



Annual Report 2003

Caribbean Agricultural Research and Development Institute 2004

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Acronyms and Abbreviations

ACP	African, Caribbean and Pacific Group of States
AEZ	Agro-ecological Zones
AIAEE	Association for International Agricultural Extension Education
CABA	Caribbean Agribusiness Association
CaFANN	Caribbean Farmers and NGO Network
CAFP	Caribbean Agriculture Fisheries Programme
CAIS	Caribbean Agricultural Information Service
CAMID	Caribbean Agribusiness Marketing Intelligence and Development
CAPGERNET	Caribbean Plant Genetic Resources Network
CAPHNET	Caribbean Postharvest Technology Network
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CARIFORUM	Caribbean Forum of African, Caribbean and Pacific (ACP) States
CARIFRUIT	Caribbean Fruit Network
CARINET	Caribbean Biosystematics Network
CARIVEG	Caribbean Vegetable Network
CAROT	Caribbean Roots and Tubers Network
CARTF	Caribbean Agricultural Research and Training Fund
CASRUNET	Caribbean Small Ruminant Network
CBB	Coffee Berry Borer
CDB	Caribbean Development Bank
CEDAF	Centro para el Desarrollo Agropecuario y Forestal
CEPEC	Caribbean Regional Human Resource Development Program for Economic Competitiveness
CFCS	Caribbean Food Crops Society
CIB	Coffee Industry Board
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Center
CIPMNET	Caribbean Integrated Pest Management Network
CIRAD	Agricultural Research for Developing Countries
CLAWRENET	Caribbean Land and Water Resources Network
CMS	Centre of Marine Sciences (Jamaica)
COL	Commonwealth of Learning
COTED	Council for Trade and Economic Development
CPA	Caribbean Poultry Association
CRFM	Caribbean Regional Fisheries Mechanism
CRIDNET	Caribbean Rice Industry Development Network
CRHPVT	Caribbean Regional Hot Pepper Varietal Trail
CRSP	Collaborative Research Support Programme
CTA	Technical Centre for Agricultural and Rural Cooperation
CWA	Caribbean Week of Agriculture

DEXIA	Dominica Export Import Agency
DFID	Department for International Development (United Kingdom)
DNA	Deoxyribose Nucleic Acid
DTC	Demonstration and Training Centre
EC	Eastern Caribbean
ECTAD	Eastern Caribbean Trading and Agricultural Development
ETL	Economic Threshold Level
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FORAGRO	Regional Forum for Research in Agriculture
GARD	Gilbert Agricultural and Rural Development (center in Antigua and Barbuda)
GECAES	Global Environment Change and Food Systems
HDTTC	Hounslow Demonstration and Training Centre
ICT	Information and Communications Technologies
IICA	Inter-American Institute for Cooperation on Agriculture
ILRI	International Livestock Research Institute
IMPP	Integrated Management of Pests and Pesticides
IPM	Integrated Pest Management
ISNAR	International Service for National Agricultural Research
IT	Information Technology
KIT	Royal Tropical Institute
LAN	Local Area Network
LDC	Less Developed Country
MALMR	Ministry of Agriculture, Land and Marine Resources (Trinidad & Tobago)
MDC	More Developed Country
MOU	Memorandum of Understanding
MRAG	Marine Resources Assessment Group Ltd. (UK)
NCC	National Coordinating Committee
NGO	Non Government Organisation
NIPPA	Nature Isle Pineapple Producers Association
NNC	National Network Committee
NRM	Natural Resource Management
NSRDP	National Small Ruminant Development Plan
OIRSA	Organismo Internacional Regional de Sanidad Agropecuaria
PSC	Publications and Seminars Committee
PCCMCA	Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios
PRIME	Project Review, Implementation, Monitoring and Evaluation Unit
PROCICARIBE	Caribbean Agricultural Science and Technology Network System
QAS	Question and Answer Service
RAPN	Regional Agricultural Policy Network
RBOC	Regional Branch Office in the Caribbean (of the CTA)
R&D	Research and Development
R&T	Research and Training

RFSP	Regional Food Security Project
RIMS	Regional Integrated Marketing Development Strategy
RNA	Ribo Nucleic Acid
RTP	Regional Transformation Programme
RUNetwork	Rural Universe Network
SIDALC	Agricultural Information and Documentation System of the Americas
SLREP	St Lucia Rural Enterprise Project
SMDTC	Small Ruminant Demonstration and Training Centres
SNP	School Nutrition Programme
S&T	Science and Technology
UK	United Kingdom
USA	United States of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UWI	The University of the West Indies
VDL	Veterinary Diagnostic Laboratory
WTO	World Trade Organisation
ZADI	German Centre for Documentation and Information

Introduction

- Message from the Board of Directors



Dr Keith Archibald

After almost four very difficult years when the future of the Caribbean Agricultural Research and Development Institute (CARDI) lay in the balance, the year 2003 saw a distinct improvement in the fortunes of the institute. The management of CARDI was striving quite hard to take the institute to a new level or “new dimension” as envisaged in the report of the Small Multidisciplinary Independent Team led by Dr. Carlos Aquino. The approval of the recommendations of the report by the Conference of Heads of Government of CARICOM (CHOG) was followed by a decision of the Intersessional Conference of CHOG in February 2003 to provide EC\$2,912 million from arrears owed by Governments to meet outstanding liabilities to the staff and creditors of the institute.

CARDI continues to pursue its role in repositioning the agricultural sector of the CARICOM Region. But, the institute needs to regain its position as the premier regional agricultural research and development (R & D) institute and as a centre of excellence. It remains the Lead Agency under the CARICOM Regional Transformation Programme (RTP) for Technology Generation, Validation and Transfer and for Marketing Development, Integrated Production and Marketing Programmes. Three commodities were specifically identified under the RTP for industry development by CARDI: hot pepper; sweet potato and small ruminants. These commodities identified are geared to supply regional demand, and also to look at niche marketing opportunities for export. Thus, in addition to production, value-added and marketing are important elements in the food chain.

With its new vision, CARDI is attempting to return to placing greater emphasis on R & D technologies but in a market-driven way. It is expected that this would enhance the competitiveness of the agri-food sector in the CARICOM Region. Thus, CARDI’s major challenge is to provide effective support to the Ministries of Agriculture, agri-entrepreneurs and agro-processors in order to accelerate the process of technological change fitting in with the R & D needs of each CARICOM member country. Recent years have seen significant changes in the global trade environment as a result of the new World Trade Organisation (WTO) rules that have had a negative impact on the region’s major traditional export commodities, and it is now necessary to move in new and different directions.

The Chairman of the CARDI Board of Directors, Dr. Keith Archibald, was given another three year term by the CARDI Board of Governors, providing a measure of continuity for the institute. As strongly recommended by the Aquino Team’s report, a substantive Executive Director was energetically sought who is expected “to guide and empower the institute” and to mobilise its stakeholders and the needed resources for the transformation of the institute in keeping with the new vision. The CARDI Board of Governors made the selection of Dr. Wendel Parham, an agricultural economist from Belize, to be the new Executive Director

for a three-year term from 1 January 2004. It is expected that when the new Executive Director assumes office, he will make every effort to also promote CARDI's image as a centre of excellence.

The Inter-American Institute for Co-operation on Agriculture (IICA) continues to work closely with CARDI in executing its programmes and projects for the development of the region's agri-food sector. In a new co-operation agreement between IICA and CARDI, IICA will *inter alia*, assist CARDI with meeting the salary of the new Executive Director for two years. The Technical Centre for Agricultural and Rural Co-operation (CTA) in the Netherlands has continued its close association with CARDI in improving its information and communications capability, and CARDI still has responsibility for the operation of the CTA Regional Branch Office in the Caribbean (RBOC).

The Food and Agriculture Organisation of the United Nations (FAO) will collaborate more closely with CARDI in strengthening its Information and Communications Unit, and also in establishing an effective Project Development and Implementation Unit. These units should help to boost CARDI's delivery of R & D services. FAO will also locate the Water Management/Irrigation Specialist and the Trade Facilitation Specialist on its Regional Food Security Project (RFSP) at the CARDI headquarters in Trinidad, and it is expected that there will be some benefit to CARDI from this arrangement.

A new contribution formula for the payment of member Government contributions to CARDI in respect of its annual core budget was approved by the CHOG. Although the core budget remains unchanged under the new contribution formula, the larger countries (or so-called MDCs) will pay less and the smaller countries (or so-called LDCs) will pay more than in the past. This agreement will thus provide some much-needed relief to the larger countries that have been bearing the brunt of the core budget.

Finally, the Board of Directors of the institute is extremely grateful and deeply appreciative of the efforts of the staff during the period of its difficulties for their dedication and conscientiousness in serving the agri-food sector of the region especially in these globalised times as the institute focused on the re-positioning of the region's agricultural sector. The Board of Directors of CARDI is also deeply appreciative of the support and consideration of the CARDI Board of Governors in its struggle to keep the CARDI ship afloat, and expresses hope for a much-improved CARDI in the not-too-distant future.

Dr. Keith Archibald
Chairman
CARDI Board of Directors

Research for Development

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- Country and Regional Programmes
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 - Traditional Crops
- Organic Crop Production
 - Small Ruminants
- Natural Resource Management
- Whitefly and Whitefly Transmitted Geminiviruses

Country Summaries

The following is a very brief summary of activities and projects conducted in each of CARDI's country units in the Caribbean Community (CARICOM) during 2003. These summaries provide an overview of the various initiatives and activities within specific Member States of the Community.

Antigua and Barbuda

For many years, the CARDI unit in Antigua and Barbuda has produced seeds of the hot pepper varieties West Indies Red and West Indies Yellow. During 2003, seeds of the new Caribbean CARDI Green cultivar were added to the seed production programme. Seeds of forage legumes were also produced. Technical assistance was given to local farmers in breadfruit and in pineapple. Assistance to agribusiness entrepreneurs included post-harvest research and training into quality control systems for herbs and spices; small ruminant entrepreneurs were trained in production, meat cuts, tanning and leather craft.

Barbados

Barbados is the centre for CARDI's hot pepper breeding programme and yield trials have been initiated here and in several other member states to compare CARDI developed cultivars, established commercial varieties and some Caribbean landraces. The CARDI Barbados unit continued its Integrated Pest Management (IPM) services to the sugar industry in Barbados; the moth borer infestation level remained below the threshold for the damage to be economically detrimental to the industry. Another aspect of support to the sugar industry has been research to develop management strategies to control sugar cane ratoon stunting disease. CARDI's biotechnology work was also co-ordinated from Barbados with the Barbados CARDI Country Representative being the Chairman of the CARICOM appointed Regional Biotechnology Committee.

Belize

The CARDI unit in Belize has been responsible for seed multiplication and commercial seed production of cereals and grain legumes to supply commercial farmers in the country. The specific commodities for which seeds have been produced include yellow and sweet corn, chickpea, cowpea, mungbean, peanut, pigeon pea and soybean. In addition, the Belize government's new commodities initiative was supported by multiplication of germplasm for two chaya accessions. Another important government initiative support-

ed by providing seeds was the soybean project. The unit also gave support to an FAO Telefood post-harvest grain storage project. Under the European Union CARTF project, CARDI was the Research and Training (R & T) provider to several agribusiness enterprises in Belize.

Dominica

Research work in dasheen continued and the CARDI Representative in Dominica was elected to the Board of the International Society for Tropical Root Crops. Research results have identified the time period to harvest, after planting, to achieve the optimum yield for the manufacture of dasheen chips. Research with the Smooth Cayenne pineapple cultivar produced results that will allow producers to make predictions as to the yield and quality of harvest. Another commodity on which research produced results was yam; the causes of yam hol- lowing were investigated and a management strategy for yam anthracnose was being developed.

Grenada

The seedling nursery at CARDI's Westerhall Demonstration and Training Centre produced large quantities of vegetables and hot pepper seedlings for the local farming industry. This facility generated income for CARDI and more importantly, generated income for local farmers; over \$80 was estimated to be earned by farmers for each \$1 they pay for seedlings. The total economic impact of the nursery was over EC\$5 million. Research aimed at dwarfing trees which produce large golden apples resulted good yields from second-year re-growth of topped grafted trees. Technical information was supplied to local farmers on a wide range of subjects and commodities. The casual agent of the disease, which caused wilting in nutmeg trees, was identified. Post har- vest research in jams and jellies, made from sapodilla, was initiated.

Jamaica

The Sam Motta Demonstration and Training Centre (SMDTC) was maintained with funding from the bauxite company ALPART Mining Ventures. This centre operated on reclaimed bauxite lands to demonstrate small ruminant production and marketing and transfer the technology to farmers. At the Hounslow Demonstration and Training Centre (HDTTC), CARDI worked with the Ministry of Agriculture in research on forages and feeding for small ruminants. CARDI's contract with the Coffee Industry Board, to control the coffee berry borer by biologi- cal methods, ends in 2004; parasitoids were reared and released and data collected on the pest and para- sitoids infestations at the release sites. Another plant protection project due to terminate in 2004 is the Integrated Pest Management Collaborative Research Support Programme (IPM CRSP) project of which CARDI, Jamaica is the Caribbean Centre. This has generated, tested, transferred and validated IPM technolo- gies for a range of crops. CARDI also provided entomology services for the management of the Brown Citrus Aphid as part of the Jamaica Government's Citrus Replanting Project. Soil and water management studies have developed strategies for the management of vulnerable and marginal soils and closely related to this work has been the development of organic farming systems for Jamaica.

Montserrat

Volcanic activity continued to make fieldwork in this island quite difficult. Joint work with the Ministry of Agriculture was striving to develop the local cassava industry. The CARDI technician resident in Montserrat also gave support to the national extension and quarantine services and assisted in the volcano damage assessment and task force.

St Kitts and Nevis

Integrated Pest Management (IPM) interventions have been successful in reducing insect infestation and damage for several crops including yam, sweet potato and papaya. Sweet potato variety trials were conducted and considerable technical assistance was given to farmers, the Ministry of Agriculture and other stakeholders.

St Lucia

The year 2003 saw the completion of the St Lucia Rural Enterprise Project (SLREP) for which CARDI was responsible for technical intervention in land resource management. The Dennery Demonstration and Training Centre provided farmers with planting material and demonstration plots; income was generated from the sale of planting material. CARDI's representative in the country has expertise in post-harvest technology; in this regard washing equipment for fruit was provided to the St Lucia Marketing Board, two hot water treatment facilities were developed for exporters and many hoteliers were trained in selection and storage of fresh fruits and vegetables. A very successful project to develop the local rabbit industry was completed and there were also projects for the development of agribusiness in the production of cut flowers and juice concentrates.

St Vincent and the Grenadines

CARDI's regional effort in sweet potato development was led from St Vincent and the Grenadines. A survey of producers revealed that the sweet potato grub was the major constraint to production. An IPM programme targeting all pests and diseases of sweet potato will be developed. Research continues into banana planting density under irrigated conditions. Support was given to the Ministry of Agriculture in the national crop diversification effort and in the development of the arrowroot industry.

Trinidad and Tobago

In 2003, work in small ruminant development in the country focused on the areas of animal health and promotion of improved forage species. In this regard a survey, in collaboration with the Ministry of Agriculture, Land and Marine Resources (MALMR), IICA and the University of the West Indies (UWI), was carried out to determine the prevalence of Johne's Disease in small ruminants. In addition mulberry plants were distributed to farmers and livestock stations in Trinidad and in Tobago; farmers were encouraged to integrate mulberry into the feeding systems for both small ruminant and dairy cattle. Trinidad and Tobago was also the centre for CARDI's organic farming development; technical assistance in organic farming was given to several farmers and farming organisations. In Tobago at the Goldsborough Demonstration and Training Centre, several cash crops were evaluated to determine cost-effective production and marketing systems for the island's farmers. As part of CARDI's support for agribusiness development, assistance is being given to stabilise pumpkin and hot pepper landraces.

Hot Pepper

Hot Pepper (*Capsicum chinense* Jacq.)

In 2003 CARDI initiated a regional project on hot pepper improvement for the Caribbean known as the Caribbean Regional Hot Pepper Varietal Trial (CRHPVT). The objectives of the trial included evaluating production, marketing and processing of fresh fruits harvested from advanced accessions compared to a popular local variety. Activities focused on the production of new and improved varieties of hot pepper for the Caribbean through the development of breeding lines extracted from the cultivar, West Indies Red; purification and stabilisation of Caribbean hot pepper landraces, and the development of recombinant inbred lines (RILs) from the cross Scotch Bonnet x Bird Pepper.

Three breeding lines were advanced to the S₇ generation during 2003, thereby achieving high levels of uniformity and stability to permit evaluation in comparative trials with established varieties. The breeding lines were temporarily labelled CARDI Green, CARDI Red and CARDI Purple. Two of the breeding lines, CARDI Green and CARDI Red were selected to be part of the Caribbean regional hot pepper varietal trial.

The process of the genetic purification and stabilisation of 10 Caribbean hot pepper landraces (hot pepper biotypes which originated in the Caribbean) was started in 1997. By the year 2003 they were in the seventh generation of selfing with a high degree of uniformity and stability having been achieved in these landraces.

The following landraces were selected and included in the regional varietal trial (CRHPVT): Red Congo, Tiger Teeth, Touvin, Cayenne and Red Flat. A total of 565g S₇ seed was produced which was adequate to meet the needs of the CRHPVT. In Antigua and Barbuda commercial hot pepper

seed of West Indies Red and Yellow was produced in 2003. CARDI Green was introduced into the seed production programme for the first time. Seed production activities in Antigua and Barbuda were constrained due to the lack of resources; this should be addressed in the future.

The hot pepper industry in Belize was based on the production and marketing of fresh fruit and processed products of *Capsicum chinense* hot peppers, locally referred to as Habanero peppers, and has been evolving from around the mid-1990's into a relatively diverse industry.

Production for the export of fresh fruit was the main activity in the Belize Hot Pepper Industry. West Indies Red was the main variety produced for fresh fruit export with other important varieties being Yellow Scotch Bonnet, and Orange Habanero. The CARDI Belize unit was the distributor of seed of West Indies Red and Yellow Scotch Bonnet while local commercial seed supplier's sold seed of Caribbean Red and Orange Habanero. However, West Indies Red hot pepper seed was generally imported from CARDI Antigua and Barbuda. The seeds were repackaged in Belize and sold after germination tests were conducted to confirm quality.

Previous initiatives by the Belize unit in collaboration with the Ministry of Agriculture and Fisheries had resulted in the successful development of technologies for the commercial production of hot pepper seed. These initiatives, considered to be the foundation for the development of the local hot pepper seed industry, had been constrained by the shortage of financial resources to increase the unit's seed production acreage and/or purchase fruits from selected seed growers, and to acquire necessary equipment to improve the physical quality of the seed produced. CARDI's overall financial position precluded any increase in seed production/fruit purchase and purchase of the seed blower. However, the requisite equipment was acquired in 2003 when the Ministry of Agriculture



Hot Pepper

and Fisheries through funding from Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) provided the unit with a South Dakota Seed Blower. The equipment efficiently removed higher percentages of light seed and foreign matter from the seed lots resulting in improved germination, vigour and overall quality of the seed.

Other participating countries in the Caribbean regional hot pepper varietal trial (CRHPVT) during 2003 included CARDI Dominica, St Lucia, Trinidad and Tobago and Grenada.

The CARDI Grenada unit continued to be part of the national hot pepper task force by providing technical advice and support to the development of the hot pepper industry.

The CARDI unit in St Vincent and the Grenadines worked with the Marketing Corporation and the Mission Taiwan to introduce two new varieties, Fresno and Santa Fe Grande, in an attempt to diversify its hot pepper germplasm and respond to the market demand. Participation in the CRHPVT was scheduled to commence during 2004.

A notable viable hot pepper industry is in Jamaica where the preferred variety for cultivation is the Scotch Bonnet. This industry is viable both on the local and export markets with a wide range of seasonings and sauces stemming from Scotch Bonnet production. The Scotch Bonnet cv. however, is very susceptible to numerous pests and diseases such as broad mite, gall midge and viruses and their aphid vectors. The CARDI selection, West Indies

Red, was promoted in Jamaica to help stabilise production levels since it demonstrated a high tolerance especially to the debilitating Tomato Etch Virus. In Jamaica, the role of this cultivar is widely accepted and appreciated among stakeholders in the industry.

Collections of two distinct gall midge species (one a fruit pest and the other a flower pest) were made from hot pepper fields in Jamaica and sent to Pennsylvania State University for identification. Hot peppers exported to the USA from Jamaica require mandatory fumigation to prevent the entry of a *Contarinia* species that US taxonomists have indicated to be one of the species on the peppers. However, efforts to confirm the taxonomic classification through biosystematics failed. Therefore, the development of molecular tools to distinguish between species in the cryptic gall midge complex was initiated to facilitate rapid and confirmatory diagnosis of the presence of each species. This work will continue.

In tandem with the effort to apply biotechnological methods to solve problems, two Caribbean scientists completed training techniques in molecular biology during a 2-week intensive course at Pennsylvania State University.

Topics included DNA/RNA purification, restriction enzymes, labelling probes, southern blotting and hybridisation, plasmid isolation and cloning, DNA sequencing, polymerase chain reaction and protein immunodetection by western blotting.

Root Crops

Sweet Potato (*Ipomoea batatas*)

CARDI has been mandated to provide technical leadership in the development of a regional sweet potato industry under the CARICOM Regional Transformation Programme (RTP) for agriculture. Research activities in St Kitts and Nevis reflected a



Sweet potatoes damaged by the whit grub (*Phyllophaga* sp.).

response to the regional mandate as well as to local priorities. The development of collaborative linkages and preparation of a regional sweet potato project was seen as a major activity for the Institute. CARDI Representatives from St Vincent and St Kitts and Nevis visited the International Potato Center (CIP) in Peru. The objective of this visit was to initiate inter-institutional collaboration in the development of the regional sweet potato industry and explore possible areas of collaboration and the modalities to activate such collaboration.

Work in St Vincent and the Grenadines was done to evaluate selected varieties for market acceptance, yield and resistance/tolerance to pest and diseases. In addition, a baseline survey was conducted to document pest incidence and pest management practices for *Euscepes* sp. Planting material from 21 varieties of sweet potato was collected and evaluated at the CARDI field station during the year. Some of these varieties were named after the area from which they were collected since the farmers were unable to provide the local name of the accessions. Based on market demand in the country the most acceptable varieties were the red skinned, white fleshed ones e.g. Black Vine and Big Red with the least acceptable being the carrot coloured Lover's Name. This variety was however one of those demanded by the export market. Further plans involved the replanting of the varieties in an attempt to identify them using the varietal catalogue of sweet potato in St Vincent and the Grenadines developed by Gunsam 1995.

A baseline survey to document pest incidence and pest management practices for *Euscepes* sp. was also conducted in St Vincent and the Grenadines as part of an Integrated Pest Management (IPM) system development which is a research activity of the Caribbean site of IPM CRSP based in Jamaica. A survey to determine the status (absence/presence) of *Cylas formicarius* was also conducted. Twenty-five weevil pheromone traps were located in the north-eastern part of the country and were being monitored. The survey, conducted with the assistance of the Extension Division of the Ministry of Agriculture, also examined the demographics of the sweet potato farmer (gender, reason for production, years in production), farm size, varieties, source of planting material, crop nutrition, pest and disease incidence, harvesting and yield.

At least 16.2% of the persons interviewed indicated that they had no pest problems, while damage by the white grub (*Phyllophaga* sp.) was identified by 53.5% of the farmers making it the pest of greatest economic importance to sweet potato farmers in St Vincent and the Grenadines. Rats were also identified by 50.5% of the respondents as causing damage.

Chemical controls for these grubs are non-existent in the production system even though it was known that some form of control is needed. Leaf spots and weeds were insignificant problems. Chemicals were mostly used when pest damage was observed and on the advice of extension officers or friends.

Since the survey results showed that the major pest problem was the white grub (*Phyllophaga* sp.) and not *Euscepes* sp. there is a need to focus on IPM management for the white grub. A trial was planned both in the wet and dry seasons, using three export varieties and three chemicals to assess tolerance and effects of the insecticides on the white grub. Communication with extension officers and farmers has been established.

Sweet potato is an important root crop to St Kitts and Nevis. The crop is grown both for food security and market potential, however, its production is limited by a number of pests the most serious of which is the sweet potato weevil, *Cylas formicarius*. This pest can damage up to 75% of marketable size roots. Other pests such as *Euscepes* in Nevis, white grub, other rootworms, tingid bugs and beetles caused sporadic damage. Pest management was also sporadic and largely controlled through cultural practices.

CARDI conducted an evaluation on 10 lines of sweet potato for tolerance to the sweet potato weevil, *Cylas formicarius*, at the Institute's DTC. Both the crowns and roots were evaluated for weevil damage using a scale of 0-5. Roots were graded in three size categories: large or Grade I, medium or Grade II and small (culls) or Grade III. The yield in terms of total and marketable number and weight of roots were also recorded.

The first crop was planted in May and harvested in October. This crop yielded no swollen roots due to the extremely dry weather and lack of irrigation at the DTC.

The local cultivars were generally more prolific than the USDA types in terms of vegetative growth and root yield. There was no significant difference ($P=0.53$) in the level of root tolerance among cultivars. In most instances, damage was superficial and close to the stem end of the plant, which became exposed as roots enlarged and caused the surrounding soil to crack and/or erode. This permitted entry of the weevil which in the case of Clarke, tunnelled into the root tissues.

Dasheen (*Colocasia esculenta*)

CARDI's research has contributed to the expansion of the dasheen fresh produce trade in the region over the past 10 to 15 years. However, the industry

must diversify towards "value added strategies" i.e. agro-processing in order to expand production and increase farmer earnings since dasheen in its fresh form is losing its appeal. This is due to the limitations associated with storage and preparation (peeling and scratching allergies) and the fact that rice is a more attractive purchase due to its ease in storage and preparation.

In Dominica one of the potential areas for processing the crop was a dasheen chip which was being manufactured by the national companies La Robe Creole Plantation Ltd. and Bannis Farms in the 1990's. The former company used the "common" dasheen, at different maturity dates, however complaints of acidity (itching) problems persisted and production had to be stopped. Bannis Farms selected the "purple" petiole dasheen and then blanched the peeled corm before deep-frying which resulted in partial success in eradicating the acidity problem. However, they did indicate that the time and temperature spent blanching were inconsistent, along with other factors (abundance of cultivar), which lead to inconsistencies in the standardisation process.

Research activities by CARDI evaluated the effects of different dasheen cultivars, maturity indices and agro-ecological zones on dasheen chip acidity. The experiment involved the use of three cultivars – common, white and pink dasheen grown under standard agronomic practices. The harvested corms were given to each agro-processor for the preparation of the chips. An acidity test using a Hedonic scale was used to assess the samples. The general test procedures involved coding the samples to indicate the dasheen cultivar, age at harvest, location grown and method of processing.

The results indicated that corm age made no significant difference on chip acidity scores. Also noted was that there were no significant differences between the chip acidity scores of the three cultivars.

Table 1 shows that, white dasheen harvested at 7 months, the common dasheen harvested at 8 months, and white dasheen at 8 months produced the least acrid chips ($p < 0.05$).

However, overall acidity was minimal, so the larger and heavier corms were selected. Apart from ensuring that the manual peeling of the corms would be easier, the heavier corms ensured greater cash returns to the farmer.

Dasheen is considered the number one root crop in St Vincent and the Grenadines with exports to the United Kingdom, France, United States of America and other Caribbean islands. Like Dominica, there was a focus on adding value to the crop especially since the Marketing Corporation was embarking on vacuum packing of the crop in order to keep up with increasing demand in the lucrative export market.

The benefits of tissue culture as a method of rapid propagation are well known. In St Vincent and the Grenadines the Taiwan Mission produced plantlets of the white dasheen at its tissue culture laboratory since a market exists in France for this variety. The production from tissue culture plantlets was compared to the traditional planting material in St Vincent and the Grenadines. This was done by

CARDI in collaboration with the Ministry of Agriculture at two different agro-ecological zones (AEZ) on the island. One AEZ was located at the CARDI Rabacca Field Station and the other at the Ministry's Dumbarton Agricultural station in the Mesopotamia Valley. The soils at Rabacca are of the Soufriere Series, which has recent volcanic ash with good drainage, while the Dumbarton Station has the soil type of the Greggs Series, which also has good drainage.

Harvesting at four months showed that corms were not fully developed but those of the tissue culture produced more root growth than the traditional corm.

Some physiochemical properties of the harvested dasheen corms were determined at the Food Science Laboratory at the University of the West Indies (UWI) St Augustine. The chemical analysis revealed that dasheen grown at both sites had a similar composition with no difference due to method of propagation (traditional vs. tissue culture).

It was noted that the moisture content for dasheen harvested from Dumbarton was lower than that from Rabacca even though both areas had a similar rainfall pattern. These corms with a lower mois-

Table 1. The effect of corm ages (month) and cultivars interaction on acidity scores of dasheen grown in Dominica

Age (months)	Dasheen cultivars		
	Common	Pink	White
4	0.842	1.463	1.424
5	1.723	1.449	1.079
6	1.299	1.207	1.650
7	1.166	1.434	0.850
8	0.852	1.282	1.007
d.f	8	8	8
S.E.D.	0.349	0.349	0.349
P	0.034	0.034	0.034

ture content may store better than those from Rabacca.

An analysis was also done on the possible phenolic activity measured as a colour change of the peeled dasheen. The colour changed 10 minutes after peeling corms produced from both propagation methods. The enzymatic reaction was the least for corms produced by the traditional method at Rabacca, which may be advantageous for primary processing and therefore should be further explored.

The results of both yield and proximate chemical composition showed no difference between the plants cultivated from the traditional corms and those grown from tissue culture plantlets. As such, these results indicated that the use of tissue culture plantlets for dasheen production was a viable option that may be commercially exploited.

Yam (*Dioscorea* spp.)

The St Kitts Sugar Manufacturing Corporation (SSMC), the island's largest producer of yam both for domestic consumption and planting material, complemented CARDI's efforts since 2000. CARDI provided technical advice in the production of yam.

As a result, yam production experienced a resurgence since 2000, which meant that farmers were no longer constrained by the availability of planting material *inter alia*.

Technical advice on the control of wire worm and white grub through workshops and field visits was also provided during the year to yam farmers in St Kitts and Nevis. It was aimed at enhancing the farmers' production practices, which were affected by soil insects that caused damage on the holdings of many yam farmers. CARDI continued to monitor the yam harvest and to analyse its effects.

Cassava (*Manihot esculenta*)

CARDI provided support to cassava production in Montserrat through the multiplication of cuttings to supply planting material. Cassava is an important source of carbohydrate for the country and given the ongoing volcanic crisis is critical for food security. In addition the production of cassava bread is a traditional activity which provides added value to the product and there exists the possibility of satisfying export demand for cassava bread. Cuttings were propagated in field plots to provide planting material to support the expanding production of the crop. However these plots were destroyed by the volcanic eruption in mid 2003 and will be replanted when favourable growing conditions return.

Cassava also was another important crop in the Ministry of Agriculture's diversification programme in St Vincent and the Grenadines. With the assistance of the Food and Agricultural Organization (FAO), a cassava production facility was established at Orange Hill. The intention was that this facility be used for processing of both sweet and bitter cassava.

The CARDI unit in St Vincent and the Grenadines sourced 29 varieties of cassava from CIAT for germplasm evaluation, while the Taiwan Mission agreed to assist in the hardening of the tissue-cultured material. Suitable varieties will be selected and used in the local cassava processing programme. However, reports to date indicated that the survival rate of some of the varieties was low due to high mortality during weaning and hardening.

On the other hand, the Dominica unit undertook research to investigate the effect of stem diameter on yield, which was a continuation of the characterisation study of eight indigenous cassava cultivars started four years ago. This experiment involved cultivating, observing the initial growth of the cassava plant and the effect of stem diameter at planting

on the yield of the eight cassava cultivars.

Cassava stalks were obtained from the previous crop and the stalks were selected from branches that had developed at different positions on the harvested plant. The stalk diameter for the eight cultivars ranged between 10 and 26 mm. Stalks were grouped based on stem diameter.

Crop management involved free hand weeding between plants and brush cutting along the paths and no fertiliser was applied to the plants. Horn worm infestation resulted in the loss of 3.0 % of the plants. The presence of shoot fly was evident but the infected plants showed very little damage since few shoots were affected.

At the end of the crop cycle data were collected on the number and weight of tubers produced per plant, length and width of the individual tubers and the weight of uprooted plants without their tubers attached. Table 2 shows that there were no significant differences between yield parameters. The mean total tuber weight per plant from the eight cassava cultivars ranged from 1.36 kg to 2.26 kg. The cultivar with the highest mean total tuber weight per plant was Beward and the cultivars

Cent Livre DelG and Zekake had the lowest mean total tuber weight per plant. The mean tuber length ranged from 21.39 cm to 26.85 cm with Cent Livre DelG having the highest mean and Zekake having the lowest mean tuber length.

Cereals and Grain Legumes

The CARDI unit in Belize continued its collaboration with the Ministry of Agriculture, Fisheries and Co-operatives, non-governmental organisations, private industries and individual farmers in the area of agricultural research and development. The main focus of the Institute's activities in Belize was on the improvement of crop productivity and quality and the increase in the availability of quality seed of crops under investigation. This was done with a view to lowering the cost of production of domestic and export crops through the development and utilisation of appropriate and sustainable technologies.

Table 2 Yield parameters of eight indigenous cassava accessions

Accessions	Storage root length (cm)	Storage root diameter (cm)	Mean number of storage roots per plant	Mean total weight of tubers per plant (kg)	Mean fresh weight per plant (kg)
Beward	24.95	3.92	4.80	2.26	1.34
Bois Blanc	24.03	3.56	6.34	1.52	1.57
Bois Bleu	26.43	3.64	4.82	1.68	1.49
Cent Livre DelG	26.85	3.52	4.37	1.36	1.42
Cent Livre LOE	21.60	3.36	5.90	1.93	1.30
Sept Fey	22.64	3.79	5.05	1.66	1.41
Tecoco	26.50	3.69	6.23	2.15	1.96
Zekake	21.39	3.53	6.39	1.36	1.40
S.E.D. (27d.f.)	2.85	0.286	1.036	0.497	0.281
P	0.322	0.633	0.322	0.490	0.404



Soybean

Soybean [*Glycine max* (L.) Merrill]

Soybean research activities in Belize continued to focus on the screening and evaluation of cultivars/lines with a view to identifying for commercial production those that performed as good as, or better than CARDI S-15, CARDI S-89, Padre and D-082-2740, the cultivars currently recommended for commercial production. Cultivars/lines were first screened in unreplicated preliminary trials and those that appeared promising were identified for inclusion in subsequent evaluation trials.

Selection criteria included among other things:

- Late maturity for the June crop season
- Early maturity for the November crop season
- High yield potential
- Minimum 10 cm height of the lowest pod
- Good pest and disease tolerance
- Low percentage of discoloured (weathered) grain

Of the 93 entries in the preliminary evaluation trial, planted in December 2002, observations were recorded from 40 entries. Of this number, 30 performed better than the control CARDI S-15, which yielded 0.38 kg/plot. Three entries in particular CARDI 92-08, CARDI 92-15 and Cristiline had a grain yield of more than 1.00 kg/plot, the seeds of which were multiplied for further testing.

In addition to the preliminary evaluation trial, 12 selected cultivars/lines were planted in November 2002 in a varietal evaluation trial. CARDI S-15 was included as the control. Huasteca 200 was included, in the trial for the first time. This was a new variety that was acquired from Mexico under the Belize government's Soybean Project. It was found to out yield all entries, producing 1,892 kg/ha. This entry too will be further evaluated in both crop seasons.

The Belize unit continued to provide technical assistance to staff of the Soybean Project and participating farmers in the areas of site selection, land preparation, fertiliser recommendations, weed management, harvesting, drying and grading. Soybean farmers also benefited from a training workshop on soybean production. A manual on soybean production was prepared, and submitted to the staff of the Soybean Project for further distribution.

Peanut (*Arachis hypogaea* L.)

Belize has the capability of maintaining a sustained peanut production programme to satisfy domestic demand and for export to other CARICOM states. There were however a number of constraints to producing cheaper and better quality peanuts, including high labour requirements, high labour costs, as well as low productivity due to low input levels. The peanut research activities in 2003 therefore continued to focus on the screening and evaluation of peanut cultivars/lines, with the aim of identifying for commercial production, those that perform as good as, or better than those currently in use. Activities were also directed at identifying cultivars/lines for specific end uses such as in the manufacture of peanut butter and salted nuts.

Cultivars/lines were first screened in unreplicated preliminary evaluation trials, and the promising cultivars/lines included in subsequent varietal evaluation trials. Selection criteria included among things: yield, kernel size, days to maturity and suitability for specific end uses.

Of the 43 entries planted in December 2002 in the preliminary evaluation trial, data were recorded from 12 entries only. In particular, entries WS-1 and WS-4 were found to be highly resistant to rust disease, while entries WS-1, ICGV-88407, -91001B and -91007 were moderately resistant to leaf spot disease in both crop seasons, performing better than the control entry, Tennessee Red. In the other preliminary evaluation trial conducted in June 2003 in which 43 entries were also planted, data were recorded from only 12 entries. WS-1, ICGV-88258 and -87273A were found to be resistant to rust disease, and entries WS-4, -88258, -88273A, -88361 Red, -88378, -88395, -88407, -9100A and -91007 were moderately resistant to leaf spot disease. Here too, performance was better than that of the control entry, Tennessee Red.

Due to the unavailability/suitability of land, the CARDI 2003 peanut variety trial was not conducted. The Belize unit however continued to provide technical assistance to local peanut producers as well as to extension officers, processors and exporters. On-farm testing and validation of research findings in production and post-production activities was also facilitated by the unit.

Cowpea (*Vigna unguiculata* (L.) Walp.)

Over the years cowpea production in Belize increased from 365 ha in 1993 to 2,830 ha in 2002. Cowpea has become an important non-traditional export crop for Belizean farmers, with over 90% of the crop being exported, generating in excess of EC\$31 million in 2003. During the period under review, the Belize unit produced a total of 29.5 kg, 28.2 kg and 45.5 kg seed of the cowpea cultivars/lines, CARDI Red, California No. 46 and California No 5, respectively.

Technical assistance was also provided to farmers in cowpea production technologies, particularly in

the areas of weed, insect, pest and disease management.

Corn (*Zea mays* L.)

Most of the corn produced in Belize is utilised in the manufacture of livestock feed, with a small, but significant percentage used directly as food especially in rural areas. The evaluation of both yellow and white grain corn hybrids was initiated in 2002, to assess the potential of currently recommended hybrids, and also to identify other suitable high yielding hybrids for medium-sized and large-scale producers. As a result of problems with the availability/suitability of land, however, no yellow hybrid corn and/or white hybrid corn trials were conducted in Belize in 2003. Nevertheless, there was commercial production of the recommended white corn hybrid/variety – Pioneer 30F94. The 2003 harvest yielded 7,501.5 kg at a rate of 2,027.4 kg/ha. and was sold to the Reimer Feed Mill. Revenue generated was EC\$ 3,600.00.

Chickpea (*Cicer arietinum* L.)

Chickpea represented one of the 10 crop types produced on the CARDI Belize Field Station. In November 2002, 20 entries acquired from the FAO were planted for the first time in an unreplicated preliminary evaluation trial. Of all the entries planted, FLIP93-93C out yielded the rest. Three entries had larger seed size, and these will be further evaluated especially in light of the preference for such seed in the Caribbean market.

Vegetables

Callaloo (*Amaranthus* sp.)

Today the production of many leafy vegetables has a heavy reliance on pesticides, which is of global

concern. As a result there has been an increased focus in the Caribbean on the drastic reduction and rationalisation of pesticides which would impact on consumer safety and the reduction of environmental and user hazards. In Jamaica, methods to utilise threshold based spray application decisions were being validated on callaloo and crucifers through the development of an appropriate model. The research model for high pesticide input into vegetable systems, which was developed on vegetable amaranth in Jamaica, was explained to researchers from Barbados and Trinidad and Tobago.

The validation activities on callaloo IPM systems employed two strategies as follows:

- (1) exclusion of major pests using a row cover of 70% light transmission in combination with cultural practices
- (2) use of new biorational chemistries applied within the framework of a resistance management programme (rotation of chemicals and the use of the threshold-based pesticide application guide developed for lepidoptera species on callaloo) in combination with cultural practices.

The latter system continued to show the potential to reduce pesticide input in callaloo production compared to the farmer practice of weekly sprays (lambda-cyhalothrin).

Exclusion plots continued to provide superior crop

protection compared to the other management systems by limiting losses due to insect damage to 0-10% compared to 0-50% for the other systems.

Some of the highlights were that exclusion cages and application of biorationals using a threshold-based spray application gave significantly improved protection of the crop from insect damage when compared to farmer practice. Additionally, exclusion plots were a pesticide-free system giving the product a competitive advantage, which could fetch a higher price. It is important to note that exclusion as a management option was maintained without the use of pesticides. However, other compatible non-chemical tactics would enhance the system (sticky traps, soaps, oils and biopesticides). The threshold-based sampling plan demonstrated the potential to reduce the frequency of pesticide applications by 46%-92%.

Tomato (*Lycopersicon esculentum*)

Five varieties of tomato, both determinate and indeterminate were evaluated in a field trial at Rabacca in St Vincent and the Grenadines. These tomato varieties were previously tested in an undercover experiment by the Research and Development Division of the Ministry of Agriculture.

Santa Rose had the greatest average yield/plant and Red Ruby the least as indicated in Table 3. The fruits were stored under ambient conditions to measure shelf life and results indicated that fruits of the variety Red Pride deteriorated more quickly than any other variety.

Table 3 Results of a tomato varietal trial carried out in Rabacca St Vincent

Tomato variety	Average yield/plant(Kg)	Average fruit weight (g)	Growth Habit
Dragon Fire	1.80	100	Indeterminate
Santa Rose	2.19	154	Indeterminate
Red Ruby	1.18	104	determinate
Santa Maria	1.50	100	Indeterminate
Red Pride	1.37	138	determinate

Dragon Fire fruits had a shelf life of 40 days before rotting and Santa Rose 35 days. The Research and Development Unit of the Ministry of Agriculture obtained similar results. Dragon Fire and Santa Rose by virtue of long shelf life and comparatively superior yield were adjudged the best varieties for further trials.

Fruit Crops

Pineapple [*Ananas comosus* (L.) Merr.]

Pineapple production in Dominica has traditionally been small scale, for local consumption and limited to four indigenous cultivars. However, over the last few years farmers have shown an interest in commercial production of the crop recognising that it is a sustainable revenue earner. The interest of the farmers was formalised in 1999 when they formed the Nature Isle Pineapple Producers Association (NIPPA) with the aim of meeting the necessary prerequisites for regional production and marketing. The CARDI Dominica Unit completed a project in Commercial Pineapple Production and Marketing Systems in collaboration with the Ministry of Agriculture, NIPPA, Republic of China (ROC) Agricultural Mission and the Project Review, Implementation, Monitoring and Evaluation (PRIME) Unit. The ROC Agricultural Mission introduced four improved cultivars – TN#4, TV#6, TN#1 and Smooth Cayenne in an attempt to improve the quality of pineapples in Dominica. The Smooth Cayenne was used in this project since it is considered the major export cultivar. NIPPA had been experiencing problems with sustainable production and fruit quality due to the following:

- A lack of planning in crop establishment and a co-ordinated recording system
- Variations in fruit sugar/ acid ratios and brix levels because of the agro-ecological zone (AEZ) in which the crop was established.

CARDI Dominica provided technical assistance to examine the effects of different AEZs and planting dates on the production and quality of the marketed cultivars.

Factorial experiments examining the effects of quarterly planting dates, and different AEZs on morphological, yield and quality characteristics of the Smooth Cayenne; showed that the cultivar had different yield, maturity and quality responses, depending on where and when it was planted. In pineapple the size of the plant normally has a direct correlation to the size of the fruit obtained, in addition to the factors of soil type and nutrition and as such these findings were of great importance to the commercial producers of pineapple. The findings will allow commercial producers to more accurately predict yield and time to maturity. Additionally, producers will be able to understand the difference in fruit quality from the various locations and thus allow fruits to be marketed by quality (taste) characteristics. Time of planting also affected fruit quality; fruits which develop in the cooler months tend to be higher in acidity and lower in sugars.

The results of these experiments indicated that location and staggering planting have an effect on yield and fruit quality and are therefore critical when planning a sustainable production system. As a follow up to this project experiments will also be conducted on the other export cultivars TN#4 and TN#1.

Golden apple (*Spondias cytherea* L.)

The dwarfing of golden apple remains an important research activity since the low growing (dwarf) trees with large fruits are important to improve the production and marketing of the fruit locally and for exports. In Grenada work continued on dwarfing golden apple by topping grafted trees and also grafting on to other *Spondias* species.



Grafting and pruning of tall golden apple trees resulted in marketable yields of fruits from low-growing trees after 2 years re-growth. CARDI Grenada embarked on a project that had three major achievements as follows:

1. Low growing trees bearing large fruits obtained from pruning grafted trees.
2. Economic yield obtained 2 years after pruning.
3. Pruned trees were harvested easily from ground level thus avoiding the risk of climbing tall trees for harvesting.

The dwarfing of golden apple trees by topping grafted trees started in July and August 2001 with 6 year old grafted golden apple trees. The resultant regrowth of secondary shoots was observed to see if a low growing tree bearing large fruits could be produced.

It was observed that the minimum height at which fruits were borne had increased from the previous year for all but one of the trees, which was anticipated due to normal growth. However, there was some increase in the minimum height caused by the death of some lower branches. Death occurred due to shading from the upper branches of the trees and from adjacent trees because they were spaced too close. Nevertheless all fruits borne could have been harvested from the ground level which resulted in minimal losses during harvest. Notably, a marketable yield of large fruits was obtained from each tree for the first time after pruning thus significantly reducing fruit damage and risk to human life. It can now be concluded that low growing large fruited golden apple has been obtained through the process of grafting and topping (*see photo above*). The large fruits obtained were easily harvested from ground level.. However, since the re-growth was only 2

Two year old regrowth of topped grafted golden apple

years old further observations of the trees must be made over the next few years as most likely continual pruning may be necessary to maintain the low growth of the trees.

In 2001 large golden apple scion were grafted on to red plum rootstock and planted to examine the dwarfing of golden apple through grafting on other *Spondias* species. The scion grafted in 2001 died during 2003 due to the lack of moisture during the dry season; however the rootstocks continued to survive in a healthy and vigorous condition. The plum rootstock was shallow rooted and as such was not able to salvage sufficient moisture from the soil to keep the golden apple scion alive.

The grafting of golden apple on to red plum rootstock as a means of dwarfing golden apple although a possibility was proving difficult not only at the nursery stage but also at field establishment and growing stage. A better performance at the growing stage might be obtained if the plants were established at a location with a higher rainfall level and less marked dry season, as the harsh dry season seemed to be a factor in the death of the scion.

The technique of grafting on to other *Spondias* species has not proven to be a success and as such another technique should be investigated. Such a technique could be crossing the large fruited tall golden apple trees with the small fruited dwarf type in the hope of producing a true dwarf tree which bears large fruit. Research work will continue in this area.

Papaya (*Carica papaya* L.)

Populations of the papaya mealybug continued to exist at low levels in papaya orchards across St Kitts and Nevis and it is known that natural enemies played a crucial role in regulating the mealybug populations. CARDI conducted work to determine the natural enemy complex of the papaya mealybug (*Paracoccus marginata*) in the country. A number of

natural enemies, particularly predators were observed in the field. Live mealybugs were collected from host plants, encapsulated in gelatin capsules and kept under ambient conditions and examined regularly up to one month after encapsulation for emergence of parasitoids. It was observed that both adults and larvae of the introduced ladybird beetle *Cryptolaemus montrouzieri* and the indigenous *Scymnus* spp fed on the pest. Both intact mummies and mummies with exit holes were found at many field sites. This indicated that parasitoids were active in the field and were well distributed throughout the islands based on emergence from live encapsulated mealybugs. The overall level of parasitism ranged from >1% to 44% and was based on the parasitoids encountered such as *Anagyrus loecki* Noyes and Menezes, *Aprostocetus*, *Apoanagyrus californicus* and *Cheiloneurus inimicus*. The above-mentioned parasitoids were apparently giving good control of the pest since there have been no further outbreaks during the year. Monitoring continues and attempts will be made to develop rearing systems for outstanding candidates for mass releases if required.

Traditional Crops

Coffee (*Coffea Arabica* L.)

The Coffee Berry Borer (CBB) Project in Jamaica, aimed at elucidating the effectiveness of biocontrol agents to manage the CBB [*Hypothenemus hamper* Ferrari] entered its fourth year. This project is

viewed by CARDI as part of the approach for the implementation of Integrated Pest Management (IPM) strategies in managing the CBB.

During 2003, protocols for the mass rearing of two parasitoids, *Cephalonomia stephanoderis* and *Phymastichus coffea* were consolidated. In addition, parasitoids belonging to the genus *Prorops nasuta* were re-introduced.

In all, a total of 216,915 parasitoids were produced in 2003 including 169,570 *C. stephanoderis*, 26,262 *P. nasuta* and 21,083 *P. coffea*. Some 44,675 parasitoids were released for establishment in fields and in the conduct of efficacy trials. Table 4 provides a breakdown of these releases.

The post-release assessment of parasitoid establishment in Greenock and Rose Hill revealed the presence of developmental stages of *P. coffea*, suggesting that the parasitoid had successfully reproduced in the field and its establishment was confirmed. The presence of this parasitoid was also confirmed in Flamstead, where high (50%) levels of CBB parasitism were recorded. *P. coffea* was also recovered from a field at Baronhall, even after the organochlorine insecticide endosulfan had been applied to the field.

In addition to these trials, an IPM strategy for the management of the CBB was implemented on one farm in the Blue Mountains. It was demonstrated that a combination of IPM tactics was effective in reducing the CBB population to levels lower than

Table 4 Location and number of parasitoids released in 2003 in Jamaica

Parasitoid	No. released	Location
<i>C. stephanoderis</i>	32, 749	St. Andrews – Rose Hill, Maryland, Flamstead and Good Hope
<i>P. coffea</i>	9, 526	St. Catherine – Mountain Hill St. Andrew – Maryland and Flamstead St. Ann – Greenock
<i>P. nasuta</i>	2, 400	St. Andrew – Rose Hill

when endosulfan was used, or when no control measures were taken.

Sugarcane (*Saccharum officinarum* L.)

In 2003, scientists of the CARDI unit in Barbados continued to provide technical assistance to the sugar industry. During the period under review, a total of 482 larvae were collected from the field. Of this amount, 139 produced cocoon masses from which emerged 3,725 *Cotesia flavipes*, 17 *Lixophaga* and 2 *Saccharivora* parasites. These were released in fields across Barbados.

Along with those larvae collected from the field, a total of 1,230 larvae were isolated and reared on an artificial diet. The laboratory parasitism level was found to be 32.8%, and an average of 26 parasites/cocoon mass were produced.

In terms of parasite releases, fields with a percent-

Table 5 Location and number of *C. flavipes* parasites released in 2003 in Barbados

Location	Number of parasites released
ARVTU	1, 956
Buttals	447
Castle Grant	150
Edgecumbe	89
Fisherpond	180
Lears	180
Orange Hill	165
Redland	55
Rock	1, 200
Searles	142
Spring Hall	55
The Valley	30
Warleigh	85
WICSCBS	2, 040
TOTAL	6, 774

age infestation greater than the Economic Threshold Level (ETL) of 5% were identified during the annual joint infestation survey, and parasites released in locations across the island. A total of 6,774 parasites were produced and released in 2003 (Table 5).

The overall joint infestation level in the fields sampled averaged 2.54%, which was below the ETL of 5%. Included in the samples were the six major commercial sugarcane varieties grown in Barbados, namely B62163, B74541, B77602, B80251, B80689 and B82238. With the exception of B80689, which had an infestation level of 5.1%, all of the other commercial varieties recorded levels below the ETL (Table 6).

Table 6 Mean percentage joint infestation level of the major commercial sugar cane varieties, 2002 – 2003, in Barbados

Variety	Mean % of infestation
B62163	0.9
B74541	2.0
B77602	1.4
B80251	1.9
B80689	5.1
B82238	2.4

Nutmeg [*Myristica fragrans* (Houtt)]

Nutmeg is a spice crop of significant economic importance to Grenada, however, the nutmeg root rot disease, which is also known as the nutmeg wilt, has affected the production and quality of the nutmeg. The Grenada Cooperative Nutmeg Association (GCNA), CARTF, Ministry of Agriculture and the nutmeg growers collaborated with CARDI to investigate the causal agent(s) and develop a strategy for the management of the disease.

The first activity of the research involved a survey of the nutmeg farms to chart the development of the disease and also to identify possible areas to centre the research and implement control strategies.

Table 7: Location and the frequency of organisms isolated in Grenada

Culture No	Chantilly	Rosemont	Clozier
1	Nil	Pythium	Nil
2	Bacteria	Contaminant	Fusarium
3	Pythium	Contaminant	Nil
4	Pythium	Fusarium	Contaminant
5	Contaminant	Nil	Contaminant
6	Pythium	Nil	Pythium
7	Pythium	Fusarium	Contaminant
8	Bacteria	Pythium	Pythium
9	Pythium	Nil	Pythium
10	Nil	Nil	Contaminant
11	Pythium	Pythium	Pythium
12	Pythium	Pythium	Contaminant
13	Pythium	Contaminant	Pythium
14	Pythium	Contaminant	Pythium
15	Contaminant	Nil	Nil
16	Fusarium	Contaminant	Nil
17	Pythium	Nil	Fusarium
18	Bacteria	Pythium	Contaminant
19	Nil	Nil	Pythium
20	Nil	Contaminant	Fusarium
	50% oomycete (Pythium)	25% oomycete (Pythium)	35% oomycete (Pythium)
	5% Fusarium	10% Fusarium	15% Fusarium
	20% no growth	35% no growth	20% no growth
	25% contaminants	30% contaminants	30% contaminants

Chi square = 1.741 (2 d.f) P= 0.4187

Overall, the disease was present on 56% of the farms surveyed.

The isolation and identification of the organism(s) was then undertaken by collecting root samples from randomly selected trees at three sites. The samples were surface sterilised under laboratory conditions, plated on potato dextrose agar and incubated at 20°C. After three days the cultures were examined under the microscope for identification. Soil samples were also taken from the three locations as were root samples. Soil samples of 10g each were placed in 100ml of sterile distilled water and mixed in a plate shaker and vor-

texed for 60 seconds prior to plating serial dilution. Colonies were then identified using a microscope. Table 7 shows the three locations and frequency of the pathogens isolated

Another activity undertaken was inoculation studies, which involved the use of seedlings in a randomised complete block with four treatments replicated in four blocks. *Fusarium* and *Pythium* inoculated roots were rotten after 1 week but the plants produced new roots and survived.

Describing the aetiology of the disease was undertaken through field visits in which the diseased

trees were inspected and the symptoms were explained. The designing and testing of management strategies for the control of the disease was another activity.

The main achievement of the research work conducted during 2003 was the identification of the causative organism of the nutmeg root rot disease nutmeg root rot (a root rot and not a wilt) as the fungus *Pythium* spp. and the partial development of a disease management strategy.

The rot of the feeder roots without much damage to the larger roots is the characteristic of Oomycete (*Pythium* and *Phytophthora*). When the symptoms are visible on the tree canopy, most of the feeder roots were already dead, hence the treatment had to begin from the early stages of disease initiation.

Organic Crop Production

In Trinidad and Tobago, technology and information transfer in organic farming methodologies to stakeholders of the national agricultural sector in general, and the organic farming sector in particular, was the focus of CARDI'S work in the area of organic crop production. Collaborative work with the Inter-American Institute for Co-operation on Agriculture (IICA) constituted the major part of activities conducted in 2003. Five national sensitisation workshops were held in Antigua/Barbuda, Grenada, Guyana, Dominica and Trinidad and Tobago aimed at supporting the establishment of an organic horticultural industry in the afore-mentioned territories. These workshops were part of a larger IICA/CEPEC/CIDA project for the regional development of organic agriculture.

In Jamaica, a trial was conducted to evaluate different organic mulches for weed management in cabbage production. The mulches used were derived from the following plant species: Neem (*Azadirachta indica* [A. Juss]), Quick stick (*Gliricidia sepium*

[Jacq.]), Leucaena (*Leucaena* sp. [Benth]), Velvet beans (*Mucuna* sp. [Adams]), and Guinea grass (*Panicum maximum* Jacq.). The experiment used a randomised block design with four blocks, each of which contained six treatments as follows: control (not mulched), mulched with Neem, mulched with *Leucaena*, mulched with *Gliricidia*, mulched with *Mucuna* and mulched with Guinea grass.

Cabbage seedlings were planted in treatment plots measuring 1.5 m x 1.0 m. Mulching followed three weeks later. The weeds under assessment were classified into three groups based on their morphological features, i.e. broad leaves, grasses and sedges. The results of the trial indicated that total weed growth (as percentage cover or density in plots mulched with *Gliricidia*, *Mucuna* and Guinea grass were significantly lower ($P < 0.05$) than the control at both five and seven weeks after mulching (Figures 1 and 2).

The results confirmed the generally accepted idea that weed reduction is a benefit to be derived from mulching with organic materials, and is better than leaving the soil exposed. It should however be noted that these were the results of a single trial and there is a need to repeat the experiment before final conclusions could be drawn.

Apart from the work described above, the Jamaica Unit was also involved in the demonstration of organic farming techniques that could be applied to the production of callaloo (*Amaranthus* sp.) and hot pepper (*Capsicum chinense*). Studies were conducted to evaluate the impact of three organic manures – cow manure, goat manure and vermi-compost from coffee – on the growth of these crops. On the callaloo plots four treatments were applied as follows: cow manure at 0.25 kg/plant/hole and at 0.5 kg/plant/hole, vermi-compost at 0.5 kg/plant/hole and goat manure at 0.5 kg/plant/hole. On the hot pepper plots all three manures (cow, goat and vermi-compost) were applied at a rate each of 0.5 kg/plant/hole.

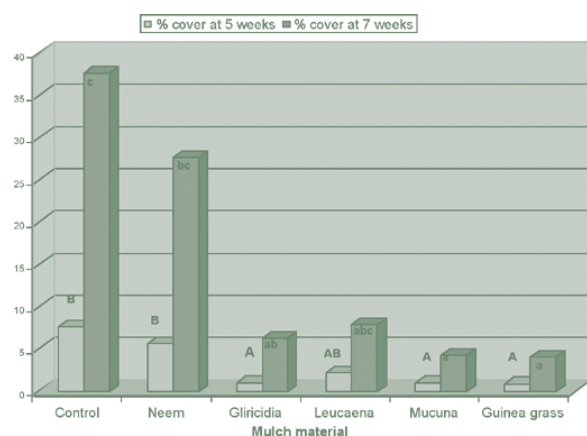


Figure 1 Percentage weed cover at five and seven weeks after mulching with different plant material and an un-weeded control

Note: Bars labelled with the same lower case or upper case letters are not significantly different ($P>0.05$) from each other

With respect to organic callaloo, the data indicated that cow manure at both levels and goat manure had a more beneficial effect on the yield of callaloo than did vermi-compost. An examination of marketable callaloo yields showed that plots treated with cow manure at 7,500 kg/ha showed significantly higher yields than plots treated with vermi-compost. There were no significant differences between the other treatments. The unmarketable yield data indicated that plots treated with goat manure were significantly higher than plots treated with cow manure at 7,500 kg/ha, and plots treated with vermi-compost at the fourth and fifth harvests, respectively. This component of yield steadily

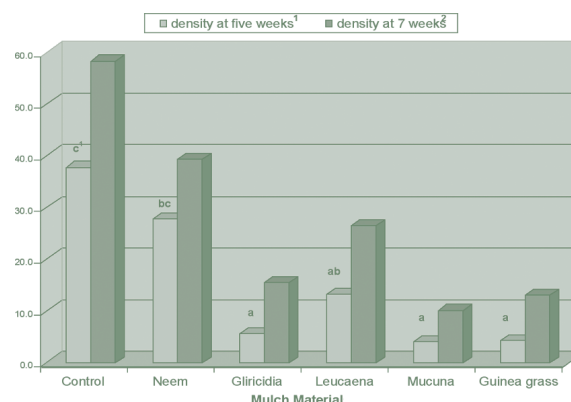


Figure 2 Weed density at five and seven weeks after mulching with different plant materials and an unweeded control.

Note: Bars labelled with the same letters are not significantly different ($P>0.05$) from each other

increased from zero in the first harvest to being the major part of the yield component in the fifth week. This was directly correlated to pest infestation of the crop by the fifth harvest.

In the trials with the West Indies Red cultivar of hot pepper it was found that in general, growth and yield in the plots treated with cow and goat manures were better than with vermi-compost. Plants treated with cow manure were consistently taller than the other two treatments, while goat manure treated plants were most times taller than vermi-compost treated plants.

Table 8 Yield and yield parameters of hot peppers in relation to treatments

Yield Parameter	Treatment		
	T1	T2	T3
Number of fruits	1,477	1,864	2,577
Weight of fruits (kg)	12.94	14.54	24.69
Calculated yield (kg/ha)	10,788	12,118	20,572

T₁: Vermicompost at 5,000 kg/ha; T₂: Goat manure at 5,000 kg/ha; and T₃: Cow manure at 5,000 kg/ha

With respect to the number of fruits on the plants at 9, 12, 13 and 14 weeks after transplanting, plots treated with cow manure had significantly higher numbers ($P < 0.05$) than those treated with vermicompost. There was no significant difference ($P > 0.05$) between plots treated with cow and goat manures.

The yield of pepper (kg/ha) in relation to treatments was also determined. It was found that cow manure was superior to the other two manures in terms of the yields produced (Table 8). Of note too, was that the yield of the cow manure treated plots was also comparable to the standard yield expected for West Indies Red hot pepper grown under conventional conditions with inorganic fertilisers.

Natural Resource Management

CARDI's involvement in the project co-ordinated by the Centre of Marine Studies (CMS) of the Department of Life Sciences of the University of the West Indies, continued in 2003 the project's final year. This project, which was funded by the Department for International Development (DFID) of the United Kingdom through the University of York/Marine Resources Assessment Group (UY/MRAG Limited) has been ongoing since 2000. Its primary focal points were St Lucia and Jamaica, where a review of soil management and farming practices, including the use of agro-chemicals in the Caribbean, was conducted.

The final report entitled *Review of Soil Management and Farming Practices, including the Use of Agro-Chemicals in the Caribbean, with particular reference to St. Lucia and Jamaica*, includes all the other reports prepared for the project, as well as the results of the farm surveys conducted in Jamaica and St Lucia. Stakeholder workshops were held in both participating territories at the end of the project,

to report on its findings and recommendations.

On the issue of farming practices and soil conservation techniques, it was found for example, that:

1. In St Lucia there has been a decrease in the number of medium (>10 but <200 ha) and large (>200 ha) farms, and a corresponding increase in the number of smallholdings since the 1960's. At the same time there has been an increase in the number of permanent crops, indicating more intensive land use.
2. In both islands, a large part of the land is on hill-sides, although Jamaica has a higher proportion of its farms on steep slopes. Soil conservation technologies were used although infrequently, in both Jamaica and St Lucia. These fell into two broad categories:
 - Engineering structures (i.e. building of terraces, stone barriers and walls)
 - Vegetative/farming practices (i.e. protecting soil through soil and vegetative management using contours/vegetable hedges, grass barriers, mulching or other practices).
3. It has been found in some farms in Jamaica and St Lucia, and also around the Caribbean, that proper soil erosion control can be achieved through the integration of selected engineering and biological or cultural control measures.

There has been overwhelming support for the integration of soil conservation with other farming practices, rather than treating it in isolation, and also for the involvement of farmers in the selection/modification of the various soil and water management techniques.

Coming out of the farmer surveys, it was noted that the use of fertilisers and pesticides was widespread on both islands. Chemical fertilisers were being used on most farms, although very few farmers had soil chemical analyses done. This was more pronounced in Jamaica than in St Lucia. Pest and dis-

ease control was done almost entirely by chemical applications in both islands. Farmers indicated that the use of agro-chemicals increased their yields and improved the appearance of their produce. The control of weeds was however mainly done by mechanical means. In both islands the majority of farmers indicated that they would utilise increased amounts of agro-chemicals if they had the resources.

Many farmers in both St Lucia and Jamaica were not aware of the environmental impacts of using agro-chemicals on their farms. Farmers also indicated that excess chemicals were stored for future use, applied to the soil, or buried. Containers were disposed of by burning, and most farmers used some form of protective clothing while spraying. The interval between spraying pesticides and harvesting of crops was 1-2 weeks in both islands. In St Lucia it was even reported that this interval could be less than one day. Farmers in both islands were generally unaware of any incidences where human health was affected by the spraying of chemicals. Hospital data from Jamaica has however indicated some incidences with children less than five years old being the main victims.

Among the recommendations made it was noted that:

1. IPM systems that reduce pesticide use on crops and promote pest control by non-chemical methods should be introduced into the farming communities and recommended in both islands.
2. Socio-economic analyses, including cost-benefit analyses should be conducted for different farming practices, including options for agro-chemical use (e.g. IPM)
3. A comprehensive, well-developed Integrated Management of Pests and Pesticides (IMPP) programme should be designed by stakeholders, including local and regional agro-chemical importers and manufacturers, farmers, environmental groups, state bodies, the public and the rel-

evant university departments.

4. Training courses on environmental protection and the excessive use of agrochemicals on the environment should be conducted in both islands. Further training on the environmental impacts of certain farming practices (i.e. in terms of erosion) should also be encouraged.

Further details on the findings of the study and the recommendations made can be found in the paper by L. Simpson, *Review of Soil Management and Farming Practices, including the Use of Agro-Chemicals in the Caribbean, with particular reference to St. Lucia and Jamaica*. Research project DFID NRSP R7668. Jamaica, CARDI, April 2003. Available as downloadable files under the Land-Water Interface option at <http://www.mragltd.com>.

Small Ruminants

Throughout 2003, CARDI along with its collaborators continued its work in the development and establishment of the Jamaica and Trinidad and Tobago small ruminants sector. In Jamaica, at both the Hounslow Demonstration and Training Centre (HDTTC) and the Sam Motta Demonstration and Training Centre (SMDTC) Goat and Sheep Demonstration and Training Centres experiments were conducted in the critical areas of breed improvement and cost-effective and sustainable feeding and production systems. In an aim to further strengthen the sector, CARDI also participated in the drafting of a National Small Ruminant Development Plan, which was commissioned by the Agricultural Support Service.

At the HDTTC, two locally adapted forage legumes – pigeon pea [*Cajanus cajan* (L.) Mill sp.] and blue pea [*Clitoria ternatea*] – were evaluated for use in small ruminant feeding systems. They were evaluated over two growing seasons, and the effects of season of sowing and age at first cut were examined. It was found that pigeon pea does not adapt to repeated cutting regimes like multi-purpose fod-

der trees such as leucaea [Leucaena leucocephala (Benth)] and therefore, cannot be used as such. Blue pea on the other hand, has potential as a fodder crop due to its high crude protein concentration even with an 8-week cutting interval.

The result of the study to evaluate levels of inclusion of alfalfa hay in grower/finisher small ruminants feeding systems showed that chevon and lamb can be produced economically by employing feeding systems that use high levels (60-100%) of legume (alfalfa) hay during the growing period, and by-product concentrate feed during the finishing period. This trial was conducted in two phases and served to evaluate the weight gain potential of alfalfa hay fed to sheep and goats at Hounslow. The live weights and feed intake records were summarised over the data collection periods. At the end of the finishing phase two animals each from the two species (i.e. sheep and goats), and from each treatment were slaughtered and carcass measurements taken.

In other work at the HDTC, 62 pre-dominantly Boer and Nubian does were imported by producers during 2003 to augment improved goat breeding on the island. Data collected from five sample producers employing improved production technologies revealed that Boers and Nubians expectedly had high productivity, but their crossbreds with native goats were also comparable to the purebreds in productivity.

At the SMDTC, work in 2003 centered on the continued evaluation of alfalfa and the commencement of work on mulberry (*Morus* spp.) and mucuna (*Mucuna pruriens*), as part of the process to develop a forage-based feeding system for the goats at the SMDTC, as well as improve the quality of the mined out bauxite lands. In addition to this, there was also the development and implementation of breeding/multiplication programme, the primary focus of the DTC.

In the case of Trinidad and Tobago, a major mile-

stone of the work involving small ruminants in 2003, was the approval of the project *Creating a Sustainable Small Ruminant Industry in Trinidad and Tobago: The Development of a Control/Management Strategy for Johne's Disease* under the IICA/CARDI Agreement. This project is a collaborative effort between CARDI and the Ministry of Agriculture, Land and Marine Resources (MALMR), the University of the West Indies (UWI) and the Inter-American for Corporation on Agriculture (IICA).

Major activities under this project for 2003 included:

1. *Training of animal health professionals* – a workshop was conducted in July 2003 to train Veterinary Officers and Animal Health Assistants from the MALMR in the protocol to be followed for efficient sample collection and processing that was conducted during the August/September 2003 period. A second workshop has been carded for February 2004 to seek to develop a disease management strategy for Johne's disease. An expert in the area Dr Claus Buergelt of the University of Florida has been invited to facilitate this process under the University of Florida/CARDI Agreement.
2. *Collection of epidemiological data* – as indicated above this was done during the period August to September 2003. Blood samples were taken from a total of 2,936 sheep and goats on 277 small ruminant farms in Trinidad and in Tobago. The teams that surveyed farms in each of the districts comprised field staff of the Animal Production and Health Division of the MALMR, and included the Veterinary Officer with responsibility for the particular region, an Animal Health Assistant and a Stock Assistant.
3. *Sample analysis* – in all, a total of 2,746 samples were collected during the field exercise. These were analysed at the Veterinary Diagnostic Laboratory (VDL) of the MALMR. The serum samples were tested for the presence of specific antibodies to *Mycobacterium para tuberculosis* (the causative agent of Johne's disease), using the indirect

Enzyme-linked Immunosorbent Assay (ELISA). All 2,746 samples tested negative. This has raised a number of issues with respect to the laboratory procedure, the sampling methodology, as well as the improper selection of animals. Subsequent to the August/September 2003 exercise, samples were collected from one farm involved in the survey, and using a different ELISA system it was found that some animals tested positive for Johne's disease. Based on this therefore, and on the results of the survey it is clear that there is a need to continue to collect and test samples from suspected farms and animals. It will also be imperative that a more robust laboratory technique be developed for evaluating Johne's Disease in Trinidad and Tobago to enhance the sample analysis procedure.

4. *Collection of farming systems data* – this activity was conducted concurrently with the sample collection phase of the project. A questionnaire was designed to glean as much information as possible from small ruminant producers on not only the types of systems in place, but also to assist in determining (in the context of Johne's disease), how these impact on animal health.

The survey confirmed that the majority of individuals involved in small ruminant farming could be considered small, possessing between one and ten animals. Goat farms dominated the sample frame, accounting for 35%. Barbados Blackbelly was identified as the most common sheep breed, while the Saanen was the most common goat breed. 74.4% of the farmers surveyed had never heard about Johne's disease. Where farmers had heard about it, 46.4% identified Veterinary Officers and Animal Health Assistants as their primary source of information.

With specific reference to the impact of the production system on animal health, the survey revealed that in addition to small ruminants, farmers also kept large ruminants (cattle and buffalo) and non-ruminants (rabbits, poultry and pigs).

Where this mixed type of production is found, farmers need to be aware that Johne's is a disease of all ruminant animals. Therefore, where sheep and goats are kept together with cattle and buffalo for example, the latter may serve as a reservoir of the disease, and thus encourage its spread.

The survey also revealed that 31.0% of the farmers had dirt floors in their pens. Manure was generally (40.5% of respondents) swept into the area surrounding the pen, and also spread on pastures. Where this is generated from diseased animals, the implications for disease spread are clear.

Farmer to farmer sales was also identified by 88% of the respondents as the primary means of increasing herd/flock size. In such instances there might not be any requests made for animals to be tested prior to the completion of the transaction. This can thereby result in farmers unwittingly facilitating the spread of this debilitating disease.

A major finding of the survey was that although 50.2% of the farmers reported having a disease control programme in place, there are still apparently systems in place on-farm, that predispose animals to Johne's and other diseases. A re-evaluation of farm management practices is therefore required.

Whitefly and whitefly transmitted geminiviruses

The institute completed an activity, which was part of the European Union Caribbean Agriculture and Fisheries Programme IPM Project, which involved the establishment of a whitefly, and whitefly-transmitted geminiviruses database for the Caribbean.

The goal of the project was to improve the access

of CIPMNET national co-ordinators to information for making decisions related to co-ordinating research on whitefly and whitefly transmitted geminiviruses. The project involved data collection, data compilation and analysis and the production of the report.

Many challenges were faced in obtaining information from some countries, in addition selective translation of the copious non-english documents was necessary. However, over 200 pieces of grey and published literature were obtained during the data collection exercise. From the information gathered during this exercise it appears that much of the required component research has been effected somewhere in the Caribbean, often with good results and some

are ongoing. Additionally, the information analysed indicate that research activity is highest in the Dominican Republic and Jamaica followed by Martinique, Puerto Rico, Trinidad and Guadeloupe.

The literature also showed that the areas in which research and development efforts have been most sustained are vector/virus characterisation and distribution, documentation of host range; screening for host plant resistance and biological control. However, the need for the goals and objectives of all current regional initiatives to be rationalised to form a fully coordinated regional whitefly and whitefly-transmitted geminiviruses management programme was elucidated.

Information and Communications

External Services and Projects

- CTA/CARDI Regional Branch Office for the Caribbean
- Caribbean Agricultural Information Service (CAIS)

Internal Services and Projects

- Publications Services
- Information Technology Services
- Information and Records Centre
- Corporate Communications

The Information and Communications Department is responsible for maintaining and developing the Institute's internal information and communications systems and resources, while at the same time working with stakeholders to improve the information and communications capacity of the wider agricultural sector. Hence, the department's services and programmes cater to both internal and external clients.

External Services and Projects

CTA/CARDI Regional Branch Office for the Caribbean

CARDI has functioned as the Regional Branch Office for the Caribbean of the Africa, Caribbean and Pacific/European Union (ACP-EU) Technical Centre for Agricultural and Rural Cooperation (CTA). In this regard the RBOC continued to enhance the role of the CTA in the Caribbean region as well as improve the access to the information, and stakeholders' capacity in information and communications management. This through the coordination of CTA funded projects implemented by CARDI or in collaboration with a range of Caribbean stakeholder groups, which provided the opportunities to establish new partnerships for both the CTA and CARDI.

Hence a number of proposals were prepared to

seek project funding for co-publications, studies, network development and co-seminars on behalf on Caribbean stakeholders. Proposals from the Caribbean Poultry Association (CPA), the NGO-SPAT, the Agricultural Society of Trinidad & Tobago, Gilbert Agricultural Development Center, Caribbean Regional Fisheries Mechanism (CRFM), Ministries of Agriculture. Projects included support for information services, needs assessment, publications, network development.

CTA supported projects may be coordinated or implemented by CARDI, public sector or private sector agencies or non-governmental agencies singly or in collaboration with a range of partners. Thus the activities described in the rest of this section includes activities organised or undertaken with financial resources from the CTA with human resources, administrative and logistical support being provided by CARDI.

Regional Agricultural Policy Network (RAPN)

Efforts to establish a Regional Agricultural Policy Network (RAPN) for the Caribbean, intensified during 2003. CARDI worked closely with IICA to facilitate the development of this network through coordinating the hosting of a regional workshop to provide training in agricultural policy network management. Thirty one persons from fourteen countries across the Caribbean participated in a CTA/CARDI workshop held in collaboration with IICA, in

Guyana in October 2003, during the Caribbean Week of Agriculture (CWA). The workshop provided potential national and regional managers of networks with the skills, methods and tools necessary to develop mechanisms and activities to improve agricultural policies. Furthermore, the training workshop was designed to enhance a common understanding among key stakeholders on the functioning and management of a regional agricultural policy network, as a basis for helping the regional network to better achieve its mission.

CARDI supported the launch of the RAPN which also coincided with the Caribbean Week of Agriculture (CWA), through the coordination of a presentation, preparation of information products to mark the network launch.

CariPestNet

CariPestNet, a network designed to provide a rapid, cost effective and efficient mechanism for identifying and advising on plant pests and diseases, was launched in November 2003. Twenty participants from 12 countries attended this meeting. The network, which is being coordinated by CARINET, has since been engaged in developing an electronic forum, designing and building a website, selecting moderators and resource persons. CariPestNet

Organisation and Management of Fisher Folk Organisations

CTA and CARDI has been working in collaboration with the Caribbean Regional Fisheries Mechanism (CFRM) to support the development of a strategy and action plan aimed at improving the organisation and management of fisher folk organisations in the Caribbean region. A regional survey to identify the needs, problems and priorities of Caribbean Fisher Folk Organisations, and the major constraints to the development, organisation and management of these organisations in the Caribbean region, will be executed in 2004. The survey will be executed through the use of open-ended and semi-structured interviews in at least nine Caribbean countries. Analyses to be undertaken include a study of the

environment and stakeholders of Fisher's Organisations in the Caribbean as well as the experiences of Caribbean Fisher's organisations and their potential for networking. Survey results will be discussed at a regional meeting of Fisher Folk Organisations in Belize in 2004.

Management of Question and Answer Services (QAS)

The harnessing of information and communication resources to provide relevant, timely information to support decision making is even more important in the context of the dwindling human and financial resources. Eighteen participants from 12 countries were exposed to concepts of identifying user needs, working with stakeholders and partners, networking, promotion and evaluation *inter alia*, as part of a range of techniques and mechanisms designed to provide information to support the development of the agricultural sector.

CTA and CARDI hosted this workshop in collaboration with the Ministry of Agriculture St Lucia, which were able to share their experiences on various aspects of the Question and Answer Services (QAS) with other regional colleagues.

Strategic use of Information and Communication Technologies (ICTs) in the Caribbean Agricultural Sector.

The critical role of information and communications technologies (ICTs) and its potential to impact on the agricultural sector were highlighted in this regional workshop, which was held in Antigua and Barbuda in October 2003. Some 24 Senior Researchers, policy and decision makers from 12 countries were provided with increased skills to identify how the strategic use of ICTs could assist their respective organisations to achieve their objectives. A number of potential projects which could impact on the national and regional agricultural sectors were also identified. The then International Service for National Agricultural Research (ISNAR), the Commonwealth of Learning (COL), as well as the Food and Agriculture Organisation (FAO) partnered with CTA

and CARDI to present this workshop. Potential areas for the development of follow-up projects have been identified for follow-up both at the national and regional levels.

Seminars and Conference Support

The CTA RBOC facilitated the attendance of one participant to the 19th Annual Conference of the Association for International Agricultural Extension Education (AIAEE), while five participants were sponsored to attend the 39th Caribbean Food Crops Society Conference, held in Grenada in July 2003.

CTA funding also enabled the institute to participate in the 2003 Executive Committee Meeting of the Association of Caribbean University Research and Institutional Libraries, held in November 2003, in Grenada.

CTA/CARDI had the opportunity to obtain feedback and support for the implementation of a survey of farmers and NGOs at a meeting of regional farmers and NGO groups held in St Vincent in October 2003. That meeting was hosted by the Eastern Caribbean Trading and Agricultural Development (ECTAD) – one of the CTA national partners in the Caribbean region.

Participation in these international and regional meetings provided the opportunity for Caribbean professionals to interact and exchange ideas and information with their counterparts from both within the region and at international levels.

Publications

Two videos and one booklet were produced through CARDI and the Caribbean Integrated Pest Management Network (CIPMNET) a regional network aimed at exchanging information about the subject among Caribbean researchers and other stakeholders.

Is Our Food Really Safe? and Participatory Rural appraisal: Pathways to Clearer Understanding.

Farmer Field School – A New Way of Learning, were the subject of the videos produced as part of this joint effort. The publication *Farmer Participatory Approach for Ecological Crop Management – A Resource Guide for the Caribbean* supported the videos. Copies of these publications are available from the CIPMNET Secretariat.

The CTA support to the publication of PROCI-CARIBE News continued in 2003. However, due to a number of staff constraints only two issues of the newsletter were published by the end of 2003. Efforts will be made to produce a 'double issue' in 2004 so that the information can reach the intended audience.

Photographic Library

Efforts to develop the photographic library intensified in 2003 after having been in abeyance for sometime. Staff members in the Publications Unit improved skills in photography and use of appropriate software to manage multi-media

Bibliographic Database

The CTA continued to provide support for the development of the bibliographic database at CARDI headquarters which is used to facilitate better access to information for both CARDI staff and regional stakeholders. Focus on increasing the input of 'grey' literature (local publications many of which are not officially published) continued, although limited human resources meant that just over 200 records were added to the databases.

Cross cutting issues - Gender Policy

Gender is one of the cross cutting issues under the CTA strategic Plan 2001-2005. During this current strategic period, the CTA has been intensifying efforts to integrate cross cutting issues into its programme. The RBOC provided comments and feedback on a draft CTA proposal to streamlining gender in the CTA's regional programmes. It is expected that a number of these gender-related

policies will be implemented by CTA headquarters and also through its branch offices and partners in 2004.

Promotional Efforts

Exhibitions featuring publications and services of CTA/CARDI were put on at all regional workshops supported by CTA/CARDI and at ACP-EU forms where possible. In addition a CTA/CARDI Exhibition was also held as part of the activities during the CWA, and thus provided an opportunity for a wide range of stakeholders to be exposed to activities supported by the CTA, and for dissemination of publications and information on services. These forums also served as avenues for identifying potential projects for funding and emerging areas of stakeholder interest.

Support to capacity building through the Caribbean Agricultural Information Service (CAIS)

CAIS has a focus on contributing to the sector's needs for increasing competitiveness within the agricultural sector, by improving the capacity to manage information and communications. The work programme is built around network development, capacity building, generation and dissemination of information and sensitisation and advocacy. These activities are well in keeping with both the CTA mission and objectives, and as CTA Regional Branch Office for the Caribbean (RBOC), CARDI continues to coordinate the development of programmes and projects to assist stakeholders.

E-forum on strategic use of ICTs in agriculture

Participants who attended the CTA/CARDI workshop in 2003, formed an electronic discussion group with a view to fleshing out some issues and developing joint projects in priority areas identified - adult literacy; information infrastructure and content. The e-group is being hosted by the Canadian based tech-

nical support agency, Commonwealth of Learning (COL).

Devolution of Question and Answer Services (QAS)

The devolution of activities associated with a Question and Answer Service (QAS) is currently being carried out on a phased basis in the region. Jamaica, St Lucia, St Vincent and the Grenadines, Barbados, St Kitts/Nevis (Nevis), Antigua and Barbuda, Trinidad & Tobago, Grenada, Haiti and Dominica have all benefited from this project support to date through training and/or development of information services.

Some countries have already embarked on follow-up projects since the completion of the training in 2003. For example, the Gilbert Agricultural and Rural Development (GARD) Center in Antigua initiated an information needs assessment; CARDI Headquarters has agreed to facilitate the attachment for an Agricultural Officer from the Centeno Research Station, Trinidad & Tobago, in support of their efforts to enhance information services to the local farming community. A national QAS workshop has been scheduled for Haiti in 2004.

The evaluation report of the workshop management of question and answer service (QAS) indicated that further work needs to be undertaken to improve skills in cataloguing, classification and development of QAS.

Farmers' Associations and NGO Network Survey

A Survey to identify the information needs, organisational resources, and willingness to network of by Caribbean Farmers and NGO Groups, got underway in December 2003. A literature review to identify any earlier research carried out on this topic was completed and it is anticipated that the questionnaire to obtain information from Caribbean groups will be designed and tested by early 2004. The next phase of the project will be selection of data collectors to undertake the field study in each country. The sur-

vey is scheduled for completion in April 2004, and the output will include a directory of Farmers Associations in the Caribbean region. The results of the survey will be a key item on the agenda of a Regional Meeting of Farmers' and NGOs scheduled for 2004. The outcome of deliberations at this meeting will determine the next steps in this project which CARDI has coordinating along with an interim network of farmers and NGO groups (CaFANN) which was formed at a CTA/CARDI Workshop early in 2002 by the groups present at that meeting.

Joint/ Collaborative Work

Production CD ROMs

CARDI continued work on a joint collaborative project with IICA to prepare multi-media CD ROM production guides. The Hot Pepper and Dasheen CD-ROMs were piloted and reviewed by a joint CARDI/IICA team. Based on a number of the recommendations detailed revision of both information products are being undertaken by a CARDI in-house team coordinated by the Publications and Seminars Committee.

World Rural Women's Day

CARDI participated in a panel along with the University of the West Indies to make a presentation at a Seminar hosted by the Inter American Institute for Cooperation on Agriculture (IICA) in support of the Regional Network of Rural Women for World Rural Women's Day in October 2003. The theme was in keeping with the theme information and communications technologies (ICTs) as a tool for the development of for women. Members present requested further support and technical assistance to assist them to make better use of the technologies available and this was noted for the work programme in 2004.

SIDALC

The Institute responded to an initiation from IICA to deepen the collaborative work in the area of infor-

mation and communications management and submitted a proposal detailing CAIS's operational programme and highlighting potential areas for joint activities through the Caribbean Agricultural Information Service (CAIS). It is expected that the programme will be reviewed and that the IICA headquarters in Costa Rica will provide feedback.

Royal Tropical Institute (KIT)

In December 2003, the Institute hosted a representative of Royal Tropical Institute (KIT), based in the Netherlands. KIT is a non-profit research and development institution based in the Netherlands concerned with international development co-operation. KIT develops methodologies in the fields several fields including agriculture and provides databases, publications and other information resources and services in rural development, tropical agriculture. KIT and CARDI in reciprocal visits are currently reviewing a draft MOU with a view to undertaking collaborative projects. Projects in Cataloguing and classification, database development, electronic resources have already been identified, while the development of systems for innovation as well as databases for monitoring research are being explored.

Internal Services and Projects

Publications Services

In addition to delivering routine desktop publishing and reprographic services, the unit improved the in-house skills in layout, effective writing and photography to both CARDI staff and selected CARDI partners. Technical assistance under the CAIS work programme supported the ongoing development of a system of cataloguing and classification of photographs and the development of a Photographic Library. This system will facilitate easy storage and retrieval of the photographs for use in publications and multi-media information and communication products.

CARDI's Publications and Seminars Committee (PSC) is the mechanism which supports the publication and dissemination of information for wider audiences through encouraging publications, including quality control and facilitating the hosting of seminars through its Seminar Series, still limited to a largely internal audience. A range of topics covered included the following:

Information Technology Services

Help Desk queries from users of the CARDI Local Area Network (LAN) were reduced by as much as 25%, with the increased stability of the LAN and hence improved delivery of facilities such as email, uploading of files and storage capacity of the existing network. This is one benefit of the commissioning of the new server purchased in 2003. However, ongoing cash flow problems limited the efforts to upgrade the access to desktop computer facilities as plans to purchase much needed computers had to be postponed yet again. The option to source equipment for use in projects continues to be explored.

Information and Records Centre

Over three hundred clients benefited from the Question and Answer Service (QAS) offered as part of information services to the Caribbean in 2003. The highest demand was for CARDI and CTA publications, information on roots and tubers, fruit and tree crops, as well as integrated pest management. Researchers remained the largest group of users, however, there was increasing use of the facilities by farmers, policy makers and other QAS service centres in the Caribbean, along with a growing non-Caribbean group of users. Walk in requests are still very significant and represented just around 50% in 2003, however email requests are growing rapidly – approximately 35% of requests for information were via email. Requests via telephone are approximately 14%, while requests by mail or fax are virtually non-existent, together accounting for just over 1% of requests made to the Information Centre.

CARDI PSC Seminars for 2003

11 February 2003
Marketing Unit Operations by Dr Ardon Iton

29 April 2003
International Relations in Agriculture by Michelle John

17 June 2003
The CAMID Network – Strategy and Work Programme 2003/2004 by Vassel Stewart

7 August 2003
Guidelines to Hot Pepper Production by Herman Adams

17 September 2003
Research and Training Activities of the Agribusiness Unit by Beverley Chase and Maurice Wilson

In the Records Centre work on developing the internal file classification system to allow standardisation and easy access to corporate information continues to be challenged by limited staff resources and the need to balance the classification system with the routine document delivery and information services. Further training of staff in the area of records management has been recommended for 2004.

Corporate Communications

While recognising the need for increased efforts in improving its corporate communications, and disseminating information to stakeholders, the Institute has limited resources in this area. A Corporate Communications Committee initiated in 2002 as an in-house team designed to bring attention to this area co-ordinated the publication of selected advertisements and articles aimed at highlighting CARDI's activities to its key stakeholders

Efforts to institutionalise the issue of press releases to coincide with significant events at both Headquarters and the Country Representations met with greater success in 2003, as demonstrated by over 50% increase in the number of press releases issued during the period under review. In addition, over thirty issues of the bi-monthly publication the CARDI Weekly were published and distributed to stakeholders via email. A proposal was also prepared with a view to sourcing technical assistance

and other resources in the area of corporate communications in an effort to fill the skills gap in this area. The proposal will be submitted to relevant donor and technical support agencies early in 2004.

Overall the Information and Communications programme covered a wide range of projects both for internal and external clients. The majority of the objectives set for the programme were achieved,

even as increasing emphasis was placed on integrating and consolidating various projects and activities which made up the programme. Major challenges continued to be limited human resource and institutional capacity both at the Institute and among collaborators in member states. Hence during 2004, recommendations have been made for increased focus on human resource development and institutional strengthening as mechanisms to improve the performance of projects.

Biometrics

Since CARDI was established in 1975, it has always had a strong biometrics unit. This has ensured the scientific integrity of CARDI's work over the years and also that the correct conclusions were drawn from analyses of data generated.

CARDI's biometrics services have always been available to clients and collaborators throughout the region. In 2003, 58 persons from outside the institute contacted and were given service by the biometrics unit. This service ranged from advice on how to collect data, help with the data collection processes and analysis of data right through to interpretation, writing up and presentation.

To help scientists perform and understand statistical analysis, the biometrics unit has given regular training courses throughout the CARICOM region. In 2003, a short one-week course was given to members of research staff of the Ministry of Agriculture and Rural Development, Barbados.

Closely related to biometrics is the issue of impact evaluation. Whereas biometrics ensures quality control of the output of research and development, impact relates to how research and development improves lives. CTA is developing a textbook on *Assessing the impact of information on development* and a booklet *Smart tools for evaluating the performance and impact of agricultural information products and services*. CARDI's biometrician is a member of the CTA team developing these information products and has been involved in impact assessment work in the Caribbean.

Another important area is the quality of refereed journals and CARDI's biometrician is involved in editing and reviewing for several West Indian scientific journals.

Science and technology (S&T) are vital to the future development of the region. S&T must be strongly supported by statisticians in general and by biometricians for biological S&T in disciplines such as agricultural research.

PROCICARIBE

Because of limited financial and human resources the PROCICARIBE system operated with a very small secretariat; about four hours per week of supervisor's time and about eight hours per week of research assistant's time. The 3rd Executive/Steering Committee Meeting scheduled for Guyana on 10 October 2003 during the Caribbean Week of Agriculture was cancelled because of a lack of a quorum.

NARS Institutional Development

A workshop was organised in Barbados on 26 September 2003 on commodity chain analysis for the small ruminant industry. A framework for the formation of regional small ruminant producers association was also developed at the meeting.

Network Activities

The review of the PROCICARIBE system as mandated by the Executive/Steering Committee at its 2nd meeting in Trinidad in March 2002 was started with the drafting of the questionnaire and terms of reference for the consultant.

CAPGERNET

Researchers involved in CAPGERNET bred and selected two new stable hot pepper genotypes – CARDI Red and CARDI Green – which should be undergoing field evaluation in the Caribbean Regional Hot Pepper Varietal Test (CRHPVT). Preliminary observations have shown that four accessions within the Caribbean Regional Hot Pepper Germplasm Collection might have high levels of tolerance/resistance to the broad mite which is a serious pest on hot peppers in the region. These accessions should be subjected to further evaluations and utilised as cultivars in their own right or as parents in crosses to confer resistance to commercial cultivars.

CARINET

The network coordinated pest identification and management training courses throughout the region.

CASRUNET

In Barbados a study, using PCR techniques to ascertain whether Barbados Blackbelly off types and mixtures, or the breed as present in Oklahoma USA could be considered genetically as belonging to the population present in Barbados was completed. The results suggested that only 80 per cent of reference population was correctly classified as Barbados Blackbelly and none of the "Blackbelly" off types, mixtures or sheep from the USA was classified as belonging to the reference group in Barbados.

The network in Jamaica facilitated the export, by the Goat Breeders Society of Jamaica, of three Boer breeding does to Antigua in July 2003.

Belize initiated steps to acquire improved breeds of sheep and goats from Mexico and the USA to accelerate both meat and milk (goat) production.

A document entitled *A Study of the Small Ruminant Industry in Trinidad and Tobago: A Programme Towards Self-Sufficiency* which detailed an analysis of the small ruminant industry in the country including measures for the sustained development, was submitted to the Minister of Agriculture, Land and Marine Resources for consideration and action.

In Barbados studies aimed at increasing productivity and profitability by (a) reducing seasonal anoestrous in dairy goats, (b) shortening lambing intervals in sheep and (c) using "replacers" for goat milk to raise kids were completed (a and c) or continued. The results for (a) showed that the oestrus cycle in goats could be successfully manipulated to induce breeding in anoestrous goats using Melatonin and that the kidding season could be brought forward by about three months in the process. For (c), it was concluded that milk replacer and/or powdered milk could replace the suckling in dairy goats without compromising weight gain.

A study on economic viability of the small ruminant sub-sector in Jamaica was completed with the description of six economically viable production models.

CIPMNET

Most of the activities initiated in 2002 under the EC-CARIFORUM CAFIP-IPM project were completed successfully in the reporting year as follows:

Coconut Lethal Yellowing survey

Four of the seven proposed countries (Antigua & Barbuda, St Lucia, Suriname and Trinidad & Tobago) collected the samples for the survey. One of the four countries showed the presence of LY phytoplasmas in several samples.

Farmer Field Schools

The pilot project in Trinidad and Tobago was completed with the publication of the manual and video of the *Farmer Participatory Approach for Ecological Crop Management – A Resource Guide for the Caribbean*. Also, 12 Master Trainers from seven countries (Jamaica, Haiti, Dominican Republic,

Dominica, Trinidad & Tobago, Suriname and Guyana) were certified from the pilot project. Subsequently, during a 16-week period from August to December 2003 the Farmer Field Schools concept was introduced in the listed territories except Guyana.

Information and Communication

The CaribbeanIPM@Yahoogroups.com electronic network was strengthened by a linkage to the global PestNet electronic group based in south-east Asia. This network offers tremendous assistance in pest diagnostics and management by experts worldwide.

Global Linkages

In January 2003 Dr Claude Vuillaume of CIRAD, Guadeloupe visited several territories in the region to forge collaborative research linkages. PROCICARIBE coordinated the initiatives. Mr. Herman Adams, Head, Project Development and Planning, CARDI represented PROCICARIBE at the 4th meeting of FORAGRO held in Panama City, Panama during 17-18 September 2003.

Project Development and Planning

The main objectives of the Project Development and Planning Unit during 2003 were the mobilisation of resources through the submission of project proposals; ensuring timely and adequate reporting on projects being implemented; co-ordination of the development of project proposals through broad and in-depth consultations; exploring new collaborative partnerships and donors; and monitoring and evaluation of project implementation.

There were a seven on-going projects and activities under the CARDI/IICA collaboration programme which started before 2003. Three were completed during the year:

- Training of two regional scientists at CIP (Peru)
- Control of Johne's Disease on small ruminants (Trinidad and Tobago)
- Support the attendance of a CARDI scientist to the International Society of Tropical Root Crops conference in Tanzania, November 2003.

The other four projects were advanced by another year:

- The use of morera in forage based feeding systems
- Establishment of production and marketing databases for the regional agribusiness sector
- Preparation of CD-ROMs on dasheen, onion and hot pepper
- The IICA/CARDI revolving fund

Of the 13 new projects submitted for approval to IICA, eight were selected for funding, as follows:

1. Development of community-based small ruminant enterprises on mined-out bauxite lands – Jamaica Mocho Goat Development Project
2. Provision of technical assistance to farmers in the Walkers Wood Agricultural Project in Jamaica
3. Improving the hot pepper industry of

Trinidad and Tobago

4. Development of a CD-ROM course in Agribusiness Management
5. Compilation and distribution of small ruminants information products
6. *Increasing opportunities within the farming sector: A market assessment for convenience foods (pre packaged vegetables) in Trinidad*
7. The development of technical packages for the commercial production of ten indigenous medicinal plants selected for marketing as medicinal plant commodities
8. Development of commercial seedling and vegetable production systems under shadehouse in St Vincent and the Grenadines.

The unit was directly involved in the implementation of seven projects/activities shown in Table 10 on the following page.

Efforts were made in fostering collaboration with international institutions and donors as follows:

- Memorandum of Understanding was signed with the University of Florida.
- Meetings were held with visitors from Penn State University.
- CARDI was represented at meetings of the Caribbean Water Partnership hosted by the Netherlands Embassy.
- Discussions were held with FAO on the initiatives to site an economist and an irrigation specialist in CARDI under the CARICOM/FAO Food Security Project.
- The concept for livestock feed project was discussed with the National Flour Mills and UWI.

The unit also carried out numerous other activities of a technical assistance or co-ordinatory nature within CARDI's hot pepper sub-programme, CAPGERNET and internal corporate communications.

Table 10 Status of the seven new projects

Project	Status
The EU whitefly project	Completed
Preparation of the hot pepper CD-ROM	Advanced
Hot pepper manual for Barbados	Drafted and submitted to CR of CARDI-Barbados for completion
Hot pepper and pumpkin seed production project for Agricultural Society of Trinidad and Tobago	Advanced as scheduled
CARICOM/MEXICO hot pepper project	Two Caribbean scientists visited Mexico, one Mexican scientist visited the Caribbean to review the hot pepper industry; the Caribbean Regional Hot Pepper workshop was held in Port of Spain in November 2003
Support for attendance at Caribbean Food Crops Society 39th Annual Conference	EURO 5,998 was received from CTA and five CARDI scientists were supported
MASHAV - Israel training in pressurised irrigation systems and intensive vegetable production systems	Funds from the CDB and support from MASHAV were secured to hold the training in the Caribbean in 2004

Agribusiness

The strategic plan of the agribusiness programme continued to be the promotion and consolidation of CARDI as a credible Research & Training (R & T) provider within the region through:

- The provision of agribusiness advisory and technical services by the forging of collaborative linkages with local and regional agricultural/agribusiness institutions.
- The continued provision of technical assistance and advisory services to primary and down stream agribusiness enterprises.
- The provision of joint consultancy services through networking activities.

In terms of technical assistance & advisory services the main activity focus during the year was the provision of (Research & Training) services under the CARTF programme. Additionally, new opportunities for technical assistance in business advisory and technology services continued to be evaluated.

Additionally during the year 2003, the Business Unit prepared and submitted to the Board of directors its 5-year strategic plan over the period 2004-2008 (circulated to all unit heads/representations).

Within the above context, the year 2003 saw CARDI increasingly recognised as an R&T provider in many of its representations. During the year 16 new projects valued at approximately US\$557,000 were implemented. In this regard, the cumulative agribusiness portfolio increased from US\$173,000 as at December 2002 to US\$730,000 by December 2003.

During the coming years, the Unit's plans include maintaining the momentum of resource mobilisation to accelerate the process of technology transfer to agribusiness enterprises through industry development while continuing to promote an accelerated investment culture through strategic training and technical assistance. Accordingly, the programme will be targeting its principal stakeholders, collaborators/donors and the private sector.

Marketing

In 2003, the Marketing Unit contributed to the development of the Region's agricultural sector in which marketing assistance was provided to agribusiness enterprises, farmers, processors, exporters, and to Ministries of Agriculture in Member States.

In recognition of the significant role of the private sector to maximise market opportunities, enhance productivity and competitiveness, and secure a competitive production structure to yield foreign exchange earnings, the Marketing Unit conducted market studies, and provided a wide range of services.

Commodity case studies were completed for cassava, sweet potato and hot pepper and a regional hot pepper consumer study was carried out. In support of the CARDI/CTA work programme for 2003 activities at the regional level assisted in the development of selected commodities in the Caribbean. Commodities focussed on were small ruminants, cassava, sweet potato and dasheen. A Regional workshop, designed to sensitise participants and stakeholders of the industries as well as to develop a framework to better equip the respective industries to become more competitive, was held in Trinidad and Tobago

In the quest to propel growth and development the Unit facilitated pack-house equipment for Grenada, St Lucia, St Vincent and the Grenadines, and Trinidad and Tobago. A washing line for fruits and vegetables was provided to these Member States. This will assist to increase the efficiency of their exports.

In addition, to improve the quality of fresh produce available to domestic markets in St Lucia and Trinidad and Tobago, and also for the fresh produce export business packing house washing lines were provided to NAMDEVCO and the St Lucia Marketing Board.

The Marketing Unit also provided marketing advice/assistance to private and public sectors on the commodities for which CARDI has responsibility under the Regional Transformation Programme (RTP).

Selected Publications

- Adams H. 2003. The production of new and improved hot pepper cultivars for the Caribbean. Presented at the Annual Technical Conference of the Ministry of Agriculture and Rural Development, Barbados
- Andall R. 2003. The dwarfing effect of grafting and pruning on large traditional golden apple (*Spondias cytherea* Sonn.) Presented at the 39th Annual Meeting of the Caribbean Food Crops Society, Grenada. 13-19 July 2003
- Asiedu F H K and Lauckner F B. 2003. Guidelines for livestock experimentation and management. Published by CARDI, Jamaica
- Asiedu, F.H.K. and Lauckner, F.B. 2003. ACP science and technology policy networks and institutions - The Caribbean experience. Presented at the 2nd Meeting of ACP Informal Working Group on Science & Technology, Ede, The Netherlands, 28 November–3 December 2003
- Asiedu, F.H.K., McDonald, D. and Seaton, J.M. 2003. Observations on non-dormant alfalfa cultivars at two locations in Jamaica. CARDI Review 3, 1-8
- CARDI. 2003. CARDI Weekly. Newsletter. St Augustine, Trinidad and Tobago: Caribbean Agricultural Research and Development Institute
- Clarke-Harris D. 2003. Rational Pesticide use in IPM of pesticide-reliant vegetable crops in the Caribbean, Presented at the 39th Annual Meeting of the Caribbean Food Crops Society, Grenada: 13-19 July 2003
- Clarke-Harris D O and Fleischer J S. 2003 Sequential sampling and biorational chemistries for management of lepidopteran pests of vegetable amaranth in the Caribbean. J. Econ. Entomol. 96 (3): 798-804
- Iton A and Samsoundar J. 2003. Determining per capita consumption of sweet potato (*Ipomea batatas*) for adults in St Vincent & the Grenadines. Presented at the Annual Technical Conference of the Ministry of Agriculture and Rural Development, Barbados
- Paulraj L and Gibbs I. 2003. Measuring the efficacy of the biological control programme for sugarcane moth borer (*Diatraea saccharalis* F.) in Barbados: joint infestation surveys for the period 1999-2002. Presented at the
- Paulraj L, de Boer, H and Rao, S. 2003. Survey of sugarcane ratoon stunting disease in Barbados. CARDI Review. 3, 9-18
- Roberts C, Ramsubag A and Umaharan P. 2003. The impact of tissue culture in the English speaking Caribbean. International Journal of Island Affairs, INSULA, Year 12, No. 1: 11-16
- Robin, G. 2003. Taro (*Colocasia esculenta* (L) Schott Var. *esculenta*): production, constraints and research in Dominica and other Caribbean Countries. Presented at the Third Taro Symposium, Nadi, Fiji., 21 – 23 May 2003

- Robin, G. 2003. The effects of agronomic practices, seasonality and agro-ecological zones, on suckering, scarring and weight of dasheen (*Colocasia esculenta* (L) Schott var. *esculenta*). A paper presented at the 39th Annual Meeting of the Caribbean Food Crops Society, Grenada, 13 – 19 July 2003
- Robin, G. 2003. Developing systems for sustainable production of export grade dasheen (*Colocasia esculenta* (L) Schott Var. *esculenta*) in Dominica. A paper presented at the 13th Symposium of The International Society for Tropical Root Crops (ISTRC), Arusha, Tanzania, 10 – 14 November 2003
- Simpson, L. 2003 Possible effects on the environment of agricultural practices on hillsides in Jamaica. Presented at the 17th Annual National Conference on Science and Technology, Kingston, Jamaica, 19-22 November, 2003
- Simpson, L. 2003. Review of soil management and farming practices, including the use of agro-chemicals in the Caribbean, with particular reference to St Lucia and Jamaica. Research project DFID NRSP R7668. Jamaica: CARDI, April 2003
- Titus P, Lawrence W and Bishop C. 2003. The commodity systems approach to sustainable agricultural development in St Vincent and the Grenadines with reference to specific crops - challenges and opportunities. A paper presented at the 39th Annual Meeting of the Caribbean Food Crops Society, Grenada, 13 – 19 July 2003

Finance

The Finance Department, in its management of the institute's funds, provided financial information and training to internal as well as some external clients. During 2003 the Assistant Accountant, Mr. Simon Sieunarine visited St. Vincent and the Grenadines and St. Kitts & Nevis to provide orientation and training to Administrative Assistants. The department also provided some accounting assistance to the Caribbean Agri-Business Association (CABA).

The Challenge during 2003 was cash management. The lack of adequate funds meant that some activities had to be delayed or in some cases where commitments were made, the liability incurred.

Table 10 shows a summary of the Income Statement with the years 2001 and 2002 as comparatives. The lower net deficit in 2003 is as a result of write off of fixed assets in 2002 together with lower personnel costs in 2003. It is important to identify that it was in 2001 that a provision was made for part of Guyana's debt (\$5.2 Mn), hence the large expenditure figure in that year. The

improved position was also as a result of cost containment exercises.

Table 11 below separates the results of core operations and donor financed operations. As is expected, donor funded projects are usually breakeven and any differences are explained by timing differences.

Table 12 on the following page shows that budgeted Government Revenue for 2003 was EC\$7.75 Mn, actual collections were EC\$7.42 Mn. The effect was to increase arrears of government contributions by EC\$0.33 Mn from EC\$12.8 Mn at 31 December 2002 to EC\$ 4.2 Mn at 31 December 2003. The difference in the arithmetic calculation (EC\$1.10 Mn) relates to Guyana's arrears.

Donor revenue increased in from EC\$ 1.5 Mn in 2002 to EC\$ 1.7 Mn in 2003. CTA (EC\$ 0.9 Mn), CARTF (EC\$0.3) and Coffee Industry Board – Jamaica (EC\$ 0.2 Mn) being the major contributors, accounting for 82% of total donor revenue. Other traditional donors continued their support of CARDI's programmes and are detailed in the

Table 10 Summary of the Income Statement with the years 2001 and 2002 as comparatives.

(EC\$ thousands)	2003	2002	2001
Total Revenues	9,921	9,881	10,881
Total Expenditure	10,385	11,849	17,420
Net Surplus/(Deficit)	(464)	(1,968)	(6,539)
Net Assets	11,525	11,989	13,953

Table 11 Core operations and Donor financed operations

(EC\$ thousands)	2003 Core	2003 Donor	2002 Core	2002 Donor
Total Revenues	8,254	1,667	8,335	1,546
Total Expenditure	8,679	1,706	10,613	1,237
Net Surplus/(Deficit)	(425)	(39)	(2,278)	309

Table 12 Budgeted government revenue

(EC\$ thousands)	2003	2002
Gov't Contributions Due	7,752	7,769
Amount actually Paid	7,422	6,016
Shortfall	(330)	(1,753)

notes to the financial statements.

The balance sheet as highlighted in Table 10 shows CARDI's net assets as at December 2003 being valued at EC\$11.5 Mn. This comprises of fixed assets

of \$7.0 Mn net current assets of \$4.6 Mn and long term liabilities of \$0.1 Mn. Part of the current exercise being undertaken by the department is the physical verification of the CARDI's fixed assets.

The outlook for 2004 is to focus on areas through which the Institute could generate revenue. Core financing is generally committed and cannot support potential core project or investments. The liquidation of outstanding contributions to core, which currently stands at EC\$14.2 is a springboard from which the Institute could cancel staff and other liabilities and begin to retool.

Human Resource

A review of the performance management system was completed resulting initially with the implementation of a pilot of the performance appraisal tool. This pilot is to conclude in January 2004. During 2003 the Human Resource manager visited six country units to deliver team building workshops and the introduction of the performance management system. The review of all job descriptions began in 2003 and is expected to be completed in the first quarter of 2004. During the year 2003 - 11 persons were recruited, five persons promoted and eight persons received external training. Medical Insurance benefits were enhanced without additional cost. The Human Resource unit continues to efficiently administer the medical insurance plan while constantly seeking improvements.

Directorate and Personnel

Board of Governors

Honourable Anthony Wood	Chairman, Barbados (<i>until June</i>)
Honourable Erskine Griffith	Chairman, Barbados (<i>from June</i>)
Honourable Vere C Bird (Jnr)	Antigua & Barbuda
Honourable Daniel Silva	Belize
Honourable Vince Henderson	Dominica
Honourable Claris Charles	Grenada
Honourable Reepu Persaud	Guyana
Honourable Roger Clarke	Jamaica
Honourable Margaret Dyer-Howe	Montserrat
Honourable Cedric Liburd	St Kitts/Nevis
Honourable Calixte George	St Lucia
Honourable Selmon Walters	St Vincent & the Grenadines (<i>until June</i>)
Honourable Girlynn Miguel	St Vincent & the Grenadines (<i>from June</i>)
Honourable John Rahael	Trinidad & Tobago (<i>until November</i>)
Honourable Jarrette Narine	Trinidad & Tobago (<i>from November</i>)

Board of Directors

Dr Keith Archibald	Chairman
Mr Hollis Henry	Antigua & Bermuda for Leeward Islands) <i>until May</i>
Mr Winston Burleigh	Antigua & Bermuda (for Leeward Islands) <i>from May</i>
Mr Carston Simmons	Barbados
Mr Sergio Garcia	Belize
Mr Raymond Austrie	Dominica (for Windward Islands) <i>until May</i>
Mr Davis Letang	Dominica (for Windward Islands) <i>from May</i>
Mr Dindyal Permaul	Guyana
Dr Richard Harrison	Jamaica
Dr John Pegus	Trinidad & Tobago
Ms Desiree Field-Ridley	CARICOM Secretariat
Dr Patsy Francis	University of Guyana
Prof Charles McDavid	The University of the West Indies
Mr Lionel James	Caribbean Development Bank
Mr Bruce Lauckner	Executive Director, Ag

Alternate Members

Ms Nadica McIntyre	Grenada (Alternate for Windwards)
Ms Ann Marie Dewar	Montserrat (for the Leeward islands)

Observers

Mr Raphael Archibald	St Kitts/Nevis
Ms Pamela Brown	St Vincent & the Grenadines
Mr Julius Polius	St Lucia

Mr Aaron Parke	Inter-American Institute for Cooperation on Agriculture (IICA)
Mr David Bowen	Food and Agriculture Organisation of the United Nations(FAO)
Dr Carl B Greenidge	Technical Centre for Cooperation on Agriculture and Rural Development (CTA)

Senior Management Team

deFreitas, Claudette. MLIS	Information Resources Manager
Iton, Ardon. PhD	Head, Marketing Unit
Lauckner, Bruce. BSc	Executive Director (Ag.)
Nero, Curtis. ACCA	Accountant
Gibson, Norman. MPhil	Manager, Research and Development (Ag.)
Pillgrim, Valarie. MBA	Corporate Planner (<i>to March 2003</i>)
Rampersad-Fook, Margaret. MSc	Human Resources Manager
Wilson, Maurice. MSc	Agribusiness Development Specialist

Professional Staff

Adams, Herman. MSc	Plant Breeder, CR	Barbados
Andall, Reginald. MSc	Technology Transfer, CR	Grenada
Asiedu, Francis. PhD	Animal Science, CR	Jamaica
Belgrove, Kelly. MSc	Information Scientist	Headquarters (<i>from October</i>)
Blythe, Adali.	Administrator	Jamaica
Clarke-Harris, Dionne. MPhil	Entomology	Jamaica
Dalip, Kathy. PhD	Entomology	Jamaica
Fearon, Albert. MSc	Technology Adaptation	Jamaica
Hosein, Azim. MPhil	Technology Adaptation	Guyana
John, Michelle. MSc	Scientist	Headquarters (<i>from October</i>)
Jones, Frederick. MSc	Plant Pathology, CR	St Lucia (<i>until May</i>)
McAndrew, Neville. MSc	Agronomy	Belize
Paulraj, Litta. PhD	Tissue Culture	Barbados
Pilgrim, Ronald. MSc	Postharvest Technology	St Lucia (<i>CR from June</i>)
Petersen, Joan. BSc	Agronomy	Trinidad and Tobago
Rhodes, Llewellyn. MPhil	Entomology, CR	St Kitts/Nevis
Roberts, Cyril. PhD	Biotechnology	Barbados (<i>CR from May</i>)
Robin, Gregory. MPhil	Agronomy, CR	Dominica
Ross, Julius. MSc	Horticulture, CR	Antigua and Barbuda
Scantlebury, Collin. MSc	Tissue Culture	Barbados
Simpson, Leslie. PhD	Soil Science	Jamaica
Sinha, Anil. MSc	Agronomy, CR	Belize
Sieunarine, Simon. MBA	Assistant Accountant	Headquarters (<i>from February</i>)
Titus, Pathleen. MPhil	Agronomy, CR	St Vincent and the Grenadines
Williams, Dwight. MSc	Scientist I	Jamaica (<i>from July</i>)

Technical staff***Antigua***

Adams, Sylvester
 Batchelor, Delvin
 Browne, Bradbury
 Henry, Angela

Field Assistant
 Technical Assistant
 Field Assistant
 Administrative Assistant

Barbados

Forde, Morreen
 Hope, Ron
 Niles, Marcia
 Pollard, Ashton
 Assistant
 Sisnett, Derek
 Wood, Barbara
 Worrell, Ferdinand

Secretary
 Technical Assistant
 Administrative Assistant
 Senior Laboratory
 Laboratory Assistant
 Laboratory Assistant
 Field Assistant

Belize

Alpuche, Rosita

 Garcia, Angel
 Lindo, Martin

Administrative Assistant
(until June)
 Watchman
 Technician

Dominica

Corriette, Lucille
 Etienne, Dorian
 James, Suzanne
 St Luce, Mervin

 Thomas, Jacob

Administrative Assistant
 Technician
 Technician
 Research Assistant
(from September)
 Field Assistant

Grenada

Bruno, Janelle
 Charles, Elton
 Raymond, Reuben

Administrative Assistant
 Technician *(from June)*
 Field Assistant

Jamaica

Allen, Carlton
 Asiedu, Elizabeth
 Bailey, Una
 Barnes, Joel
 Barnes, Ralston
 Brown, Maxine
 Davis, Winsome

Research Assistant *(from May)*
 Accounts Clerk
 Maid/Cleaner
 Technical Assistant
 Technical Assistant
 Research Assistant
 Accounts Clerk *(from July)*

Fuller, Christopher	Research Assistant
Gordon - Sangster, Andrea	Secretary (<i>from January</i>)
Hanson, Norman	Farm Supervisor
Jones, Desmond	Technical Assistant
Matherson, Sandra	Receptionist
Maxwell, Ervin	Agricultural Labourer
McDonald, Lloyd	Expeditor/Driver
Morris, Erna	Accounting Assistant
Morrison, Clovis	Technical Assistant (<i>until August</i>)
Pitterson, Patrick	Research Assistant
Robinson, Kenrick	Technical Assistant
Samuels, Paul	Technical Assistant
Simpson, Donald	Technical Assistant
Trought, Anthony	Research Assistant
Webb, Francine	Research Assistant
Williams, Dwight	Technical Assistant (<i>until May</i>)
Wizzart, Archibald	Accounts Clerk (<i>until February</i>)
Monsterrat	
Murraine, Robert	Technician
St Kitts	
Browne, Roderick	Field Assistant
Farier, Austin	Senior Technician
Hamilton, Sharon	Administrative Assistant
Knight, Laurence	Technician (<i>from October</i>)
St Lucia	
Auguste, Gabriel	Field Assistant
Frederick, Sylvester	Field Station Supervisor
Myers, Peter	Technician
O'Brien Sharon	Administrative Assistant
St Vincent and the Grenadines	
deFreitas, Jacqueline	Administrative Assistant (<i>until September</i>)
Gittens, Avelyn	Administrative Assistant (<i>from October</i>)
Sampson, Lenford	Technician
T & T Unit	
John, Michelle	Research Assistant (<i>until September</i>)
Leith, Hendrickson	Administrative Assistant
Quashie, Selby	Technician
Headquarters	

Abraham-King, Shelley	Accounting Assistant
Baptiste, Marva	Accounting Assistant
Basdeo, Krishna	Messenger/Driver
Bassant, Ramsaran	Office Assistant/Driver
Belgrove, Kelly	Research Assistant (<i>until September</i>)
Butler, Sharmin	Kitchen Attendant
Brathwaite, Laticher	Information Assistant
Calliste, Jean	Telephone Operator
Chase, Beverly	Research Assistant
Christo, Trevor	Production Assistant
Cruickshank, Karel	Personnel Clerk (<i>January 2003</i>)
Dookie-Hamil, Rajdaye	Accounts Clerk
Dubarry, Candice	Supervisor, Printing Services
Hamilton, Elizabeth	Administrative Secretary (<i>from February</i>)
Jones, Marcus	Statistical Assistant
Kaloo, Leslie-Anne	Snr. Accounting Assistant
Khan, Prematie	Accounts Clerk
Maharaj, Debra	Executive Assistant
Muller, Pauline	Information Assistant
Prevost, Shanna	Research Assistant (<i>until October</i>)
Perez, Lisa	Graduate Assistant (<i>from June</i>)
Rambadan, Shamela	Graduate Assistant (<i>until June</i>)
Redhead, Margaret	Administrative Secretary
Roach, Keith	Production Assistant
Samaroo, Allan	Network Analyst
Samsoondar, Jaiwantie	Research Assistant
Scarlette, Carlene	Research Assistant (<i>from October</i>)
Sieunarine, Simon	Accountant (<i>until January</i>)
Simmons, Jasmin	Information Assistant
St George, Paula	Clerk (<i>from February</i>)
Williams - Pierre, Cherry Ann	Research Assistant (<i>until October</i>)
Wilson, Hazel	Senior Administrative Secretary

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