CARDI

Annual Report 2007

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Acronyms and Abbreviations

ALPART	Alumina Partners of Jamaica
ASTI	Agricultural Science and Technology Indicators
ASR	Asian Soybean Rust
BOD	Board of Directors
BOG	Board of Governors
CABI	CAB International
CaFAN	Caribbean Farmers Network
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CDB	Caribbean Development Bank
CGIAR	Consultative Group for International Agricultural Research
CMV	Cucumber Mosaic Virus
CR	CARDI Representative
CREI	Citrus Research and Education Institute
CTA	Technical Centre for Agricultural and Rural Cooperation
C-TEP	Caribbean Trade Expansion Project
CTV	Citrus Tristeza Virus
DNA	Deoxyribonucleic acid
DOA	Department of Agriculture
DTC	Demonstration and Training Centre
EC	Eastern Caribbean
ECTAD	Eastern Caribbean Trading, Agriculture and Development Company Ltd.
FAO	Food and Agriculture Organisation of the United Nations
GDTC	Goldsborough Demonstration and Training Centre (Tobago)
GTZ	German Technical Cooperation
IBA	Indole-3-butyric acid
IBPGR	International Board for Plant Genetic Resources
ICT	Information Communications Technology
IICA	Inter American Institute for Co-operation on Agriculture
IICD	International Institute for Communication and Development
ILRI	International Livestock Research Institute
IPM CRSP	Integrated Pest Management Collaborative Research Support Program (USAID)
IPM	Integrated Pest Management
NAMDEVCO	National Agricultural Marketing and Development Company (Trinidad and Tobago)
NIPPA	Nature Island Pineapple Producers Association (Dominica)
OECS	Organisation of Eastern Caribbean States

PRCD	Public Relations and Communications Department
PVY	Potato Virus Y
QAS	Question and Answer Service
RBOC	Regional Branch Office for the Caribbean (of the CTA)
RTP	Regional Transformation Programme
SMDTC	Sam Motta Demonstration and Training Centre (Jamaica)
USA	United States of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UK	United Kingdom
UWI	The University of the West Indies

Chairman's Message

The year 2007 was one of major changes for CARDI. The Chairmanship of the Board of Governors was passed from the Hon. Ignatius John to the Hon. Ezekiel Joseph, (the incoming Minister of Agriculture, Forestry, Fisheries and the Environment, St. Lucia) in December 2006. Dr. Wendel Parham, Executive Director since January 2004, demitted office on 31 March, 2007. After a brief period when Mr. Bruce Lauckner was again called upon to act as Executive Director, Dr. Arlington Chesney, formerly Director of Caribbean Operations, IICA, began a 3-year period as Executive Director on 1 October 2007.

Further, Dr. Keith Archibald resigned as Chairman, Board of Directors effective 31 August 2007. Dr. Archibald had a distinguished term as Chairman for over 7 years, during which he presided over many fluctuating fortunes for the Institute. In coming to the decision to resign, Dr. Archibald thought it best to let a younger professional take over the Chairmanship. We wish him and his wife Patricia many restful, peaceful and enjoyable years to come. I took over the chairmanship from Dr. Archibald on 1 September 2007.

As a result of the above changes there is a new management team in charge of CARDI. This team with Dr. Chesney in the position of Executive Director, immediately set about re-engineering CARDI and motivating the staff for the Institute to better meet the many challenges that Caribbean agriculture is facing. As such, a new management and technical structure was developed at the Institute's Annual Planning Meeting in November 2007. The reshaped CARDI structure has now been implemented and is built on three pillars of (1) Bottom up, client led, (2) Transparency and accountability, (3) Working together. The Institute's work programme has been placed into three Strategic Axes as follows:

1. Development of Sustainable Industries
2. Development of Strategic Linkages
3. Institutional Strengthening

The first of these is where the core functions of science, technology, innovation and natural resource management are carried out. The second Axis will develop partnerships and collaborations as well as promote the CARDI brand. The third Axis comprises income generation and capacity building. The 2008 Annual Report will be formatted to reflect these Strategic Axes. As such, this 2007 Annual Report is the final one, which will be structured to reflect work in the former programmes of Crops, Livestock, Natural Resource Management and Corporate Services. Despite the restructuring, much of the work with the various commodities within the above programmes will continue. Hot pepper, root crops and small ruminants have again been identified by CARDI's member countries, stakeholders and clients as priority commodities for development. CARDI's work with these will therefore continue, but will focus more firmly on the issues with which we are now faced, namely, food security (or food sovereignty as some will define it), rising food prices and the new trading regimes with a consequential impact on the reduction of poverty and hunger. This gives full meaning to our slogan "***Improving lives through agricultural research.***"

One of the reporting changes of the revitalised CARDI has already taken place. Besides the CARDI institute-wide technical report (which you are reading), each CARDI Country Unit is now producing a Country Highlights Report, which will more clearly demonstrate to in-country stakeholders the Institute's work in the respective countries. Most of these Highlights Reports have been published as I write this message and you may have seen some of them. I hope that both the Highlights and the Annual Reports give readers an adequate account of CARDI's work during 2007. Your comments (sent to the Executive Director) will be most welcome.

Dr Richard Harrison
Chairman
CARDI Board of Directors

Executive Director's Message

In 2007, the resilience of the Caribbean Region's agriculture sector experienced a myriad of global events, such as, climate change and its impact on several phenomena, including pest, diseases, hurricanes and floods; the utilisation of crops for the production of bio fuels; and the consequence of pollution on the environment. These have led to rapidly rising food prices and raised major doubts on the Region's attainment of acceptable levels of food security, food sovereignty and nutrition.

Consequently, agriculture is again being considered as a major economic driver in the Region's development agenda. To this effect, what is required is a "New" Agriculture that:

- Spans the entire value (food and non-food) chains
- Develops direct and indirect linkages with the other productive sectors and, is market oriented
- Requires a significant quantum of human capital that is technologically trained
- Is significantly influenced by appropriate technological processes and measures

The notion of a "New" Agriculture dictates the need for a properly functional and integrated regional Technology and Innovation System (TIS). It is in this context, CARDI, as the only regional agricultural institution identified in the Revised Treaty of Chaguaramas (Chapter 12), has a key role to play in the implementation and co-ordination of the TIS.

A new Chairman of the Board of Governors (BOG), Chairman of the Board of Directors (BOD), and an Executive Director were appointed. The Chairman of the BOG, Hon. Ezechiel Joseph is the Minister of Agriculture, Lands, Forestry and Fisheries, St Lucia. The BOD Chairman, Dr Richard Harrison, a former Permanent Secretary in the Ministry of Agriculture, Jamaica is the President and Chief Executive Officer of the Sugar Company of Jamaica. The Executive Director, Dr Arlington Chesney has contributed to the development of regional agriculture during his tenure with IICA from 1994 to 2007. This new management, with the support of CARDI staff and primarily stakeholders and clients in member countries of the Institute, developed its Medium Term Plan (MTP) 2008-2010. The MTP is designed to accelerate productivity and assist in the amelioration of food prices, cost of living, poverty and hunger. The vision and mission within the MTP is based on three pillars; bottom up/client led, working together, transparency and accountability.

Thus, CARDI, through national consultations, has identified cereals and grain legumes sweet potato and other root crops, vegetables and fruits, hot peppers and small ruminants —significant component of the regional food basket—for focused research and development activities that are located within Strategic Axis 1: Development of Sustainable Industries. This Axis has two Focal Areas—Science, Technology Innovation and Natural Resource Management.

There are two other Strategic Axes.

Strategic Axis 2: Development of Strategic Linkages has two Focal Areas:

- *Partnerships and Collaborative Initiatives*, which addresses relationships ofthe Institute involving stakeholders, as well as current and potential collaborators, partners and donors. This initiative is facilitated by a promotional/information process designed to demonstrate the Institute's achievements, capabilities and the environment within which it functions.

- *Advocacy* seeks to promote/establish CARDI as a credible, lead regional research and development institution.

Strategic Axis 3: Institutional Strengthening has two Focal Areas:

- *Income Generation*
- *Capacity Building*

CARDI as a regional institution is uniquely positioned across the landscape of the Caribbean region, and through its field stations can provide a suite of Priority Actions that will provide meaningful Results to assist in addressing the issue of regional food security. It is committed to play a greater role in the fight against high and rising food prices in all member countries of the Caribbean Community (CARICOM).

CARDI continues to operate the Regional Branch Office in the Caribbean (RBOC) for the Technical Centre for Agriculture and Rural Co-operation (CTA) in the Netherlands and to work closely with the Inter American Institute for Agriculture (IICA) in the design and implementation of joint projects.

The Board of Governors, Board of Directors, the Executive Director and Management and Staff of CARDI would like to take this opportunity to express sincere thanks and appreciation to Dr Keith Archibald, the former Chairman of the Board of Directors for his sterling contribution to the Institute and the Region. Dr Archibald demitted office on 31 December 2006 after serving a period of seven years of dedicated service.

Dr H Arlington D Chesney
Executive Director
CARDI

Country Highlights

Antigua and Barbuda

As the centre of excellence for hot pepper seed production, work was focused on the production of hot pepper seed of West Indies Red, CARDI Green and Scotch Bonnet to meet regional demands. Seed of the local landrace 'Peggy Mouth' was also produced both from a conservation and commercial perspective. The Unit's capability to produce hot pepper seed commercially, also allowed it to produce other local seeds such as table squash, cucumber and corn, in order to meet the demand of farmers and consumers in Antigua and Barbuda.

The country's small farmers and the Ministry of Agriculture benefited from the human resources capabilities of the Unit, which provided technical assistance in the areas of crop production and irrigation, particularly in pineapple production during preparations to host the Cricket World Cup in 2007.

Barbados

In the absence of new hybridizations, the hot pepper varietal improvement programme has focused on exploiting the variability within two populations–Red Congo and Scotch Bonnet x Bird Pepper.

In the Red Congo population, apart from stabilizing the dominant type "Red Congo," three outstanding variant selections (two red and one yellow) have been advanced for yield trials. One of the red selections is a potentially high yielding variant, being dark green in colour before turning red, having a thick pericarp, bonnet fold and is high in pungency,

Similarly four selections (three red and one yellow) from the Scotch Bonnet x Bird Pepper cross have been advanced for yield trial. These berries are highly pungent, generally elongate in shape and the plant ideotypes suggest good potential for excellent yield.

Screening hot pepper fields for Potato Virus Y (PVY) and Cucumber Mosaic Virus (CMV) revealed that 60% of the samples collected from mature bearing plants tested positive for CMV, 78% tested positive for PVY and 36% showed mixed infections. Common weeds in the pepper field showed many species testing positive for both PVY and CMV with *Chamaesyce hirta* (L) Millsp (milk weed) and *Kallstroemia maxima (*Police macca*)* having the highest percentage for CMV (15 and 27% respectively) while *Portulaca oleracea* (Puslane, Pussley) had 27% samples being positive for PVY. Future studies will investigate weed seeds as sources for transmission.

Microsatellite primers (the sequences of which were obtained from the International Livestock Research Institute) have been used to DNA fingerprint different populations of Caribbean hair sheep. The exercise resulted in molecular categorisation of the hair sheep into six distinct breed groups—Caprine, West

Africa, St Elizabeth, All Black off-type, purebred Barbados Blackbelly, Blackbelly White Tail off-type, and Virgin Island White.

Putative unique markers were identified to confirm individuals as being purebred Barbados Blackbelly sheep. These were used to resolve between 10 unknown blood samples, which included two of purebred Barbados Blackbelly. With the markers used it was possible to readily exclude seven samples as not being purebred Blackbelly.

Preliminary experiments in the first cropping season of 2007 confirmed that West Indies Red can be rooted from cuttings and normal bearing plants eventually result. Results from an aeroponic system using 3000 ppm IBA revealed rooting after 14 days.

Belize

Assessment of the performance of the 11 hybrids and one open pollinated variety in the CARDI 2007 Yellow Hybrid Corn Trial indicated that the hybrid DKB 191 was the best in overall performance. Although it was among the latest to flower, DKB 191 recorded the third highest shelled grain percentage and highest yield of shelled grain among the 12 entries. In the CARDI 2007 White Hybrid Corn Trial, the hybrid DK 353 gave the best overall performance of the 14 hybrids evaluated.

Germplasm of soybean, cowpea, peanut, chickpea and other edible legumes were maintained and both nucleus and commercial seed produced and stored. Nucleus seeds were extracted from the harvested fruits of five hot pepper varieties, West Indies Red, CARDI Green, CARDI Red, Scotch Bonnet and Savina and will be used to raise seedlings for future production of commercial seed.

Baseline data was collected on major insect pests and their natural enemies on four varieties of hot pepper—West Indies Red, CARDI Red, CARDI Green and Scotch Bonnet—at various locations in the country. The most common pests found on all four varieties were whiteflies and cucumber beetles. The most common predators were spiders.

To address the problem of the Asian soybean rust (ASR), caused by *Phakopsora pachyrhizi*, which was recorded in Belize in January 2006 at Central Farm, two trials were conducted to evaluate various fungicides to control the disease. All of the six fungicides used were successful in controlling the soybean rust. It was found that significant benefits could be had from applying these fungicides between 55 to 65 days after planting.

Following discussions between the CARDI and the Ministry of Agriculture and Fisheries on the production and marketing of the seed paddy variety CARDI 70, arrangements were made for the contract production of the required quantity of seed to meet the need of rice farmers in the Toledo district. A total of 26,199 kg of clean seed paddy was delivered to the Toledo district for planting the 2007 May/June crop.

Dominica

In Dominica, the focus in root crops was solving the problems of anthracnose on yam, caused by *Collectotrichum gloeosporioides* and in fruit crops, the introduction of resistant root stocks to combat Citrus Tristeza Virus.

It was shown that the *Dioscorea rotundata* cv Ladies yam, which are resistant and tolerant to the disease and the *Dioscorea alata* cv Babaoule yam, which is susceptible to the disease, haboured the most virulent strain of *C. gloeosporioides* and were a source of inocula for anthracnose disease in Dominica. Population genetic studies also showed that there was a lack of gene flow between major yam growing locations and that could be a positive factor in controlling the spread of the disease. The study also established that toxins extracted from the pathogen isolates could be used to screen for resistance in the normally susceptible *D. alata* cultivars.

The study supports continued disinfestations of yam planting material as is presently recommended by the Dominican Ministry of Agriculture, introduction and screening of commercial *D. alata* cultivars with pathogen toxins from indigenous isolates and assessing the locations, size and proximity of Babaoule plantings to commercial *D. alata* holdings and other susceptible yam species, as a means of controlling the disease and sustaining commercial acreages of the *D. alata* and other susceptible cultivars for export.

Grenada

The operation of the vegetable seedling nursery continued to make a direct economic impact on the agriculture sector. Over 314, 000 seedlings were supplied to the farming community. However, this was 22% less than the previous year as new commercial nurseries have come into operation and some farmers have begun producing their own seedlings. Improvements in infrastructure saw the replacement of the insecure wooden nursery structures by a metallic one.

Good results were obtained in the regional hot pepper varietal trial with the best yielding varieties being CARDI Red, CARDI Green followed by Tiger Teeth. There were significant differences between varieties for characteristics such as berry width, berry length and total fruit weight.

Jamaica

Replicated field trials to determine the yield potential, as well as the physical and chemical characteristics of 10 popular export sweet potato varieties were conducted in three major producing areas that represented contrasting agro-ecological zones. There was a significant interaction between the yield of varieties and the location at which they were cultivated, suggesting that varieties need to be matched with conditions that are most suitable for their growth and development. Consistent with the 2005–2006 season, the sweet potato varieties, Clarendon, Eustace and Miss Mac were among the top five producers across all the locations.

Several sweet potato varieties were characterized as having high dry matter content and were identified as being most suited for making flour.

No significant differences were observed among treatments (P> 0.05) in IPM trials in which plastic mulch and selective insecticides were used to prevevt root damage by the sweet potato weevil and the sweet potato leaf beetle. Root damage by these arthropod pests were recorded as high as 75% of harvested yields. Similar to previous studies (2005–2006), populations of the sweet potato leaf beetle increased with the maturity of the sweet potato crop. These data have implications for developing scouting techniques for the beetle.

The breeding, multiplication and distribution programme of the CARDI-ALPART Small Ruminant Project, which is aimed at the delivery of improved stock continued during the year and resulted in a majority of births attaining the target of at least 87.5% of the base breed. This resulted in 36 of the improved animals being distributed as breeding stock. Oestrus synchronization, one of the techniques used to facilitate increased production and productivity was introduced, and preliminary results indicated that animal groups not treated took an average of 25 days longer than the treated group to complete kidding.

Investigations on forage production systems on mined-out bauxite lands continued to receive attention. Agronomic data collected over 18 months showed that the Mombasa cultivar produced a superior ground cover and biomass than the common Guinea grass for all cutting intervals, while the common Guinea grass had a higher dry matter percentage. With respect to the grazing grasses, while Tifton 85 exhibited a higher level of ground cover, Mulato was superior in terms of biomass production. In the case of the legumes, alfalfa showed better ground cover at the 4 and 5 week intervals, while the exotic Clitoria was better at the 6-weeks interval. The alfalfa cultivar was also superior in dry matter content.

Vegetable amaranth (callaloo) was reinstated to the USDA pre-clearance list on 13 August 2007. This non traditional export commodity estimated to have an export potential of US$175 million had been removed from the pre-clearance list of export commodities to the USA by the Ministry of Agriculture due to sanitary and phytosanitary challenges, mainly pests on the produce. Under the USAID-sponsored, IPM CRSP, the Institute spearheaded research and training activities geared towards improving the quality of callaloo produced and these activities were credited for the marked reduction in rejected callaloo shipments.

Montserrat

CARDI continued to support the Ministry of Agriculture, Lands, Housing and the Environment (MALHE) through its focused country programme. As requested by the Ministry of Agriculture, work continued with cassava and sweet potato. The growing of these crops and subsequent data collection proved challenging given the drought conditions, acid rain and ash fall ,which often occurred during the growing season of both crops.

Both crops were planted in a new area, the previous one having proven to be unsuitable for root crop production. The yields were disappointing from both commodities. In the case of sweet potato, even though there was lush leaf growth, a high proportion of the harvested roots were stringy and of no value. The clayey soil in which the cassava was grown was a major factor in reducing the yields. In both crops the application of fertiliser did not have a significant effect on yield.

The farine production project encountered problems of poor and non functional equipment, inadequate marketing and at times, lack of raw materials.

St Kitts and Nevis

In light of the closure of the sugar industry in St Kitts and Nevis, the increased availability of land and labour provides opportunities for the production and marketing of new crops to exploit existing markets. Activities were embarked upon to revive the hot pepper industry with the aim being to satisfy the demand of local processors and foster the export of fresh and processed products to regional and extra regional markets.

Technical assistance was given to an informal group of hot pepper producers to grow West Indies Red, CARDI Green and West Indies Yellow as well as some minor varieties on irrigated land. This led to the export of more than 25 shipments of hot peppers with a combined weight of about 7, 000 kg to Antigua and Miami, Florida.

Value-addition was pursued as an additional means of support to the hot pepper industry. Encouraging results were obtained when samples of red and yellow hot pepper were dried and processed into flakes and powder. An 11% dry matter recovery was achieved after drying to constant weight and at current prices, it costs EC$4.95 to dry one kg. Further studies will need to be undertaken to reduce the cost of processing.

Over the period 2000–2007, about 30 sweet potato varieties were evaluated for yield and pest resistance. Of these, 18 were donated by the USDA, while the others were of local origin. In general, the local cultivars were more prolific in terms of vegetative growth and root production than the USDA varieties.

In collaboration with the Agricultural Technical Mission of the Republic of China on Taiwan (CTM) in St Kitts and Nevis, a redesigned trapping system for sweet potato weevil was introduced and demonstrated to farmers. A local model of this system was also developed using recycled plastic water bottles. Comparisons of trapping efficiency confirmed the superiority of the new system over conventional models.

The onion variety HA1367 was found to produce the largest number of bulbs, the highest yield and the highest percentage of marketable bulbs among varieties tested to extend the cropping season in Nevis.

St Lucia

Four local sweet potato varieties—Caten, Zabwico, Tomorrow and St. Vincent—showing various levels of beta carotene as indicated by a yellow to orange coloured flesh, were identified at Desrameax, Babonneau, Choiseul and the Mabouya Valley in **St Lucia** and established in a germplasm bank at the DTC, Dennery. They were characterized, using the IBPGR Descriptors for sweet potato and further evaluated in a field trial.

In a taste test using a Hedonic Scale, samples of the four varieties were scored on a scale of 1to 5, between like and dislike. Caten obtained the highest score (98) followed by Tomorrow (96), while Zabwico and St Vincent each had a score of 86. The most promising varieties were multiplied for distribution to farmers.

In a trial conducted during the dry season (February-May) the performance of two commercial tomato varieties, Heat Master and, Hybrid 61 were examined. The time to 50% flowering and fruit set for the both varieties were about the same (60-65 days and 68-72 days respectively from date of sowing seeds). There were no significant differences between varieties for all the parameters measured. However, when yield results were extrapolated on a hectare basis, the indication is that Heat Master (18,270 kg/ha) was slightly better than Hybrid 61 (15,540 kg/ha).

Fruits of Hybrid 61 appeared to be more attractive than Heat Master due to their deep red uniform colour. They were also firmer at maturity and were therefore able to withstand the rigors of harvesting and post harvest handling, which could result in less fruit damage and extended shelf life during storage.

In collaboration with IICA, a project was undertaken to revitalize the fresh coconut water industry. A total of 122 ha of dwarf coconuts are to be established over a period of 3 to 5 years and towards this end, a coconut nursery was planted at La Resource, Dennery for the production of seedlings for distribution to farmers.

St Vincent and the Grenadines

Two sweet potato trials, which evaluated the efficacy of different chemicals and biological control agents for IPM of the white grub *Phyllophaga* spp. were brought to a successful completion. The results showed that Actara®, which had previously proven to be effective in grub management, along with Admire® were the most effective in both the dry and wet seasons. The commercial formulations of *Beauvaria sp.*, Naturalis T & O® and Botanigard® proved not to be proficient in managing the grub.

Under the CARICOM/Japan friendship agreement programme, the CARDI scientist leading the project travelled to Japan to observe sweet potato production and processing, while the Japanese scientist paid a return visit to the region and participated in evaluating several regional varieties as to their suitability for processing. Promising varieties were collected from the participating countries and laboratory analyses conducted at the Food Processing Laboratory at the University of the West Indies, St Augustine Campus.

Varieties suitable for flour, fries and juice were identified after evaluations were done for brix, dry matter, colour and starch content.

Introduced cassava clones from CIAT were planted, harvested and processed in the ongoing evaluation programme. The farine to meal yield of most of the introduced varieties (40–50%) was superior to that reported for local varieties (25%). The variety MX60, used mainly fresh in Trinidad and Tobago and obtained from tissue culture material from The University of the West Indies, St Augustine Campus, was the lowest farine yielder.

Trinidad and Tobago

Activities were undertaken to improve the hot pepper industry by eliminating a number of binding constraints experienced by hot pepper producers and in particular to address the inability of farmers to source true-to-type seed of the commercially desirable landraces in a consistent manner and reduce the increasing virus load that results from the practice of recouping seeds from commercial crops. CARDI scientists collected landrace specimens from across the country and through a process of selfing, produced uniform accessions and eliminated the problem of high virus loads on the seed material. From 99 accessions chosen for this work, eight elite accessions (seven hot pepper and one seasoning pepper lines) were selected, characterised and catalogued. A field day was held at which participants had the opportunity to view the agronomic performance of the lines in the field, get detailed information on the lines and participate in organoleptic testing.

CARDI collaborated with the Tobago House of Assembly to develop cropping systems for the commercial production of selected crops with domestic and export market appeal. The domestic market is especially important since it includes the vital hospitality sector. Given the severe labour constraints currently being experienced in Trinidad and Tobago, the interventions at the Goldsborough Demonstration and Training Centre have started to focus more on labour saving technologies.

In the case of hot pepper production, models for cost reduction involving mulching and the use of a Speedling system for seedling propagation were developed and tested. The Agritela system, which employs a polypropylene mulching sheet, worked well with hot pepper in reducing the need for and therefore the cost of labour for weeding operations. The use of the Speedling system resulted in significantly reduced seed sowing times and greater efficiency in overall seedling propagation.

A commercially scaled vegetable cropping system for sweet peppers was established at the GDTC pilot organic farm. This was a demonstration plot that highlighted organic propagation techniques on a commercial scale. Capacity building activities that included the training of the GDTC nursery workers in organic transplant production were undertaken. This was done with crops of tomato and sweet peppers utilising a methodology that was developed and tested locally. Technical packages in areas such as crop protection techniques and plant nutrient supplementation were developed and demonstrated for a number of vegetable cultivars. A production model based on the use of sunken beds was developed for growing dasheen (*Colocasia esculenta* (L.) Schott var. *esculenta*) for commercial leaf production.

In view of the negative effects that the continued rise in world grain prices is having on the development of a viable small ruminants industry in the country, a major intervention was made with the introduction of forage-based feeding systems. CARDI has identified and imported a high quality grass, Mulato (*Brachiaria* spp.) that can contribute significantly to ruminant livestock production. A germplasm bank of Mulato was established on 0.32 hectares of land at the Sugarcane Feeds Centre (SFC), and will be used to evaluate animal performance. On one farm, where cows were fed Mulato grass a 23% increase in milk production was reported.

In collaboration with the SFC, a trial in silage making was conducted using sugarcane. This was done as a means of honing the methodology that would be applied to a trial, which will compare silage made from four different grasses, namely King grass (*Pennisetum* spp.) Taiwan grass (*Pennisetum* spp.), sugarcane (*Saccharum officinarum*) and Mulato *(Brachiaria* spp.). The trial results showed that these grasses can be ensiled successfully, using low-cost technologies.

CropsProgramme

Programme Leader: Anil Sinha

Hot pepper industry

Industry overview

Hot pepper production continues to be of interest to many farmers and exporters in the Caribbean region, both as a foreign exchange earner and as a commodity for which there is a high local market demand. In many of the islands, production continues to be dominated by small farmers as the crop readily fits into semi-commercial operations in which berries are produced in a short period of time to provide a regular weekly income.

As shown in Table 1 there is a great potential for foreign exchange earning based on the USA imports of fresh peppers in which both volume and value displayed an increasing trend over the period 2002–2007. The percentage increase in volume and value in 2007 over 2006 was 5 and 6 respectively. Despite the close proximity of the Caribbean to the USA, exports from many of the Caribbean islands decreased. For example, in 2007 the volume exported from Jamaica decreased by approximately 45 percent when compared to 2006.

Table 1. USA volume and value of fresh pepper imports, 2002–2007

Year	Volume(MT)	Value($1000)
2002	401,159	458,275
2003	426,160	547,406
2004	446,007	663,566
2005	488,953	678,415
2006	555,542	750,932
2007	585,069	796,120

The three major market outlets for peppers produced in the region are (a) fresh domestic market, (b) local and regional processors and (c) fresh extra-regional markets. The quantity and quality requirements for these markets differ, with the fresh extra-regional market having the most stringent quality requirements. The development of a successful regional hot pepper industry dictates a proper understanding of the markets' requirements.

As with most small farmer agricultural development projects in the region, emphasis seems to have been devoted to production, with the hot pepper industry in the past being no exception. However, it is now fairly well documented that small holder enterprise development must have:

(a) a clearly defined target market be it wholesale, retail or export
(b) the requisite market infrastructure
(c) a logistical route to market.

Germplasm development, improvement and exploitation

The National Agricultural Marketing Development Corporation (NAMDEVCO) reported that there were over 30 certified farmers involved in hot pepper production in **Trinidad** during the year 2007. The more popular landraces and cultivars used were Faria, Hood, Big Sun, Congo, Seven Pod and West Indies Red. Recent market trends for fresh hot pepper indicated that consumers preferred a deep dark green pepper that is very pungent and flavourful. Farmers have been able to meet these criteria by recouping seeds from each crop and using them for subsequent plantings. This method however can only take the hot pepper landraces to a "plateau" and thereafter a decline inevitably sets in with an accompanying loss of income to farmers. It therefore became necessary to purify and stabilize the local (**Trinidad**) landraces in order to avert this happening. Additionally, it is important to halt the loss of the hot pepper landraces (genetic erosion) and conserve genes for commercial exploitation by hot pepper producers.

Eight elite accessions were selected from 24 preliminary selections and from other accessions in the field. These were: Scorpion, Seven Pod, Faria, Hood, Bejucal, Moruga Red, Moruga Yellow and Pimento (29-4-3). Typical plants within the final selections were isolated using organza sleeves (Plate 1). Berries harvested from these sleeves produced S_2 seeds for the (S_2) plantings in which 130 seedlings from each of the elite lines were transplanted onto the plots in the third week of December 2007. Characterisation of the eight selections were completed and catalogued. (*See Plate 3*).

Plate 1. Isolation of elite plants for hot pepper landrace stabilisation, Trinidad

In the absence of new hybridizations in **Barbados** the varietal improvement program has focused on exploiting the variability within two populations—Red Congo and Scotch Bonnet x Bird Pepper.

In the Red Congo population, apart from stabilising the dominant type "Red Congo," three outstanding variant selections (two red and one yellow) have been advanced for yield trials. One of the red selections is a potentially high yielding variant, being dark green in colour before turning red, having a thick pericarp, bonnet fold and high in pungency (Plate 2).

Plate 2. Outstanding green, thick pericarp and high pungency selection from Red Congo

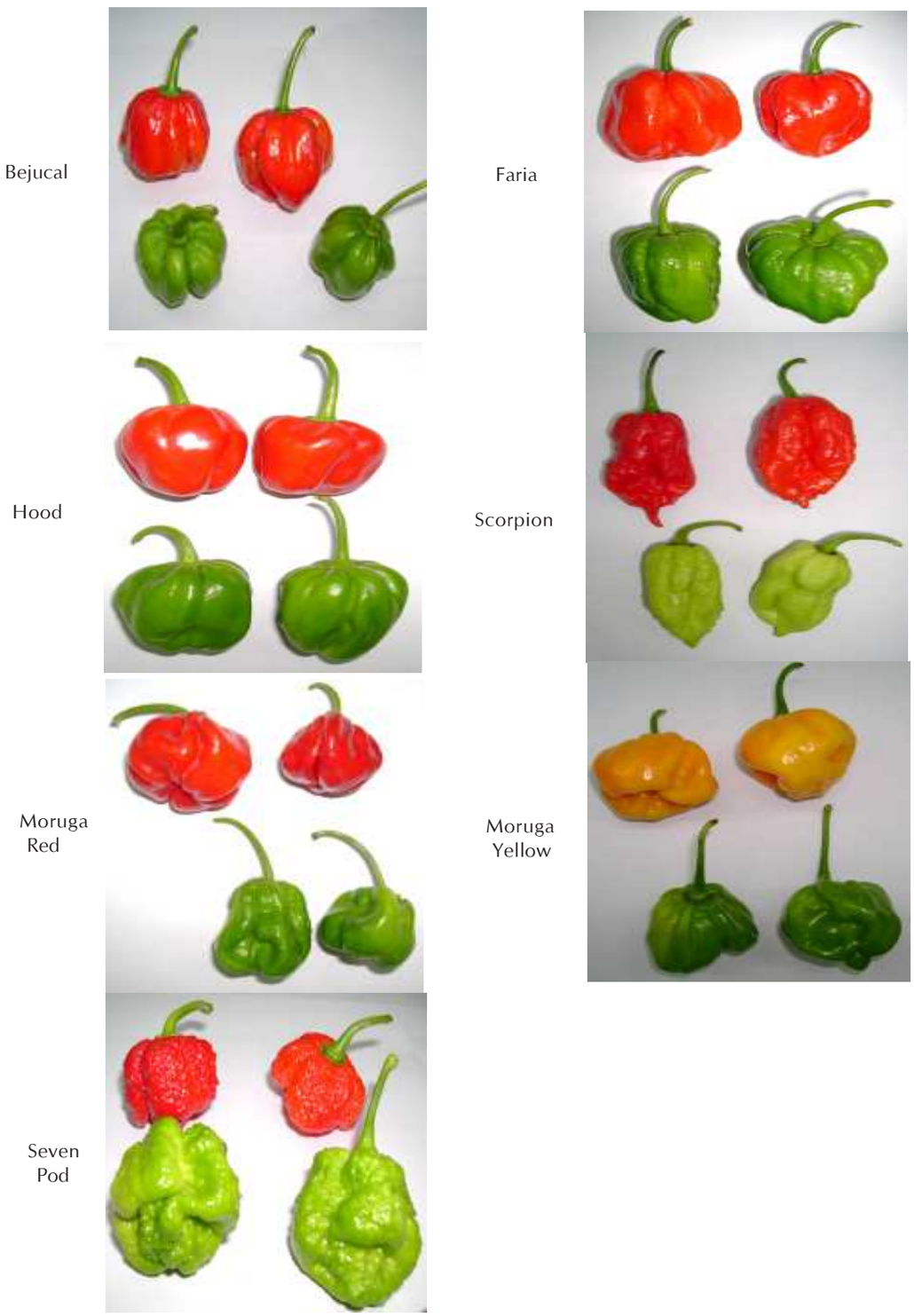

Plate 3. Photographs of mature and developed berries of seven of the elite hot pepper selections, Trinidad and Tobago

Similarly, four selections (three red and one yellow) from the Scotch Bonnet x Bird Pepper cross have been advanced for yield trials. These berries are highly pungent, generally elongate in shape and the plant ideotypes suggest good potential for excellent yield.

Seeds production

In **Antigua,** which is one of CARDI's focal centers for seed production the main thrust was on the production of quality seeds of West Indies Red (WIR), CARDI Green and to a lesser extent Scotch Bonnet and Peggy Mouth (Antiguan landrace). Processing involved grading and selecting of berries for seed extraction, evaluation of seed for quality and then sorting, resulting in a total yield of 6.1 kg of seed for distribution (Plates 4 and 5).

Plate 4 Mechanical seed extraction process

Plate 5. Pack hot pepper seed for storage]

CARDI is the source of seed of West Indies Red, which remains the dominant variety produced for the fresh fruit export in **Belize** along with other important varieties being Yellow Scotch Bonnet and Orange Habanero. The selection of varieties for specific processed products has received minimal attention hence processed products are also made from the same varieties that are produced for fresh fruit export with dried peppers only utilizing red coloured fruits of the preferred variety Caribbean Red.

A total of 24 g of nucleus seeds of five varieties, West Indies Red, CARDI Green, CARDI Red, Scotch Bonnet and Savina were extracted from harvested berries, dried and stored. The seed will be used to raise seedlings for future production of Commercial Seed.

A total of 315.8 kg of fresh berries of CARDI Green were processed and 2.7 kg of dried seed recovered. This was processed to provide 2.5 kg of clean Commercial Seed, which was placed in bulk storage in an air-conditioned seed room and will be treated, packaged and labeled prior to sale.

Production system technologies

A regional hot pepper varietal trial consisting of five varieties and two replicates was carried out in **Grenada**. The five varieties were CARDI Green, CARDI Red, Cayenne, Scotch Bonnet and Tiger Teeth. There were highly significant differences in both berry width and length among the varieties with Scotch Bonnet recording the largest width and Tiger Teeth the greatest length. While there were no significant differences between the varieties with regard to total number of fruits produced, in terms of total weight harvested, there were significant differences between the varieties (Table 2). CARDI Red, the highest yielder was significantly better than Tiger Teeth, Cayenne and Scotch Bonnet.

Table 2. Total weight of fruit harvested in regional hot pepper trial, Grenada

Variety	Fruit weight (kg)
CARDI Red	9.05
CARDI Green	8.80
Tiger Teeth	5.14
Cayenne	3.68
Scotch Bonnet	3.10
F Pr	0.025
s.e.d	1.28
l.s.d (5% level)	3.55

In another regional hot pepper trial carried out in **St Vincent and the Grenadines**. The varieties CARDI Green, CARDI Red, Cayenne, Red Congo, Red Flat, Scotch Bonnet, Tiger Teeth and West Indies Red were evaluated for yield and time to 50% flowering.

It was shown that both CARDI Green and West Indies Red achieved 50% flowering around the same time and were earlier than the other varieties (Table 3). That the time to 50% flowering was similar is understandable, since CARDI Green is a line bred from West Indies Red. These two varieties were also similar in yield, fruit weight and size and were again better than the other varieties evaluated. Tiger Teeth had the fewest fruits in 0.5 kg and Red Flat the most. Red Flat had the lowest yield at 20.0 kg and CARDI Green the highest at 64.5 kg.

In **St Vincent and the Grenadines,** four varieties of Jalapeno peppers were evaluated for the Eastern Caribbean Trading Agriculture and Development Organisation (ECTAD) to assess their production potential with a view to meet an export market. The varieties were Sayula, Ixtapa, Grande and Coyaba. All four varieties had an average of 32 days to 50% flowering. Berries were ready for harvesting in 60 days and yield after five pickings were Sayula (26 kg), Ixtapa (24 kg), Grande (20 kg) and Coyaba (19 kg).

The plants were quite small compared to the *frutescens* varieties and it was evident that for the economic production of jalapeno peppers, a higher population density was needed for crops grown under agro-ecological conditions in the Eastern Caribbean.

Table 3. Performance of eight hot pepper varieties in regional hotpepper trial St Vincent and the Grenadines

Variety	No.of fruits in 0.5 kg	Total yield	Averge kg/ plant	Time to 50% flowering (days)
CARDI Green	44	64.5	1.8	81
West Indies Red	46	60.9	1.7	81
Red Flat	83	20.0	0.6	105
Cayenne	52	40.0	1.1	105
Scotch Bonnet	48	26.5	0.8	105
Tiger Teeth	33	53.0	1.5	105
Red Congo	40	49.7	1.4	105
CARDI Red	49	45.2	1.3	105

Integrated Pest Management (IPM)

Screening of hot pepper fields in **Barbados** for Potato Virus Y (PVY) and Cucumber Mosaic Virus (CMV) revealed that 60% of the samples collected from mature bearing plants tested positive for CMV, 78% tested positive for PVY and 36% showed mixed infections.

Elucidating the source of virus particles is critical in understanding how these diseases are spread. Many sources do not show symptoms even though they carry the pathogen. Weeds were examined as a possible source of inoculum, and in a survey of common weeds in the pepper field many species tested positive for both PVY and CMV. *Chamaesyce hirta* (L) Millsp (milk weed) and *Kallestromia maxima* (Police macca) had the highest percentage for CMV (15 and 27% respectively), while 27% samples of *Portulaca oleracea* (Puslane, Pussley) were positive for PVY(Plate 6). Future studies will investigate weed seeds as sources of transmission.

Milk weed | Police macca | Pussley

Plate 6. Some common weeds that are sources of virus particles

A risk management model for Tobacco Etch Virus (TEV) is being developed in **Jamaica** to reduce the incidence and impact of the virus on Scotch Bonnet pepper. The components in the model being evaluated include weekly applications of stylet oil, reflective mulch, straw mulch, weed management and other vector/virus sources and the modification of planting dates.

A second trial was laid down in late April 2006 to repeat the study. One week before transplant, dot blots were taken from seedlings and were sent to the Biotech Centre of the University of the West Indies (UWI) to assess the status of TEV infection prior to transplanting. Subsequently, dot blots were taken at fortnightly intervals to detect the rate of infection and spread of the virus and also sent for analysis.

The results of analyses of dot blot samples which were taken from treatment plots during the second trial for the establishment of risk indices for the management of aphid-transmitted viruses in hot pepper, were received in February 2007, were inconclusive and could not be compared to those of the first trial. The objective was to assess which combination of the mulch and oil treatments evaluated was most effective in delaying the onset of viral infection by aphid vectors of the poty-viruses constraining hot pepper production in Jamaica. However, delays in turnaround time with processing of samples in the second trial obscured trends in the rate of spread of infection.

In a study of major insect pests on hot pepper, baseline data was collected in **Belize** on pepper weevil, whitefly, broad mite and thrips and their natural enemies on four hot pepper varieties—West Indies Red, CARDI Red, CARDI Green and Scotch Bonnet.

The most common pests found on all four varieties were whiteflies and cucumber beetles (*Diabrotica* spp.), although their populations remained low throughout the observation period. The highest number of whiteflies observed was 16 adults/plant, on CARDI Green while the highest number of cucumber beetles (6 adults/plant) was observed on West Indies Red. The overall mean whitefly population was highest (2.4 ± 0.40 adults/plant) on CARDI Green and lowest (1.3 ± 0.23 adults/plant) on CARDI Red. The overall mean cucumber beetle population was highest (0.6 ± 0.11 adults/plant) on Scotch Bonnet and lowest (0.4 ± 0.13 adults/plant on West Indies Red. The mean whitefly population was highest in February and fluctuated slightly during March after which it declined in April (Figure 1).

An assessment of the efficacy of selected insecticides against pepper weevil was made on seedlings of West Indies Red hot pepper variety raised under screen house conditions. The treatments included:

Actara® - 0.04g (0.001 ounce)/plant
Neem-X® - 0.75 mL (0.025 fluid oz)/plant
Helmethrin®- 0.11 g (0.25 oz)/plant
Confidor® - 0.09 g (0.003 oz)/plant

There was no significant difference in the number of larvae found in fallen peppers or in the weight of harvestable pepper fruits, before, and six and thirteen days after, insecticide treatment. However, there seemed to be some significant difference (P = 0.083) among the insecticidal treatments, with Helmethrin® being the most effective, and all others being more effective than the control, except for Actara®.

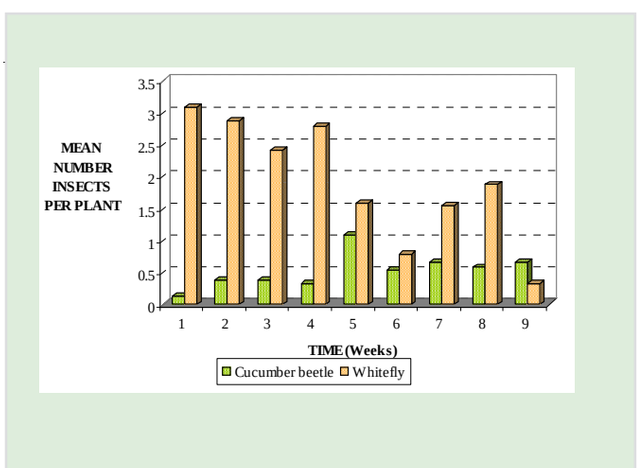

Figure 1. Mean number of whiteflies and cucumber beetles on hot pepper plants between February and May 2007

Post Harvest and Value added

Value-addition is often prescribed as an additional means for farmers and cottage industry operators to get a larger share of the consumers' food dollar. The two common products processed from hot peppers in the region are sauces and jellies. However, based on requests from buyers for pepper flakes and powder, experiments in these value-added avenues were undertaken in **St Kitts and Nevis** and **St Vincent and the Grenadines.**

Encouraging results were obtained when samples of peppers were dried in a hot air electric oven (Figure 7) for 24 hours at 55°C and then ground in a Hobart grinder (Figure 8) at the Food Processing facility of Mission Taiwan in **St Vincent and the Grenadines.**

Plate 7. Hot air dryers used to process hot pepper products

Plate 8. Hobart grinder used in crushing dried hot peppers

In **St Kitts and Nevis**, Red and yellow hot peppers were dried with an electric food desiccator through a collaborative effort with the Chinese Technical Mission at their food processing unit at Needmust. Data on the drying operation showed an 11% dry matter recovery after drying to a constant weight and that at current prices, it costs EC$4.95 to dry one kg.

These results demonstrate that acceptable quality processed product could be produced, based on such attributes as colour, aroma taste and texture. However, based on the type of driers used (electrical) and the length of time taken to dry a batch, it does not appear to be very economical. Consequently, experiments with solar dryers would have to be undertaken in the future. Further, with a conversion ratio (fresh to dry) of 10:1, commercial production of pepper flakes or powder would require large-scale production of fresh pepper.

Market Development

In light of the closure of the sugar industry in **St Kitts and Nevis**, rapid diversification of the agricultural sector is paramount. The increased availability of land and labour provides opportunities for the production and marketing of new crops to exploit existing markets. Previous attempts at commercial production and export marketing of hot pepper failed due mainly to poor organisation. However, CARDI is providing technical support to the revival of the hot pepper industry with the aim being to satisfy the demand of local processors and foster the export of fresh and processed products to regional and extra regional markets.

A small number of farmers have organized themselves into an informal hot pepper producers group and given technical assistance to grow West Indies Red, CARDI Green and West Indies Yellow as well as of some minor varieties on irrigated land (Plate 9).

In collaboration with the Department of Agriculture four training workshops were organised for farmers as well as extension staff of the Department. Following these workshops, exports of hot pepper began with more than 25 shipments of hot peppers with a combined weight of about 7,000 kg made to Antigua and Miami, Florida (Plate 10).

Plate 9. Newly established field of hot pepper under plastic mulch, St Kitts

Plate 10. Freshly harvested hot pepper for export to Antigua

Samples of dried and ground hot pepper that were produced in **St Vincent and the Grenadines** are shown in Plates 11 and 12. Alternative effective low cost drying systems will need to be found, so as to give farmers the opportunity to exploit the market for these products.

Plate 11. Samples of dried pepper

Plate 12. Sample of dried ground pepper

Sweet potato industry

Industry overview

Under the CARICOM Regional Transformation Programme for Agriculture, CARDI has the lead responsibility for the development of the regional sweet potato industry. The value chain approach (production, post harvest, marketing and value addition) is being used in the development of this industry. The crop is grown throughout the region but in some islands, sweet potato is more important than in others.

Jamaica is the largest producer and exporter, trading mainly with the United Kingdom. In the Eastern Caribbean, St Vincent and the Grenadines grows the most sweet potato and exports (more than 90% of the crop) mainly to Trinidad and Tobago. Small amounts are sent to the United Kingdom. Barbados is another significant producer (Table 4).

Table 4. Sweet potato exports for selected countries 2006. ('000kg)

Country	Amount Exported '000 kg
Barfbados	2,200
Jamaica	27,468
St Kitts & Nevis	273
St Vincent & the Grenadines	1,646
Trinidad & Tobago	464

CARDI's sweet potato work programme is mainly focused in Jamaica, St Vincent and the Grenadines and St Kitts and Nevis with Antigua and Montserrat being satellite countries.

The work programme involves characterisation of local varieties in the specified countries, germplasm collection and maintenance, crop production technologies with an emphasis on IPM measures for the major pests, evaluation and selection of suitable varieties for product development and marketing and trade.

Germplasm development, improvement and exploitation

Four local sweet potato varieties—Caten, Zabwico, Tomorrow and St. Vincent—showing various levels of beta carotene as indicated by a yellow to orange coloured flesh, were identified at Desrameau, Babonneau, Choiseul and the Mabouya Valley in **St Lucia** and established in a germplasm bank at the DTC, Dennery for characterization, using the IBPGR Descriptors for sweet potato (Plate 13).

Plate 13. High beta carotene sweet potato germplasm bank at DTC, St. Lucia

The roots varied in shape and skin and flesh colour [Plates 14 and 15]. Zabwico was deeper orange in colouration than the other varieties.

Plate 14. Shape and skin colour of four sweet potato varieties (Caten, Zabwico, St. Vincent) and Tomorrow

Plate 15. Cross sections of tubers of four sweet potato varieties (Caten, Zabwico, Tomorrow and St. Vincent) showing varied tuber colouration

These four varieties were further evaluated in a trial utilising a complete randomised block design with four treatments (varieties) and four replications on a Vertisol at La Ressource, Dennery. All varieties were harvested 3 months after planting

Table 5 shows the mean number of tubers per plant, mean weight of tubers per plant and yield per hectare for the four varieties of sweet potato.

Although Zabwico showed the highest number of roots per plant, significant differences were not observed between the varieties ($P > 0.05$). However, there were significant differences for mean weight of roots per plant ($P = 0.034$), with Zabwico producing the highest {0.66 kg) and Caten the lowest (0.16 kg) weights. Signifcant differences in yield were also observed between varieties ($P = 0.007$) with Zabwico producing the highest yield (70.6 t/ha) and Caten the lowest (13.9 t/ha).

Table 5. Mean number and weight of tubers per plant and yield per hectare of four sweet potato varieties, St Lucia

Variety	Mean* number of tubers /plant	Mean* weight of tubers /plant (kg)	Yield (t/ha)
Caten	1.05	0.16	13.9
Zabwico	3.02	0.66	70.6
Tomorrow	1.62	0.30	26.8
St. Vincent	1.92	0.36	32.6
SEM (12df)	0.50	0.10	9.4
P	0.089	0.034	0.007

* Means were taken from four replications

In a taste test using a Hedonic Scale, samples of the four varieties were scored on a scale of 1–5, between like and dislike. Caten obtained the highest score (98) followed by Tomorrow (96), while Zabwico and St. Vincent had the lowest score (86).

Production system technologies

In a fertiliser trial carried out in **Montserrat**, the response of four sweet potato varieties to two NPK fertiliser formulations, 12-12-17+2 and 12-24-12 was assessed. The varieties were Pumpkin, Black Rock, White Vine and Three Months and fertiliser was applied at planting and at rate of 400 kg/ha.

At the time of harvest, there was luxuriant foliage (Plate 16) but root development was poor and stringy (Plate 17).

Plate 16. Sweet potato in the field just before harvesting at Blakes, Montserrat

Plate 17. Stringy growth of sweet potato harvested at Blakes, Montserrat

Yields were generally low and an analysis of the data showed that there was no significant difference in yield between varieties. The different fertiliser treatments also had no significant effect on the yield of the four varieties.

The high proportion of stringy growth could probably be attributed to the nutrient level of the soil. The lush and copious amount of leaves seem to suggest an adequate amount of nitrogen in the soil. The amount of P and K did not support good root development, which was not corrected by the fertiliser applied.

Integrated Pest Management (IPM)

One major constraint to the production of sweet potato is infestation by pests, especially sweet potato weevil (*Cylas formicarius*) and white grubs (*Phyllophaga* spp.). A comprehensive approach to the management of these pests has been in progress since 2000 in Jamaica, St Kitts and Nevis and St Vincent and the Grenadines. The elements of this management strategy involved the evaluation of varieties for their resistance to the pests; the introduction, evaluation and distribution of pheromone traps; the evaluation of bio-pesticides and other pesticide applications as well as the dissemination of IPM information for these pests.

Evaluation of varieties

Between 2000 and 2007, 30 varieties were evaluated for yield and pest resistance in **St Kitts and Nevis**. Of these, 18 were donated by the USDA, while the others were of local origin. In general, the local cultivars were more prolific in terms of vegetative growth and production than the USDA varieties. These findings are summarised in Table 6.

Table 6. Evaluation of local and USDA sweet potato varieties, St Kitts and Nevis (2000–2007)

Yield potential kg/ha			
Local	kg/ha	USDA	kg/ha
Clarke	69,000	W-315	48,200
Never Miss	42,600	95-190	48,000
Green Acres	37,000	95-75	47,867
Least susceptible to sweet potato weevil			
Local	Index	USDA	Index
Kenneth	0	Picadito	0
Romney Vine	0	95-175	0
Never Miss	0.3	Regal	0.2
Least susceptible to white grub			
Local	Index	USDA	Index
Cabey	1.5	Regal	0
Never Miss	1.5	97-82	0

(0= no tuber damage; 5 = 100% tuber damage)

Trapping systems

In collaboration with the Agricultural Technical Mission of the Republic of China on Taiwan (CTM) in **St Kitts and Nevis**, CARDI is evaluating a redesigned trapping system for sweet potato weevil. This trap uses a smaller dispenser for the pheromone lure and a trap body, which can be made with recycled plastic bottles (Plate 18). Comparisons of trapping efficiency confirmed the superiority of the new system over conventional models. When compared to the standard traps, this new trapping system captures up to 8 times as many weevils. Other advantages of this trap are its ease of construction and operation due to its modular design and the fact that unlike the standard system, no water is required for its use. Farmers are being trained in its use.

Plate 18. New weevil traps–commercial (left) and trap made from recycled bottle (right)

In order to examine the efficacy of Neem X®, Admire®, Actara® and two commercial formulations of *Beauvaria* (Botanigard ES® and Naturalis T&O®) in managing the white grub (*Phyllophaga* sp.), which is the main pest of sweet potato in **St Vincent and the Grenadines,** trials were established using the sweet potato varieties Black Vine and Lover's Name. One trial was conducted during December 2006 to March 2007 (dry season) and the other in May to August 2007 (wet season). Treatment effects on the management of white grubs are shown in Table 7.

Table 7. The effect of different treatments in the control of white grub, *Phyllophaga* sp. in sweet potato over two seasons showing amount (kg) infested with grub

Treatment	Season	
	Dry	Wet
Actara®	0.67	0.16
Admire®	0.92	0.10
Beauvaria 1-Botanigard ES	1.04	0.17
Neem X®	1.21	0.18
Beauvaria 2- Naturalis T&O	1.83	0.34
Control	2.58	0.54
LSD 5% level	1.22	0.26

Although *Eucepes* was not the targeted pest in the evaluation, a measure of its incidence suggests that it is important at these times of the year. Most effective control was obtained with Actara® and the least with Admire.®

When comparing both seasons, it is evident that both the control plots and those treated with Naturalis T&O® were more damaged by grubs than the other treatments. Also, Admire® and Actara® were the most effective pesticides in magaging the grub in both the dry and wet seasons. The commercial formulations of *Beauvaria* proved to be less effective than the chemicals in managing the grub. Lover's Name, the carrot coloured variety, was also more susceptible to grub damage than the white fleshed Black Vine.

Post harvest technology and value added development

In 2007 through the CARICOM/Japan Friendship and Co-operation Fund, two projects were executed. This involved exchange visits between Japan and the Caribbean of sweet potato scientists (Plates 19 and 20). Under the project 34 selected sweet potato varieties from Barbados, Jamaica, St Kitts and Nevis, St. Lucia, St Vincent and the Grenadines, and Trinidad and Tobago were evaluated for different end uses. The Food Technology laboratory at the St. Augustine campus of the UWI, was the venue for the evaluation exercise.

Plate 19. Sweet potato breeding in Japan

Laboratory tests were conducted to determine the brix level, dry matter, sugar and starch content of the selected varieties. The varieties were also assessed for making flour, fries and juice. Specific varieties were ultimately recommended for specific end uses (Table 8).

The ultimate aim of this project is to stimulate the sweet potato agro-industry in the Caribbean region through the development of economically viable value added products from sweet potato, which have market potential. Entrepreneurs will be sensitized to existing business opportunities.

Plate 20. Sweet potato production in Japan

Table 8. Results of sweet potato varietal evaluation conducted at Food Technology Laboratory, UWI

Use	Flesh colour	
	Orange	Yellow
Flour	Centennial (T) Sampson's Lover,Audian's Lover's Name CARDI Lover's Name (SV) Clarke (SK) Thret Ford (J)	Caroline Lee (B) Chicken Foot (T) SLU#1(SL) Mandela (SL) Blue Bud Eustace (J) Up Lifter (J)
Paste	86BM-15 CBS49 (B) Centennial (T)	Caroline Lee (B) Up Lifter (J)
Juice	Carro Centennial (T)	
Fries	86BM-15 CBS49 (B)	William White (SV)) Red Man) C104 (B) St Vincent Unknown SLU#1(SL)

Planting material from 10 sweet potato varieties suited for both the local and export markets were collected from four major growing areas in **Jamaica** (St Ann, Clarendon, Manchester, St Elizabeth). The 10 varieties included: Clarendon., Dor, Eustace, Fire-on-land, Minda, Miss Mac, Quarter million, Sidges, Watson and Yellow Belly. During the period December 2006–February 2007, replicated trials were established in three sweet potato areas (Ebony Park, Clarendon; Devon, Manchester; Claremont, St Ann) which varied in agro-ecological conditions.

There was a significant interaction between the yield of varieties and the location at which they were cultivated, demonstrating that varieties need to be matched with conditions that are most suitable for their growth and development. Results were consistent with those recorded in the 2005–2006 season. The varieties Clarendon, Eustace and Miss Mac were among the top five producers across all the locations.

Proximate analyses were conducted on the sweet potato varieties harvested and the results used to determine the varieties most suited for processing into value added products. For the most part, the parameters measured compared favourably with those reported in the literature. Most of the varieties had dry matter contents that suggested that they would be most suited for making flour.

Technology transfer and outreach

In order to study the rate of adoption of IPM technologies in the production of sweet potato, baseline information and guidelines were collected from a variety of sources, and three survey instruments were developed targeting key stakeholders such as farmers, extension personnel and persons involved within the industry The instruments were pre-tested in **Jamaica, St Kitts and Nevis and Montserrat**, and based on the feedback were amended and interviewers trained in their use (question interpretation and sampling).

The data collected will be analysed to determine the impact of the adoption of sweet potato IPM technology on the knowledge and skill of farmers and sweet potato production and productivity.

Cassava industry

Cassava (*Manihot esculenta*) continues to be of interest in St Vincent and the Grenadines and Montserrat. In support of the industry in these countries, activities have focused on the evaluation of varieties that can be used to produce high yields of farine and cassava bread.

Evaluation of CIAT varieties continued in **St Vincent and the Grenadines.** As shown in Table 9, from an analysis carried out on 23 clones, 10 were found to yield more than 45% farine meal and will be retained for further evaluation.

The lowest yield was obtained from MX 60 (7.95%), which is a sweet cassava mainly used fresh in Trinidad and Tobago. The reported average yield of farine from local varieties is approximately 25%, so it is clear that the introduced clones are better producers of farine.

In **Montserrat,** a fertiliser trial was planted in November 2006. The two local varieties, bitter and sweet, were used in an experiment to select the fertiliser which would result in the best yield. The NPK formulations used were those available locally, 12-12-17+ 2 and 12-24-12. The bitter cassava yielded significantly more than the sweet and had larger tubers. However, the fertiliser treatments had no significant effect on either variety.

The fledgling cassava (farine) project in **Montserrat** experienced a number of challenges. Early in the year when cassava was available, a large amount of processing was done but marketing of the processed product was a problem. A locally produced user friendly press was acquired and a new press purchased from CARIRI will become available in 2008.

Table 9. Yield and processing data of introduced cassava clones

Clones	Cassava weight kg/plant	Meal weight kg/plant	% Meal weight to cassava weight	Farine weight kg/plant	%Farine to meal weight
CM 6740-7	120.5	41.8	34.7	19.1	45.7
CM 7514-1	53.2	23.6	44.4	11.8	50.0
CM 3306-4	78.2	32.7	41.8	15.2	46.5
CM 5306-8	45.5	16.4	36.0	8.6	52.4
CM 6438-4	19.1	7.3	38.2	3.6	49.3
PER 183	52.7	8.6	16.3	4.5	52.3
CM 7073-7	24.5	9.1	37.1	4.1	45.1
BRA 383	16.8	7.3	43.5	3.6	49.3

Other Root Crops

In response to the concerns of a farmer in Black Bay, **St Lucia** that yields from yellow yam (*D. cayenensis*) were low and tubers small, a demonstration plot was established on the farmer's holding to validate the use of nematicide Vydate® L (2.2 cc/L) as a treatment dip for yellow yam planting material for nematode control. The exercise involved the establishment of treated versus non-treated yellow yam planting material planted out in separate plots.

Tubers from treated plots were not affected by nematodes, while those from untreated plots had features characteristic of nematode infection, were knotty and unmarketable. The farmer has indicated his satisfaction with the result and has treated all his planting material with Vydate® L for planting the next year's crop.

The evaluation of a teckpak for the production of dasheen (*Colocasia esculenta*) under agro-ecological conditions in **St Vincent and the Grenadines** continued with the repeat of a soil fertility trial (Plate 21) in which three formulations of fertiliser—the banana fertiliser, 16-8-24, and 9-12-15 and 7-14-7 commonly sold by the major input supplier—were tested.

The analysis of yield data showed that there was a significant difference due to fertiliser treatments. The formulation 9-12-15 resulted in significantly higher (5% level) yields than both 7-14-7 and the control 16-8-24.The plots treated with 7-14 7 also (though not significant) yielded more than those where 16-8-24 was used. Therefore, farmers could harvest a greater amount of dasheen if they shift from the traditional banana fertiliser.

Plate 21 Dasheen fertiliser trial at Rabacca, St Vincent and the Grenadines

Vegetable crops

The seedling nursery in Grenada continued to provide an important service to the vegetable industry. Over 314,000 vegetable seedlings of 20 crops were supplied to various farmers and gardeners (Plate 22). Once again, tomato was the crop in highest demand followed by cabbage and lettuce. There was an overall decrease in the quantities of plants supplied for almost all of the crops. Seasoning pepper and beet were the only two crops which showed a significant increase in supply over the previous year.

Plate 22. Vegetable seedling nursery in production

A complete reconstruction of one nursery structure using galvanized metal and BRC was started in November 2007 to replace the original wooden structure, which was severely damaged by hurricanes Ivan and Emily in 2004 (Plate 23).

Plate 23. New nursery under construction

A trial was conducted during the dry season (February–May) at La Resource, Dennery, **St Lucia** to examine the performance of two commercial tomato varieties. One was Heat Master, which has been grown by local farmers over the years with some degree of success. The other, Hybrid 61, though not popularly grown in St Lucia has been successfully grown in Trinidad. Some of its major qualities are its uniformity, long shelf life, high yield with firm fruit, resistance to grey leaf spot, good performance in both wet and dry seasons and resistance to Verticillium Wilt and Fusarium Wilt Races 1&2.

The time to 50% flowering and fruit set for the both varieties (Heat Master and Hybrid 61) were about the same (60-65 days and 68-72 days respectively from date of sowing seeds). As shown in Plate 24, fruit size, shape and colour varied for the varieties. At the mature ripened stage Hybrid 61 is a small oblong fruit, deep red in colour compared to Heat Master, which is a round and larger fruit, lighter red in colour with a tinge of yellow.

Plate 24. Size, shape and colour differences of two tomato varieties (Hybrid 61 and Heat Master)

There were no significant differences between varieties for all the parameters measured. However, when yield results were extrapolated on a hectare basis, the indication is that Heat Master (18,270kg/ha) was slightly better than Hybrid 61 (15,540kg/ha).

Though post harvest studies were not conducted, fruits of Hybrid 61 appear to be more attractive than Heat Master due to their deep red uniform colour. They were also firmer at maturity and were therefore able to withstand the rigors of harvesting and post harvest handling, which could result in less fruit damage and extended shelf life during storage.

A seedling media trial was conducted to select the best suited media for seedling production in **St Vincent and the Grenadines**. The media evaluated were promix, coconut coir, commercially produced compost, Dumbarton mix, Taiwan Mix, promix and coconut coir, promix and compost, coconut coir and compost. In each of the combinations, each component formed 50% of the mixture

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The results showed that the mixture of promix and compost and coconut coir and compost were the two most efficient media in seedling production. Algal growth was absent on the compost media or in media mixed with compost.

The estimated annual consumption of onion in **St Kitts and Nevis** is about 150,000 kg. Local production accounts for less than 10% of this. More than 80% of onions grown is in Nevis. The main constraint to increased and sustained production is seasonality as the bulk of production occurs during the short days of autumn and winter.

The strategic approach to increased production involves both an expansion of acreage as well as increased production outside of the main season. Since most onion varieties are photoperiodic, production outside of the main season must rely on day neutral or long day varieties.

The onion varieties Jaguar, Bolder, HA 1367 and HA 202 were evaluated for yield and storability in **Nevis**. Synthetic Mercedes was severely infected by onion blotch disease and was therefore not considered to be suitable for further evaluation (Plate 25).

HA1367 produced the largest number of bulbs, the highest yield and the highest percentage of marketable bulbs (Table 10).

Table 10. Yield characteristics of onion varieties, Nevis

Variety	Total ha number of bulbs/	Yield kg/ha	Percentage marketable yield
HA1367	107,480	33,750	77
Jaguar	61,170	30,590	65
HA202	48,900	26,960	69
Boldor	46,310	22,350	52

Plate 25. Evaluation of onion varieties in Nevis

The variety HA202, the standard variety for main season production yielded less than half the number of bulbs as HA1367. However, HA202 produced a greater number of very large bulbs (Jumbo Size) so the yield difference in terms of weight was compensated.

Jaguar produced only about 60% of the number of bulbs as HA1367 but compensated by producing a high proportion of very large bulbs. This variety is particularly suited for out-of-season production given its faster maturity. However, it produces a high percentage of split bulbs which reduces marketability.

Boldor was the worst performing variety, producing the lowest number and weight of bulbs as well as the lowest percentage of marketable bulbs.

In **Jamaica**, following the conclusion of the series of planned training sessions forming part of the initiative to reinstate vegetable amaranth to the preclearance list of exports to the United States of America, farmers were evaluated and certified as eligible to export vegetable amaranth under the pre-clearance programme. Evaluation of each farmer was based on the evidence on each farm that the good agricultural practices recommended during the training exercise were being implemented.

Plate 26. US Ambassador Brenda La Grange Johnson (centre) flanked by the then Minister of Agriculture and Lands Hon. Roger Clarke (right) and CARDI Entomologist and Caribbean Site Coordinator IPM CRSP, Dionne Clarke-Harris (left) at the Launch Ceremony for Reinstatement of callalloo to the Preclearance List

The new pre-clearance regime for vegetable amaranth started in May 2007. The reinstatement of vegetable amaranth (callaloo) to the USDA pre-clearance list was launched on 13 August 2007, in a ceremony hosted by the US Ambassador to Jamaica, Brenda La Grange Johnson at the US Embassy, Kingston Jamaica (Plate 26).

The launch was strategically twinned with the opening ceremony for a one-week inspector's workshop put on by the USDA for quarantine officers from across the Caribbean region. Callaloo, a non traditional export commodity is estimated to have export potential of US$175 million.

In 1995, callaloo was removed from the pre-clearance list of export commodities to the USA by the Ministry of Agriculture due to sanitary and phytosanitary challenges, mainly pests on the produce. CARDI under the USAID-sponsored, IPM CRSP spearheaded research and training activities geared towards improving the quality of callaloo produced. These activities were credited for the marked reduction in rejected callaloo shipments.

Testing of cost reduction technologies

In an effort to seek ways to reduce the number of weed management operations conducted and additionally to lower the overall production cost, a production model was developed in which AGRITELA 3210 NE NERA and table cloth vinyl were tested in **Tobago**. The Agritela system, which employs a polypropylene mulching sheet, worked well with hot pepper in reducing the need for and therefore the cost of labour for weeding operations within the crop production area (Plate 27).

Plate 27. Chinese cabbage 'Blues F1' on Agritela 3210 NE

As a cheap alternative to AGRITELA, the performance of 'table cloth', which is a non-porous vinyl material, was investigated. Broad-leaved weeds including Puslane (*Portulaca oleracea* L.) were well controlled, but nut grass (*Cyperus rotundus*) received enough light through the material to continue growing under the plastic. Under open field conditions, the material showed no serious signs of deterioration after 10 months.

Cereal and grain legume crops

Most of the corn produced in **Belize** is utilized in the manufacture of commercial livestock feeds, with a small but very important amount used as food, especially in rural areas. Both yellow and white corn are cultivated with the greater proportion of annual acreage planted to yellow types. Large-scale producers and some medium-sized farmers commonly plant hybrid seed that is imported mainly from the USA by local seed houses. Small farmers and a significant number of medium-sized farmers generally plant open pollinated 'local' varieties. Small and medium-sized producers invariably retain the major proportion of the harvest for household use as food, as feed for small livestock, and as planting seed for the next crop. Post-production loss among these producers is usually high, and is estimated to be as high as 50% in some cases, and the portion used as seed is invariably not of good quality.

CARDI's cereal crop research and development programme is aimed at improving the production and marketing of cereal grains in Belize by focusing on the following:

- Annual evaluation of yellow and white corn hybrids to identify ones that perform better than the hybrids that are currently being planted by large-scale mechanised producers.
- Production and marketing of quality seed of the open pollinated yellow corn variety CARDI YC001 (introduced as Trinidad 7728) to meet the seed demand of small and medium-sized producers.
- Production and marketing of quality seed of the rice variety CARDI 70 to paddy producers in the Toledo district.
- Development of handling and storage systems to reduce post-harvest losses at the small farm level.

An assessment of the 12 entries, consisting of 11 hybrids and one open pollinated variety, included in the CARDI 2007 Yellow Hybrid Corn Trial indicated that the hybrid DKB 191 gave the best overall performance. Although among the latest to flower, DKB 191 recorded the third highest (78%) shelled grain percentage and highest yield of shelled grain (6,045 kg/ha) among all the entries. Plant height, ear height, and husk cover score were about average. The number of stalk lodged plants and disease score were above average, and the hybrid recorded the lowest number of plants that were lodged at the root and lowest percentage of exposed ears. The hybrid HS 14 was considered as exhibiting the second best overall performance

In an assessment of the 14 hybrids included in the CARDI 2007 White Hybrid Corn trial, the hybrid DK 353 was found to give the best overall performance with an estimated shelled grain yield of 6,701 kg/ha. Flowering, plant height and ear height were about average, while the number of root lodged plants, stem lodged plants and the husk cover score were better than average. The hybrid also ranked highest for disease score, exposed ears, and shelled grain percentage The entry MC 9971, which recorded the third highest yield of shelled grain was assessed as having the second best overall performance.

CARDI's research and development efforts in **Belize** during the 1980s have resulted in moderate successes with commercial soybean production. At that time, the major constraints identified were the relative high cost of production and the absence of an oil extraction facility to improve the marketing and utilisation of locally produced beans. However in early 2000 the Government of Belize placed a high priority on local soybean production to replace some Bz $19 million in annual imports of soy-based products for the livestock feed industry. Local production has been targeted to reach 8,900 hectares to provide about 20,000 metric tonnes of beans. A modern soybean processing facility has been constructed and is expected to become fully operational soon.

In support of the soybean industry, nucleus seed production plots were established and preliminary evaluation trial carried out with 97 entries.

In the case of other grain legumes, nucleus seed production and maintenance germplasm plots were established with cowpea (12 entries), peanut (43 entries) and chickpea (14 entries).

Following discussions with the Ministry of Agriculture and Fisheries (MAF), **Belize** on the production and marketing of seed paddy of the variety CARDI 70, arrangements were made with the management of Belize River Farms (formerly Big Falls Ranch) for the contract production of the required quantity of seed paddy, which was required to meet the needs of rice farmers in the Toledo district.

Production of the seed paddy crop was handled by Belize River Farms where there is the requisite infrastructure, machinery and equipment for irrigated paddy production. The harvested, dried seed paddy was delivered to CARDI for cleaning and packaging before delivery of 26,199 kg of clean seed to the MAF Extension Staff in the Toledo district.

Tree and fruit crops

In **Grenada,** Bunchy top disease has been an ever present problem on papaya (*Carica papaya*). The main management technique has been fortnightly applications of insecticides to control the insect vector, which transmits the disease. Other techniques have included avoiding the use of fertiliser containing the ammonium ion; thorough hardening of plants before transplanting and intercropping with *Musa* species such as plantain and banana.

Over the last 4 years farmers have been using Known You papaya varieties Tainung No.1, Tainung No. 2 and Red Lady from Taiwan. These varieties are reported to be tolerant to bunchy top and it has been suggested that management practices to control the disease are not necessary.

In October 2007 a plot containing 44 plants of a susceptible local selection was planted and fortnightly observations carried out to record any incidence of bunchy top disease. When the presence of the disease is established, one or more of the Tainung varieties will be grown alongside the local susceptible variety and observations made on the disease incidence on both varieties.

In collaboration with IICA, CARDI is working to revitalise the fresh coconut water industry in **St Lucia**. A total of 122 ha of dwarf coconuts are to be established over a period of 3 to 5 years. Towards this end, a coconut nursery was planted at La Resource, Dennery for the production of seedlings (Plate 28) for distribution to farmers.

Plate 28 Production of dwarf coconut nursery at DTC, St Lucia

The exotic fruit germplasm continues to be a vital source of planting material for the farming community of **Grenada**. Once again, the Ministry of Agriculture sourced germplasm from CARDI for further multiplication and distribution to farmers. This made a significant contribution to the availability of orchard plants to assist farmers in their recovery efforts from the ravages of recent hurricanes.

Fruit from two promising sapodilla landraces were collected from farms in St Andrews, **Grenada** and analysed for various quality characteristics. As shown in Table 11. the fruit weight, fruit size and sugar content were good. However, one had non-uniform ripening, was rough and gritty in flesh texture, while the other had latex deposits in the flesh. Because of these negative characteristics the germplasm was unsuitable for further selection.

Table 11. Fruit quality characteristics of two sapodilla landraces,

Name	Fruit Weight (g)	Length (cm)	Width (cm)	Latex Deposit	Uniformity of ripening	Brix	Pulp Texture
Donna	150	6.8	6.3	Absent	Non-uniform	19.1	Rough gritty
Lydris	183	7.0	6.6	Present	Uniform	19.1	Smooth

In **St Vincent and the Grenadines**, a fertigation trial was established in collaboration with the Ministry of Agriculture, Forestry and Fisheries, Irrigation Unit and the St Vincent Banana Growers Association. The spacing as recommended by the St Vincent Banana Growers Association was 6'x6'x9'. The fertiliser formulation used was 11-5-27. and initially fertigation was once weekly using 9 to 14 kg of fertiliser in 113 litres of water with the plants being irrigated for one hour at each irrigation cycle. The emitters located at 30 cm intervals discharge one litre/hr.

The trial is being monitored and yield data will be collected (Plate 29).

Plate 29 Banana fertigation trial at Rabacca, St Vincent and the Grenadines

Nature Island Pineapple Producers Association (NIPPA) continues to promote the cultivation of the market tested and accepted T #4, T #11, and Smooth Cayenne pineapple cultivars in **Dominica**. Currently, on some pineapple farms, both the plant and ratoon crops are fertilised with a foliar fertilizer (20-20-20) in accordance with the manufacturer's guidelines. Some farmers fertiliser both the plant and ratoon crops using granular NPK fertilisers applied by hand to each plant, while others do not fertiliser the ratoon crop. Since farmers keep the ratoon crop for at least 3 years, it has become necessary to assess the full potential of the ratoon crop through validation of the traditional and introduced management practices.

A preliminary investigation on the effect of different rates of N and K applications on ratoon yields was undertaken but there was loss of data setts due to praedial larceny and rat damage to a number of fruits. However, it was observed that though smaller, fruits of the ratoon crops were sweeter, less acidic and more aromatic than fruit of plant crops (Table 12). The experiment will be repeated to examine the effects of fertiliser on the quality of ratoon crops of pineapple.

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Table 12. Differences in fruit weight and brix for the plant and ratoon crop*.

	% Brix		Weight (kg)	
Cultivar	Newly planted	Ratoon	Newly planted	Ratoon
SC	13.28	19.42	1.38	0.56
T#4	14.91	19.02	0.95	0.53
T#11	12.83	17.42	1.44	0.83

* Source: CARDI Dominica 2005, 2006 and 2007 Annual Reports

Livestock Programme

Programme Leader: Francis Asiedu

Small ruminant industry

Overview

CARDI's mandate under the RTP provides for leadership of the sustainable development of the regional small ruminants industry. In this regard, the Institute continues to be guided by the core elements of the Small Ruminants Industry Development Plan (*revised 2006*) that was defined by regional industry stakeholders. This plan calls for intervention in the production and post-production process, marketing, development of Information and Communication Technologies (ICTs) and networking systems and critically, the development of a sustainable human capacity base for the industry. By tackling these issues along with our strategic partners the Institute is attempting to strengthen the research and development process in the region. This is a binding constraint that was identified by the *Jagdeo Initiative*, and which CARDI is addressing with respect to issues related to livestock research and development.

CARDI's livestock programme has been developed in response to the needs of member countries. In this regard there is a great focus on genetic improvement, feeds and feeding systems and health and nutrition management. One of the trends that has been observed in the region, relates to fluctuating livestock numbers and farmers. One of the major reasons for this is the increasing scourge of praedial larceny. It is not uncommon for farmers to lose upwards of 40 animals in a single night. As a consequence, governments are looking again at praedial larceny squads and taking more direct measures to curb this growing phenomenon. A national consultation held in Trinidad and Tobago in 2007 highlighted these concerns among others.

The need for sustainable agriculture that is not tied to extra-regional imports has also given emphasis to the development of forage-based feeding systems. Much of this work is taking place in Jamaica and Trinidad and Tobago, where a range of improved grasses and legumes are being evaluated for livestock feed. This work underlies CARDI's drive to utilise locally available resources to support efforts to increase productivity at the farm level. Superior animal genetic resources in sufficient quantities remain one of the constraints facing the regional industry. Several countries rely on the importation of exotic breeds from extra-regional sources, but high costs makes this prohibitive for most farmers.

The government of Barbados has imposed a moratorium on the export of that nation's best known livestock resource, the Barbados Blackbelly Sheep. This has had serious repercussions for regional farmers that are interested in starting up or expanding current production. This has exacerbated the perennial problem of not having sufficient animals of the right quality to support more than 25% of the meat market derived from small ruminants.

Underpinning many of the issues facing the regional industry is the lack of credible information on the true state of small ruminant farming in the

Caribbean. Except for St. Kitts-Nevis, Very few statistics are collected on animals passing through the abattoir. This is because in most countries of the region, slaughtering of small ruminants is often an unregulated backyard activity. Ironically, this also contributes to the problem of praedial larceny. There is an absolute need to tighten regulations not simply because it is a health and food safety issue but also because the current situation severely curtails the collection of vital statistics. Without these numbers, it will be impossible to accurately address the development needs of the regional industry.

It is for this reason that in 2007, CARDI signed an agreement with the Government of Japan through the CARICOM-Japan Friendship Cooperation facility, to carry out a regional survey of the small ruminants industry. It is anticipated that the information gathered would give regional planners the tools to accurately assess and design effective interventions for the sustainable development of the industry. CARDI is leading this process.

Improvement of quality and availability of small ruminant genetic resources

The primary focus of the CARDI-ALPART project in **Jamaica** is to provide improved breeding stock to the farming communities on the Manchester Plateau. Therefore, the breeding plan for the DTC is focused on the perpetuation of the purebred lines and the upgrading of locally acquired stock to produce for distribution male offspring with breeding percentages of not less than 87.5 of the top-cross buck. More than 75 per cent of the kids produced in 2007 attained this target.

Exotic animals imported into the country were meant to improve the productive capacity of the local stock. Therefore, the optimum level of the various crosses must be determined. With respect to animal performance based on breed percentage the trend is that the best performers are at 75 per cent of the base breed as indicated by Alpine, Boer and Nubian with weaning at 90 days, the average daily gain were 166, 124, 140 g respectively as compared to 117, 100 and 122 g at ≥ 87.5 for the same breeds over the same period (P = 0.010). This finding suggests that more data must be collected at several locations before a definitive statement can be made concerning the optimum cross with the native and exotic breeds.

The overall performance of the three pure breeds of kids in terms of birth and weaning weights and average daily gains at weaning is presented in Table 13 below.

Table 13. Overall performance by breed percentages of kids produced at SMDTC in 2006/2007 in terms of birth and weaning weights and average daily gains at weaning

Item	Birth weight (kg)	Weaning weight (kg)	Average daily gain (g)
≤ 87.5% of breed	3.02	13.32	115.68
75% of breed	3.30	17.16	154.43
< 75% of breed	3.17	12.40	100.29
F prob.	0.131	0.002	0.002
SEM	0.48	2.67	27.29
df	70	37	36

Oestrus synchronization, a key management strategy of any livestock production system used to facilitate increased production and productivity in goats was added to the breeding programme at the DTC where animals were exposed to hormonal treatment with an aim to shorten the kidding interval and season. Preliminary results indicated that animal groups not treated took an average of 25 days longer than the treated group to complete kidding.

At the end of 2007, there were 184 heads of animals comprised of six mature bucks, 109 mature does, 11 weaner bucks, 30 weaner does and 48 kids. For the first time in several years the mortality in both mature animals and kids was below 10 per cent. Of the 153 animals sold, 36 went for breeding and included 30 males.

Production system technologies

In **Jamaica**, one of the main features of the breed improvement project is that it is mostly executed on mined-out bauxite lands and therefore effective forage production must be a major consideration. This has led to the studies aimed at developing the most effective forage production system for small ruminant on these soils, where persistence, agronomic performance and feeding value of several grasses and legumes are being measured.

Four forage grass cultivars, Mulato (*Brachiaria hybrid cv Mulato*), Jarra Grass (*Digitaria milanjiana*), Pangola (*Digitaria eriantha*) and Tifton 85 (*Cynodon dactylon cv Tifton 85*) were established on mined out bauxite soils in Manchester, **Jamaica**. The forage cultivars with harvesting intervals of 3, 5 and 7 weeks continued to be evaluated for agronomic performances and nutrient content.

While the Tifton showed consistently higher ground cover during the year, the Mulato gave a higher biomass yield over all the cutting intervals (Table 14). The new Pangola (Jarra grass) was inclined to have more tillers and reproductive portions than the other forages during the test period.

Table 14. Agronomic performance of four grass cultivars grown on mined-out bauxite lands in Manchester, Jamaica

Interval	Parameter	Mulato	Jarra	Pangola	Tifton 85
3-week	Ground cover %	40.	12	41	68
	Height (cm)	29	17	20	26
	Biomass (g)	2,455	211	692	1,825
5-week	Ground cover %	59	19	61	97
	Height (cm)	40	25	32	43
	Biomass (g)	8.142	500	1,808	4,450
7-week	Ground cover %	76	22	59	91
	Height (cm)	45	20	29	37
	Biomass (g)	6,930	300	1,700	4,860

In another trial in **Jamaica**, three forage legume cultivars, New Clitoria (NC), Common Clitoria (CC) and Florida 99 Alfalfa (Alf) were established on mined-out bauxite soils in Manchester and harvested at intervals of 4, 5 and 6-weeks.

Alfalfa gave better ground cover at the 4- and 5-week interval while the exotic clitoria was better at the 6-week interval. The alfalfa cultivar was also superior in dry matter content.

Studies were carried out in **Trinidad** to evaluate four grasses, Tanner, *Brachiaria radicans*, Mulato, *Brachiaria* sp., Tifton, *Cynodon* sp. and Pangola, *Digitaria decumbens* as feed resources.

The field dry matter percentage, dry matter yield (kg/ha), crude protein content (g/kg DM) and ash content (g/kg DM) of the 8-week re-growth of the four grass varieties under evaluation were made for each of four months sampled—April, August, October and December.

With the exception of the dry matter yield in August, no significant differences (P>0.05) were detected among varieties for any of the parameters studied irrespective of the month sampled. There was also no differences (P>0.05) in crude protein content among the varieties for any particular month. Differences only arose within variety between months.

The results seem to suggest that generally, where an 8-week re-growth interval is required, under poor quality, low fertility soils, any one of the varieties under evaluation can be used as a pasture grass at least up to the ninth month after establishment.

Over the two-year experimental period, no management practices were carried out following establishment, with the exception of cutting back of plots to a height of about 15 cm from the ground level after sampling. The two grasses that persisted were Tanner and Mulato. Some Tifton and Pangola plots succumbed to competition by weeds.

Table 14 shows the dry matter yield for the four grasses under evaluation for Year 1 and Year 2. During PY 1, seven re-growths were measured. Yields were highest for Tanner, Mulato, Tifton 85 and Pangola in that order. During PY2, six re-growths were measured with yields being highest for Tanner, Mulato, Tifton 85 and Pangola, respectively.

Table 15. Dry matter yield (kg/ha) for Mulato, Tifton 85, Pangola and Tanner

	Mulato	Tifton 85	Pangola	Tanner
[a]PY1 DM Yield (kg per ha)	30,258	27,155	25,119	34,484
[b]PY2 DM Yield (kg per ha)	17,410	8,726	6,518	16,179
Overall (Yr1+Yr2) DM Yield (kg per ha)	47,668	35,881	31,637	50,663

By the last cutting, samples were found on all four of four Mulato plots, three of four Tanner plots, two of four Pangola plots and one of four Tifton 85 plots. Permanency is a key requirement for a pasture species. Varieties selected for pasture should be able to persist for a minimum of 3 years. Based on this study, it can be assumed that Mulato is able to persist more readily than the other grasses over time.

CARDI has identified Mulato, *Brachiaria* sp. as a forage that can contribute significantly to ruminant livestock production. Consequently, a germplasm bank of Mulato was established on 0.32 ha of land at the Sugarcane Feeds Centre (SFC), **Trinidad,** to be used to evaluate animal performance. Visits were made to seven sites to farmers desirous of using Mulato for pasture establishment and technical advice given on the appropriateness of the sites, as well as on issues relating to land preparation and sward management.

In collaboration with the Sugarcane Feeds Centre, a trial exercise in silage making was conducted using sugarcane. This was done as a means of honing the methodology that would be applied to a trial which will compare silage made from four different grasses, namely: King grass, (*Pennisetum* spp.), Taiwan grass (*Pennisetum* spp.), sugarcane (*Saccharum officinarum*) and Mulato (*Brachiaria* spp.). The trial results showed that these grasses can be ensiled successfully, using low-cost technologies.

A sample of the silage produced is shown in Plate 30. The results indicated that the in the treatment with the lowest concentration of sulphuric acid (30 ml H_2O + 20 ml 50% H_2SO_4) the pH was found to be 2.3 on day 28. This was lower than the level required for the preservation of forage (i.e. pH 3.0–3.5) and further work is needed to determine the appropriate 'mix' that would be required to increase the pH value to the desired level.

Plate 30. A sample of sugarcane silage, Trinidad

Charting the way forward

An inception workshop was held in March 2007 in Trinidad to apprise national stakeholders of a *Regional Small Ruminants Improvement Project,* which is designed to collect critical information on the industry. This will allow stakeholders to assess the true state of the sub-sector and then make informed decisions on the way forward. On completion, an important output of this project will be a set of projects that are deemed necessary and sufficient to secure the accelerated development of the regional small ruminants sector.

Participating countries were asked to submit lists of small ruminant farmers in active production in order to derive a survey sample. The institutional surveys were started in **Trinidad and Tobago** towards the end of 2007.

Dairy industry

The major constraints that inhibit development of the dairy industry in **Trinidad** include inadequate feeds and feeding systems, poor record keeping and inappropriate fertility management. CARDI is collaborating with Nestlé, the Ministry of Agriculture, Land and Marine Resources and the UWI to alleviate these binding constraints. Our partners in this consortium are focused on record keeping and fertility management whereas CARDI is making interventions primarily in feeds and feeding systems development and management.

In this regard, technical assistance was provided to establish 11 hectares of Mulato on two model farms, one at Carlsen Field (Mr Bholai) and the other at Wallerfield (Mr Dolloway). Mr Bholai reported a 23% increase in milk production when cows were fed Mulato grass (Plate 31). This is consistent with reports from Mexico where Mulato is being used in the dairy industry.

CARDI is also providing technical assistance in the transfer of this technology to dairy farmers on the State Lands Project. Approximately 100 hectares of Mulato grass has been established on 30 farms in the Wallerfield and Carlsen Field State Lands Project areas.

Plate 31. Cow grazing Mulato on Bholai Farm, Carlsen Field, Trinidad

Natural Resource Management Programme

Programme Leader: Cyril Roberts

Biotechnology

Microsatellite markers obtained from the International Livestock Research Institute (ILRI) have been used in **Barbados** to DNA fingerprint different populations of Caribbean hair sheep. The exercise resulted in molecular categorisation of the hair sheep into six distinct breed groups—Caprine, West Africa, St Elizabeth, Barbados Blackbelly, White Tail OT and Virgin Island White—as shown in the phylogenetic tree below (Figure 2). This has confirmed or corroborated the phenotypic identification of these breeds. Furthermore, putative unique markers were identified to confirm individuals as being purebred Barbados Blackbelly Sheep. This suggests that given blood sample from any phenotypic Barbados Blackbelly Sheep it can be ascertained whether or not it is purebred. This will enable pedigree certificates to be attached to semen from such purebred rams and, hence, premium prices demanded for them.

Putative unique markers were identified to confirm individuals as being purebred Barbados Blackbelly sheep. These were used to resolve between 10 unknown blood samples, which included two of purebred Barbados Blackbelly. With the markers used it was possible to readily exclude seven samples as not being purebred Blackbelly. This aspect of the study is currently being repeated to verify these results and to find markers linked to production and productivity traits.

Studies carried out in **Barbados** on the vegetative propagation of hot pepper confirmed that West Indies Red can be rooted from cuttings and normal bearing plants eventually result. An experiment where three lengths (3, 4 and 5 inch) of apical shoot tips, along with 5-inch lengths of immature and mature stem cuttings were treated with 0, 1000, 3000 and 8000 ppm concentrations of IBA hormone and then placed in sterile pot-

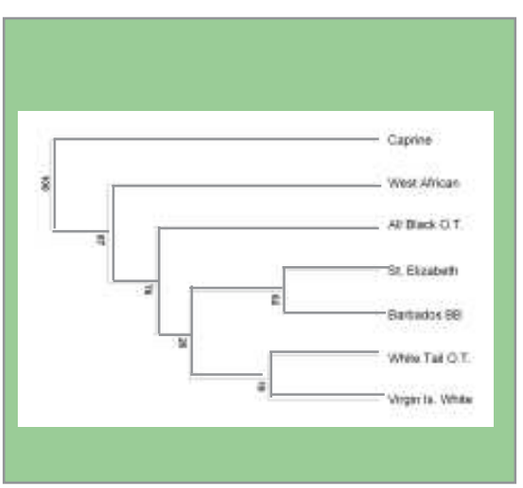


Figure 2. Phylogenetic tree of the relationship between Caribbean hair sheep

ting mix was done. Results after four weeks revealed rooting frequencies among apical shoot tips was best ranging from 0–71%. Analysis showed that neither IBA concentration nor shoot tip length significantly affected rooting frequency. Results also suggested that immature and mature cuttings displayed higher survival rates. Analysis of the results leads to speculation that source of apical shoot tip cuttings and cooler environmental conditions (original experiment done outdoors) would lead to more efficient rooting. Preliminary results from an aeroponic system using 3000 ppm IBA revealed rooting after 14 days (Plate 32).

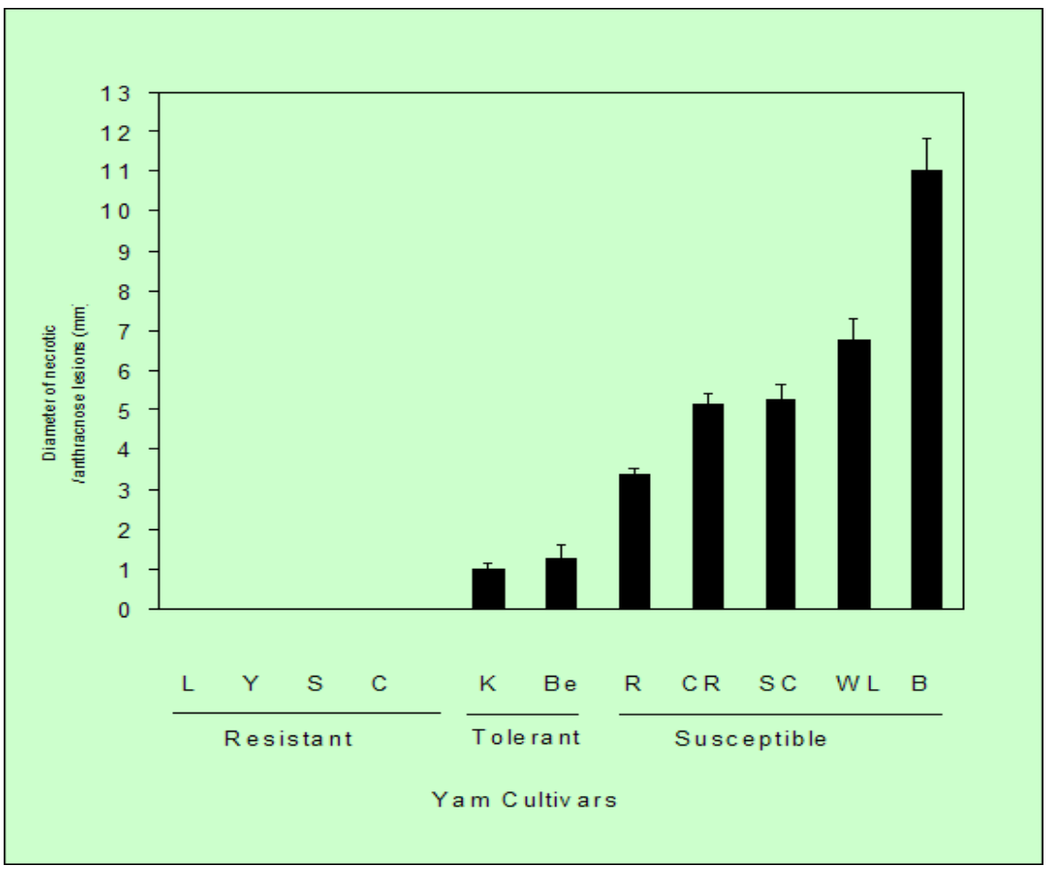
Plate 32. Roots developing on West Indies Red 5-inch apical shoot cuttings after 14 day in 3000 ppm IBA

Pathogenic and genetic variation of *Colletotrichum gloeosporioides* Penz. the causative agent of yam anthracnose was the subject of a major study (PhD) carried out in **Dominica.** The work involved investigations on pathogenecity, population genetics and phytotoxicity activity of the pathogen.

The toxins extracted from isolates of *C. gloeosporioides* from yam induced necrotic symptoms that were identical to typical anthracnose symptoms on yam. Toxins of isolates from Ladies, Yellow, Red, and Cush Cush yams all damaged the *Dioscorea alata* types tested except Kinabayo and Belep yams, both of which were affected by toxin of the isolate from Yellow yam only. Ladies, Yellow, Silk and Cush Cush yams were not affected by all toxins tested. Overall, the toxin of the isolate from Ladies yam had the most serious affect on the yams tested. In contrast, yams tested with the toxin associated with the isolate from Cush Cush yam were least severely affected. The other toxins, one each of the isolates from Red and Yellow yams affected yams to significantly different extents.

It was shown that the *D. rotundata* cv Ladies yam which is resistant and tolerant to the disease and the *D. alata* cv Babaoule yam, which is the most susceptible (Figure 3), both haboured the most virulent strain of *C. gloeosporioides* and were a source of inocula for anthracnose disease in Dominica. Population genetic studies also showed that there was a lack of gene flow between major yam growing locations and that could be a positive factor in controlling the spread of the disease. The study also established that toxins extracted from the pathogen isolates could be used to screen for resistance in the normally susceptible *D. alata* cultivars.

The study recommends continued disinfestations of yam planting material as is presently recommended by the Dominican Ministry of Agriculture, introduction and screening of commercial *D. alata* cultivars with pathogen toxins from indigenous isolates and assessing the locations, size and proximity of Babaoule plantings to commercial *D. alata* holdings and other susceptible yam species, as a means of controlling the disease and sustaining commercial acreages of the *D. alata* and other susceptible cultivars for export.



Key: **L**=Ladies, **Y**= Yellow, **S**=Silk, **C**=Cush Cush, **K**=Kinabayo, **Be**= Belep, **R**=Red, **CR**=Costa Rican, **SC**=St. Croix, **W L**=White Lisbon, **B**=Babaoule

Figure 3: Mean lesion diameter induced on 11 yam types inoculated with toxins extracted from *C. gloeosporioides* isolates from Ladies, Yellow, Red and Cush Cush yams.

Integrated Pest Management (IPM)

The Asian Soybean Rust (ASR), caused by *Phakopsora pachyrhizi*, is one of the most devastating diseases of soybean worldwide, causing yield losses of up to 90%. ASR was for the first time recorded in **Belize** in January 2006 at Central Farm. Two trials were conducted in 2007 to assess the efficacy of various fungicides to control ASR. Six fungicides (Duett 25 SC, Score 25 EC, Tilt 25 EC, Amistar 50 WG, Silvacur Combi 30 EC and Bravo 50 EC) were evaluated in plots that received one or two fungicide applications. All compounds controlled ASR when compared to the untreated control and disease severity was less in all plots treated with fungicides. Seed weights and yields were

higher in all the plots treated with fungicides except those treated with Bravo. These results indicate significant benefits can be had by applying fungicides between 55 to 65 days after planting. Additional research on the timing of application and rotation of triazoles and strobilurin fungicides is needed.

Farmers in **Dominica** could lose foreign exchange earnings of over EC$3 million per annum and an estimated EC$15 million over the next 5 years, if citrus exports and supplies to the local market are significantly decreased as a result of Citrus Tristeza Virus (CTV). Since 2000, there has been an increasing incidence of a dieback, leading to eventual tree death. This problem has been reported on all varieties and has been particularly severe on West Indian Lime in Soufriere in the south of the island. As a result, the lucrative green lime export trade has diminished and the supply to the lime-processing factory has fallen from an average of 70–90 tonnes per year over the last decade to less than one tonne in the past year.

A survey in 2001 indicated that the problem was island-wide and that 95% dieback in lime trees were observed in Soufriere and approximately 40% in Giraudel and the Roseau Valley respectively. CTV was confirmed as the causal agent.

A more recent survey has indicated widespread presence of psorosis, other citrus viroids, and the wide spread distribution of the Citrus Tristeza Virus vector (*Toxoptera citricida*). The Ministry of Agriculture has developed a 5-year plan for controlling CTV and CARDI is validating three newly introduced CTV resistant root stocks—Cleopatra Mandarin (CM), Swingle Citrumelo (SC) and Citron Carrizo (CC) in an experiment established to compare the performance of Tahiti (TL) on the three CTV resistant root stocks.

Data collected so far shows that CM/TL had the most vigorous growth with consistently higher values for plant height, foliage height and foliage width for observations made over one year. The percentage increase in mean scion diameter for this period was SC/TL (175), CM/TL (153) and CC/TL (72).

Studies were carried out in **Trinidad** and **Jamaica** for the development of a sampling protocol for two major Lepidoptera species on cabbage. At the harvest of the first season of cabbage production in South Oropouche, **Trinidad**, the treatment effects on larval frequency and marketable heads of cabbage were significant ($P < 0.001$ and $P < 0.05$, respectively). Farmer practice plots had significantly more diamond back moth than all other treatments. With respect to marketable heads there was no significant difference between weekly-sprayed plots and those treated at threshold despite a 50–60% reduction in pesticide input for the season. Also, Match® (weekly and threshold) and Tracer® (weekly) performed significantly ($P < 0.05$) better than the farmer practice plots.

Once again it was demonstrated that the biorational products Match® and Tracer® were effective in managing Lepidopteran pests in cabbage production, both at weekly and applications at threshold. It is noteworthy that only four applications of Tracer® and five of Match® were employed for threshold plots while there were ten applications of both these products in weekly-sprayed plots. Through IPM strategies, it is possible to reduce the input of pesticides while still adequately protecting the crop from damage by lepidoptera.

In week-4 in a similar study conducted at Bushy Park, St Catherine, **Jamaica**, a high population of larvae was recorded and by week-6, the treatment differences were classically discernible by the visible levels of damage in each plot. However, by

week 7, persistent heavy rains resulted in proliferation of a bacterial pathogen *Erwinia* sp., which caused high levels of mortality, which was more pronounced in exclusion plots (especially the plots with the cover fixed) leading to the termination of the trial.

Organic Agriculture

Studies in organic farming techniques began in 2000 in **Jamaica** and have involved compost production including vermi-composting and the collection of data on nutrient availability from various compost mixes. In addition, the growth and performance of hot pepper and callaloo grown in rotation under organic farming conditions and utilising vermi-compost, cow manure and goat manure have been assessed in demonstration plots on the research station.

Organic demonstration plots of callaloo and hot pepper were cultivated, harvested and data collected and analysed. In this second assessment, the commercial biorganic manure again showed superior effects on the growth and yield of both callaloo and hot pepper compared to vermi-compost and cow manure. Vermi-compost production continued and 220 kg was harvested during the year.

In mid December, a commercially scaled vegetable cropping system was established in three alleys bounded by Glyricidia hedges within the main mango orchard of the pilot organic farm, in **Tobago.** The plots were established with King Henry sweet peppers from organically grown transplants produced at the Goldsborough DTC nursery. The Glyricidia hedges were pruned to let in around 70% sunlight to the sweet pepper cropping area and the cuttings used to mulch the mango trees. Harvesting of the sweet pepper crop is expected to begin in late February 2008. Another two plots were prepared to cultivate determinate tomatoes (Celebrity F1 and Paragon F1) produced from certified organic seed at the GDTC Nursery.

The GDTC nursery workers were trained in organic transplant production of tomato and sweet peppers (Plate 33). The methodology utilising available materials acceptable to organic standards was developed and tested during the period September to December 2007. The transplants were produced for the organic pilot farm vegetable production trials.

Plate 33. Organically grown tomato seedlings on coconut coir

A series of 24 small plots were established within the sugar apple orchard system of the pilot organic farm. These plots were planted with several vegetable varieties to demonstrate the required techniques to the workers and to evaluate the performance of specific cultivars for the period February to September 2007. The seedlings used were from conventional sources.

Invasive species

The red palm mite, *Raioella indica* Hirst, which entered the Caribbean region in the French speaking territories in 2004, has now been reported in at least nine Caribbean countries and Florida.

CARDI is assisting in the coordination of the various actions being taken by the affected countries. The red palm mite presents a serious threat to the regional coconut industry with yield losses of well over 50% reported at some locations. In addition to coconut (Plate 34), a number of plants, which are of economic importance to agriculture and the tourism sector are hosts of this pest. These include some palms, musa species (banana and plantain), ginger and heliconia.

Plate 34 Coconut palm affected by red palm mite in St lucia

International help to control the pest is being pursued with the Government of India and the Commonwealth Secretariat. CARDI has been fully involved in the programme of the government of **St Lucia** to control red palm mite. Surveys have identified the distribution of the pest and also possible natural enemies. Preliminary experiments with safe chemicals have produced some results.

In **Jamaica**, CARDI is represented on the national sub-committee of the Plant Health Coordinating Committee (PHCC) for the management of red palm mite, which was confirmed present in the country in April 2007. CARDI participates in discussions and gives technical advice towards the development of a national strategy and has the specific task of developing and coordinating the public awareness component of the strategy.

CARDI has also been involved in government control programmes in **Dominica** and **Trinidad and Tobago.**

In the US, an entomologist from the University of Florida has visited Mauritius, and identified some possible natural enemies, which are being evaluated in the laboratory in Florida. The Commonwealth Agricultural Bureau (CABI) also has a programme to control the red palm mites.

In July 2007, the presence of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) was confirmed in **Jamaica**. CARDI is also represented on the sub-committee of the PHCC, which was convened to develop a management strategy for this pest. The main focus has been the introduction of biological control agents. Contributions were made to the development of the methodologies for monitoring, surveillance and management, and the Institute was given the specific task of coordinating the public awareness portfolio.

Post Harvest, Marketing and Agribusiness Programme

Programme Leader: Ardon Iton

Marketing and Agribusiness

The Marketing Unit at CARDI headquarters supports the Institute's research and development programmes and the wider Caribbean agri-food sector with knowledge of the status of the markets, identification of commodities for which product improvement is required and the general marketing of agricultural products.

During the year, the Unit commenced a project entitled the *Caribbean Trade Expansion Project (C-TEP,* which is a USAID funded project aimed at expanding the range of non-traditional produce entering North American markets. Phase 1 of the project is managed and implemented by North-South Institute and Global Strategy Group of Florida, Alcorn State University of Mississippi, and CARDI as the Caribbean counterpart.

Dominica and **St Lucia** were selected as the islands for the implementation of the project given their previous experience in exporting non-traditional agricultural produce and the poor performance of their agricultural sectors, since the onset of a declining banana industry. These two islands once exported some non-traditional produce to the UK along with their banana. However, given the major transformation taking place in global agrifood markets a paradigm shift was required by the farmers and exporters for the project to achieve its stated objectives.

Small farmer participation in modern agrifood markets requires them to meet such stipulations as: consistent delivery with regards to quality and quantity, stipulated grades and standards, food safety and traceability regulations and last but not least a competitive price. In an attempt to minimize the risk to which the farmers and exporters are exposed, Miami importers offered contracts. Since contract farming/exporting is not a common practice in the OECS this dictated the need for intense training sessions for actors along the supply chain.

During the period CARDI along with the other project implementors conducted workshops in post harvest/quality assurance systems for breadfruit, dasheen, ginger, hot pepper, pumpkin and tannia in Dominica and St Lucia.

Market Visits

Two market visits were made to Miami, Florida. On these visits meetings were held with several regular importers of agricultural produce from the Caribbean. Generally, they all expressed a need to have a more regular supply of products such as hot pepper and dasheen. In the case of hot pepper the need for more varieties to be exported from the region was also expressed.

In an attempt to improve the marketing capabilities of farmers and other stakeholders in the agriculture sector members of the unit undertook and facilitated several training exercises. For example as part of the *FAO Food Security Project, Phase 1*, the unit trained 65 persons in **St Kitts and Nevis** in basic marketing with a focus on exporting to Miami, supplying the hospitality sector and responding to changes in agri-food markets.

Post harvest

Wax apple, *Syzygium samarangense* Merr. & Perry is a species belonging to the family Myrtaceae. It was first introduced into **St Lucia** by the Taiwanese in the 1980s. Over the years it has become a popular fruit. As the demand increases it will have the potential of becoming an important fruit crop in the farming system. The fruit is light red in colour and bell-shaped, narrow at the base, very broad, flattened, indented and adorned with four fleshy calyx lobes at the apex (Plate 35). The fruit may contain one or two somewhat rounded seeds or none.

Plate 35. Wax apple fruit (*Syzygium samarangense* Merr.& Perry)

Fruits are usually sold loose in open containers by supermarkets, in trays and open polythene bags by vendors by the roadside. A trial was conducted to investigate the shelf life of wax apple under the existing methods used in retailing fruit and for further development as a potential export crop. Two temperatures (ambient and 7^{0}C) and two methods of packaging (sealed and open polythene bags) were examined

The percent weight loss for the different treatments is shown in Table 16. There were significant differences between treatments ($P < 0.05$). Sealed bags were much better. Fruits stored in sealed polythene bags lost less weight than those in open bags. Though there was significant interaction between temperature and packaging, a cooler temperature did not seem to have much of an advantage.

Table 16. Percentage weight loss of wax apple during storage

Treatment	% wt. Loss
Sealed bags at 7 ^{0}C	2.3
Open bags at 7 ^{0}C	11.0
Sealed bags at AT	0.9
Open bags at AT	14.1
SEM (8df)	0.66
P	0.01

AT = at ambient temperature

After 12 days in storage there were no significant treatment effects on the appearance and firmness of the fruit. However, it appeared that cold (7 ^{0}C) temperature did more harm than good to the fruit.

Pack house operators of the **St Lucia** Marketing Board (SLMB) were trained in the post harvest handling of breadfruit (Plate 16) and the SLMB assisted in carrying out trial export shipments of breadfruit utilising the pack house at CARDI's DTC.

Plate 16. Preparing a trial shipment of breadfruit for export at DTC for SLMB

Under the USAID funded Caribbean Trade Expansion Project (C-TEP), training was provided in post harvest handling and quality assurance in **Dominica** and **St Lucia**. Seventy participants, comprising mainly farmers, exporters, pack house operators, extension officers and processors attended the training workshop. The crops targeted were hot pepper, breadfruit and dasheen.

Information and Communication Programme

Programme Leader: Claudette de Freitas

Information Management/and CTA/CARDI Regional Office for the Caribbean (RBOC)

This programme is the focal point for collection, organisation and dissemination of information in CARDI. It comprises the Information Centre, responsible for the delivery of information services to both staff and other stakeholders across the region, as well as the Records Centre. A major part of the programme includes the coordination of the Technical Centre for Agricultural and Rural Cooperation (CTA) Regional Branch Office for the Caribbean (RBOC).

Information and Records Services

The Information Centre, as well as the Records Centre, together form a major hub for the delivery of information based on requests from staff, clients and other stakeholders. In 2007 the Centre responded to over 400 requests on a wide variety of agricultural related topics. Additionally, over 5,000 documents were distributed to a range of stakeholders within the Caribbean, as well as extra-regionally. The majority of the requests were in the area of crop science and production, in particular roots and tubers; fruit and tree crops and vegetables Requests for information were also made in animal production and health, mainly on small ruminants.

During 2007, emphasis on collection development and organising of the Information Centre at CARDI Headquarters continued. The overall goal of this activity is ultimately to develop the collections relevant to current projects, and create depositories of CARDI and CTA documents, at both the Institute's Headquarters and the Country Offices. The main focus of this activity for the period, has been on organising the collections at Headquarters, while acquiring and disseminating documents relevant to respective Country Offices.

A significant output of the Centre was the establishment of its E-library. Presently there are over 300 electronic documents ranging from conference presentations to journal articles. The E-library supplements the Centre's CD-ROM collection. Collectively, both these resources provide access to some 500 full text documents.

In March, 2007 the Information Centre registered with Science Direct, a service that offers more than a quarter of the world's scientific, medical and technical information online. The success of a pilot project, which focused on offering access to this information to one CARDI Country Office, has resulted in plans to extend this service to other CARDI Offices in 2008.

The Selective Dissemination of Information Service for staff generated close to 600 notifications on a range of subjects. This service, coupled with ongoing updates of the Institute's notice boards, kept persons abreast of topical issues and features.

The Headquarters Records Unit launched a management of electronic records effort in 2007, aimed at improving the turn-around time to access information. File movement was enhanced with the implementation of selected software applications. Further to this, an in-house seminar titled *Records: Everybody's Business* was held in September 2007, to raise awareness and support implementation of a new approach to Records Management.

CARDI as CTA Regional Branch Office in the Caribbean (RBOC)

CARDI continued its partnership under the Memorandum of Understanding with the Technical Centre for Agricultural and Rural Cooperation (CTA). Since 1987 the CTA has provided institutional and technical support to assist an improved policy, institutional and technical framework for agricultural and rural development in the Caribbean. Activities have focused on the provision and dissemination of information; technical assistance and training in various aspects of information and communication management; delivery of services; conduct of studies and evaluations.

Major target audiences for the CTA/RBOC services include key stakeholders within the agricultural sector such as policy makers; researchers and scientists; extension agents; farmers and farmer associations; information brokers; marketing agencies; the private sector; women and youth. Over the last year RBOC supported events were hosted in six countries.

In 2007, CARDI co-ordinated and/or co-hosted three regional workshops with the CTA. A total of 62 persons were trained at these workshops with 47% of the participants being females and 53% representing males; only 11% of the participants fell into the youth category. Additionally, the RBOC contributed to 10 other events throughout the region where youth and women featured among the major beneficiaries.

Selected CTA/CARDI Supported Events Seminars and Workshops

Communication Tools & Methods for Practitioners in Food and Nutrition Security, 7-11 May, St Kitts and Nevis

This workshop served to increase the capacity of health practitioners working in the area of food and nutrition security, by providing them with tools and methods to support better communication and influence with policy makers and other key stakeholders in the health and rural development sector. The workshop was held in collaboration with the Caribbean Food and Nutrition Institute (CFNI).

Training of Trainers Workshop on Agricultural Science, Technology and Innovation (ASTI) Systems 10-14 September, Trinidad and Tobago

Twenty-seven persons from 12 countries were trained to improve understanding of the concept and application of an innovation system framework. This follows CTA's collaborative efforts with KIT, Vrije University and CAB International, which developed training resources to build the capacity of nationals of Africa, Caribbean and Pacific states in analysing agricultural, science, technology and innovation systems. Beneficiaries will continue to use tools and techniques to train others in the region to facilitate ASTI system processes.

CTA/CARDI Internal Seminar
12-14 November, Trinidad and Tobago

CTA supported the Institute in the development of its medium-term plan for the period 2008–2010. This workshop brought together over 50 representatives from the CARDI Board of Directors and Board of Governors, staff, partners and stakeholders, to develop a strategic framework for innovative application of science and technology processes along the entire agri-product chain. The resulting CARDI's strategy for the Medium Term 2008–2010 integrates the key global and regional issues and policy frameworks, including the *Jagdeo Initiative* and the *Agro Plan 2015*. It is centred on three strategic axes:

- The Development of Sustainable Industries
- The Development of Strategic Linkages
- Institutional Strengthening.

Innovation and Foresight for Repositioning Caribbean Agriculture
18-21 September, Grenada

A team of CARDI scientists participated in a workshop based on the collaborative effort of CTA and the Caribbean Council for Science and Technology (CCST), which built on earlier efforts to support regional science and technology initiatives. The workshop facilitated dialogue on the relevance of innovation and foresight in charting the future of Caribbean agriculture and scientific endeavours and optimising its use to effectively respond to emerging threats.

CTA supported Caribbean Representation at Web 2.0 Conference
25-27 September, Rome

Mrs Claudette de Freitas of CARDI, Mr Richard Rampersaud and Ms Kathryn Duncan both of IICA attended the Web 2.0 Conference, held as part of a week-long dialogue to focus on the use of information, communication tools and associated technologies. The event also served to inform stakeholders in food security, rural development and natural resource management, on how to improve networking, collaboration and exchanging knowledge. It was hosted by CTA and supported by the Food and Agriculture Organisation, the International Institute for Communication and Development (IICD), German Technical Cooperation (GTZ) and the Consultative Group on International Agricultural Research (CGIAR)among others.

Capacity Building and Technical Assistance Improving Capacity for CaFAN

The Institute continued to provide technical assistance to the CTA supported Caribbean Farmers Network (CaFAN). Activities included workshop facilitation and presentation, participation in the CaFAN Executive Committee, as well as the drafting of a Memorandum of Understanding between CaFAN and CARDI to be finalised in 2008. This is with a view to assisting farmers to play a more active role in the development of the Caribbean agricultural sector.

Question and Answer Services (QAS)

CARDI worked in collaboration with CTA to prepare a series of proposals for funding of *QAS* in several countries in the region including Antigua and Barbuda, Barbados, Dominica, Jamaica, St Kitts and Nevis, St Lucia, and St Vincent and the Grenadines. These proposals were aimed at increasing the number of farmers targeted for the service to 60% of the client group within a 3-year period.

Promotion and Better Access to Information

In 2007 a collaborative effort was undertaken by the RBOC and the CARDI Country Offices to review and update the list of Caribbean subscribers to the CTA Publications and Distribution Services. Through this initiative key stakeholders throughout the region are now able to keep abreast of CTA/CARDI activities and information.

A Collection of Web Resources for Gender and Gender Development

In recognition of the significant contributions to agriculture made by women, CTA has incorporated gender as a cross-cutting issue and guiding principle of the institution. As a partner implementing CTA supported projects, the RBOC undertook the compilation of web based resources, designed to provide information to key on gender development. The Web resources are grouped into four areas for easy reference as presented below:

- Gender and Education
- Gender and Information and Communication Technology
- Gender and Health
- Regional Women's Groups

RBOC Supported Exhibitions in 2007

Agrofest, Barbados

National Symposium on Agriculture, Dominica

13th Annual Agriculture Open Day, St Kitts/Nevis

UWI Open Day–"Planting for Food Security", Trinidad and Tobago

St James Government Secondary School – Career Enhancement Fair, Trinidad and Tobago

XXXVII Annual Conference of the Association of the Caribbean University, Research and Institutional Libraries (ACURIL), Puerto Rico

The Denbigh Agricultural & Industrial Show, Jamaica

7th Caribbean Week of Agriculture, Jamaica

Ministry of Agriculture, Land and Marine Resources–"Food Fair Exhibition", Trinidad and Tobago

Public Relations and Communications Department

The Public Relations and Communications Department (PRCD) provided services to country offices of the Institute in member countries across the Caribbean region and at Headquarters, Trinidad and Tobago in the area of protocol, public affairs, exhibitions, media activities, publication, and Information and Communication Technologies (ICTs).

PRCD co-ordinated corporate communications strategies that enhanced public awareness and visibility of the Institute nationally and regionally. The department designed, produced and disseminated high-quality publications, brochures, factsheets, posters, and manuals as educational and learning resources regarding scientific findings and the transfer of knowledge and technology based on research activities.

Published publications include among others Hot Pepper Production Manual for Trinidad and Tobago, A Guide for Sustainable Production of Export Grade Pineapple in Dominica, Annual Reports, CARDI Review, and CARDI Update,

During 2007, the department conceptualised, produced and disseminated a plethora of press releases that contributed to increased public awareness and visibility of the Institute on radio, newspapers and television stations at national and regional forums, and produced 10 radio jingles on post harvest in the OECS for Food and Agriculture Organisation (FAO), Rome.

PRCD provided specialised services in particular media logistics, and hosted a hot pepper Open Field Day resulting in coverage in national, regional and international media.

The department co-ordinated and featured an outstanding exhibition at 2007 Caribbean Week of Agriculture, Jamaica, and the National Agricultural Exhibition of the Agricultural Society of Trinidad and Tobago.

The Manager of PRCD represented CARDI at the National Consultation on Food Prices, Trinidad and Tobago, the Meeting of the Caribbean Community (CARICOM) Information and Communication Technologies (ICTs) Steering Committee, Guyana, and at numerous conferences, meetings, seminars, and exhibitions to provide support to regional initiatives and promote the ongoing activities, and accomplishments of the Institute at various forums. The department co-ordinated technical and operational services for meetings of CARDI's Board of Governors and Board of Directors.

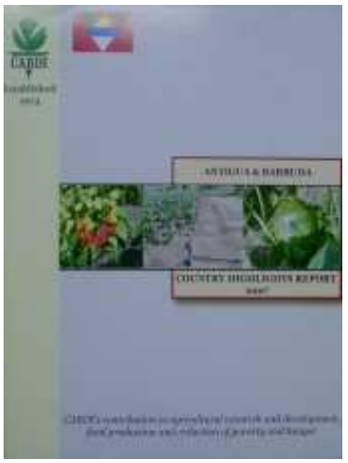
PRCD worked closely and provided support to the Caribbean Invasive Species Working Group (CISWIG) for co-ordinating activities in the areas of publicity (national and regional), networking, collaboration and partnership.

With respect to (ICTs) under the auspices of PRCD although technological challenges were insurmountable, the department provided technical support and services to the Institute's Local Area Network (LAN), updated Windows to Windows XP system, replaced desktops with laptops (docking stations) and hyperlinks to relevant websites of stakeholders and collaborators to promote regional events.

Some events that exposed CARDI's work to the public are shown in Plates 36 and 37.

Plate 36. Public Relations & Communications Manager, Mr Selwyn E King at the 7th Caribbean Week of Agriculture (CWA) 2007 in Jamaica.

Plate 37. Participants in a hot pepper organoleptic test in Trinidad



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Wilson M. 2007. Selecting a model for R&D impact analysis: the CARDI Dominica portfolio. Paper presented at the 27th West Indies Agricultural Economics Conference, Belize, July 2007.

Financial Report

A significant aspect of 2007 was the settlement of the 2002 to 2004 negotiations with most unions. This resulted in a 10% increase for technical staff and a 5% increase for professional staff over the period. The new salaries became effective from December 2007.

These increases resulted in payment of arrears of salary of EC$619,000 for the period January 2002 to December 2004 with 65% of the arrears being paid in December 2007. The balance was to be paid in 2008 as the respective unions agreed to the settlement.

The portion of the arrears arising from the 2002 to 2004 increase, for the period 2005 to 2007 will be paid to staff when the funds have been identified.

The Government of Barbados paid 60% of its arrears (EC$0.6 Mn) in 2007. This amount, together with reserves from previous arrears and collections, financed the payment of salary arrears resulting from the negotiated settlements referred to above.

The following are highlights from the Audited Financial Statements for 2007:

Table 17 shows a summary of the Income Statement for 2007 with the years 2006 and 2005 as comparatives. The Net Deficit in 2007 was EC$1.8 Mn., less than that of 2006 in which period the deficit was EC$2.3 Mn. The write-off of fixed assets in 2006 and higher depreciation charges being the main reasons for the difference.

Table 17. Summary of the Income Statement for 2007, 2006 and 2005 in EC$'000

Item	2007	2006	2005
Total Revenues	9,134	9,189	9,927
Total Expenditure	10,956	11,470	11,580
Net Surplus/(Deficit)	(1,822)	(2,281)	(1,653)
Net Assets	3,933	5,737	8,019

Table 18 below separates the results of Core operations and externally financed operations. The deficit on the externally funded co-operative programmes is as a result of work carried out in 2007 with the relevant income received in 2006 or 2008. That is, it resulted from timing differences.

With respect to the Core Income Statement, expenses include the non-cash items (including depreciation), which totaled EC$1.4 Mn in 2007 and EC$2.2 Mn in 2006, mirroring closely the losses.

Table 18 Core operations and externally (Cooperative) financed operations in EC$'000

Item	2007		2006	
	Core	Co-op	Core	Co-op
Total Revenues	8,236	898	8,236	954
Total Expenditure	9,843	1,113	10,469	1,002
Net Surplus/(Deficit)	(1,607)	(215)	(2,233)	(48)

Table 19 below shows that the budgeted Government Revenue for 2007 was $7.79 Mn, while actual collections were $9.03 Mn. The effect was to reduce arrears of government contributions from EC$13.1 Mn to EC$11.8 Mn. The funds were used to pay arrears of salary resulting from negotiated increases as well as to invest in some necessary fixed assets.

Table 19. Budgeted Government Revenue compared with actual collections, in EC$'000

Item	2007	2006
Gov't Contributions Due	7,790	7,662
Amount actually Paid	9,028	8,748
Excess	1,238	1,086

Revenue from Co-operative programmes increased from EC$ 1.0 Mn in 2006 to EC$ 1.1 Mn in 2007. CTA (EC$ 0.4 Mn) and IICA (EC$ 0.3 Mn) being the major contributors, accounting for 64% of total external funding.

The Balance Sheet as highlighted in Table 1 above shows CARDI's Net Assets as at December 2007 being valued at $3.9 Mn. This comprises of Fixed Assets of $2.3 Mn, Net Current Assets of $2.1 Mn and Long Term Liabilities of $0.5 Mn.

In the year 2008 and the medium term, CARDI must continue the focus on co-operative programmes as a means of financing the work programme. Core revenues are only able to cover personnel and other fixed cost, so that new funding streams remains a priority for the Institute.

KPMG

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INDEPENDENT AUDITORS' REPORT
To the Members of Caribbean Agricultural Research and Development Institute

Report on the Financial Statements

We have audited the financial statements of Caribbean Agricultural Research and Development Institute (the Institute) set out on pages 2 to 23 which comprise the balance sheet as at December 31, 2007, and the statements of operations, accumulated fund and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory notes.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with International Financial Reporting Standards. This responsibility includes: designing, implementing and maintaining internal controls relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error; selecting and consistently applying appropriate accounting policies; and making accounting estimates that are reasonable in the circumstances.

Auditors' Responsibility

Our responsibility is to express an opinion on the financial statements based on our audit. We conducted our audit in accordance with International Standards on Auditing. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal controls relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal controls. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements, present fairly, in all material respects, the financial position of the Company as at December 31, 2007 and its financial performance, statements of accumulated fund and cash flows for the year then ended in accordance with International Financial Reporting Standards.

KPMG

Chartered Accountants
November 12, 2008
Port of Spain,
Trinidad and Tobago, W.I.

KPMG Chartered Accountants, a Trinidad and Tobago partnership, is the Trinidad and Tobago member firm of KPMG International, a Swiss cooperative

H C Rodriguez
P A Davis
R R Alleyne

Balance Sheet

December 31, 2007
(Expressed in Eastern Caribbbean Authority dollars)

	Note		2007	2006
ASSETS				
Non-current assets				
Property, plant and equipment	7	$	2,330,055	3,051,394
Current assets				
Prepaid expenses			29,113	33,045
Accounts receivable:				
Member governments	8a		1,695,693	3,163,324
Other			189,958	233,329
Fixed deposits	4b		434,978	410,356
Cash	4a		2,354,412	1,380,997
			4,704,154	5,221,051
Total Assets		$	7,034,209	8,272,445
ACCUMULATED FUND AND LIABILITIES				
Non-current liabilities				
Net long-term liabilities	5		196,510	106,449
Due to funding agencies	12		462,888	304,922
			659,398	411,371
Current liabilities				
Currrent portion of long-term liabilities	5		143,100	142,089
Bank overdrafts	4c		558,506	494,309
Accounts payable and accrued liabilities	9		837,819	698,989
Due to The University of the West Indies			815,753	724,856
Provision for pension costs			-	7,009
Due to employees			40,408	56,547
Current portion of due to fundig agencies			46,289	-
			2,441,875	2,123,799
Net total liabilities			3,101,273	2,535,170
Accumulated fund		$	3,932,936	5,737,275
Total accumulated fund and liabilities			7,034,209	8,272,445

The accompanying notes form an integral part of these financial statements.

Approved on behalf of the Board

Director **Director**

2

Statement of Operations

For the year ended December 31, 2007
(Expressed in Eastern Caribbbean Authority dollars)

	Note	TOTAL 2007	TOTAL 2006
Revenue			
Government contributions:			
Annual core budget		$ 7,790,000	7,662,025
Non-government contributions:			
Co-operative Programmes/Technical Assistance	6	1,060,103	985,054
Consultancies		29,267	68,407
Produce sales		310,940	285,113
Interest income		70,738	52,652
Gain/loss on translation		(143,176)	105,927
Miscellaneous		33,605	30,211
Total revenue		9,151,477	9,189,389
Expenditure			
Personnel - professional		3,284,802	3,028,191
Personnel - support		2,455,187	2,503,987
Casual labour		568,068	568,853
Materials, supplies and services		296,279	307,892
Motor vehicle costs		296,150	293,736
Official local travel		42,622	62,706
Official foreign and regional travel		299,165	270,350
Training and workshops		516,257	608,184
Field station and laboratory		162,532	247,415
Office and administration expenses(Schedule 1)		1,548,761	1,305,798
Depreciation	7	380,891	1,670,426
Board meetings		106,710	117,000
Gain on disposal of fixed assets		(19,413)	(68,084)
Provision for doubtful debts		303,500	303,500
Write-off of fixed assets		714,499	250,475
Total expenditure		10,956,010	11,470,430
Net deficit of revenue over expenditure		$ (1,804,533)	(2,281,041)

The accompanying notes form an integral part of these financial statements.

CORE		PROJECTS	
2007	2006	2007	2006
7,790,000	7,662,025	-	-
68,196	52,516	991,907	932,538
29,267	68,407	0	0
298,303	266,535	12,637	18,578
63,451	50,355	7,287	2,297
(143,541)	105,927	365	0
15,439	29,998	18,166	213
8,121,115	8,235,763	1,032,362	953,626
3,218,955	2,961,123	65,847	67,067
2,388,775	2,437,658	66,412	66,329
547,274	528,289	20,794	40,564
268,274	214,198	28,005	93,694
291,011	260,632	5,139	33,105
41,338	36,599	1,284	26,107
206,074	230,064	93,091	40,286
132,298	247,524	383,959	360,660
160,201	182,346	2,331	65,069
1,496,809	1,097,046	51,952	208,752
380,891	1,670,426	-	-
106,710	117,000	-	-
(19,413)	(68,084))	-	-
303,500	303,500	-	-
714,499	250,475	-	-
10,237,196	10,468,796	718,814	1,001,634
(2,116,081)	(2,233,033)	311,548	(48,008)

Statement of Accumulated Fund

December 31, 2007
(Expressed in Eastern Caribbbean Authority dollars)

		2007	2006
Accumulated fund - beginning of the year	$	5,737,275	8,019,457
Foreign currency translation differences		194	(1,141)
Net deficit of revenue over expenditue		(1,804,533)	(2,281,041)
Accumulated fund - end of the year	$	3.932,936	5,737,275

The accompanying notes form an integral part of these financial statements.

Statement of Cash Flows

December 31, 2007
(Expressed in Eastern Caribbbean Authority dollars)

	2007	2006
CASH FLOWS FROM (USED IN) OPERATING ACTIVITIES		
Net excess of expenditure over revenue	$ (1,804,533)	(2,281,041)
Adjustments to reconcile net excess of expenditure over revenue to net cash from (used in) activities		
Unrealised foreign currency translation differences	194	(1,141)
Depreciation	380,891	1,670,426
Gain on disposal of fixed assets	(19,413)	(68,084)
Write-off of fixed assets	714,499	250,475
Gains arising from change in fair value	(17,778)	-
Changes in current assets		
Decrease in accounts receivable	1,511,002	1,270,836
Decrease in prepaid expenses	3,932	4,314
Increase in accounts payable and accrued liabilities	138,830	39,471
Increase in due to the University of the West Indies	90,897	90,870
Decrease in provision for pension costs	(7,009)	(160,832)
Decrease in due to employees	(16,139)	(303,023)
Increace in due to funding agencies	204,255	-
Net cash from operating activities	1,179,628	512,271
CASH FLOWS FROM (USED IN) INVESTING ACTIVITIES		
Purchase of property, plant and equipment	(356,275)	(356,390)
Proceeds from disposal of property, plant and equipment	19,415	68,084
Net cash used in investing activities	(336,860)	(288,306)
CASH FLOWS FROM (USED IN) FINANCING ACTIVITIES		
Proceeds of long-term liabilities	291,303	99,500
Repayment of long-term liabilities	(200,231)	(181,876)
Net cash used in financing activities	91,072	(82,376)
Net increase (decrease) in cash and cash equivalents	933,840	141,589
Cash and cash equivalents at beginning of the year	1,297,044	1,155,455
Cash and cash equivalents at end of the year	$ 2,230,884	1,297,044
Cash and cash equivalents represented by:		
Cash	$ 2,354,412	1,380,997
Fixed deposit	434,978	410,356
Bank overdrafts	(558,506)	(494,309)
	$ 2,230,884	1,297,044

The accompanying notes form an integral part of these financial statements.

Notes to Financial Statements

December 31, 2007

1. Incorporation and principal Activity

The Institute is an autonomous organisation serving the states of the Caribbean Community (CARICOM). The member states are Antigua/Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts - Nevis, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago.

The Caribbean Agricultural Research and Development Institute was incorporated on December 5, 1974 and its main objective is to contribute to agricultural development through the generation and dissemination of appropriate technology for the benefit of CARICOM. These financial statements were authorised for issue by the directors November 12, 2008.

2. Functional and presentation Currency

These financial statements are expressed in the currency of the Eastern Caribbean Currency Authority (EC) which is the Institute's functional currency.

3. Summary of significant accounting principles

(a) Statement of compliance

These financial statements have been prepared in accordance with the International Financial Reporting Standards issued by the International Standards Board.

(b) Use of estimates and judgements

These financial statements are presented in Eastern Caribbean Currency Authority (EC) dollars and have been prepared under the historical cost convention except for the revaluation of fixed assets. The preparation of financial statements in conformity with IFRSs requires management to make judgements, estimates and assumptions that affect the application of policies and reported amounts of assets and liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances, the results of which form the basis for making the judgements about carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates.

Notes to Financial Statements *(Continued)*

3. Summary of Significant Accounting Principles *(Continued)*

(b) Use of estimates and judgements (Continued)

The estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimate is revised if the revision affects only that period, or in the period of the revision and future periods if the revision affects both current and future period.

In particular, information about significant areas of estimation uncertainty and critical judgements in applying accounting policies that have the most significant effect on the amount recognised in the financial statements are described in the following notes.

(c) Property, plant and equipment

All property, plant and equipment are recorded at cost. Subsequent additions and all other assets are stated at cost. Depreciation is calculated on the straight line basis at the following rated designed to write off the assets over their estimated useful lives.

Leasehold properties (period of lease)	3.33%
Buildings	5%
Equipment	15%
Motor Vehicles	25%

(d) Foreign currency translation

Where the reporting currency of countries in which some of the Institute's operations are located is not in EC dollars, then the assets and liabilities are translated into EC dollars at the rates of exchange in effect at year-end, and revenue and expenses are translated at average rates. Gains and losses resulting from translation are recorded in the Accumulated Fund.

Transactions in foreign currencies are recorded at the approximate rate of exchange prevailing on the date of the transaction. Gains and losses resulting from foreign currency transactions are recorded in the statement of operations.

Notes to Financial Statements *(Continued)*

3. Summary of Significant Accounting Principles *(Continued)*

(e) Revenue recognition

Government subventions are reported as receivable when awarded. The revenue is recognised as core income in the designated period, which is normally the expected payment date. To the extent these have not been collected, they are reflected in Accounts receivable.

The contributions from external donor agencies for projects are recorded as revenue upon receipt of funds. Undisbursed funds held in project holding bank accounts at year-end are recognised as deferred revenue to the extent that they relate to projects not yet started or where they exceed budgeted expenditure.

(f) Cash and cash equivalents

For the purposes of cash flow statements, cash and cash equivalents comprise cash in hand, deposits held at call with banks and investments in money market instruments, net of bank overdraft.

(g) Trade and other payables

Accounts payable is stated at cost.

(h) Impairment

The carrying amounts of the Institute's assets are reviewed at each balance sheet date to determine whether there is any indication of impairment. If any such indication exists, the asset's recoverable amount is estimated.

(i) Financial instruments

Financial instruments carried on the balance sheet include cash and bank balances, investments, receivables, trade creditors, leases and borrowings. The particular recognition methods adopted are disclosed in the individual policy statements associated with each item.

Notes to Financial Statements *(Continued)*

3. Summary of Significant Accounting Principles *(Continued)*

(j) Provisions

Provisions are recognised when the Institute has a present legal or constructive obligation as a result of past events, it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate of the amount of the obligation can be made.

(k) New Standards and interpretations not yet adopted

At the date of authorisation of the financial statements there were new standards, amendments to standards and interpretations which were in issue but were not yet effective for the year ended December 31, 2007, and have not been applied in preparing these financial statements and are as follows:

IFRS 1	First-time Adoption of International Financial Reporting Standards - Amendments relating to cost of an investment on first-time adoption	January 1, 2009
IFRS 2	Share-based Payment - Amendment relating to vesting conditions and cancellations	January 1, 2009
IFRS 3	Business Combinations - Comprehensive revision on applying the acquisition method	July l, 2009
IFRS 5	Non-current Assets Held for Sale and Discontinued Operations - Amendments resulting from May 2008 Annual Improvements to IFRSs	July 1, 2009
IAS 1	Presentation of Financial Statements – Amendments relating to dislosure of puttable instruments and obligations arising from liquidation	January 1, 2009
IAS 1	Presentation of Financial Statements – Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 16	Property, Plant and Equipment – Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009

Notes to Financial Statements *(Continued)*

3. Summary of Significant Accounting Principles *(Continued)*

(k) New Standards and interpretations not yet adopted (Continued)

IAS 19	Employee Benefits - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 20	Government Grants and Disclosure of Government Assistance - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 23	Borrowing Costs - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 27	Consolidated and Separate Financial Statements - Consequential amendments arising from amendments to IFRS3	July 1, 2009
IAS 27	Consolidated and Separate Financial Statements - Amendment relating to cost of an investment on first-time adoption	January 1, 2009
IAS 27	Consolidated and Separate Financial Statements - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 28	Investments in Associates - Consequential amendments arising from amendments to IFRS3	July 1, 2009
IAS 28	Investments in Associates - Amendments resulting from May 2008 Annual Improvements to IFRS3	January 1, 2009
IAS 29	Financial Reporting in Hyperinflationary Economies - Amendments resulting from May 2008 Annual Improvements to IFRS3	January 1, 2009
IAS 31	Interests in Joint Ventures - Consequential amendments arising from Amendments to IFRS 3	July 1, 2009
IAS 31	Interests in Joint Ventures - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009

Notes to Financial Statements *(Continued)*

3. Summary of Significant Accounting Principles *(Continued)*

(k) New Standards and interpretations not yet adopted (Continued)

IAS 32	Financial Instruments: Presentation - Amendments relating to puttable instruments and obligations arising on liquidation	January 1, 2009
IAS 36	Impairment of Assets - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 38	Intangible Assets - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 39	Financial Instruments: Recognition and Measurement - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 39	Financial Instruments: Recognition and Measurement - Amendments for eligible hedged items	July 1, 2009
IAS 40	Investment Property - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IAS 41	Agriculture - Amendments resulting from May 2008 Annual Improvements to IFRSs	January 1, 2009
IFRIC 12	Services Concession Arrangements	January 1, 2008
IFRIC 13	Customer Loyalty Programmes	July 1, 2008
IFRIC 14	IAS 19- The Limit on a Defined Benefit Asset, Minimum Funding Requirements and their Interaction	January 1, 2008
IFRIC 15	Agreements for the Construction of Real Estate	January 1, 2009
IFRIC 16	Hedges of a Net Investment in a Foreign Operation	October 1, 2008

The adoption of these standards and interpretations are not expected to have a material impact on the financial statements.

Notes to Financial Statements *(Continued)*

4. Cash

a. Cash consists of:

		2007	2006
Core:			
Current Accounts	$	779,810	336,057
Savings Accounts		1,108,977	480,012
Petty Cash		5,869	5,434
Cash in Transit		21,624	137,213
		1,916,280	958,716
Projects:			
Current Accounts		17,800	187,023
Savings Accounts		420,332	235,258
		438,132	422,281
	$	2,354,412	1,380,997

b. Fixed deposits

Fixed deposits consist of:

Core deposits	$	434,978	410,356

c. Bank overdrafts

Bank overdrafts consist of:

Core accounts	$	558,506	494,309

The bank overdraft is secured by a lien over a fixed deposit of $375,652. (2006 -$406,265) at Republic Bank Limited in Trinidad and Tobago.

Notes to Financial Statements *(Continued)*

5. Net Long-term Liabilities

			2007	2006
Net long-term liabilities consist of:		$		
a)	i. Republic Bank Limited (Trinidad & Tobago)		5,691	21,597
	ii. Republic Bank Limited (Trinidad & Tobago)		-	60,421
	iii. Republic Bank Limited (Trinidad & Tobago)		-	10,936
	iv. Republic Bank Limited (Trinidad & Tobago)		62,625	-
	v. Republic Bank Limited (Trinidad & Tobago)		170,536	-
b)	First Caribbean (International) Bank – Belize		-	1,848
c)	S L Horsford & Co. (St Kitts)		29,873	48,714
d)	First Caribbean (International) Bank (Dominica)		7,499	16,126
e)	First Caribbean (International) Bank (St Lucia)		29,562	38,700
f)	National Commercial Bank (St Vincent)		33,824	50,196
			339,610	248,538
Less current portion of long-term liabilities			(143,100)	(142,089)
	Net long-term liabilities	$	196,510	106,449

a) (i) The amount to Republic Bank Limited (Trinidad) (2005-1) is being repaid over thirty-six (36) months of monthly instalment of $1,460 inclusive of interest. The current rate of interest is 11.08% per annum. Loan commence April 2005. The proceeds from this loan were used to purchase a motor vehicle.

(ii) The amount to Republic Bank Ltd. (Trinidad) (2004-1) is being repaid over thirty-six (36) months of monthly instalment of $6,989 inclusive of interest. The current rate of interest was 12.75% per annum. Loan commence October 2004. The proceeds from this loan were used to reduce overdraft on A/C#160127293001 held at Republic Bank Ltd.

(iii) The amount to Republic Bank Ltd. (Trinidad) (2004-2) is being repaid over thirty-six (36) months of monthly instalment of $1,426 inclusive of interest. The current rate of interest is 11.08% per annum. Loan commence October 2004. The proceeds from this loan was used to rsecure a motor vehicle.

(iv) The amount to Republic Bank Ltd. (Trinidad) is being repaid over thirty-six (36) months of monthly instalment of $1,672 inclusive of interest. The current rate of interest is 12.75% per annum. Loan commence January 2007. The proceeds from this loan were used to secure a motor vehicle fo Country Representative, Trinidad and Tobago unit,

Notes to Financial Statements *(Continued)*

5. Net Long-term Liabilities *(Continued)*

a. (v) The amount to Republic Bank Ltd. (Trinidad) is being repaid over Thirty-six (36) months of monthly instalment of $7,298 inclusive of interest. The current rate of interest was 12.75% per annum. Loan commence April 2007. The proceeds from this loan were used to reduce overdraft on A/C#160127293001 held at Republic Bank Ltd.

b) The amount to First Caribbean International Bank (Belize) is being repaid over thirty-six (36) months of monthly instalments of $1,407 inclusive of interest. The current rate of interest is 16% per annum. Loan commence January 2004. The proceeds from this loan were used to secure a motor vehicle.

c) The amount to S.L. Horsford (St. Kitts) is being repaid over seventy-two (72) months of monthly instalments of $1,967 inclusive of interest. The current rate of interest is 15.44% per annum. Loan commence June 2003. The proceeds from this loan were used to secure two motor vehicles.

d) The amount to First Caribbean (International) Bank (Dominica) is being repaid over sixty (60) monthly instalments of $797 inclusive of interest. The current rate of interest is 13% per annum. Loan commence September 2003. The proceeds from this loan were used to secure a motor vehicle.

e) The amount to First Caribbean International Bank (St Lucia) is being repaid over forty (40) months of monthly instalments of $1,064 inclusive of interest. The current rate of interest is 12.5% per annum. Loan commence October 2006. The proceeds from this loan were used to secure a motor vehicle.

f) The amount to National Commercial Bank (St Vincent) is being repaid over forty-eight (48) months of monthly instalments of $1,700, inclusive of interest. The current rate of interest is 12% per annum. Loan commence April 2006. The proceeds from this loan were used to secure a motor vehicle.

Notes to Financial Statements *(Continued)*

6. Non-Government contributions

Non-Government contributions consist of:

	2007	2006
Co-operative Programmes/Technical Assistance		
IICA	$ 291,075	-
CRSP - IPM	71,028	202,656
CTA Workshops and Regional Branch Office	426,894	596,179
Aluminium Partners - Jamaica	9,512	20,270
Other	261,594	165,949
	$1,060,103	985,054

Notes to Financial Statements *(Continued)*

7. Property, plant and equipment

	Leasehold Properties	Buildings	Equipment	Motor Vehicles	Livestock	Total
Cost						
Balance -						
January 1, 2007	$ 627,892	2,470,009	6,792,980	1,603,660	70,492	11,565,033
Additions	-	-	118,259	238,016	-	356,275
Write-off of fixed assets		(107,346)	(6,229,043)	(375,145)	-	(6,711,534)
Disposals	-	-	(522)	(94,416)	-	(94,938)
Gains arising from change in value	-	-	-	-	17,778	17,178
Balance at December 31, 2007	$ 627,892	2,363,663	681,674	1,372,115	88,270	5,132,614
Accumulated Depreciation						
Balance -						
January 1, 2007	$ 125,453	1,209,955	5,893,128	1,285,103	-	8,513,639
Write-off assets	-	(107,346)	(5,514,542)	(375,145)	-	(5,997,033)
Disposals	-	-	(522)	(94,416)	-	(94,938)
Charge for the year	20,909	118,134	8,336	233,512	-	380,891
Balance at December 31, 2007	$ 146,362	1,220,743	386,400	1,049,054	-	2,802,559
Carrying Value						
Balance at December 31, 2006	$ 502,439	1,260,054	899,852	318,557	70,942	3,051,394
Balance at December 31, 2007	$ 481,530	1,141,920	295,274	323,061	88,270	2,330,055

8a.		2007	2006
Accounts receivable			
- Member Governments	$	9,031,231	10,195,362
Less provision for doubtful debts		(7,335,538)	(7,032,038)
	$	1,695,693	3,163,324

Notes to Financial Statements *(Continued)*

8b. Accounts Receivable – Member Governments

Accounts Receivable – Member Governments is stated net of provision for bad and doubtful debts. The debt owed by the Government of Guyana and Antigua is fully provided for at year-end due to its long outstanding nature. The total liability for the Guyana Government as at the balance sheet date is $5,221,969 (2006 - $5,221,969) and Antigua is $1,810,068 (2006 - $1,506,567). However, the Institute is negotiating with both Governments on settlement of these debts.

9. Accounts payable

Included in the accounts payable balance of $837,819 (2006 - $698,989) are overpayments by various Member Governments for contributions amounting to $305,665 (2006 - $232,783).

10. Financial risk management

Overview

The Company has adopted risk management policies and has set appropriate limits and controls to manage and mitigate financial risk. The Company has exposure to the following risks from its use of financial instruments and from transacting business with some of its suppliers on a prepayment basis.

- credit risk
- liquidity risk
- market risk

a} Credit risk

The Company has exposure to credit risk, which is the risk that a counterparty will be unable to pay amounts in full when they fall due. The Company's exposure to credit risk arises primarily from Member Governments' subscriptions and cash holdings at bank. The Company has policies in place to ensure that and investments are with reputable institutions.

(i) Accounts receivable - Member Governments

The Company has formal objectives, policies and processes for managing the risk exposure arising from Member Governments. They rely an these parties to honor their debt in accordance with the CARDI Act and resolutions as per the Board of Governors meetings.

The Company established an allowance for impairment that represents its estimate of incurred losses in respect of Accounts receivable from Member Governments and investments. The allowance for doubtful debts is based on when the Company that the receivable balance is uncollectible.

Notes to Financial Statements *(Continued)*

Financial risk management (continued)

a) (ii) Cash and cash equivalents

The Company limits its exposure to credit risk by only investing in liquid securities and only with counterparties that are licensed under the Banking Act. Management does not expect any counterparty to fail to meet its obligations.

b} **Liquidity risk**

Liquidity risk is the risk that the Company will not be able to meet its financial obligations as they fall due. The Company's approach to managing liquidity is to ensure, as far as possible, that it will always have sufficient liquidity to meet its liabilities when due, under both normal and stressed conditions, without incurring unacceptable losses or risking damage to the Company's reputation. Liquidity risk may result from an inability to sell a financial asset at, or close to, its fair value.

Typically, the Company ensures that it has sufficient cash on demand and marketable securities to meet expected operational expenses including the servicing of financial obligations.

The contractual maturities of financial liabilities measured are at amortised cost

		Carrying Amount	Contractual Cash Flows	1Year or Less	2-5 Years	More than 5 Years
Loan and borrowings	$	339,610	339,610	143,100	196,510	-
Due to employees		40,408	40,408	40,408	-	-
Due to funding agencies		509,177	509,177	46,289	462,888	-
Accounts payable		837,819	837,819	837,819	-	-
Bank overdraft		558,509	558,506	558,506	-	-
December 31, 2007	$	2,285,520	2,285,520	1,626,122	659,398	-

		Carrying Amount	Contractual Cash Flows	1Year or Less	2-5 Years	More than 5 Years
Loan and borrowings	$	248,538	248,538	142,089	106,449	-
Due to employees		56,547	56,547	56,547	-	-
Due to funding agencies		304,922	304,922	-	304,922	-
Accounts payable		698,989	698,989	698,989	-	-
Bank overdraft		494,309	494,309	494,309	-	-
Provision for pension cost		7,009	7,009	7,009	-	-
December 31, 2006	$	1,810,314	1,810,314	1,398,943	411,371	-

Notes to Financial Statements *(Continued)*

Financial risk management (continued)

(c) Market risk

Market risk is the risk that changes in market prices, such as foreign exchange rates, interest rates and equity prices will affect the Company's income or the value of its holdings of financial instruments. The objective of market risk manageruent is to manage and control market risk exposures within acceptable parameters, while optimising the return on risk.

Currency risk

The Company is exposed to currency risk on sales, purchases and borrowings that are denominated in a currency other than the respective functional currency of Company, which is the Eastern Caribbean Authority (EC). The main currencies are the United States dollar (USD), the Jamaican dollar (J), the Barbados dollar (BD), the Trinidad and Tobago dollar (TTD) and the Belize dollar (BZ).

The Company has formal objectives, policies and processes for managing the risk exposure relating to adverse fluctuations in exchange rates.

Exposure to currency risk

The Company's exposure to foreign currency risk at balance sheet date was as follows, based on notional amounts:

Notes to Financial Statements *(Continued)*

Financial risk management (continued)

(c) Market risk (continued)

Balance Sheet Exposure

2007

	EC$	USD	J$	TTD	BZ$	BD$	CDN
Cash and cash equivalents	479,880	665,407	571,613	21,279	72,482	543,751	-
Fixed deposits	-	-	3,713	431,264	-	-	-
Bank overdrafts	(12,036)	-	-	(546,469)	-	-	-
Accounts payable and accrued liabilities	(35,890)	*	(12,955)	(325,803)	(21,707)	(35,799)	-
Due to the University	-	-	-		-	-	-
of theWest Indies	-	-	(825,753)	-	-	-	-
Due to funding agencies	-	-	-	-	-	-	(509,177)

2006

	EC$	USD	J$	TTD	BZ$	BD$	CDN
Cash and cash equivalents	340,604	559,822	356,263	15,492	19,486	89,330	-
Fixed deposits	-	-	3,735	406,621	-	-	-
Bank overdrafts	(515)	-	-	(493,794)	-	-	-
Accounts payable	-	-	-	-	-	-	-
and accrued liabilities	(19,736)	-	(111,116)	(279,406)	(3,104)	(52,934)	
Due to the University							
of the West Indies	=	=	-	(724,856)	-	-	-
Due to funding agencies	-	-	-	-	-		-(304,922)

Notes to Financial Statements *(Continued)*

11. PAYE and Health Surcharge

As at year-end, there is an amount of $203,945 (2006 - $203,945) of unpaid PAYE and Health Surcharge to the Board of Inland Revenue in Trinidad and Tobago. In accordance with Section 99(4) of the Income Tax Act of Trinidad and Tobago, these unpaid amounts attract a penalty of 100% and interest.

12. Due to funding agencies

	2007	2006
Due to funding agencies	$ 509,177	304,922
Less: Current portion of due to funding agencies	(46,289)	-
Net long-term portion due to funding agencies	$ 462,888	304,922

The Canadian International Development Agency (CIDA) has requested payment from CARDI of an amount of $509,177 (CDN$189,822) in respect of the Caribbean Sheep Production and Marketing Project (255/12723) for the period June 1990 - 1996. This was a result of CARDI not being able to provide a clear audit trail between the entity accounts and the claims submitted to CIDA.

Based on correspondence from CIDA dated March 13, 2008, CIDA has proposed the following settlement terms:

a) CIDA will waive the accrued interest on the principal as long as CARDI covers the commission of the collection agency.

b) CARDI will pay 10% of he principal and collection agency commission by March 31, 2008, and

c) The remaining 90% over the next two year period 45% in February 2009 and the remaining 45% in February 2010.

The Institute has complied with (b) above and clause (c) is currently being negotiated with the donor agency.

Notes to Financial Statements *(Continued)*

13. Contingencies

(a) The United States of America Agency for International Development has issued a bill for collection on July 30, 1996 for the amount of $2,310,518 (US$859,504) in respect of the West Indies Tropical Produce Support Project for the period July 1, 1991 to December 31, 1994. This was as a result of the sub-grant to Caribbean Agricultural Trading Company since accounting records were not available for audit. The bill of collection was issued to both the Institute and the Organisation of Eastern Caribbean States, since they were jointly and severally liable for the funds. This debt is being discussed with USAID by Caricom Secretariat on behalf of CARDI with a view to settlement.

Schedule 1

Office and Administration

For the year ended December 31, 2007
(Expressed in Eastern Caribbean Authority dollars)

		2007	2006
Office and administration costs			
Bank interest charges	$	144,522	99,834
Insurance		27,925	33,647
Computer Supplies		55,399	86,134
Rental and repairs			
- Office equipment		10,428	11,067
- Building		119,342	122,913
Utilities		225,495	243,795
Legal and professional		524,705	433,529
Other office administration cost		408,945	250,351
Communication services		13,574	7,753
Information services		18,426	16,775
	$	1,548,761	1,305,798

Directorate

Board of Governors

Honourable Ezechiel Joseph	Chairman, St Lucia
Honourable Charlesworth Samuel	Antigua and Barbuda
Honourable Erskine Griffith	Barbados
Honourable Vildo Marin	Belize
Honourable Dr John Colin McIntyre	Dominica
Honourable Gregory Bowen	Grenada
Honourable Robert Persaud	Guyana
Honourable Roger Clarke	Jamaica (*January–August*)
Honourable Dr Christopher Tufton	Jamaica (*September–December*)
Honourable Margaret Dyer-Howe	Montserrat
Honourable Cedric Liburd	St Kitts and Nevis
Honourable Montgomery Daniel	St Vincent and the Grenadines
Honourable Jarette Narine	Trinidad and Tobago

Board of Directors

Dr Keith Archibald	Chairman (*January–August*)
Dr Richard Harrison	Chairman (*September–December*)
Mr Donald Edwards	Antigua and Barbuda
Mr Barton Clarke	Barbados
Mr Jose Castellanos	Belize
Ms Claudia Bellot	Dominica
Ms Lana McPhail	Grenada
Dr Dindyal Permaul	Guyana
Mr Donovan Stanberry	Jamaica
Mr Eugene Skerritt	Montserrat
Dr Hermia Morton-Anthony	St Kitts
Mr Pearlievan Wilkin	Nevis
Mr Martin Satney	St Lucia
Mrs Cheryl Biddy	St Vincent and the Grenadines
Ms Philippa Forde	Trinidad and Tobago
Ms Desiree Field-Ridley	CARICOM Secretariat
Dr Theodosius Velloza	University of Guyana, Guyana
Professor Dyer Narinesingh	The University of the West Indies (*until August*)
Mr Luther St Ville	Caribbean Development Bank
Dr Wendel Parham	Executive Director (*January–March*)
Mr Bruce Lauckner	Executive Director (*March–September*)
Dr H Arlington D Chesney	Executive Director (*October–December*)
Mr Aaron Parke	Inter-American Institute for Cooperation on Agriculture (IICA)
Dr Barbara Graham	Food and Agriculture Organisation of the United Nations, (FAO)
Dr Hansjorg Neun	Technical Centre for Agricultural and Rural Co-operation (CTA)

Members of Staff

Senior management

Adams, Herman. MSc	Consultant, Planning and Development
Ali, Farzan. MBA	Human Resource Manager
Chesney, H. Arlington, D. PhD	Executive Director (*from October 2007*)
deFreitas, Claudette. MLIS	Information Resources Manager
Hutchinson, Maxine. MBA	Human Resource Manager (*until September)*
Iton, Ardon. PhD	Head Marketing Unit
King, Selwyn. BSc	PR and Communications Manager
Lauckner, Bruce. BSc, C.Stat.	Research and Development Manager (Ag.)
Nero, Curtis. ACCA	Accountant
Parham, Wendel. PhD	Executive Director (*to March 2007*)
Wilson, Maurice. MSc	Agribusiness Development Specialist

Other professional staff

Andall, Reginald. MSc	Technology Transfer	Grenada
Asiedu, Francis. PhD	Animal Science,	Jamaica
Clarke-Harris, Dionne. MPhil	Entomology	Jamaica
Dalip, Kathy. PhD	Entomology	Belize
Fearon, Albert. MSc	Technology Adaptation	Jamaica
Gibson, Norman. MPhil	Animal Science, Head T&T Unit	Trinidad and Tobago
John, Michelle. MSc	Animal Scientist	Trinidad and Tobago
Lawrence, Janet. PhD	Entomology	Jamaica
McAndrew, Neville. MSc	Agronomy	Belize
Morris, Opal. BA	Librarian	Trinidad and Tobago
Paulraj, Litta. PhD	Tissue Culture	Barbados
Pilgrim, Ronald. MSc	Post harvest, Technology	St Lucia
Petersen, Joan. BSc	Agronomy	Trinidad and Tobago
Rhodes, Llewellyn. MPhil	Entomology,	St Kitts and Nevis
Robin, Gregory. MPhil	Agronomy, CR	Dominica
Ross, Julius. MSc	Horticulture, CR	Antigua and Barbuda (*until September 2007*)
Roberts, Cyril. PhD	Biotechnology	Barbados
Scantlebury, Collin. MSc	Tissue Culture	Barbados
Simpson, Leslie. PhD	Soil Science	Jamaica
Sinha, Anil. MSc	Agronomy, CR	Belize
Sieunarine, Simon. MBA	Assistant Accountant	Trinidad and Tobago
Titus Pathleen. MPhil	Agronomy	St Vincent and the Grenadines
Williams, Dwight. MSc	Scientist 1	Jamaica (*until Feb. 07)*

Technical staff

Antigua and Barbuda	
Adams, Sylvester	Field Assistant
Batchelor, Delvin	Technical Assistant
Bowman, Donnet	Administrative Assistant *(from Oct. 2007)*
Browne, Bradbury	Field Assistant
Josiah, Carol	Laboratory Assistant (*from Dec. 2007*)
Matthews, Kimberley	Administrative Assistant (*up to Sept. 2007*)
Barbados	
Best, Paul	Field Assistant (*from Dec. 2007*)
Forde, Morreen	Secretary
Niles, Marcia	Administrative Assistant
Pollard, Ashton	Senior Laboratory Assistant
Waithe, Jennifer	Laboratory Assistant (*from Dec. 2007*)
Wood, Barbara	Laboratory Assistant
Belize	
Garcia, Angel	Watchman
Lindo, Martin	Technician
Reynolds, Tenesha	Clerical Assistant
Reyes, Hector	Graduate Assistant *(from Oct. 2007)*
Tzib, Cornello	Technician (*from April 2007*)
Dominica	
Corriette, Lucille	Administrative Assistant
Etienne, Dorian	Technician
St Luce, Mervin	Research Assistant (*from Jan. 2007*)
Grenada	
Bruno, Janelle	Administrative Assistant
Raymond, Reuben	Technical Assistant
Jamaica	
Asiedu, Elizabeth	Accounts Clerk
Barnes, Ralston	Technical Assistant
Brown, Maxine	Research Assistant (*until Sept. 2007*)
Davis, Winsome	Accounts Clerk
Gordon-Sangster, Andrea	Secretary
Hanson, Norman	Farm Supervisor
Jones, Desmond	Technical Assistant
Powell, Sandra	Receptionist
Maxwell, Ervin	Agricultural Labourer
McDonald, Lloyd	Expeditor/Driver
Morris, Erna	Accounting Assistant

Jamaica .(*continued*)

Robinson, Kenrick	Technical Assistant
Samuels, Paul	Technical Assistant (*until Oct. 2007*)

Montserrat

Murraine, Robert	Technician

St Kitts and Nevis

Browne, Roderick	Field Assistant
Farier, Austin	Senior Technician
Knight, Laurence	Technician
Samuel, Samantha	Administrative Assistant

St Lucia

Auguste, Gabriel	Field Assistant
Frederick, Sylvester	Field Station Supervisor
O'Brien, Sharon	Administrative Assistant
Thomas, Jacob	Field Assistant

St Vincent and the Grenadines

Baptiste, Lauron	Technician
Gittens, Avelyn	Administrative Assistant

Trinidad and Tobago Unit

Hosein, Ansari	Technician
Hudson, Rachel	Clerk (*from Oct. 2007*)
Leith, Hendrickson	Administrative Assistant
Mohammed, Kadeem	Technician
Quashie, Selby	Technician
St George, Paula	Secretary (*until May 2007*)

Headquarters

Abraham-King, Shelly	Accounting Assistant
Baptiste, Marva	Accounting Assistant
Basdeo, Krishna	Messenger/Driver
Basssant, Ramsaran	Office Assistant/Driver
Besai, Denise	Graduate Assistant
Butler, Sharmin	Kitchen Attendant
Brathwaite, Laticher	Information Assistant
Christo, Trevor	Production Assistant (*until Oct. 2007*)
Cruickshank, Karel	Personnel Clerk
Daly, Cyndi-Anne	Administrative Secretary (*from Nov. 2007*)
Dookie-Hamil, Rajdaye	Accounts Clerk
Dubarry, Candice	Supervisor Printing Services (*until Nov. 2007*)
Hamilton, Elizabeth	Administrative Secretaryt
Hart, Abegail	Junior Accounting Assistant
Johnson, Christian	Graduate Assistant (*from September*)

Headquarters *(Continued)*

Jones, Marcus	Statistical Assistant
Kalloo, Leslie-Anne	Senior Accounting Assistant
Maharaj, Debra	Executive Assistant
Mohammed, Anesia	Administrative Secretary (*until Nov. 2007*)
Redhead, Margaret	Administrative Secretary
Roach, Keith	Production Assistant
Shand, Leigh	Information Assistant
Wilson, Hazel	Senior Administrative Secretary

Contact Information

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