet, Antigua Black, Boutielle, and Smooth Cayenne) grown commercially in St. Lucia.

Pineapple (*Ananas comosus* (L) Merril) belongs to Bromeliaceae family. The fruit is described as a compound fruit formed from a group of small individual fruits (the eyes or fruitlets). It is surmounted by a crown capable of producing a new plant. Naturally the eyes mature progressively from the bottom to the top. Pineapple is a non-climacteric fruit i.e. it does not ripen or improve eating quality after harvest.

Usually subjective indicators are used to determine when pineapples are ready to harvest such as size, colour change, opening out and flattening of the eyes or a dull, solid sound when fruit is tapped with the back of the hand as compared to a hollow thud from an immature fruit. However these are not reliable indicators. Generally fruits are at an early stage of maturity when the eyes (fruit-lets) show a light pale green colour. At this stage, sugar content and the conversion of starch to sugars takes place rapidly in just a few days before the fruit reaches full maturity. However, the organoleptic (taste) quality and aroma of the fruit is dependent on the maturity stage at which the fruit is harvested.

In order that fruits attain their optimum eating quality they must be allowed to ripen fully on the plant. If they are harvested too early, fruits will be flavourless and without fragrance. They will be very acid with low sugar content, poor aroma, colourless flesh, susceptible to internal browning and chilling injury at low storage temperatures (below 10-13^{0}C). However, due to their hard flesh, they can withstand the rigours of post harvest handling.

Fruits harvested too late i.e. at an advanced stage of maturity (shell colour fully yellow) are very sweet, low acidity with a distinct yellow flesh. At this stage of maturity they are very susceptible to mechanical damage, fungal attack and the possibility of the onset of fermentation taking place. Such fruits are usually consumed within a few days.

The translucency of the flesh increases from the early stage of maturity through subsequent maturity stages with the highest translucency (>50% of fruit translucent) at the more advanced stage of maturity.

The actual maturity of the fruit cannot be determined solely by the colour or other external attributes. It is the composition of the flesh which allows determination of maturity. A minimum total soluble solids (TSS or sugar) content of 12% and a maximum acidity of 1% will assure minimum flavour acceptability (the optimal sugar/acid ratio: roughly 0.9 to 1.3). It is important to note that, for identical maturity, big fruits are often less coloured than small ones. Disparities may also exist between the colour and the maturity of the flesh due to climatic factors which produce seasonal variations.

Farm visits were conducted to identify the four main pineapple cultivars (Antigua Black, Smooth Cayenne, Boutielle and Victoria Sweet) grown in St. Lucia (Plates 17, 18, 19, & 20). The identity of these cultivars was verified with the Extension Officer of Ministry of Agriculture responsible for pineapple production and the farmers on whose farm the cultivars were identified.

Plate 17: Antigua Black

Plate 18: Smooth Cayenne

Plate 19: Boutielle

Plate 20: Victoria Sweet

Maturity of the different cultivars were observed in the field using subjective indicators such as size, colour change, opening out and flattening of the eyes or a dull sound when tapped with the back of the hand. Farmers' experiences and knowledge for determining the youngest stage at which fruit attain maturity for harvest were also used. At this stage of maturity, fruits showed a light green colour, opening and flattening of the eyes particularly at the base of the fruit. Determination of this critical stage was then used as the bench mark, on which subsequent advance stages of maturity were determined. These stages were based on the percentage of skin colour change over time (from green to yellow/orange) from the base of the fruit to the top, as fruit maturity usually starts at the base of the fruit.

Five maturity stages for each cultivar were identified based on the percentage of skin colouration (yellow/orange) of the fruit.

- Maturity stage 1 – 0 % skin coloured (skin green)
- Maturity stage 2 – 25 % skin coloured
- Maturity stage 3 – 50 % skin coloured

- Maturity stage 4 – 75% skin coloured
- Maturity stage 5 – 100 % skin coloured

Fruits at the various maturity stages were harvested and tests were conducted for Total Soluble Solids (TSS), % Brix and Total Titratable Acidity (TTA). The flesh colour and translucency were also subjectively assessed and correlations were established between skin colour and internal fruit attributes (flesh colour, flesh translucency, TSS, % Brix and TTA). These correlations were used to determine the maturity stages for the four cultivars.

Pictorial maturity descriptors were documented to determine maturity stages of pineapple cultivars (Antigua Black, Smooth Cayenne, Boutielle and Victoria Sweet).

Skin colour comparisons for five stages of pineapple fruit maturity are shown in Plates 21, 38, 55 and 72. Flesh colour comparisons are shown in Plates 22, 39, 56 and 73.

Tables 10, 11, 12 and 13 give the major physico-chemical attributes at five stages of maturity for the four pineapple cultivars. Plates 23 to 32, 40 to 49, 57 to 66 and 74 to 83 compare flesh colour and translucency between different fruit maturity stages.

Relationships between pineapple flesh and skin colour for five maturity stages of pineapple cultivars are shown in Plates 33 to 37, 50 to 54, 67 to 71, and 84 to 88.

Pineapple cultivar: Antigua Black (average fruit weight: 3 – 5 lb, 1.3 – 2.3 kg)

Plate 21: Comparing skin colour of Antigua Black pineapple fruits at five maturity stages

Plate 22: Comparing flesh colour of Antigua Black pineapple fruits at five stages of maturity

Table 10: Attributes of Antigua Black pineapple at five stages of maturity

Maturity stage	Skin colour	Flesh colour	Flesh translucency	Total soluble solids (% brix)	Total titratable acidity (%)	Brix/acid ratio
1	Light green	Creamy yellow	Opaque	15.5	0.32	48.4
2	25% orange	Light yellow	Slight	15.2	0.40	38.0
3	50% orange	Yellow	Moderate	14.5	0.31	46.7
4	75 % orange	Deep yellow	High	15.1	0.41	36.8
5	100% orange	Deep yellow	High	16.9	0.87	19.4

Comparisons of flesh colour and translucency between different maturity stages of Antigua Black:

Plate 23: Comparing maturity stages 1 and 2

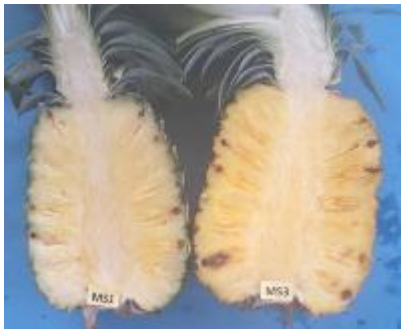

Plate 24: Comparing maturity stages 1 and 3

Plate 25: Comparing maturity stages 1 and 4

Plate 26: Comparing maturity stages 1 and 5

Plate 27: Comparing maturity stages 2 and 3

Plate 28: Comparing maturity stages 2 and 4

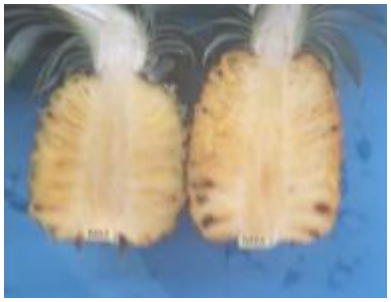

Plate 29: Comparing maturity stages 2 and 5

Plate 30: Comparing maturity stages 3 and 4

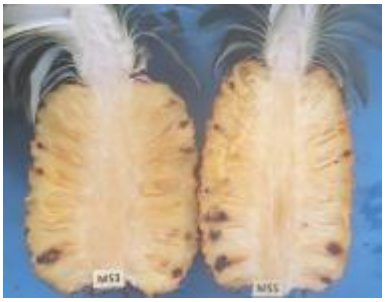

Plate 31: Comparing maturity stages 3 and 5

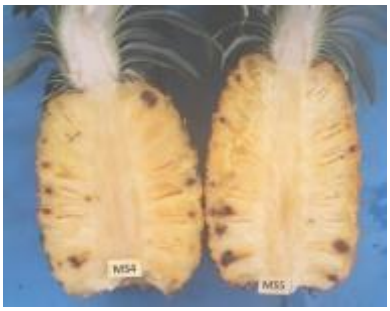

Plate 32: Comparing maturity stages 4 and 5

Flesh and skin colour relationships for different maturity stages of Antigua Black

Plate 33: Relationship of maturity stage 1

Plate 34: Relationship of maturity stage 2

Plate 35: Relationship of maturity stage 3

Plate 36: Relationship of maturity stage 4

Plate 37: Relationship of maturity stage 5

Pineapple cultivar: Smooth Cayenne (average fruit weight: 4 – 5 lb, 1.8 – 2.3 kg)

Plate 38: Comparing skin colour of Smooth Cayenne pineapple fruits at five stages of maturity

Plate 39: Comparing flesh colour of Smooth Cayenne pineapple fruits at five stages of maturity

Table 11: Attributes of Smooth Cayenne pineapple at five stages of maturity

Maturity stage	Skin colour	Flesh colour	Flesh translucency	Total soluble solids (% Brix)	Total titratable acidity (%)	Brix/acid ratio
1	Light green	Creamy yellow	Opaque	18.3	0.9	20.3
2	25% orange	Light yellow	Moderate	18.3	0.73	25.2
3	50% orange	Light yellow	High	14.8	0.67	22.1
4	75 % orange	Light yellow	High	15.6	0.87	19.9
5	100% orange	Light yellow	High	18.0	0.87	20.7

Comparisons of flesh colour and translucency between different maturity stages of Smooth Cayenne

Plate 40: Comparing maturity stages 1 and 2

Plate 41: Comparing maturity stages 1 and 3

Plate 42: Comparing maturity stages 1 and 4

Plate 43: Comparing maturity stages 1 and 5

Plate 44: Comparison maturity stages 2 and 3

Plate 45: Comparing maturity stages 2 and 4

Plate 46: Comparing maturity stages 2 and 5

Plate 47: Comparing maturity stages 3 and 4

Plate 48: Comparing maturity stages 3 and 5

Plate 49: Comparing maturity stages 4 and 5

Flesh and skin colour relationships for different maturity stages of Smooth Cayenne

Plate 50: Relationship of maturity stage 1

Plate 51: Relationship of maturity stage 2

Plate 52: Relationship of maturity stage 3

Plate 53: Relationship of maturity stage 4

Plate 54: Relationship of maturity stage 5

Pineapple cultivar: Boutielle (Average fruit weight: 5 – 6 lb, 2.3-2.7 kg)

Plate 55: Comparing skin colour of Boutielle pineapple fruits at five stages of maturity

Plate 56: Comparing of flesh colour of Boutielle pineapple fruits at five stages of maturity

Table 12: Attributes of Boutielle pineapple at five stages of maturity

Maturity stage	Skin colour	Flesh colour	Flesh translucency	Total soluble solids (% brix)	Total titratable acidity (%)	Brix/acid ratio
1	Light green	Creamy yellow	Opaque	10.4	0.62	16.7
2	25% orange	Yellow	High	14.8	0.91	16.3
3	50% orange	Yellow	High	17.3	0.79	21.7
4	75 % orange	Yellow	High	13.9	0.54	25.8
5	100% orange	Yellow	High	19.1	0.95	20.0

Comparisons of flesh colour and translucency between different maturity stages of Boutielle

Plate 57: Comparing maturity stages 1 and 2

Plate 58: Comparing maturity stages 1 and 3

Plate 59: Comparing maturity stages 1 and 4

Plate 60: Comparing maturity stages 1 and 5

Plate 61: Comparing maturity stages 2 and 3

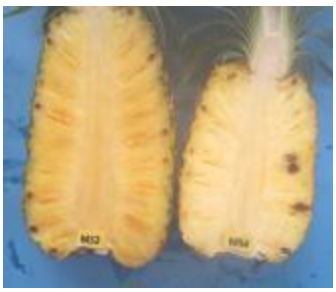

Plate 62: Comparing maturity stages 2 and 4

Plate 63: Comparing maturity stages 2 and 5

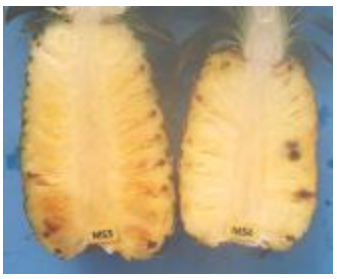

Plate 64: Comparing maturity stages 3 and 4

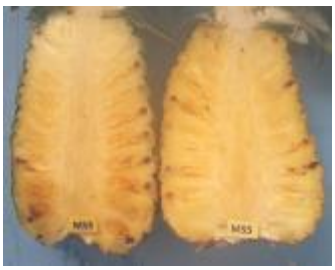

Plate 65: Comparing maturity stages 3 and 5

Plate 66: Comparing maturity stages 4 and 5

Flesh and skin colour relationships for different maturity stages of Boutielle

Plate 67: Relationship of maturity stage 1

Plate 68: Relationship of maturity stage 2

Plate 69: Relationship of maturity stage 3

Plate 70: Relationship of maturity stage 4

Plate 71: Relationship of maturity stage 5

Pineapple cultivar: Victoria Sweet (average fruit weight: 3 – 5 lb, 1.3-2.3 kg)

Plate 72: Comparing skin colour of Victoria Sweet pineapple fruits at five stages of maturity

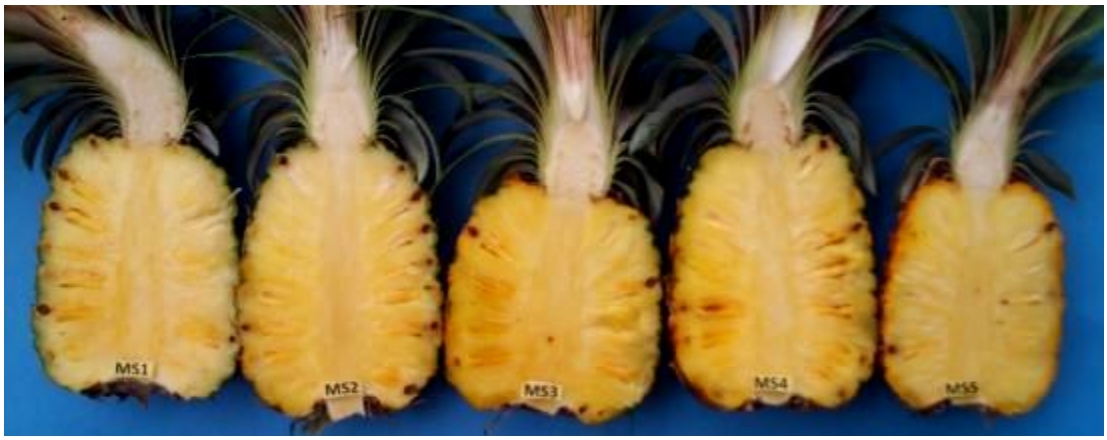

Plate 73: Comparing flesh colour of Victoria Sweet pineapple fruits at five stages of maturity

Table 13: Attributes of Victoria Sweet pineapple at five stages of maturity

Maturity stage	Skin colour	Flesh colour	Flesh translucency	Total soluble solids (% brix)	Total titratable acidity (%)	Brix/acid ratio
1	Green	Cream	Opaque	19.8	1.10	18.0
2	25% orange	Creamy yellow	Slight	16.2	1.39	11.7
3	50% orange	Yellow	High	18.0	1.21	14.8
4	75 % orange	Yellow	High	19.4	1.22	21.8
5	100% orange	Yellow	High	17.8	0.89	12.1

Comparisons of flesh colour and translucency between different maturity stages of Victoria Sweet

Plate 74: Comparing maturity stage 1 and 2

Plate 75: Comparing maturity stage 1 and 3

Plate 76: Comparing maturity stage 1 and 4

Plate 77: Comparing maturity stage 1 and 5

Plate 78: Comparing maturity stage 2 and 3

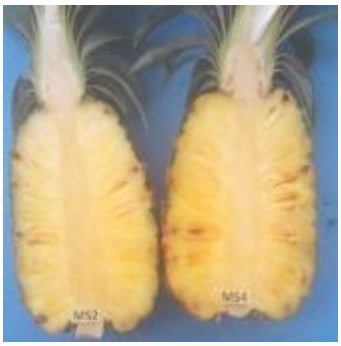

Plate 79: Comparing maturity stage 2 and 4

Plate 80: Comparing maturity stage 2 and 5

Plate 81: Comparing maturity stage 3 and 4

Plate 82: Comparing maturity stage 3 and 5

Plate 83: Comparing maturity stage 4 and 5

Flesh and skin colour relationships for different maturity stages of Victoria Sweet

Plate 84: Relationship of maturity stage 1

Plate 85: Relationship of maturity stage 2

Plate 86: Relationship of maturity stage 3

Plate 87: Relationship of maturity stage 4

Plate 88: Relationship of maturity stage 5

The five maturity stages for all the cultivars, irrespective of their physico-chemical attributes, satisfied the minimum soluble solids (sugar) content of 12% and a maximum acidity of 1% that will assure minimum flavour acceptability.

A training workshop on the determination and use of pineapple maturity indices for various market outlets was conducted in collaboration with the Ministry of Agriculture and the Pineapple Producers Cooperative Society (PPCS). The workshop, held at the R and Zee Service Station in Piaye, Choiseul was attended by over 40 participants including registered members of the PPCS, other farmers, technicians and other relevant stakeholders (Plate 89). Posters highlighting the various maturity stages for each pineapple cultivar were displayed and used to demonstrate maturity indices during the workshop.

Plate 89: Ronald Pilgrim explains maturity indices of pineapple during the workshop

Workshop recommendations:

- The market should determine at what stage of maturity fruits are harvested.

- Maturity stages 1, 2 and 3 are most suitable for markets that require fruits that will be stored for an extended period (over 3 days). These fruits have a longer shelf-life, are more firm and can withstand the rigours of handling. They are best suited for distribution to hotels and supermarkets where low temperature storage takes place. These fruits if allowed to develop a full yellow colour after harvest will not be of an inferior eating quality, than when harvested.

- The more advanced maturity stages 4 and 5 are desirable for fruits that will be consumed immediately (between 1-2 days). Such fruits are more prone to physical damage and must be handled with care. They also tend to deteriorate quite rapidly, which may result in fermentation and off-flavours.

- For the export market, fruits should be harvested at maturity stages 1 and 2.

- Fruits that are immature should not be harvested as they do not develop a good flavour, are low in sugar (Total Soluble Solids) and are more susceptible to chilling injury. It should be noted, that the younger the fruit, the more prone it is to internal browning and chilling injury, particularly when stored at low temperatures.

4.3.1.2 Dwarf coconut seedlings production

For a number of years, large scale coconut estates in St. Lucia cultivated coconutsprimarily for the production of copra. The copra was processed to produce mainly coconut oil and other by-products on a small scale (e.g. margarine, cosmetics). Since the 1980s, coconut production has been declining primarily as a result of low yielding (1-2 metric tons per hectare) aging trees, abandoned banana farms that were inter-planted with coconuts, mite infestation and general lack of management.

The growing popularity and demand for better priced fresh water (jelly nut) nuts have impacted positively on coconut production in St. Lucia. This is the primary reason that, over the last 5 years, the Ministry of Agriculture through its Crop Development Programme has continued to revitalise the coconut industry. The ministry programmes are rehabilitating and expanding acreages in an effort to reverse the downward production trends shown in coconut production over the years. Support for continued revitalisation and development of the coconut industry in St. Lucia with emphasis on the fresh water (jelly nut) nuts is therefore of paramount importance. CARDI's activity aims at assisting the rehabilitation process through the provision and establishment of improved dwarf cultivars that are high yielding, disease (lethal yellowing) resistant and of good tasting quality (water/jelly).

CARDI is providing technical assistance to MALFF by undertaking a water nut (coconut) seedling production project at its DTC (Plate 90). The project has funding of EC$200,000 provided by MALFF and will produce 40,000 coconut seedlings over a period of 2.5 years. The project will be implemented in five phases and each phase is expected to produce 8,000 seedlings.

Plate 90: Coconut seed nut establishment at CARDI DTC

4.3.1.3 Production and sale of vegetables, food crops and fruit

CARDI in an effort to generate much needed revenue cultivated four selectedfood crops (pumpkin, spinach, amaranth and okra) at its DTC during the first 9 months of the year on 0.30 ha of land. These crops were mainly sold to the St. Lucia Marketing Board (SLMB) generating a net profit of EC$3,269 (Table 14).

Table 14: Yields, expenditure and revenue for selected crops

Crop	Hectares	Expenditure (EC$)	Quantity (Kg)	Revenue (EC$)
Spinach	0.05	950	518	1,990
Okra	0.10	1,010	1443	1,516
Pumpkin	0.10	1,150	1510	2,472
Callaloo	0.05	390	143	791
Total	**0.30**	**3,500**		**6,769**
Net profit				**3,269**

5.0 Staff Members

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