

CARDI JAMAICA

2005 / 2006 ANNUAL REPORT





**CARDI JAMAICA UNIT
ANNUAL REPORT
2005 / 2006**

“Improving lives through agricultural research”



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Acronyms and Abbreviations

ACP	African, Caribbean, Pacific
ADC	Agricultural Development Corporation
ALPART	Alumina Partners of Jamaica
ALCAN	Aluminium Canada
ANOVA	Analysis of Variance
ASSP	Agricultural Support Services Project of the Ministry of Agriculture
BrCA	Brown Citrus Aphid
BSJ	Bureau of Standards Jamaica
CAPP	Certification of Agricultural Produce Project
CARDI	Caribbean Agricultural Research and Development Institute
CASE	College of Agriculture Science and Education
CASRUNET	Caribbean Small Ruminant Network
CDB	Caribbean Development Bank
CIDA	Canadian International Development Agency
COL	Commonwealth of Learning
CPGCA Ltd.	Christiana Potato Growers Cooperative Association Limited
CROSQ	CARICOM Regional Organization for Standards and Quality
CRFM	Caribbean Regional Fisheries Mechanism
CRP	Citrus Replanting Programme
CTA	Technical Centre for Agricultural and Rural Cooperation of ACP-EU
CTV	Citrus Tristeza Virus
CXC	Caribbean Examination Council
DTC	Demonstration and Training Centre
EC	Eastern Caribbean
ECTAD	Eastern Caribbean Trading and Development Company
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
FAO	Food and Agricultural Organization of the United Nations
FOL	Fire on Land
FORAGRO	Foro Regional de Investigación y Desarrollo Tecnológico Agropecuario
FSPID	Food Storage and Prevention of Infestation Division
GBSJ	Goat Breeders Society of Jamaica
GECAFS	Global Environmental Change and Food Systems
GHG	Greenhouse Gas
ICC	International Cricket Council
ICENS	International Centre for Environmental and Nuclear Science
IDRC	International Development Research Centre
IGAT	Instituto de Ganadería Tropical
IICA	Inter-American Institute for Cooperation on Agriculture
IPM	Integrated Pest Management
IPM CRSP	Integrated Pest Management Collaborative Research Support Program
ISPM	International Standards for Phytosanitary Measures
JADF	Jamaica Agricultural Development Foundation
JAS	Jamaica Agricultural Society
JBI	Jamaica Bauxite Institute
JEA	Jamaica Exporters Association
JOAM	Jamaica Organic Agricultural Movement

JSAS	Jamaican Society for Agricultural Sciences
JSFA	Jamaica Sheep Farmers Association
JSIF	Jamaica Social Investment Fund
JVMA	Jamaica Veterinary Medical Association
LAC	Latin America and Caribbean
MACC	Mainstreaming Adaptation to Climate Change
MALMR	Ministry of Agriculture Land and Marine Resources of Trinidad and Tobago
MEDA	Mennonite Economic Development Associates
MINAG	Ministry of Agriculture
NCCARD	National Coordinating Committee for Agricultural Research and Development
NOAEP	National Organic Agriculture Enhancement Programme
NRM	Natural Resources Management
PAC	Project Advisory Committee
PCF4	The Fourth Pan Commonwealth Forum
PCR	Polymerase Chain Reaction
PGRPA	Plant genetic Resources for Food and Agriculture
PMC	Project Management Committee
POW	Programme of work
PSU	Pennsylvania State University
PIOJ	Planning Institute of Jamaica
QM	Quarter Million
RADA	Rural Agricultural Development Authority
REACT	Rural Enterprise Agriculture and Community Tourism
SANREM	Soil and Natural Resources Management
SED	Standard Error of Difference
SEM	Standard Error of the Mean
SIDS	Small Island Development States
SMDTC	Sam Motta Sheep and Goat Demonstration and Training Centre
SPLB	Sweetpotato Leaf Beetle
SRIDP	Small Ruminant Industry Development Plan
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA/APHIS	United States Department of Agriculture and the Animal and Plant Health Inspection Services
USDA/FAS	United States Department of Agriculture Foreign Agricultural Service
UWI	University of the West Indies
WAS	Weeks after sowing
WAT	Weeks after transplanting
WWAP	Walkers Wood Agricultural Project
YB	Yellow Belly



Foreword

I am pleased to present the 2005/2006 Annual Report of the Jamaica Unit of the Caribbean Agricultural Research and Development Institute (CARDI). This report focuses specifically on our contributions to the Government and peoples of Jamaica in the development of technologies in the areas of Livestock Production and Natural Resource Management. It also covers work in the CARDI mandate related to market development and information and communications within the agricultural sector.

The Livestock Programme consolidated earlier successes in the area of goat production systems. We continued to work with our partners to provide improved breeding stock to the farming communities and to select high yielding, good quality and adaptable forages to enhance feeding systems.

In the Natural Resources Management Programme, the work on IPM focused on sustainable and environmentally friendly management of pests and food safety issues of non-traditional export commodities – callaloo, hot pepper and sweetpotato – and an important domestic crop – cabbage. We also continued to extend to other Caribbean countries the IPM models developed in Jamaica. In organic agriculture studies continued on the use of various organic manures and their effect on the productivity of hot pepper and callaloo. In addition, information on vermiculture continued to be gathered with the aim of providing the technology to organic farmers.

The Market Development Programme, though in its infancy, covers an important area of commercialising our technologies. At present the main activities are the commercial production of vegetables on the Mona DTC and the production of high quality livestock feed using agricultural by-products. We are also determining the value added characteristics of sweetpotato.

The establishment and functioning of the National Coordinating Committee for Agricultural Research and Development (NCCARD) with the Ministry of Agriculture in the chairmanship position and CARDI as the secretariat is one of the most important development over the reporting period. The NCCARD seeks to harmonise and bring collaboration in agricultural research and development efforts among public and private sector stakeholders.

The CARDI family takes this opportunity to express its gratitude to the Government and peoples of Jamaica through the Ministry of Agriculture and Lands for the continued financial and moral support. We are equally grateful to our numerous donors and collaborators, especially ALPART, RADA, USAID (through IPM-CRSP), Bureau of Standards Jamaica, Jamaica Organic Agricultural Movement and the Goat Breeders Society of Jamaica.

Francis Asiedu, Ph.D.
CARDI Representative

Highlights – 2005/6

The CARDI Jamaica Unit Annual Report 2005/6 highlights specifically our contribution to the development of the small ruminant industry, sweet potato enterprise development, integrated pest management in vegetables and sweetpotato, entomological support to the citrus replanting programme of the Ministry of Agriculture, organic agriculture and the sustainable development and management of Jamaica's natural resources, market development and information and communication.

Technical Programmes

Livestock Programme

CARDI, together with its partners especially farmers, continued the efforts to develop the sheep and goat industry in Jamaica. The activities undertaken in these efforts were the development and provision of improved breeding stock, development of sustainable feeding systems and the upscaling of the technologies and the monitoring of progress of the sheep and goat industry.

Breed Improvement

At the Sam Motta Demonstration and Training Centre (SMDTC) we continued the cross breeding among the Alpine, Nubian and the Boer exotic breeds and the Native goat towards the attainment of 87 per cent genotype of the top-cross buck. Over the period in review 50 per cent of the 257 kids produced attained this target. Breed type did not influence the birth weights and weight gains to 90 days for the kids produced from the cross breeding in 2005. In 2006, at the 75 per cent level the offspring of the Alpine breed had significantly higher weaning weights (18.3 kg) and average daily weight gains than the other breeds. During the two years, 96 improved breeding animals were distributed from the SMDTC to farmers and 41 farmers with a total of 62 does utilized the community buck service.

Breeding techniques

A study was also initiated to improve productivity in goats through breeding efficiency and to evaluate the effectiveness of oestrus synchronization in goats in Jamaica. Initial results indicate that treated animals produced kids over a period of eight days while the untreated group produced kids over a 55-day period.



Feeding and Production Systems

Over the period there were three studies to evaluate some native and exotic forage species. In the first study, the agronomic performance and nutritive value of Mombasa, Guinea grass and *Panicum maximum* (common Guinea grass) grown on mined out bauxite land in Manchester was assessed. The initial results showed that Mombasa demonstrated faster ground coverage, thicker culms, greater plant growth in terms of increasing height, final height attained and herbage biomass accumulation, but the non-stem fraction remained comparable to the *typica* variety. The second study evaluated the performance of Mulato (*Brachiaria hybrido cv Mulato*), Tifton 85 (*Cynodon dactylon cv Tifton 85*), Jarra grass (*Digitaria milanjana*) and common Pangola (*Digitaria eriantha*). The first year evaluation indicated a superior performance of Tifton 85 and common Pangola compared to the other two species. The third study evaluated three forage legume cultivars, including two blue peas (*Clitoria ternatea*) varieties - exotic and native - and one alfalfa (*Medicago sativa cv Florida 99*) variety and in the first year the exotic clitoria performed superior to the other legumes.

Technology Transfer and Outreach Systems

The outreach programme continued to provide an avenue to bring small ruminant production technologies to farmers and to monitor developments in the small ruminant industry

Goat Commercialization Project

Our role in the Government-sponsored Goat Commercialisation Project is to recommend/recruit and train farmers from the central and western parishes to the programme. During the two years, notwithstanding several constraints, activities continued in this programme.

Development of training and other outreach systems

During the period in review there were 457 visitors who came to the centre for various tours and information in addition to over 130 persons who attended an open day in November 2006. During the period there were 23 farm visits where activities ranged from technical assistance on forage production to breeding and multiplication techniques. Additionally at least 45 farmers, students and institutions visited the Livestock Section and were provided with technical advice on various crops and livestock activities resident at the SMDTC.

Monitoring the adoption and impact of improved technologies

The object of the exercise was to determine the level of improvement of the local stock or the relevant crosses of the major breeds that is necessary to maximize production. Because of the diverse feeding regimes, management practices and breed combinations only trends could be identified at this time. Further data therefore need to be collected to determine the percentage of exotic breed where diminishing returns set in as observed in other herds.

Natural Resource Management Programme

The CARDI's Natural Resource Management programme now encompasses projects in integrated pest management for vegetables, sweetpotato, and hot pepper, entomological support to the citrus replanting programme and organic agriculture studies.

Integrated Pest Management Collaborative Research Support Programme (IPM CRSP Project)

Callaloo

The USDA APHIS interception data have indicated a dramatic reduction of pest interceptions in shipments of fresh vegetable amaranth (callaloo) submitted for export to the USA. The collaborative on farm research and training conducted under the IPM CRSP was credited with this notable improvement in product quality. Consequently, USDA APHIS has initiated a programme to reinstate callaloo on the preclearance list. CARDI/IPM CRSP has played a key role in training exercises.

In a collaborative effort involving USDA APHIS, MINAG, RADA and CARDI/IPM CRSP, a series of four training sessions forming part of the initiative to reinstate callaloo on the preclearance list was held across the island.

Approximately 120 participants, comprising the extension and quarantine officers and members of the Montpelier research and development team who will be involved in farmer certification exercises for callaloo producers across the island, exporters and farmers were trained.

Cabbage

An on farm demonstration/validation plot was established in Caura Valley Trinidad to work with the farmers in the area to build on their prior sensitization to the use of IPM, which they gained through ongoing farmer field school activities being conducted in the area.

In Caura Valley, Trinidad, over two cropping seasons, the threshold-based system of monitoring and timing of pesticide applications for major pests (Lepidoptera) on cabbage, which was being demonstrated in the plots, indicated the potential to reduce pesticide input in cabbage production without appreciably compromising marketable yields. In season 2 pesticide input was reduced by 67-78% using thresholds.

Two field days were held in Caura Valley, Trinidad re Vegetable IPM, specifically, threshold-based pesticide applications and the use of biorational pesticides in cabbage production. Over 90 stakeholders including farmers, researchers and extension officers were in attendance.

Late 2006, a similar demonstration plot was established in South Oropouche, Trinidad, to target growers in that area.



A cabbage crop established in Mavis Bank, St Andrew, Jamaica, for experimentation and demonstration was concluded. Threshold-based pesticide applications and exclusion using row covers were demonstrated. IPM options resulted in reduced (by 37.5%) to no pesticide inputs compared to farmer practice (weekly sprays). A training session/field day was held 13 September 2006. The focus of the training was the integrated management of lepidopteran pests on cabbage with a seminar on the general principles and advantages of IPM and an overview of the experiment, followed by a tour of the experimental plots.

Hot pepper

Using molecular probes developed in 2004 for the gall midge present in fruit pedicel, results indicated that what were previously thought to be a single species, contain two species/subspecies that are clearly separated by the molecular probes we have designed.

A systematist of the taxonomic group of Cecidomyids was contacted to provide a species description of gall midges on hot pepper in Jamaica, so that descriptions would encompass both the morphological and molecular progress made to date.

Subsequently, efforts of the Hot Pepper Task Force to have a Pest Risk Analysis (PRA) done for the pest were facilitated by Agricultural Support Services Project (ASSP). A PRA has since been conducted and a report sent to the USDA for the revision of the quarantine status of the pest.

Sweetpotato

A mulch trial was established in two areas - Bushy Park, St Catherine and Ridge Pen, St Elizabeth. Plastic mulches retarded weed growth and could be a potential tool for farmers.

Less feeding damage by the sweetpotato leaf beetle was observed on the sweetpotato variety quarter million than on the yellow belly and fire-on-land varieties in the Bushy Park trial.

The efficiencies of four types of SPW pheromone traps were evaluated and were found to be effective at capturing weevils.

A summary presentation of the sweetpotato work of the Jamaica Unit was made at a meeting of CARDI's root crops group (St Vincent and the Grenadines)

Weed Management

Field activities in weed management studies have been completed and the first draft of the Ph.D. Thesis entitled *Weed Management for Organic Agriculture in Jamaica: An Evaluation of the Impact of Soil Solarization and Mulching on the Weed Communities in Onions and Hot Peppers* was completed. Among major findings were:

Weed Density

Mulching with the white on black plastic alone or with solarization was consistently most effective in reducing the weed density.

There was no apparent value to solarizing before mulching with white on black plastic in order to further reduce weed density, solarizing before mulching with grass gave better weed reductions than solarization alone or grass mulching alone.

Solarization alone was not effective in this experiment.

Species Richness

The species richness of the community was altered in different ways by the various treatments. The richest communities were the un- mulched ones. The solarized unmulched treatment was not significantly different from the unsolarized-unmulched treatment at seven weeks indicating that solarization, at that stage of the experiment, had no detectable effect on the richness of the developing weed community.

All the mulched treatments (white on black plastic and the grass mulch treatments) significantly reduced the number of species in their weed community. Neither of the solarization mulch combinations accounted for any further reduction in the number of species in their community than that observed in the mulch treatments alone.

Species Composition

There were also variations in the species composition of the various treatments. The plastic mulch treatments were the most effective in altering the weed composition since of the three practices it consistently had the least number of species (thereby removing most of the species from the community). However, even the treatments that had similar number of species had differences in their species composition.

Citrus Replanting Project

The contract for research services- entomology to the CRP came to an end and the final outputs and recommendations submitted to the project implementation unit in MOAL which contracted CARDI to provide these services.

All activities, results and recommendations for the contract period were amalgamated in a completion report which was reviewed, revisions made and the final report accepted September 2006. Key findings were as follows:

- Data collected by the end of 2003 for development of an optimal sampling plan, indicated a varying sampling requirement which is dependent on aphid density
- General Linear Model was fitted to the population data over the two years at the four study sites. The model fitted was highly significant ($P < 0.001$) with the accumulated analysis of variance showing highly significant effects for site and stage of hardening of flush ($P < 0.001$). The flush stage NE/NH (newly expanded/newly hardening) had the highest incidence of brown citrus aphids

- In 2005, outbreaks were generally, for all sites, observed during January to March; July/August to November/December. Highgate, St Mary, the wettest site during the period of study had the most outbreaks lasting for the longest periods
- Five batches of parasitoid, *Lipolexis oregmae* (totaling 930 adults and 560 mummies) were imported from the University of Florida and used in the development of laboratory rearing techniques
- In October 2005, adult *L. oregmae* emerged from aphid samples collected at Clarendon Park, Clarendon, thus confirming the results of PCR analyses which indicated that the parasitoid was already in Jamaica. This changed our planned focus in biocontrol studies from introduction to one of augmentation of *L. oregmae* populations
- Monitoring of field parasitism levels generally indicated < 15% parasitism
- During a parasitoid survey, samples were collected from 26 farms (318 flushes) in six selected parishes: Manchester and St Mary (3 farms each); Clarendon and St James (4 farms each) and St Catherine and Hanover (6 farms each). Two species of parasitoids, *Lipolexis oregmae* and *Lysiphlebus testaceipes* were recorded on 16 and 4 farms, respectively and the former was the dominant species on farms where both species were found
- The confirmation of the presence and the wide distribution of *Lipolexis oregmae* are significant findings as the parasitoid was only known to occur in Florida and Bermuda, in this region, where, in both cases, the Guam biotype was introduced from Asia as part of classical biocontrol programmes to manage the BrCA, vector of CTV.
- Major predators of BrCA *viz* coccinellids and lacewings, appear to be in citrus orchards throughout the year.
- In laboratory assays the number of aphids consumed by the predominant coccinellid, *Cycloneda sanguinea* increased with increasing density of the BrCA.
- The larval stage of *C. sanguinea* consumed larger numbers of aphids than the adult life stage.
- The results of predation studies demonstrate that *Cycloneda sanguinea* can potentially impact the growth of BrCA populations; in particular at small aphid population densities where the consumption rate is higher
- Results from screenhouse trials indicated the following trends in the relative efficacies of the treatments (i.e. the level of BrCA mortality effected by each treatment): Safer Insecticidal Soap® and NeemX® > Orchard Oil® > BioNeem®
- In followup screenhouse trials, the efficacies of NeemX® and BioNeem® were shown to increase when mixed in acidified medium (pH 5-6).

- In laboratory assays significant differences in the effect of test pesticides on mortality of parasitoid, *L. oregmae* were apparent (Orchard Oil® = Bioneem® > NeemX® > Safer Soap).
- Treatment differences in mortality of psyllids Orchard Oil® = Safer Soap > Bioneem® > NeemX®, were only significant (P=0.040) for observations 1 hour after treatment.
- In the plants sprayed with water, the coverage achieved by the mistblower generally exceeded that achieved by the knapsack sprayer however this difference was not significant

Organic farming demonstration

Trials conducted on the use of the nutrient sources cow manure, vermi-compost made from discarded coffee beans and a commercial organic fertilizer for the production of organic callaloo and hot pepper showed that under the prevailing climatic conditions in 2006, there appeared to have been a better overall performance of plots treated with the commercial organic fertilizer compared to the vermi-compost and cow manure.

Market Development Programme

In this programme commercial potential of CARDI's technologies in crop and livestock production was determined. of selected vegetables and the pilot commercialization of livestock feed utilizing agricultural by-products and crop residues was carried out. Over the two years a total of 4,867 kg of vegetables were produced providing an income of over J\$250,680.00. The pilot commercial production of livestock feed from agro and industrial by-products began in 2006 and 27.4 tons of feed was produced and distributed to mostly small ruminant farmers.

Sweetpotato Enterprise Development

During 2005-2006, replicated trials were established in two major growing areas which differ in agro-ecological conditions, to determine yield potential, physical and chemical characteristics and value added potential of the ten most popular export varieties in Jamaica. Sweetpotato yields differed significantly among the varieties and between the locations. Varieties also differed by their tolerance to major pests. Varieties Eustace, Quarter Million and Miss Mac were the highest yielders. Sweetpotato varieties were characterized by vine and root features. These data were used to develop a descriptor for farmers, researchers and exporters

Information and Communications Programme

Small Ruminant Information Products

This project is aimed at supporting the development of the small ruminant industry in the Caribbean by facilitating the wider dissemination and utilisation of generated and/or adapted small ruminant technologies in the region. Activities included acquiring seven appropriate media and software, inventorying and acquiring, in their original form, 100 known small ruminant IPs and the reproduction of 75 manuscripts and about 40 pictures.

National Coordinating Committee for Agricultural Research and Development (NCCARD)

The establishment of the National Coordinating Committees for Agricultural Research and Development (NCCARD) in member countries is an effort to put into operation the research coordination mandate of the Institute. In Jamaica, an interactive meeting/workshop for participating agencies/institutions to present their POW was organized on 8 June 2005. Proceedings of the workshop, with a matrix of suggested constituents of commodity and thematic clusters, were distributed to stakeholders in November 2005. This set the stage for the development of six commodity clusters – Vegetables, Root Crops, Tree Crops, Small Ruminant, Herb and Spices and Sugar cane. Of these all except the tree crops and sugar cane clusters have been relatively active.

Farmer experimentation and innovation

In the last quarter of 2005, CARDI, under contract from CTA and in collaboration with 13 other national agencies/institutions started a project to document some of the innovations of Jamaican farmers. A case study on the innovations of ten farmers was completed. A presentation on the case study was made to policy makers and other stakeholders on 27 February 2006. Final draft technical and financial reports were submitted to CTA

National Programme for the Certification of Agricultural Produce (CAPP)

The programme seeks to develop and implement a national certification programme for agricultural produce that conform to required safety, quality and environmental standards. CARDI was contracted to prepare a farmer's manual for the CAPP. The contract was signed in December 2005 and the manual was prepared, submitted, reviewed and is presently being re-organised for re-submission.

Technical Assistance

The technical assistance project is aimed at providing “on-request” assistance to the farming community and other agricultural agencies and institutions in Jamaica and the wider Caribbean.

Technical Assistance Given

- We provided technical assistance to the following institutions and agencies:
- Agricultural Support Services Project (ASSP): (Continued with the preparation of training aids including, factsheets, posters and pamphlets/handouts for the training of farmers in good agricultural practices in papaya, sweetpotato, ginger, escallion and hot pepper production and post harvest)
- The International Centre for Environmental and Nuclear Science (ICENS): ICENS began a project on the environmental risk of Cadmium in Jamaica and the CARDI Biometrician was requested to give technical assistance to the project. He visited Jamaica over the period 11-15 April 2005 and held discussions with the stakeholders and specifically assisted in the development of their sampling designs and plans. This support is continuing.
- Government of Turks and Caicos Islands (TCI): At the request of the government of the TCI the CARDI Soil Scientist undertook a mission to the Turks and Caicos Islands to assess the soil potential for agricultural purposes. The output of the mission was a report which gave details on the major soil series on the North and Middle Caicos islands and their capability to sustain economic agricultural production of selected crops. The report concluded with several general and specific recommendations for the advancement of agriculture in the TCI, and the possible role for CARDI.

Other technical assistance to stakeholders:

- Mr. Donovan Edwards, a science teacher at the Papine High School, did a four-week attachment with the Unit under the Scientific Research Council (SRC) science teachers' apprenticeship programme.
- CARDI was also requested to be part of a committee to prepare a Plant Genetic Resources for Food and Agriculture (PGRFA) Country Report for Jamaica.
- CARDI was invited to Jamaica's Second National Communication (SNC) Greenhouse Gas (GHG) Inventory Workshop which detailed the plans and procedure for developing the SNC. The Institute was subsequently contracted to do the inventory for the agriculture sector.
- CARDI has been requested to be represented on the Project Advisory Committee (PAC) of the Mainstreaming Adaptation to Climate Change (MACC) Project, as a Co-opted Member to deal with agricultural matters.
- Scientists of the Unit assessed mole crickets problem at the Sabina Cricket grounds for the Jamaica Cricket 2007 Ltd. as part of the preparation for the ICC World Cup.
- CARDI, at the request of IICA, delivered three training session on IPM in hot pepper and sweetpotato and soil management at field days for farmers on the Walkers Wood Agricultural Project on a cost recovery basis.
- The Unit also hosted Dr José Morales, Director of Instituto de Ganaderia Tropical (IGAT) of Cuba with the view to developing technical collaboration between CARDI and IGAT.
- The Livestock group provided technical assistance to 39 farmers in the areas of selection of goat breeding stock, forages for feeding, setting up goat production units, outlay of appropriate goat housing facilities and general husbandry practices.
- Albert Fearon acted as Chief Small Ruminants Judge at the Hague and Denbigh Agricultural Shows.



Boards and Committees Served

We provided our services for seventeen local committees. These were:

- Jamaica Organic Agriculture Movement (JOAM) Programme Management Committee (L. Simpson, K. Dalip)
- Methyl Bromide Working Group (K. Dalip)
- National Organic Agriculture Enhancement Programme Sub-Committee on Research and Development (J. Lawrence, Chairman)
- National Organic Agriculture Enhancement Programme Sub-Committee on Sensitization and Training (L. Simpson).
- Plant Health Coordinating Committee (K. Dalip/ J. Lawrence)
- Council Members, Jamaican Society for Agricultural Sciences (F. Asiedu, J. Lawrence)
- Project Management Committee of the Sam Motta Demonstration and Training Centres (Francis Asiedu, Albert Fearon, Leslie Simpson, Dwight Williams)
- Technical Committee of the Bureau of Standards Jamaica Certification for Agricultural Produce Programme (J. Lawrence)
- Alliance of the Bureau of Standards Jamaica/Jamaica Agricultural Society Certification for Agricultural Produce Programme (J. Lawrence)
- Goat Breeders Society of Jamaica (A Fearon)
- Jamaica Organic Agriculture Movement (JOAM) Management Steering Committee (J. Lawrence)
- Jamaica Organic Agriculture Movement (JOAM) Standards and Certification Committee (J. Lawrence, Chairman)
- Manchester Plateau Community Council (D Williams)
- Manchester Parish Development Committee (A Fearon)
- NCCARD Root Crops Cluster (J. Lawrence, Chairman)
- NCCARD Vegetables Cluster (D. Clarke-Harris, Chairman)
- Technical Committee of the Bureau of Standards Jamaica Certification for Agricultural Produce Programme (J. Lawrence)

Exhibitions and Shows

The CARDI Jamaica Unit participated fully in the 53rd and 54th Annual Denbigh Agricultural and Industrial Shows. We showcased our work in IPM of vegetable crops and sweetpotato, goat management systems, and natural resources management, particularly soil management and organic agriculture, and also participated in the goat championships judging competition. The goats from the Sam Motta DTC and exhibited by us won several first prizes.

Publications

Staff produced 43 publications of various types during the two year.

Weather

Total rainfall for Jamaica in 2005 was 2,106 mm and this was higher than the 30-year mean of 1,949 mm and the previous two years of 1,854 mm and 1,808 mm in 2003 and 2004 respectively. The relatively high total rainfall was mainly due to the passage of many hurricanes in the vicinity of Jamaica during the hurricane season. Two hurricanes Dennis and Emily passed during the month of July. There were also regular showers in August, but while September was relatively dry, October saw extremely high rainfall owing to the passage of Hurricane Wilma close to Jamaica and the general atmospheric disturbance as there were six tropical storms in the Atlantic during the month. December also saw heavy rainfall and some flooding.

By contrast in 2006 the total rainfall for Jamaica was 1,671.5 mm which is extremely dry and much less than the 30-year mean rainfall. This low rainfall could be in part due to the low hurricane activity in the region during 2006 which would normally determine the rainfall level in the latter part of the year. But, in fact the earlier months of the year were extremely dry in most parishes, and the rest of the year saw only moderate levels of rainfall.

The mean annual rainfall in the 13 parishes for 2005 and 2006 are shown in Figures 1 and 2. In both years Portland was the wettest parishes with mean annual rainfall of 3,839 mm and 3,388 mm in 2005 and 2006 respectively. In 2005, St James was

the driest Parish with 1,176 mm of rainfall but in 2006 this dubious honour went to Clarendon where only 895 mm of rain fell for the year. All the parishes except Hanover, Westmoreland, St James and St Thomas received more rainfall than the 30-year mean in 2005. In 2006 this was reversed with all parishes except St Mary receiving less rainfall than the 30-year average.

Mean monthly rainfall for the parishes for 2005, 2006 and the 30-year mean is given in Figure 3. The rainfall distribution in the two years was quite different. In 2005, most parishes showed rainfall peaks in June/July and the highest rainfall was recorded in October. In 2006, the rainfall peak was mainly during the period June to September but some parishes had the highest rainfall in November and December. In 2005, the parishes with the highest rainfall during the year were Portland, St Thomas and St Mary, while those with the lowest were St James, Westmoreland and Trelawny. The traditionally dry parish of St Elizabeth had a fairly high rainfall in 2005, but this was mainly in the months of May-October and caused some unusual flooding in the parish. In 2006, the wettest parishes were Portland, St Mary and Westmoreland, while the driest were Clarendon, St Catherine and St Thomas. It is very unusual for St Thomas to be among the drier parishes

Project activities carried out by CARDI in Jamaica are located in the parishes of Manchester, Clarendon, St Catherine and Kingston and Kingston/St Andrew.

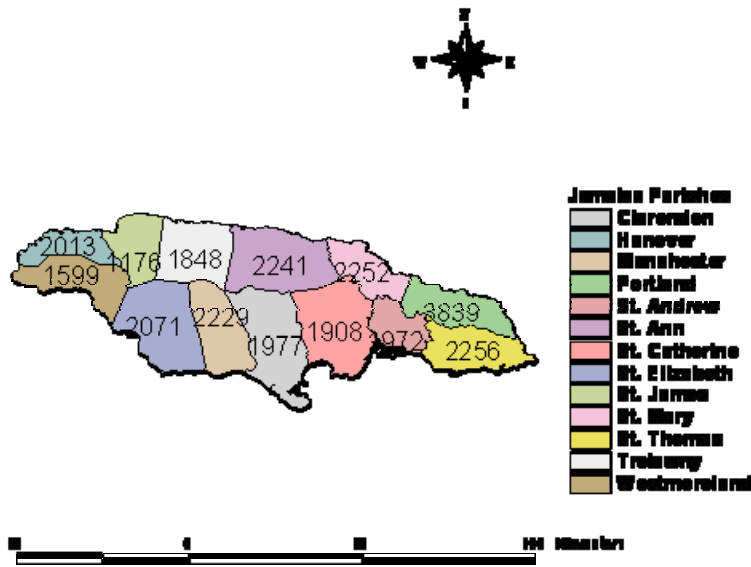


Figure 1 Mean annual rainfall in 2005 for parishes in Jamaica

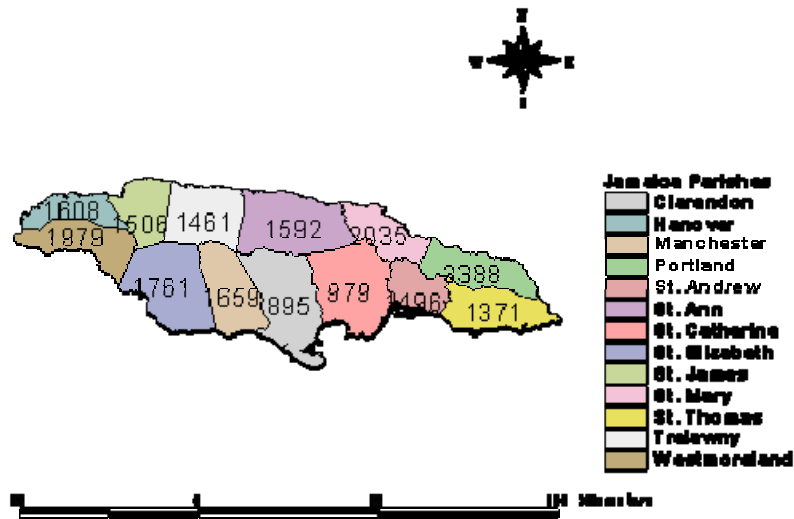


Figure 2 Mean annual rainfall in 2006 for parishes in Jamaica

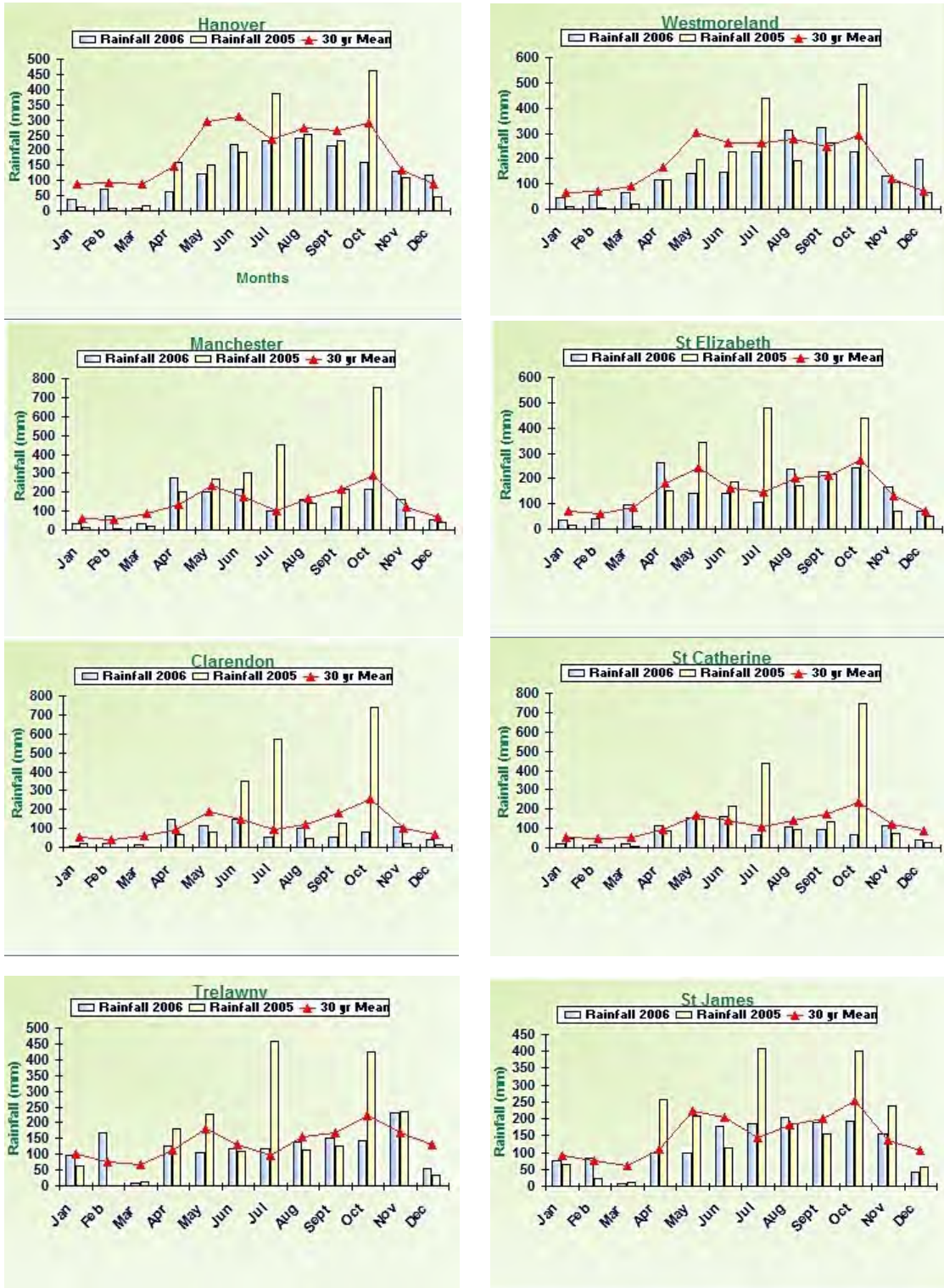


Figure 3a Mean monthly rainfall for 2004, 2005 and the 30-year mean for Hanover Westmoreland Manchester, St Elizabeth, Clarendon, St Catherine, Trelawny and St James

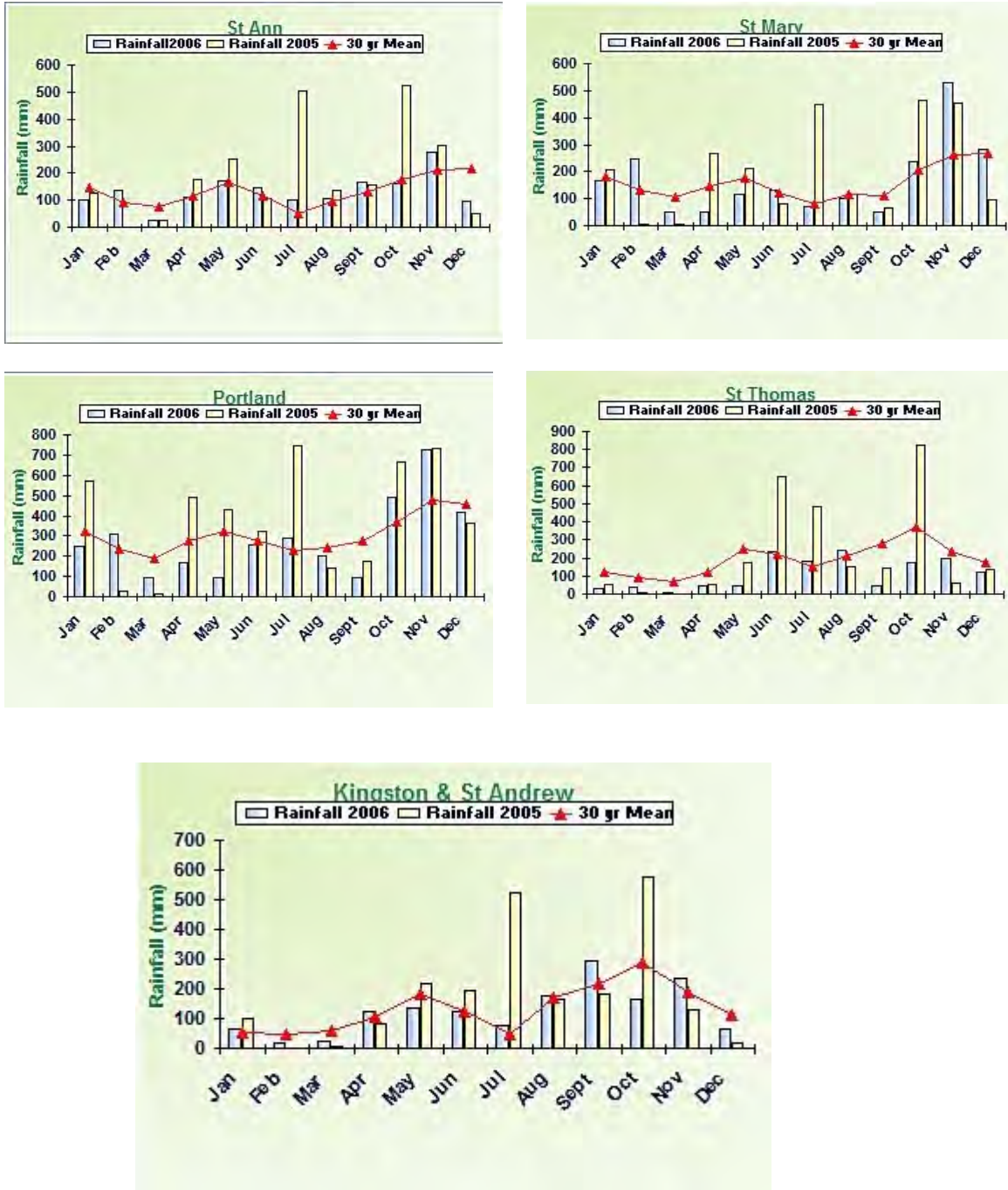


Figure 3b Mean monthly rainfall for 2005, 2006 and the 30-year mean St Ann, St Mary, Portland, St Thomas and Kingston & St Andrew

Technical Programmes

Livestock Programme

CARDI, along with its collaborators, including MINAG's Research and Development Division, RADA, the Goat Breeders Society of Jamaica (GBSJ), the Jamaica Sheep Farmers Association (JSFA) Alumina Partners of Jamaica (ALPART), Agriculture Support Service Project (ASSP), Jamaica Agricultural Society (JAS), UNITAS of Jamaica (UNITAS), Jamaica 4-H Club, IICA, H.E.A.R.T. Academy, JBI and farmers continued the efforts to develop the small ruminant industry in Jamaica. The activities were undertaken on the Sam Motta Goat and Sheep Demonstration and Training Centre (SMDTC) and on producers' properties. The provision of improved breeding stock continued through the multiplication and distribution programme along with the community buck service. An evaluation of the use of hormonal oestrus synchronization as a technique to improve reproductive performance in goats continued. The centre continued to develop sustainable production systems through the evaluation of three strains of legumes and six strains of grasses in feeding systems. The outreach programme also continued to provide an avenue to bring small ruminant technologies to farmers and to monitor developments in the small ruminant industry. The collaboration between MINAG, the Livestock Team, RADA and farmers throughout Jamaica enabled the dissemination of small ruminant production information to producers and

participants throughout Jamaica. The collaborative effort was instrumental in the preparation and submission of a small ruminant policy to the government. The maintenance of linkages with industry participants and farmers, participating in the Small Ruminant Industry Development Project (SRIDP) are also features of this project.

Breed Improvement

The national small ruminant improvement strategy enunciated by the stakeholders is for the research/breeding stations and designated breeder stock producers to maintain purebred stock, multiply within the purebred stock and cross breed among the purebreds and the Native types up to the generation when the top-cross buck represents 87.5 per cent of the crossbred animal. The major goat breeds used for breed improvement during the two years included Nubian, Boer, Alpine, and the Native type.

Production of improved breeding stock

The total of 257 kids produced over the period in review was lower than projected since in a period in 2006 where at least 50 kids were anticipated only 11 was produced. A group of twenty-eight kids were produced in the final quarter of the same year ruling out the probability of infertile bucks, since the same set of sires were used on both occasions. The animals that returned to heat from the initial group were all exposed to the same bucks and at the time of reporting were in advanced stages of pregnancy with an anticipated kidding from mid January of 2007. In light of the situation, special attention will now

be paid to weather condition, forage availability, and conception rates of goats exposed in the period of February to March in any year.

In keeping with the objective to have breeding stock for distribution at a level of at least 87.5 per cent of the relevant purebred lines, more than 50 per cent of the kids produced in the period in review have attained this target. The Alpine type animals have produced 29 per cent offspring of 87.5 or more per cent of the purebred line while the Boer and Nubian types have produced 57 and 60 percent respectively. The percentages are poised to improve dramatically in the next reporting period as the Alpine, Nubian and Boer have produced 41, 26 and 23 percent of offspring respectively that have attained at least 75 per cent of the base breeds (Table 1).

Table 1 Breed percentages of kids produced at SMDTC 2004 -2005

Breed Type*	Total Born	>87.5%		75%		<75%	
		No.	%	No.	%	No.	%
Al	51	15	29.4	21	41.2	15	29.4
Bo	51	29	56.9	14	25.5	8	15.7
Nu	75	45	60	17	22.7	13	17.3
Total	177	89		52		36	

* Breed types: Al = Alpine, Bo = Boer, Nu = Nubian

The production parameters presented in Table 2 revealed a slightly higher but not significant ($P=0.665$) birth weight of 3.07 and 3.11 kg for 2004 to 2005. A similar situation existed with breed/type where the Boer type was numerically higher (3.15 vs. 3.03 and 3.07) but not different from the Nubian or Alpine types ($P=0.498$). The birth weights of male kids were significantly higher ($P=0.001$) than female kids and male single kids had superior birth weights ($P=0.001$) than their female counterpart and other birth types. Male kids

especially male single kids show a superior weaning weight. The data suggest the male kids showed a superior growth rate from birth to weaning with single kids performing better.

Table 2 Kids performance at the SMDTC based on year of birth, breed type, sex and birth type for 2004-2005

Item	Birth Weight	Weaning Weight	Average Daily Gains
Year			
2004	3.07	13.75	116.94
2005	3.11	14.03	122.4
F prob.	0.665	0.698	0.485
StDev	0.5595	3.532	37.61
d.f.	176	101	99
Breed Type			
Alpine	3.03	13.94	121.19
Boer Nubian	3.15	13.13	110.11
Nubian	3.07	14.45	125.46
F prob.	0.498	0.285	0.216
StDev	0.5591	3.508	37.3
d.f.	176	101	99
Sex			
Male	3.21	15.29	133.55
Female	2.95	12.49	104.94
F prob.	0.001	0.0001	0.001
StDev	0.5438	2.245	34.82
d.f.	176	101	99
Birth Type Born			
Single	3.3	14.76	127.31
Twin	2.92	12.85	104.91
Triplet	2.34	13.08	118.3
F prob.	0.001	0.023	0.052
StDev	0.5123	3.419	36.74
d.f.	176	101	99

The nature of the project did not allow for further meaningful data collection since most of the males and some females would have been distributed for breeding before the eighth month which would give a clearer picture of the animal's performance. The animals left would not be a true reflection since the better ones would have been selected for sale and the ones remaining would not have the competition of their siblings to properly measure growth

rates. To alleviate this situation at least 20 animals have been selected from the different breed types to be grown out for analysis.

The breeding programme is aimed at producing offspring that will maximise the production capability of a particular breed influence. While some difficulties were encountered in terms of data collection and

maintenance of trials during the period some useful information were obtained. The data collected, analysed and presented in Table 3 seemed to suggest that at the level of 75 per cent the offspring of the Alpine breed seemed to do better in terms of the weaning weights (18.3 kg) and average daily weight gains (166.2 g) at $P = 0.018$ and $P = 0.010$ respectively.

Table 3 Performance by breed percentages of Alpine, Boer and Nubian kids produced at SMDTC in 2005/2006 in terms of birth and weaning weights and average daily gains at weaning

Item	Birth weight (kg)	Weaning weight (kg)	Average daily gains (g)
Alpine \geq 87.5%	2.83	13.23	116.5
Alpine = 75%	3.3	18.28	166.17
Alpine < 75%	3.21	12.4	100.29
Boer \geq 87.5%	3.2	12.13	99.75
Boer = 75%	3.9	14.38	124.21
Boer < 75%	-	-	-
Nubian \geq 87.5%	3.04	13.94	122.26
Nubian = 75%	3.08	15.77	140.19
Nubian < 75%	3	-	-
F prob.	0.035	0.018	0.01
SEM	0.46	2.67	26.81
df	70	37	36

The Boer offspring at a breed influence of more than 87.5 per cent exhibited the lowest weaning weight of 12.1 kg. When viewed from an overall standpoint (Table 4) it was confirmed that at 75 per cent of the major breeds there was a superior weaning weight and average daily gain up to ninety days. The animals with less than 75 per cent of the major breeds exhibited the lowest rate of growth and weaning weights. The data presented is just a trend, therefore, further information and data must be collected at several locations before a definitive statement can be made concerning the optimum cross with the native and exotic breeds to realise maximum output.

Table 4 Overall performances by breed percentages of kids produced at SMDTC in 2005/2006 in terms of birth and weaning weights and average daily gains at weaning

Item	Birth weight (kg)	Weaning weight (kg)	Average daily gain (g)
\geq 87.5% of breed	3.02	13.32	115.68
75% of breed	3.3	17.16	154.43
< 75% of breed	3.17	12.4	100.29
F prob.	0.131	0.002	0.002
SEM	0.48	2.67	27.29
df	70	37	36

Distribution and enhancing of improved breeding stock

There are farmers who could not or did not own a quality breeding buck because of several factors such as affordability, feasibility or risk of larceny. Consequently a sire service was established at the Sam Motta DTC. Mature buck(s) were specifically assigned for the stud buck service and made available to the community. The farmers were asked to make a minimal contribution for the maintenance of the bucks and purchase medication for pest control.

The use of this service started out slowly but intensified towards the end of the

Table 5 Summary of stock sales at SMDTC, January - December 2006

Category	Bucks	Does	Total
Breeding stock	42	27	69
Meat	20	7	27
Total	62	34	96

Assessment of breeding techniques for the improvement of reproductive indicators and coefficients

One key management strategy of any livestock production system is to reduce unproductive time. Similarly, in any goat production system reducing the average number of doe open days will improve the efficiency of the system (all other things being equal). It is suggested that the ideal kidding rate for any farm is an average of three kidding in two years. However assessment and management of the doe's oestrus cycle is critical.

period. The increase may be attributed in part to an Open Day held during the final quarter of 2006 where more farmers were made aware of the facilities. During the period, some 96 animals were distributed from the SMDTC of which 69 were sold as improved breeding stock (Table 5) and twenty-seven for meat. Fifteen of the improved does were allocated to our collaborators ALPART for their Tenant farmers. Forty-one farmers with a total of 62 does utilised the community buck service. The designated small ruminant breeders which were monitored also made significant contribution to the number of improved breeding stock distributed.

In Jamaica where natural breeding is practiced by a majority of small ruminant farmers, a large variation in doe open days is a common feature. In many species of animals, hormonal manipulation is utilised to reduce these large variations and by extension improve productivity. While hormonal manipulation is utilised within other local livestock industries, this practice have not been widespread in the goat industry. CARDI believes that there are benefits to be obtained from hormonal manipulation and therefore an evaluation of this technique has been added to its work programme at the Sam Motta Goat and Sheep Demonstration and training Centre (SMDTC). The objectives of the study, therefore, are to improve productivity in goats through breeding efficiency and to evaluate the effectiveness of oestrus synchronization in goats in Jamaica.

Twenty animals of Boer and Nubian breed types were selected and placed in groups of 10. Five Nubian-type and 5 Boer-type mature females and treated with Lutalyse® (Dinoprost), while a similar number from each breed type were left untreated as the

control. The animals were given the first treatment of 1.6 mL per animal with a follow-up treatment of the same amount 11 days after the first application. The untreated groups were exposed to the buck 2 days prior to the final application of the hormones. All animals of each breed type were hand mated using the same buck for both synchronized and untreated. The trial will be replicated over three breeding seasons using the same animals of different stage of maturity as far as possible. The parameters being measured includes; conception rate, kidding interval, litter size and productivity of the buck.



Plate 1 Hormone treatment being administered by veterinarian at SMDTC

Animals from the experiment started kidding in mid December 2005. The animals in the treated group kidded over a period of 8 days while the untreated group spanned a period ranging from mid December 2005 to late March, 2006. Ninety per cent of the synchronized animals kidded while eighty per cent of the untreated animals produced kids, albeit over an extended period. The details of the production from the trial are presented in Table 6. The average birth weight of the animals born in the experiment was 3.2 kg. From the breed type used all the Boers and 80 per cent of the Nubians from the treated group kidded while only 40 per cent of

Boers and 60 per cent of the Nubians of the untreated group produced kids in the period. Animal in the treated group showed a litter size of 1.33, while the untreated group had a litter size of 1.625. The weaning weights of both Boer and Nubian were similar for the treated group while the Boers exhibited a higher weaning weight in the untreated group. The majority of the animals born out of the trial were 9 months during the period in review. The weights were higher than the herd average but this was a small group of animals that did not have a lot of competition for feed. There were also no set patterns with regards to the 9 month weights with respect to the two treatments. While the mortality rate from the group was relatively low to the time of weaning some of the Boer type animals were inadvertently sold for breeding stock. The weights of kids born to animals in the experiment were consistent with those of the entire herd at least up to weaning, suggesting that the synchronization did not affect the does in terms of their ability to feed their offspring.

Demonstration of small ruminant productivity at SMDTC

A monthly inventory was kept at the SMDTC where all animals at the station are categorised based on stage of maturity with the major categories being mature bucks, mature does, weaner bucks, weaner does, buck kids and doe kids. Mature animals are considered to be animals over one year old while a weaner is considered to be older than three months but less than one year and has not produced a kid. The information also took into consideration the sales, births and mortality records of the herd.

There were 171 heads of animals at the end of the period in review (Table 7). These comprised five mature bucks, 107 mature

does, 9 weaner bucks, 21 weaner does and 29 kids.

Table 6 Performance of two breed/types of goats synchronized and untreated to evaluate breeding efficiency in the 2005-2006 trial

Items	Treated		Untreated		Overall	
	Boer	Nubian	Boer	Nubian	Treated	Untreated
Number kidding	5	4	4	4	9	8
Per cent kidding	100	80	80	80	90	80
Ave. Birth Wt (kg)	3.27	3.1	3.3	3.1	3.2	3.25
Kidding period (days)	8	4	55	28	8	55
Litter size at birth	1.4	1.25	1.75	1.5	1.33	1.625
Ave. Weaning Wt (kg)	13.1	13.2	15.5	13.17	11.63	13.85
Litter size weaned	1.2	1.25	1.25	1	1.23	1.13
Ave, 8/9 month wt (kg)	26.3	28.5	29.3	25.7	27.3	27.22

In an effort to measure the productivity of the animals at the Station, twenty-four animals representing the Boer, Alpine and Nubian types, were being grown out for analysis. The animals selected were a mixture of purebred and percentages of each breed, and separated by sex.

alarmingly low for the 9 month weights. All groups of animals lost weigh between 6 and 9 months of age. The Boer type animals seemed to be the class most negatively affected to the extent where there was a 50 per cent mortality of the group. While the Alpines also lost weight they demonstrated the best average daily weight gains between weaning and nine months. The trial was discontinued and investigations are being done to assert the general sluggishness after weaning. The current trend was noticed on a lesser scale in the previous year.

Table 7 Herd composition of stock at SMDTC, as of December 31, 2006

Category	Total
Mature Bucks	5
Mature Does	107
Weaner Bucks	9
Weaner Does	21
Buck Kids	19
Doe Kids	10
Total	171

Data collected during the year are presented in Table 8. While the data seemed to suggest that the births and weaning weights are comparable with industry standards but below in terms of six month weights, it was

Development of feeding and production systems Technologies

Evaluation of Guinea grasses, *Panicum maximum* (Mombasa Guinea grass and common Guinea grass) grown on mined out bauxite land in Manchester

Studies on the effect of cutting intervals 3, 4, 5 and 6 weeks on the herbage biomass

production, segregated above-ground parts and nutritive value of two forage grass cultivars Common Guinea Grass (*Panicum maximum cv. typica*) and Mombasa Guinea Grass (*Panicum maximum cv. mombasa*) commenced during the year (Plate 2). Ease of establishment was evaluated through ground cover assessment at 4, 8, 12 and 16 weeks, biomass yield accumulation over 16 weeks. Further assessment for biomass yield over 2 years and leaf to stem ratio is being conducted.

Table 8 Performance of goats at SMDTC based sex and breed/type up to 9 months.

Item	Birth weight (Kg)	Weaning weight (Kg)	Pre-weaning ADG (90d (g))	6-month weight (kg)	Post-weaning ADG (180d (g))	9 Month weight (Kg)	Post-weaning ADG (240d (g))
SEX							
Male	3.3	15.92	140.19	23	84.03	22	40.53
Female	2.8	13.52	119.03	19.5	64.2	17.7	27.87
Overall	3.05	14.72	129.61	21.25	73.53	19.58	32.4
BREED/TYPE							
Alpine	2.99	14.84	131.67	22.86	88.89	21.43	43.93
Boer	3.16	13.25	112.15	16.7	36.12	14.7	9.66
Nubian	3.01	16.06	145	23.16	80.56	21.5	36.27
Overall	3.05	14.72	129.61	21.25	73.53	19.58	32.4

The results seemed to indicate that both cultivars had similar growth habit attaining similar height irrespective of the cutting interval ($P = 0.563$, Table 9). Plant height increased with increasing cutting interval for both varieties.

The *mombasa* variety showed greater ease of establishment with significantly higher ground cover for 4, 8, 12 and 16 weeks after planting (Table 10). For both varieties ground coverage increased linearly with the *mombasa* variety achieving 100% coverage significantly earlier ($P < 0.001$) than the *typica* variety. Lignification was evident after



Plate 2 Overview of typical and mombasa Guinea grass (*Panicum maximum*) evaluation plots, Sam Motta DTC, 2005-2006

3 weeks as non-stem to stem fractions were significantly higher ($P = 0.031$) for the 4-, 5- and 6-week cutting intervals.

Table 9 Effects cutting interval on the height (m) of mombasa and typica Guinea grasses (*Panicum maximum*), Sam Motta DTC, 2005-2006

Variety	Cutting interval (wk)				Mean
	3	4	5	6	
Typica	0.356	0.417	0.423	0.542	0.419
Mombasa	0.383	0.428	0.421	0.521	0.411
Mean	0.347	0.423	0.422	0.531	0.415

sed (df 299) for comparing means: Variety = 0.0132 ($P = 0.563$), Cutting interval = 0.0191 ($P < 0.001$), Variety x cutting interval = 0.0270 ($P = 0.819$)

Table 10 Effect of time after planting on ground cover percentage of mombasa and typica varieties of Guinea grasses (*Panicum maximum*), Sam Motta DTC, 2005-2006

Variety	Ground cover percentage Time after planting (wk)				Mean
	4	8	12	16	
Typica	31.4	51.8	76.3	91.7	62.8
Mombasa	72.2	92.1	98.6	100	90.7
Mean	51.8	72	87.4	95.8	76.8

sed (df 95) for comparing means: Variety = 3.04 ($P < 0.001$), Time after planting = 4.30 ($P < 0.001$), Variety x time after planting = 6.09 ($P < 0.001$)

Table 11 Effect of cutting interval on herbage biomass accumulation (kg/ha) of mombasa and typica varieties of Guinea grass (*Panicum maximum*), Sam Motta DTC, 2005-2006

Variety	Herbage Biomass (kg/ha) Cutting interval (wk)				Mean
	3	4	5	6	
Typica	1132	1506	1452	1818	1417
Mombasa	1303	1623	1611	1933	1561
Mean	1217	1565	1531	1875	1489

sed (df 299) for comparing means: Variety = 66.0 ($P = 0.029$), Cutting interval = 95.2 ($P < 0.001$), Variety x cutting interval = 134.6 ($P = 0.986$)

Tiller production of the *typica* variety per 0.5 m^2 was, on average, significantly higher ($P = 0.013$) than that of the *mombasa* variety, and especially for the 4- and 5-

week cutting intervals (Table 12). This indicates that a tiller for the *mombasa* variety produced much higher herbage biomass, characteristics of its more robust thick culm, and hence the relatively high biomass production.

Table 12 Effects cutting interval on the tiller numbers of mombasa and typica Guinea grasses (*Panicum maximum*) for the first 18 weeks after the initial clearing cut, Sam Motta DTC, 2005-2006

Variety	Tiller numbers Cutting interval (wk)				Mean
	3	4	5	6	
Typica	136.1	147.5	130.8	136	137.6
Mombasa	131.3	115.7	109	132	121.9
Mean	133.7	131.6	119.9	134	129.8

sed (df 47) for comparing means: Variety = 6.04 ($P = 0.013$), Cutting interval = 9.87 ($P = 0.318$), Variety x cutting interval = 13.96 ($P = 0.306$)

The first year evaluations seemed to suggest that the more robust *mombasa* variety demonstrates greater aggressiveness during establishment and regrowth periods. While the variety demonstrated faster ground coverage, thicker culms, greater plant growth in terms of increasing height, final height attained and herbage biomass accumulation, the non-stem fraction remained comparable to the *typica* variety (Plate 3).

Evaluation of Mulato *Brachiaria*, Tifton 85 *Cynodon*, and Jarra grass and common Pangola grasses

Four forage grass cultivars, Mulato (*Brachiaria hybrido* cv Mulato), Tifton 85 (*Cynodon dactylon* cv Tifton 85), Jarra grass (*Digitaria milanjaniana*) and common Pangola (*Digitaria eriantha*) were established on mined out bauxite soils in Knockpatrick, Manchester (Plate 4 and Plate 5). The forage cultivars with harvesting intervals of 3, 5 and 7-weeks continued to be evaluated for agronomic

performances and nutrient content. The major parameters measured were ground cover at 4, 8, 16, and 22 weeks, biomass yield accumulated over 22 weeks and sward density. Assessment for biomass yield over 2 years and leaf to stem ratio is being conducted. The following are the results for the first year of evaluation.



Plate 3 Typical Guinea grass (*Panicum maximum*), (above), with relatively dense tillers but narrow leaves than the mombasa variety (below), Sam Motta DTC, 2005-2006

Summarized in Table 13 is the ground cover percentage of all four cultivars for all cutting intervals. None of the cultivars achieved 100% coverage before the clearing cut at 22 weeks but ground cover was significantly higher ($P < 0.001$) for the common Pangola and the Tifton 85 cultivars for all three cutting intervals (Table 13). There was significant interaction ($P < 0.001$) between variety and cutting interval as the 5-week Jarra cultivar was noticeable lower than all other combinations while that for the 5-week

Tifton 85 was higher than all other combinations.



Plate 4 Overview of Mulato (*Brachiaria hybrida cv Mulato*), Tifton 85 (*Cynodon dactylon cv Tifton 85*), Jarra grass (*Digitaria milanjiana*) and common Pangola (*Digitaria eriantha*) evaluation plots, Sam Motta DTC, 2005-2006

Table 13 Effect of cutting interval on ground cover percentage of Mulato (*Brachiaria hybrida cv Mulato*), Jarra grass (*Digitaria milanjiana*), common Pangola (*Digitaria eriantha*) and Tifton 85 (*Cynodon dactylon cv Tifton 85*) grass cultivars, Sam Motta DTC, 2005-2006

Cultivar	Ground cover percentage			Mean
	Cutting interval (wk)			
	3	5	7	
Mulato	55.5	53.8	53.1	54.5
Jarra grass	53.1	42.5	55.4	50.5
Common Pangola	82.8	83.9	62.1	78.9
Tifton 85	74.9	88.8	79.6	79.9
Mean	66.6	67.2	62.6	65.9

sed (df 260) for comparing means: Cultivar = 2.97 ($P < .001$), cutting interval = 2.75 ($P = 0.250$), Cultivar x cutting interval = 5.49 ($P < 0.001$)



Plate 5 Plots of Jarra grass (*Digitaria milanjiana*) (above), (b) Mulato (*Brachiaria hybrido cv Mulato*)(centre) and (c) Tifton 85 (*Cynodon dactylon cv Tifton 85*), (below) Sam Motta DTC, 2005-2006

Non-stem to stem proportion was significantly lower ($P < 0.001$) for both the common Pangola and the Tifton 85 when compared to both the Jarra and the Mulato cultivars (Table 14). Non-stem to stem proportion seemed to improve from 3-week through to 7-week cutting interval.

Table 14 Effect of cutting interval on non-stem to stem proportion of Mulato (*Brachiaria hybrido cv Mulato*), Jarra grass (*Digitaria milanjiana*), common Pangola (*Digitaria eriantha*) and Tifton 85 (*Cynodon dactylon cv Tifton 85*) grass cultivars, Sam Motta DTC, 2005-2006

Cultivar	Non-stem to stem proportion			Mean
	Cutting interval (wk)			
	3	5	7	
Mulato	1.00	1.00	1.00	1.00
Jarra grass	0.99	1.00	1.00	0.99
Common Pangola	0.68	0.80	0.86	0.75
Tifton 85	0.77	0.80	0.93	0.81
Mean	0.86	0.90	0.95	0.89

sed (df 260) for comparing means: Cultivar = 0.051 ($P < 0.001$), cutting interval = 0.047 ($P = 0.151$), Cultivar x cutting interval = 0.094 ($P = 0.705$)

Evaluation of forage legumes on mined out bauxite land on the Manchester Plateau

Three forage legume cultivars, including two blue peas (*Clitoria ternatea*) varieties - exotic and native - and one alfalfa (*Medicago sativa cv Florida 99*) variety were established on mined out bauxite soils in Knockpatrick, Manchester (Plates 6 and 7). The forage cultivars with harvesting intervals of 4, 5 and 6 weeks continued to be evaluated for agronomic performances and nutrient content. The major parameters measured were ground cover at 4, 8, 12 weeks, biomass accumulation over 12 weeks and sward density. Further assessment for biomass yield over two years and leaf to stem ratio were also conducted. The following are the results for the first year of evaluation.



Plate 6 Overview of blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa cv Florida 99*) evaluation plots, at Sam Motta DTC, 2005-2006

Summarised in Table 15 is the ground cover percentage of all three cultivars at 4, 8 and 12 weeks after planting. The exotic clitoria demonstrated significantly greater ($P = 0.007$) ease of establishing when compared to the native clitoria and the alfalfa. Ground cover increased linearly with increasing time after planting.

However none of the three cultivars achieved 100% coverage before the clearing cut at 12 weeks. Ground cover was significantly higher ($P < 0.001$) for the alfalfa at both four and six week intervals (Table 16) but showed a noticeable decline at five weeks. There was significant interaction ($P < 0.001$) between variety and cutting interval as the 8-week alfalfa was noticeable higher in ground cover than all other combinations while that for the 4-week native clitoria was lower than all other combinations. Herbage biomass accumulation at first clearing cut 12 weeks after planting was significantly higher ($P = 0.017$) for the exotic clitoria cultivar (Table 17).

The more erect alfalfa attained significantly greater height ($P < 0.001$) irrespective of the cutting interval ($P = 0.006$) while both blue pea cultivars were not much different in height (Table 18). Plant height increased with increasing cutting interval for all three cultivars, with the height increasing exponentially for all cultivars.

Table 15 Effect of time after planting on ground cover percentage of native and exotic blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa*) cultivars, Sam Motta DTC, 2005-2006

Ground cover percentage				
Cultivar	Time after planting (wk)			Mean
	4	8	12	
Native clitoria	12.2	25.6	43.2	27
Exotic clitoria	18.5	42.5	61.8	41
Alfalfa	15.4	27.7	45.5	27.7
Mean	15.7	32.9	51.2	33.3

sed (df 45) for comparing means: Cultivar = 4.63 ($P < 0.007$), Time after planting = 4.56 ($P < 0.001$), Cultivar x time after planting = 8.02 ($P = 0.694$)

Non-stem to stem fraction was significantly lower ($P = 0.004$) for the alfalfa cultivar when compared to both blue pea cultivars

for all cutting intervals (Table 19). Both blue pea cultivars illustrate constant non-stem to stem ratio with increasing cutting interval while the alfalfa cultivar showed decreasing non-stem to stem ratio with increasing cutting intervals.

Table 16 Effect of cutting interval on ground cover percentage of native and exotic blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa*) cultivars, Sam Motta DTC, 2005-2006

Cultivar	Ground cover percentage			Mean
	Cutting interval (wk)			
	4	5	6	
Native clitoria	44.4	52.5	53.4	49.5
Exotic clitoria	53.3	56.5	58.1	55.6
Alfalfa	59.8	56.5	83.8	66.7
Mean	52.5	55.2	66.5	57.3

sed (df 183) for comparing means: Cultivar = 2.28 ($P < 0.001$), cutting interval = 2.28 ($P < 0.001$), Cultivar x cutting interval = 3.95 ($P < 0.001$)



Plate 7 Plots of alfalfa (*Medicago sativa* cv Florida 99) (above) and blue peas (*Clitoria ternatea*) (below), Sam Motta DTC, 2005-2006

Table 17 Herbage biomass accumulation of native and exotic blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa*) 12 weeks after planting, Sam Motta DTC, 2005-2006

Cultivar	Biomass accumulation (kg/ha)
Native clitoria	625
Exotic clitoria	1319
Alfalfa	493

sed (df 15) for comparing means: Cultivar = 269.5 (P = 0.017)

Table 18 Effects cutting interval on the height (m) of native and exotic blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa*) cultivars, Sam Motta DTC, 2005-2006

Cultivar	Height of cultivars Cutting interval (wk)			Mean
	4	5	6	
Native clitoria	0.25	0.26	0.32	0.27
Exotic clitoria	0.26	0.28	0.34	0.29
Alfalfa	0.29	0.32	0.43	0.34
Mean	0.26	0.29	0.36	0.3

sed (df 183) for comparing means: Cultivar = 0.017 (P < 0.001), cutting interval = 0.018 (P < 0.001), Cultivar x cutting interval = 0.030 (P = 0.539)

Table 19 Effects of cutting interval on the ratio of non-stem to stem proportion of native and exotic blue peas (*Clitoria ternatea*) and alfalfa (*Medicago sativa*) forage legumes, Sam Motta DTC, 2005-2006

Cultivar	Non-stem to stem ratio Cutting interval (wk)			Mean
	4	5	6	
Native clitoria	0.64	0.65	0.6	0.65
Exotic clitoria	0.66	0.65	0.66	0.66
Alfalfa	0.62	0.62	0.6	0.62
Mean	0.64	0.65	0.66	0.64

sed (df 183) for comparing means: Cultivar = 0.0139 (P = 0.004), cutting interval = 0.0140 (P = 0.911), Cultivar x cutting interval = 0.0242 (P = 0.704)

Technology Transfer and Outreach Systems

The Technology Transfer and Outreach Programme is the mechanism through which small ruminant production and marketing system technologies are disseminated to small ruminant stakeholders. The activities carried out under the programme in 2005/6 are highlighted below.

Goat Commercialization Project

The Government-sponsored Goat Commercialization Project is a revolving doe project for small farmers. Based on an arrangement with MINAG, CARDI was mandated to train, recruit and recommend farmers from the central and western parishes. Notwithstanding several constraints the Livestock Team was able to visit selected farmers and make telephone contact with some of the recipients. From these communications it would seem that while most of the recipients are multiplying their animals for over 2 years the passing on of offspring from farmer to farmer needs to be improved. Messrs Basil Faloon and Dennis Ebanks from St Elizabeth and Manchester respectively reported that they each received four animals that were bred and are now showing signs of pregnancy. The third farmer Mr Carlo McLeish, in addition to having increases from the four animals received he now has a herd of over 50 crossbred Boer does, which was due to motivation from his participation in the Goat Commercialization Project.

Development of training and other outreach systems

During the period in review there were 457 visitors who came to the centre for various tours and information in addition to over 130 persons who attended an open day in November. The visitors included persons and farmers interested in obtaining information about various aspect of goat production, including, technical information on husbandry, breeding, housing, feeding and acquisition of stock. The station continued to be a repository of information and practical experience for several students preparing for Caribbean Examination Council (CXC) evaluation. The visitors during the year ranged from kindergarten to university students and their teachers who use the DTC as one of their annual sites for the students to get an appreciation of animals to university students embarking on research projects. The bulk of the visitors however, were farmers who had interest at different levels of small ruminant production. Among these were participants in the government's "Small ruminant empowerment project" where CARDI is a collaborator.

Other outreach activities

These outreach activities focused on visiting participants in the ALPART Small Ruminants Development Project and the wider Jamaica. During the period there were 23 farm visits where activities ranged from technical assistant on forage production to breeding and multiplication techniques. Production and productivity data was collected from selected holdings to compare the performance of the different breed types and breed combination. The holdings visited exhibited differing levels of adoption and development of improved goat production technology. The primary focus

of the team was to get farmers interested in trying new technology to increase production and productivity. At least one farmer exhibited interest in oestrus synchronisation by trying the procedure with a small group of goats. Where needed technology transfer was done through training and demonstrations. Farmers were also provided with literature related to small ruminant production. The project was also instrumental in training eight students from the May Day High School in smallstock and related areas in preparation for their CXC exams.

Additionally, at least 45 farmers, students and institutions visited the Livestock Section and was provided with technical advice on various crops and livestock activities resident at the SMDTC.

Monitoring the adoption and impact of improved technologies

This activity seeks to determine the effectiveness of new and improved production and marketing systems introduced to goat producers. All systems are first tested at the DTC. Several farmers over the years have adopted the whole or segments of the technology package. Over the past several years comparisons were made among different production systems, the main ones practised being all-in-one intensive and semi-intensive meat production and breeder stock production systems. This task therefore attempted to look at the technology adoption process and its effect on the farm household.

The Ministry of Agriculture and the ASSP through the JSFA sought to improve the local sheep production by importing improved sheep breeds. The process which was delayed due to veterinary requirements that the selected farms did not meet are

being addressed by the relevant authorities. Checks with the JSFA and the Ministry of Agriculture revealed that over 3,000 ewes including the imported ones that were not bred have been exposed to the imported rams. During the project year over 150 purebred and crossbred lambs were produced locally as a result of the importation Dorper ewes and rams imported by the Ministry of Agriculture and ASSP. The programme is poised to be extended with additional imports of over 150 sheep breeding stock from the United States by the same entities. The JSFA with assistance from the ASSP is embarking on the establishment of a feedlot and slaughtering facilities at the Bodles Research Station. The facilities were about 75 per cent complete at the end of the reporting period. The planned importation of close to 100 goat breeding stock from the USA is still on hold pending the resolution of the veterinary restriction on the importation of goats from farms which are not certified Scrapie free.

The importation of improved small ruminant stock coupled with the dissemination of improved production technologies, have impacted on the small ruminant landscape in Jamaica. In a continuing effort to access the levels of intervention and chart the way forward production data were collected from selected farms during the year in review. This is an ongoing activity and will continue in the next project period in an effort to measure the growth of the industry

after 15 years of intense concentration in small ruminant improvement. The production parameters as they relate to birth and weaning weights and average daily weight gains based on farm and breed percentages were the main points of focus. The farms selected in this case were two different production systems with a completely intensive and a semi-intensive operation. While the systems cannot be compared head to head because of the diversity of the operations, there are important trends which were observed. The Tables (19 to 21) illustrate some parameters being tracked.

The object of the exercise was to determine the level of improvement of the local stock or the relevant crosses of the major breeds that is necessary to maximise production. The lower average weaning weight of the Boer x Native cross may be due to the lower milk producing ability of both the Boer and the Native breeds when compared to the Nubian. Data from the Haase farm seemed to suggest that where the exotic breeds' percent is above 75 the weaning weights is higher. This trend is consistent with some of the on-station results. Because of the diverse feeding regimes, management practices and breed combination only trends could be identified at this time. Further data therefore need to be collected to determine the percentage of exotic breed where diminishing returns sets in as observed in other herds

Table 19 Production records of goat herd at the Bodles Agricultural Research Station

	Boer	Nubian	Boer x Nubian	Graded Boer	Graded Nubian
Birth Weights					
Male	3.25	3.07	3.27	3.01	2.92
Female	3.02	2.64	2.77	2.64	2.68
Overall	3.13	2.84	2.88	2.83	2.8
Weaning Weights					
Male	13.9	12.4	14.2	13	13
Female	12.5	11.3	11.6	11.9	12
Overall	13.2	11.8	12.67	12.5	12.5
8 Month Weights					
Male	23.2	21.9	21.9	23.9	23.6
Female	21.2	21.5	22.5	21.9	21.2
Overall	22.2	22	22.2	22.7	22

Table 20 Production data at Red Ranch goat farm in Rhymesbury, Clarendon

Parameters	Birth weights (kg)	weaning weights (kg)	Pre – Weaning ADG (g)
Breed/Type			
Graded Boer	2.37	16.5	471
Purebred Boer	3.34	13.04	323.6
Overall	2.82	15.07	410.1
F Prob.	0.0001	0.016	0.003
SD	0.45	4.61	154
df	49	45	45
Sex			
Male	3.05	14.75	391
Female	2.65	15.28	422.4
F Prob.	0.033	0.721	0.544
SD	0.64	4.92	170.3
df	49	45	45
Birth Type			
Single	2.73	17.58	497.3
Twins	2.87	13.6	359
F Prob.	0.486	0.006	0.006
SD	0.66	4.52	156.8
df	49	45	45

Table 21 Production records at Donald Haase Farm in Chapelton, Clarendon

	Birth weight (kg)	Weaning weight (kg)	Pre-weaned ADG	8/9 MTH WT (Kg)	Post-weaned ADG
Sex					
Male	3.35	16.455	443	35.54	140.61
Female	3.25	14.06	360.32	32.17	121.47
Overall	3.3	15.38	402.67	33.9	123.43
F Prob.	0.499	0.001	0.0001	0.021	0.004
SD	0.72	3.24	96.93	6.5	24.62
df	81	81	81	81	81
Breed/Type					
BoNat	3.29	13.11	327.18	30.57	116.41
NubNat	3.03	15.38	411.7	33.1	116.18
BoNub	3.83	16.74	430.34	37.49	138.34
BoNuNa	3.08	15.18	403.09	32.8	117.51
F Prob.	0.0001	0.03	0.042	0.012	0.012
SD	0.64	3.34	101.5	6.35	24.78
df	81	81	81	81	81
Birth Type					
Single	4.07	17.82	457.7	38.91	140.61
Twins	3.19	15.11	397.31	33.34	121.47
Triplets	2.67	12.84	339.02	28.69	105.69
Prob.	0.0001	0.002	0.025	0.001	0.004
SD	0.6	3.24	101.4	6.16	24.62
df	81	81	81	81	81
Breed percentage					
50 to 75	3.36	15.02	388.55	33.08	120.4
Greater than 75	3.28	15.55	409.23	34.28	124.84
F Prob.	0.614	0.52	0.41	0.052	0.476
SD	3.36	3.48	105.1	6.7	25.15
df	81	81	81	81	81

Natural Resource Management

The Natural Resources Management Programme of CARDI generates scientific information and component technologies and products, including integrated management strategies for pest control and postharvest systems and the management of the land and water resources of Jamaica in a sustainable manner while decreasing environmental degradation. In 2005/2006 the Jamaica Unit of CARDI executes, under this programme, projects in integrated pest management for vegetables, sweetpotato, and hot pepper and organic agriculture studies.

IPM CRSP Project

The activities slated for Phase III of IPM CRSP under the technology transfer grant in Vegetable IPM and Sweetpotato IPM were significantly advanced during 2005/6. Under a no-cost extension agreement, i.e. continuation of activities from Phase II, which have the greatest potential for impact in IPM development and applicability in the selected commodities: vegetables (leafy vegetables and hot pepper) and root crops (sweetpotato). Impact assessments and further dissemination of technologies were also areas of emphasis.

Both allotments of funding were initially slated to be available up to 31 December 2006 but due to the late release of funds under the technology transfer grant an extension to 31 March 2007 was granted on

the latter. CARDI's role in the Global IPM CRSP after March 2007 has still not been clarified but given increasing budget cuts by USAID the configuration of the project will be drastically revised.

During 2005, two planning meetings were held at Zamorano in Honduras and North Carolina State University, USA, respectively, to develop proposals for (i) Establishment of a regional IPM Centre of Excellence for vegetable crops in the Latin America and Caribbean (LAC) Region (ii) Global themes-Management of invasive species in the Caribbean, Africa, and Asia with emphasis on priority pests in the Caribbean and (iii) Applications of information technology and databases in IPM in the developing countries and development of a global IPM technology database.

All three proposals were submitted for competitive tender in July 2005 and were assessed in August 2005. All but the proposal for management of invasive species were awarded. However, the funding allocated under the LAC grant has been virtually unworkable to support activities across all members of the LAC, resulting in the marginalization of 'mature sites' including the Caribbean. The Caribbean has received limited funding from the grant awarded for development of information technology and the use of these funds has had to be rationalised as the amount allocated was significantly less than the budget that was proposed for the Caribbean component.

In April 2006, the annual planning meeting of the Global IPM CRSP was held in St Louis, Missouri to coincide with the National IPM Symposium which was held 6-7 April 2006. Achievements of IPM

CRSP were presented at several technical sessions at the symposium. During the planning meeting, the progress of administrative and technical aspects of Phase III of IPM CRSP was reviewed. Some new and emerging procedures were discussed and the future of IPM CRSP from a USAID Washington perspective was presented by Dr Robert Hedlund, Cognizant Technical Officer for the IPM CRSP and SANREM CRSP; USAID Washington. Major discussions were held on the staging of an *IPM CRSP Day* at USAID Washington, which was scheduled for 9 May 2006 to review the IPM CRSP as to its relevance to the agency's current strategic plan. A plan for the presentation to be delivered by the Management Entity of IPM CRSP during the IPM CRSP Day was discussed and suggestions made to include successful case studies from host countries and regions. It was the view of Dr Hedlund that given its track record and unique configuration compared to other CRSPs, the IPM CRSP should have a future.

IPM Systems Development for Callaloo (Vegetable Amaranth)

Interception data from the United States Department of Agriculture and the Animal and Plant Health Inspection Service (USDA APHIS) have indicated a dramatic reduction of pest interceptions in shipments of fresh callaloo submitted for export to the USA from an average of 38% interceptions in 1997 to 2.5% in 2005 (Figure 4). The annual number of shipments of fresh callaloo to the USA is on average 150.

The collaborative on farm research and training conducted under the CARDI/IPM CRSP was credited with this notable improvement in product quality.

Consequently, USDA APHIS initiated a programme to reinstate callaloo on the preclearance list. CARDI/IPM CRSP played a key role in the training exercises under this programme, in the form of both financial and technical support. Specific areas of focus in the training sessions included preclearance requirements, standards, Callaloo IPM and post harvest handling.

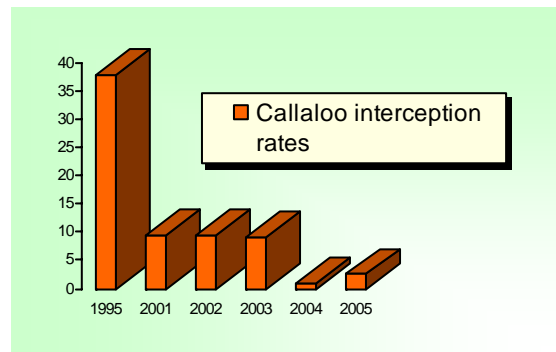


Figure 4 Annual pest interception rates for callaloo submitted for export to the USA at the two ports in Jamaica for 1995 and 2001-2005. (unpublished report; USDA-APHIS, 2005)

The training re callaloo IPM constituted a series of training sessions towards the sustainable reinstatement of callaloo to the preclearance list of commodities exported to the USA. The participants in the four training sessions, a total of 120, included, farmers, exporters and extension and quarantine officers islandwide, who will who will be involved either in farmer certification exercises or export activities under preclearance.

The commodity will be reinstated on the preclearance list in 2007.



Plate 8 IPM technology transfer. Top: Participants of the training session held in Denbigh, Clarendon, **bottom:** CARDI Entomologist identifying a pest for extension officer

IPM Systems Development for Cabbage

Technology transfer activities on cabbage

In Caura Valley, Trinidad, data collection and demonstration continued in a cabbage plot which was established in November 2005. The first cropping season ended in January 2006, during which a field day was hosted on site. Approximately 40 farmers and 30 other stakeholders attended. The threshold-based system of monitoring and timing of pesticide applications for major pests (Lepidoptera) on cabbage, which was being demonstrated in the plots, indicated the potential to reduce pesticide input in cabbage production without compromising marketable yields. At the end of that crop a second plot was established to repeat the validation/demonstration of Vegetable IPM.

During both the first and second crops, generally, the cabbage budworm was the major lepidopteran pest at Caura Valley. In observations during the second trial, lepidopteran pests were found on the outer leaves of cabbage in treated plots with the exception of plots sprayed weekly with Tracer®, which had no pests and untreated and farmer practice plots (sprayed weekly with Bioneem®) where pests were also found within the cabbage heads. While threshold plots had more larvae than weekly treated plots, this was expected since these plots were only sprayed after reaching the designated threshold. Both Match® and Tracer® were effective in managing lepidopteran pests in cabbage in both weekly and threshold treatments when compared to the control.

There were significantly ($P < 0.05$) more marketable heads of cabbage in weekly treated plots versus threshold plots for both Match® and Tracer® but it should be noted that weekly-sprayed plots received nine applications of these products in comparison to threshold plots which received three and two applications of Match® and Tracer®, respectively over the ten-week period of the trial. Therefore, the thresholds could be reduced to achieve greater control of caterpillars while still reducing pesticide input compared to a weekly-spray regime. Within an IPM strategy however, pesticide rotation would have to be practiced to ensure resistance management.

The activities in Trinidad were executed by our key collaborators in the Ministry of Agriculture Land and Marine Resources (MALMR), Trinidad and Tobago using the methodology developed by Co-Principal Investigators in CARDI Jamaica and Pennsylvania State University. The collaborative effort was streamlined

through planning meetings held with the Director of Research, MALMR and other collaborators.

In November 2006 a second validation plot was established in South Oropouche in the South of Trinidad to target vegetable growers in that region.

In Jamaica, a site for establishment of the on farm plot was identified in Mavis Bank St Andrew to conduct parallel Vegetable IPM studies, however, procurement of the test pesticide, Tracer® (spinosyns), continued to be a constraint. A decision was taken to modify the list of treatments for the trial in Jamaica to exclude the spinosyns (which although now registered for use in Jamaica is still not available locally) and include instead exclusion using floating row covers. Compared to weekly-sprayed plots (Match® weekly) which were sprayed eight times, only five threshold-based spray applications (Match® threshold) were made while exclusion plots received no chemical sprays.

Cumulative larval frequency observed over the period of monitoring in each treatment plot varied as follows: E- Exclusion (fixed) < ER- Exclusion (removed during the day) < MW -Match® weekly < MT- Match® threshold < C- untreated control. An Analysis of Variance (ANOVA) on these totals indicated that the differences were significant ($P < 0.0001$). However, a pairwise-comparison using Student's *t* showed that cumulative larval frequency in C plots was significantly higher than in E, ER and MW plots but was not significantly different from MT plots. Harvest (crop loss and marketable yield) data were compared using ANOVA to determine the benefits of IPM systems. Percentage losses were significantly different among the treatment plots ($P < 0.05$). $E < ER < MT < MW < C$. Note

that although higher cumulative larval frequencies were recorded in threshold plots compared to weekly sprayed plots, losses in the latter were greater.

A training session was conducted in IPM of cabbage pests supported by the on farm experimental plots in Mavis Bank, St Andrew. The benefits of threshold-based method of pesticide applications and exclusion using row covers in management of major cabbage pests were demonstrated in the various treatment plots to farmers, exporters and extension and quarantine officers, a total of 29 stakeholders. The training was done in collaboration with the Jamaica Agricultural Society (JAS) and the Rural Agricultural Development Authority (RADA).



Plate 9 On farm demonstration at the experiment site Mavis Bank, St Andrew, Jamaica. Row cover removed (bottom) to show reduced pest damage on cabbage

IPM Systems Development for Hot Pepper

Molecular probes to distinguish gall midge species

Samples of Scotch Bonnet hot pepper, which showed signs of gall midge damage, were collected from growers' pepper fields. Immature gall midges dissected from the pedicel were separated from those within the flower buds, placed individually in 70% ethyl alcohol and sent to laboratories at Pennsylvania State University (PSU) for extraction of DNA. Attempts were made to use polymerase chain reaction (PCR)-to amplify a partial region of the mitochondrial cytochrome b gene using universal amplification primers that had been shown by others to be successful in identifying closely related gall midges in the same tribe (Cecidomyiini) as the Jamaican hot pepper gall midges.

Molecular probes which were made by Dr. Liwang Cui (Penn State), in 2003 during training in molecular techniques, were completed by the training recipients Juliet Goldsmith (MINAG), Jamaica) and Dr Kathy M Dalip (CARDI) and they were able to reproduce the molecular results in labs in the University of the West Indies. The probes are primers for the intergenic transcribed spacers (ITSs) of the rDNA genes that are suitable for PCR of the gall midge larvae and pupae present in the hot pepper. These highly polymorphic ITSs allow easy differentiation of closely related species.

The results indicated that the gall midges present in fruit pedicel, which were thought to be a single species, contain two species/subspecies that are clearly separated by the molecular probes we have

designed. A well-defined primer from specimens collected from the buds is yet to be obtained, but morphological work has suggested that there is a different species from the bud than from the pedicel. This suggests that there is greater variation in morphological and molecular-types than we had anticipated. We need to place this in perspective of what is known about the biological variation of the taxa, and use this to claim species descriptions that are accepted by the scientific community. It is possible that we may be dealing with one or more currently undescribed species.

If we are to make further progress in quarantine issues, we need published species descriptions. Therefore, a systematist in this taxonomic group was contacted and specimens sent for species description. Ultimately, descriptions would encompass both the morphological and molecular progress made to date.

The Hot pepper Task Force further explored the possibility of having a pest risk analysis (PRA) done as this was deemed fundamental to ascertaining whether or not the gall midge warranted the stringent quarantine measures enforced.

Facilitated by discussions among US-based IPM CRSP collaborators and USDA officials, a PRA has been conducted. A report has been sent to USDA for their consideration of a revision of the quarantine status of the pest.

IPM Systems Development for Sweetpotato

Evaluation of mulches and pest tolerant varieties

Mulches (plastic and organic) and pest tolerant sweetpotato varieties (Fire-on-

Land (FOL), Quarter Million (QM) and Yellow Belly (YB) were evaluated for their potential to deter the major pests limiting crop yields and increasing the cost of production; weeds and the sweetpotato leaf beetle (SPLB). Replicated field trials were established in Bushy Park, St Catherine and Ridge Pen, St Elizabeth. Insect pest incidence, weed diversity and biomass, as well as the quality and quantity of the harvested yield were compared across treatments.

Arthropod pests: Sweetpotato leaf beetle (SPLB) populations varied with the phenology of the crop; during the season beetle numbers ranged between 0-20 per plot of 25 plants. Damage to harvested roots by the beetle ranged from 70-80% with no differences observed among the treatments. ($P > 0.05$).

Weeds: Twenty-six weed species were associated with sweetpotato plots. Plots with plastic mulch had lower number of weed species and biomass than all other treatment plots. Between 9 and 14 weed species were recorded in unmulched plots and those with organic mulch respectively. These plots had a mean weed biomass ranging between 0.16 (± 0.05) and 0.77 (± 0.15) kg/plot. Plots with the variety Yellow Belly (YB) had a lower weed biomass than Quarter Million (QM) and Fire-on-Land (FOL); this observation may be linked to the leaf area of the YB being larger than the QM and FOL varieties. Crop yields were not affected by the plastic mulches.

Weeds and the SPLB are major pests that limit yields and increase production costs to the farmer. The use of plastic mulches may be a viable option for managing weeds within sweetpotato cropping system. In addition, the variety QM appears less

susceptible to SPLB damage and therefore could be considered as an option in the management of this pest.

Trapping: The use of traps for monitoring as well as mass trapping insect pests is essential in a sweetpotato IPM programme. For the sweetpotato weevil, the efficiency of five sweetpotato weevil pheromone trap designs was evaluated (Plate 10).

All traps were able to capture sweetpotato weevils; mean catch per 48 hours was 762 (± 148) weevils, with Bushy Park having the lowest population (Figure 5). Although no significant differences were observed in the efficiency of the five trap types ($F = 1.27$; $df = 4$; $P = 0.28$), the metal trap (Modified Talekar – AVRDC) consistently captured more weevils than any other trap whereas the bottle trap with the light captured the least weevils. With the exception of the latter, the results suggest that the trap types evaluated are suitable for use in the current IPM programme which integrates cultural practices and sex pheromones to mass trap sweetpotato weevils.



Plate 10 Traps evaluated to determine their efficiency to reduce sweetpotato weevil populations.

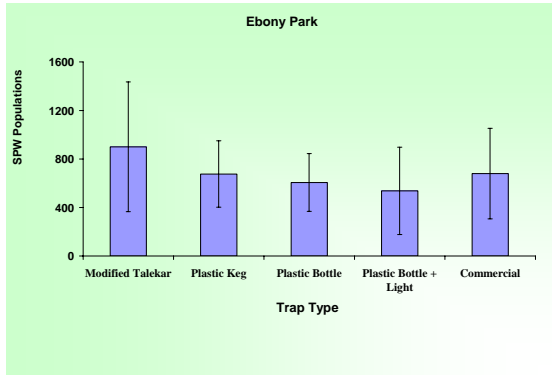


Figure 5 Efficiency of various trap designs to mass trap sweetpotato weevil populations.

Weed Management

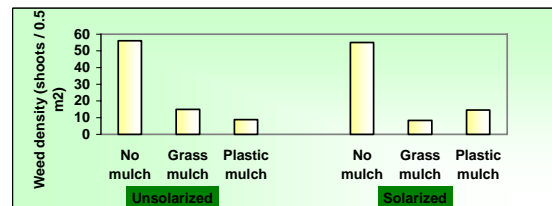
Weed management strategies for organic agriculture in Jamaica: An evaluation of solarization and mulching on the weed community and the impact on various components of the crop system

The purpose of this study was to understand how various applications of solarization, before planting the crop, and mulching, during the life of the crop, would affect weed communities locally. During the period being reported four field experiments and one small pot experiment were completed.

One trial was designed to investigate both the effects of the pre-crop soil solarization, mulching with grass and mulching with white on black plastic as individual treatments; as well as combining the pre-crop solarization with either of the mulch treatments on the weed community. The preliminary data analyses suggest that under these conditions it was *mulching with the white on black plastic alone or with solarization that was consistently the most effective in reducing the weed density*. However, while there was no apparent value to solarizing before mulching with white on

black plastic in order to further reduce weed density, solarizing before mulching with grass gave better weed reductions than solarization alone or grass mulching alone. Solarization alone was not effective in this experiment.

The richest communities i.e. those with the most species were the unmulched ones. Solarization alone had no detectable effect on the richness of the developing weed community but the *white on black plastic and the grass mulch treatments significantly reduced the number of species in their weed community*. Neither of the solarization-mulch combinations accounted for any further reduction in the number of species in their community than that observed in the mulch treatments alone. However, there were variations in the species composition of the various treatments, even the ones that had similar number of species.



The density means are the means of two quadrats in the four replicates.

F for main plot (solarized, unsolarized) treatments (1,3)=0.04: P>0.05

F for split plot (grass, plastic, and no mulch) treatments (2,19)=40.75: P>0.05

s.e.d for split plots in the same main plot treatment=7.95; s.e.d for split plots in different main plot treatment=8.08

Figure 6 The weed density at 3 weeks after solarization, for white-on-black plastic mulched, grass mulched and un-mulched treatments that were solarized for six weeks with clear plastic before planting or were left uncovered (unsolarized) for six weeks before planting

Though all the treatments had E (even communities) values over 0.5, which suggests that there was no one truly

dominant species in any of them, the mulched treatments had significantly higher E values.

The IPM CRSP support to the graduate student in weed science continued up to May 2006 and the student has completed a draft of her Ph.D. Thesis, *Weed Management Strategies for Organic Agriculture in Jamaica: An Evaluation of the Impact of Soil Solarization and Mulching on the Weed Communities in Onions and Hot Peppers*, and is undergoing revision for submission to examiners. A poster on some of the practical applications for weed management coming out of these graduate studies was mounted at the 54th Denbigh Agricultural Show, the premier annual agricultural show in Jamaica which was held 5-7 August 2006

Citrus Replanting Project

The contract between the Ministry of Agriculture and Lands and CARDI for CARDI to provide the entomological services for the Citrus Replanting Project (CRP) officially ended 31 January 2006. This reporting period therefore, was essentially spent finalising activities which were still ongoing, finalizing analyses and writing reports. In January, 2006, carryover investigative activities were conducted with respect to determination of the impact of candidate pesticides on natural enemies, evaluation of spray application technology and evaluation of the biocontrol potential of major predators. On 19 January and 22 February, 2006 meetings were convened with the Project Steering Committee and citrus growers, respectively, to present research findings to stakeholders. The final required reports were completed and

submitted during the first quarter (quarterly report-October to December 2005, annual report 2006 and a completion report). The completion report presented the consolidated research findings and recommendations from the research services over the approximately three years. Other outputs included an electronic literature database and two boxes of insect specimens. On 8 June 2006, a meeting was held with a panel of Ministry personnel to review the completion report submitted as the final output of the research services in entomology provided by CARDI. The agreed list of revisions was completed and the final revisions accepted in September 2006.

In responding to the terms of reference, of the contract for the Research Services in Entomology, the project team conceptualized the scope of works as comprising two components:

Component 1

Understanding BrCA ecology through studies on spatial and temporal distribution and the role of key factors

Component 2

Investigating and integrating management options namely biocontrol and the use of pesticides

The scope of works was then disaggregated into discrete studies involving surveys, laboratory experiments, field trials etc. Specific IPM outputs would become components of a decision support system for citrus pest / crop management. It is envisaged that these outputs will ultimately be incorporated into a citrus production and management database which can be made available in various formats for direct

access and for the development of information products.

An outline of the plan of work, experimental protocols and the proposed time frame for executing the various activities were presented in the inception report and was accepted.

The studies and outputs were as follows:

A survey to determine the geographical distribution of BrCA was conducted throughout Jamaica taking into consideration the effects of altitude and other geographical features, farm size, rootstock and scion variety. This was done to address the term of reference requiring the determination of the spatial distribution of the insect in the project area.

Determination of the seasonal distribution of BrCA was achieved by monthly monitoring of aphid populations in citrus orchards selected to represent a range of agro ecological conditions.

A comprehensive survey of natural enemies of BrCA was conducted both by direct field observations and by laboratory rearing of associated parasitoids. Laboratory and screen house studies were designed to elucidate the potential of any of these natural enemies for controlling BrCA.

These initial investigations informed the strategy for incorporating natural enemy manipulation in BrCA management especially as it related to (i) augmentative or inundative releases and (ii) the introduction of exotic natural enemies.

Studies on pesticide susceptibility of BrCA involved screen house and field trials with particular bias to biorational pesticides to minimize any deleterious impact on natural enemy populations.

Concurrently with the population studies on the BrCA, the opportunity was taken to collect data on the presence of other citrus diseases and vectors, particularly the psyllid vector of citrus greening disease whose presence in Jamaica was identified and confirmed during our course of investigations.

Major constraints relating primarily to the weather (prolonged droughts, active hurricane seasons, long periods of absence of BrCA in the field), availability of test insects and some delays in the procurement of equipment and facilities delayed the implementation of some activities and necessitated the scaling down of some initial projections. Consequently, two extensions were approved which deferred the completion date to 31 January 2006.

Technical constraints also delayed the recognition and identification of the parasitoid *Lipolexis oregamae (scutellaris)* during early surveys. Confirmation of the occurrence of this natural enemy in Jamaica represents a major scientific breakthrough as it was previously thought to occur naturally only in Asia from where it was recently introduced into Florida to provide biological control of the brown citrus aphid. The fortuitous presence of this natural enemy in Jamaica is the subject of ongoing scientific investigation in collaboration with the University of Florida.

The terms of the contract stipulated that work be conducted in close association with relevant personnel of the Research and Development Division of the Ministry of Agriculture as part of the succession plan.

Regular interaction between the project team and MINAG staff was also facilitated logistically by the provision of a furnished

office in the Plant Protection wing of the Bodles Research Station for the use of the project team. In addition space in the general Entomology Laboratory was made available to the project team for routine work. This space was shared with the staff Entomologists of the Research Station. A dedicated laboratory space for insect rearing, including the rearing of natural enemies and a purpose-built, insect-proof greenhouse was also made available by the research station

Capacity building was also facilitated during this consultation as personnel from the Plant Protection and Post Entry Quarantine Divisions at Bodles Research Station interacted closely with the project team. In addition to physical proximity, the staff of the Ministry participated in planning, review and training activities associated with the project. This provided opportunities for cross fertilization and set the stage for smooth transitioning at the end of the contracted services. Ministry and CARDI personnel also benefited from training provided by visiting Scientist Dr Marjorie Hoy of University of Florida, with expertise in biological control of a number of citrus pests including BrCA and Asian Citrus Psyllid.

The principal strategic objective of this project was to improve the state of knowledge so as to remove a critical constraint to the citrus sector. This objective was achieved and the knowledge generated constitutes an original contribution to the scientific understanding of brown Citrus aphid and the options for its management.

The results and recommendations which include scouting guidelines, identified key factors affecting BrCA, a list of key natural enemies and suggestions for their

conservation, mass rearing protocols for parasitoids and pesticide options deemed most compatible with biological control were presented in the completion report. A schematic of the recommended integrated strategy was also depicted.

A schematic summary of the recommendations is presented in Figures 7 and 8 below.

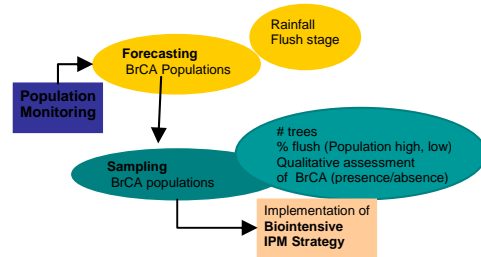


Figure 7 Schematic model illustrating monitoring components of the integrated management strategy for BrCA

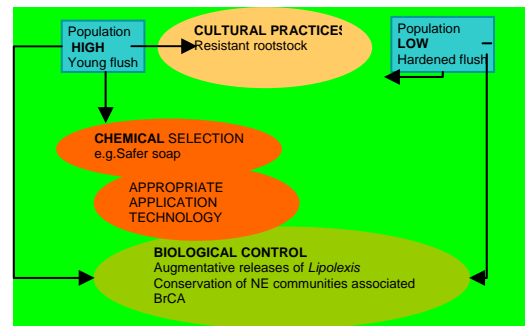


Figure 8 Schematic model illustrating integrated management strategy for BrCA

Organic Agriculture Research

Studies on organic farming techniques began in 2000 and have involved compost production including vermicomposting and data on nutrient availability from various compost mixes. In addition, the growth and performance of hot pepper and callaloo grown in rotation under organic

farming conditions and utilizing vermi-compost, cow manure and goat manure have been assessed in demonstration plots on the research station.

During 2005, organic plots of corn and tomatoes were planted and established but no manure treatments were applied due to an inability to obtain weathered goat manure. Growth of corn even without fertilizer was particularly good (Plate 11). A vermi-compost seedling trial was prepared for and planted but was discontinued after the cells of the seedling trays were affected by rainfall. The production of vermi-compost continued until October when heavy rains resulted in the inundation of the compost making facility and the destruction of the earthworms. Compost production will be re-started in the New Year, with the acquisition of earthworms.



Plate 11 The organic demonstration site showing the corn and tomato crops.

In 2006, Studies similar to those done in previous years utilizing three types of organic nutrient sources were initiated. This year the nutrient sources were cow manure, vermi-compost made from discarded coffee beans and a commercial organic fertilizer. In addition the pepper plots were under black plastic mulch and the entire area surrounded by an exclusion cage to reduce pest infestation.

In this first assessment the commercial bioorganic manure appear to have superior effect on the growth and yield of both callaloo and hot pepper compared to vermi-compost and cow manure. Table 22 gives the total fresh weight yield of callaloo obtained from the plots in relation to the three manure treatments. This yield is broken down into that which was marketable and that which was unmarketable due to pest damage. This data indicates that the plots treated with commercial bioorganic and cow manure produced significantly ($P < 0.05$) total and marketable fresh weight of callaloo compared to plots treated with vermi-compost. There was no difference in yields between plots treated with bioorganic and cow manure. Also there were no differences of unmarketable fresh weight yield amount treatments.

Table 22 Total fresh weight of callaloo harvested in relation to three manure treatments

Treatment	Callaloo harvest (kg)		
	Marketabl	Unmarketabl	Total
T1	5.75b	4.32	10.07b
T2	12.87a	4.87	17.74a
T3	15.82a	4.47	20.29a
LSD	3.37	1.35	2.98

T1: Vermi-compost at 0.5 kg per plant hole (approx. 7500 kg/ha).T2: Cow manure at 0.5 kg per plant hole.T3: Biorganic at 0.5 kg per plant hole. Values in the same column followed by the same letter are not significantly different ($P > 0.05$)

Tables 23 and 24 give the numbers and mean weights of fruits harvested per plant over seven harvests from 14-17 weeks after transplanting (WAT). In general the number of fruits and the mean weight of fruits per plant harvested from the plots treated with the bioorganic manure were higher than that obtained from the other two treatments. In addition, at 15 WAT the mean number of

fruits harvested in the organic plots was significantly higher ($P < 0.05$) than in plots treated with the other two manures. Further, at 15 and 19 WAT the mean weight of fruits harvested in the organic plots were significantly higher ($P < 0.05$) than in plots treated with the other two manures.

Figure 9 gives the mean height of pepper plants 14-22 WAT in relation to the three treatments. There were no differences in plant height among the treatments. The mean plant height is about 30 cm which is very short for the variety, but again indicates that despite irrigation water being applied, the dry weather conditions affected the growth of the plants.

Table 23 Mean number of hot pepper fruits harvested per plant in the first seven harvests in relation to the three manure treatments

Harvest	Age WAT*	No. of fruits/plant			LSD
		T1	T2	T3	
1	14	2.08	1.33	3.83	2.77
2	15	1.58b	1.33b	4.33a	2.19
3	16	1.5	2	2.75	2.24
4	17	0.67	0	0.33	0.75
5	18	0.92	0.5	1	0.97
6	19	3	4.08	9.5	4.31
7	20	3.83	2.17	5.33	3.93

*WAT: Weeks after transplanting
 T1: Vermi-compost at 1.0 kg per plant hole (approx. 5000 kg/ha).T2: Cow manure at 1.0 kg per plant hole.T3: Biorganic at 1.0 kg per plant hole. Values in the same row followed by the same letter are not significantly different ($P > 0.05$)

Vermi-compost production continued and 200 kg of vermi-compost was harvested during the year on the Mona DTC. A presentation on Vermi-composting: its benefits and how it is done was made to potential certified organic farmers at a Farm Day of the JOAM Southeast Region at Mt. Pleasant on Saturday 18 February, 2006. After the presentation, the Allen farm in Mt Pleasant, St Andrew was supplied with earthworms. Vermi-compost production on

the Allen's Farm in Mt Pleasant, St Andrew progressed favourably, but no extension of production to other farms was made.

Table 24 Mean fresh weight of hot pepper fruits harvested per plant in the first seven harvests

Age WAT*	Wt. of fruits/plant (g)			LSD
	T1	T2	T3	
14	15.98	11.46	31.61	26.38
15	11.27b	11.79b	32.56a	17.09
16	9.03	13.83	16.53	15.75
17	4.75	0	2.01	
18	6.06	3.78	7.3	7.26
19	20.32b	32.13b	65.9a	32.1
20	24.38	6.08	30.05	21.82

*WAT: Weeks after transplanting
 T1: Vermi-compost at 1.0 kg per plant hole (approx. 5000 kg/ha).T2: Cow manure at 1.0 kg per plant hole (approx. 5000 kg/ha).T3: Biorganic at 1.0 kg per plant hole (approx. 5000 kg/ha).Values in the same row followed by the same letter are not significantly different ($P > 0.05$)

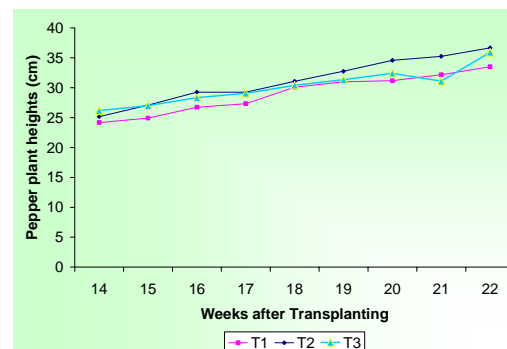


Figure 9 Mean plant heights of pepper 14-22 weeks after transplanting in relation to manure treatments

Market Development Programme

Commercial production of vegetable crops

Efforts continued, on a small scale, to generate some funds using some lands at the Mona and Sam Motta DTCs to grow and market selected vegetables, including callaloo, cabbage, corn, okra, pak choi and tomato, and sweetpotato (Plate 13). Some J\$137,000 gross revenue was generated in 2005, while in 2006 J\$ 113,000 was obtained (Table 25).



Plate 12 Hot pepper, okra and corn growing on the Mona DTC.



Plate 13 Harvested callaloo being washed and bundled for market

Table 25 Revenue obtained from commercial plots at the Mona DTC in 2005

Crops	Amount sold (kg)	Total revenue (J\$)	EC\$ equivalent
Cabbage	584	\$38,475.00	\$1,606.47
Callaloo	1033	\$78,240.00	\$3,266.81
Corn	177	\$8,400.00	\$350.73
Okra	624	\$9,070.00	\$378.70
Pak choi	33	\$1,410.00	\$58.87
Tomato	100	\$1,820.00	\$75.99
Revenue in 2005	2551	\$137,415.00	\$5,737.57
Banana	92	\$3,680.00	\$147.49
Callaloo	1803	\$90,960.00	\$3,645.69
Corn	326	\$16,300.00	\$653.31
Hot Pepper	9	\$450.00	\$18.04
Okra	73	\$1,625.00	\$65.13
Tomato	13	\$250.00	\$10.02
Revenue in 2006	2316	\$113,265.00	\$4,539.68

Pilot Commercialization of By-product and Crop Residue Feeds

Over the last decade and a half, scientists in the Region, including Jamaica, have been evaluating feed alternatives, some of which have shown considerable promise as a basis for improving animal productivity at significantly lower costs. It is estimated that there are approximately 60,000 small ruminant farms in Jamaica and this project attempts to formulate a balanced ration using agro and industrial by-products and make it available to these farmers at an affordable prices.

During the year, the construction of a small feed mixing unit was completed. Staff members were trained in the production of agro and industrial by-product rations and safety procedures. The procurement of feed

ingredients was initiated and some contractual agreements were made. Promotional discussion began with key stakeholders to set up an efficient distributing network.

The production of a 16 per cent crude protein ration commenced in the second quarter. During the final quarter, storage capacity was doubled as part of development plans. By the end of the year a total of 27.4 tonnes of feed was produced and distributed.

Sweetpotato Enterprise Development

Through an informal survey with exporters and producers the ten most popular sweetpotato varieties exported were identified. Varieties included Eustace, Watson, Minda, Miss Mac, Quarter million (QM), Yellow Belly (YB), Ganja, Fire-on-land (FOL), Uplifter, and Clarendon. During 2005-2006, replicated trials were established in two major growing areas (Devon, Manchester and Ebony Park, Clarendon) which differ in agro-ecological conditions, to determine yield potential, physical and chemical characteristics and value added potential for these popular varieties.

Sweetpotato yields differed significantly among the varieties ($F > 4.7$, $df=12$, $P < 0.001$) and between the locations ($F > 15.3$, $df=1$, $P < 0.001$). Location differences were observed suggesting that varieties need to be matched with conditions that are most suitable for their growth and development.

Varieties also differed by their tolerances to major pests. In relation to the major pest, the sweetpotato leaf beetle, *Typophorus nigritus viridicyaneus* (Coleoptera; Chrysomelidare), consistently across locations the varieties Ms Mac and Eustace had the highest damage with >70% of roots harvested being affected by the beetle. In contrast, the variety Watson demonstrated tolerance at both sites.

Sweetpotato varieties were characterized by vine and root features (Table 26). These data were used to develop a descriptor for farmers, researchers and exporters (Plate 8). The descriptor has been circulated to stakeholders for review. The lack of characterization of sweetpotato varieties has been cited by persons within the industry (researchers, extension, market, processors) as a major limiting factor for growth; this poster was therefore circulated to stakeholders within the industry for feedback. To date, the response has been positive.

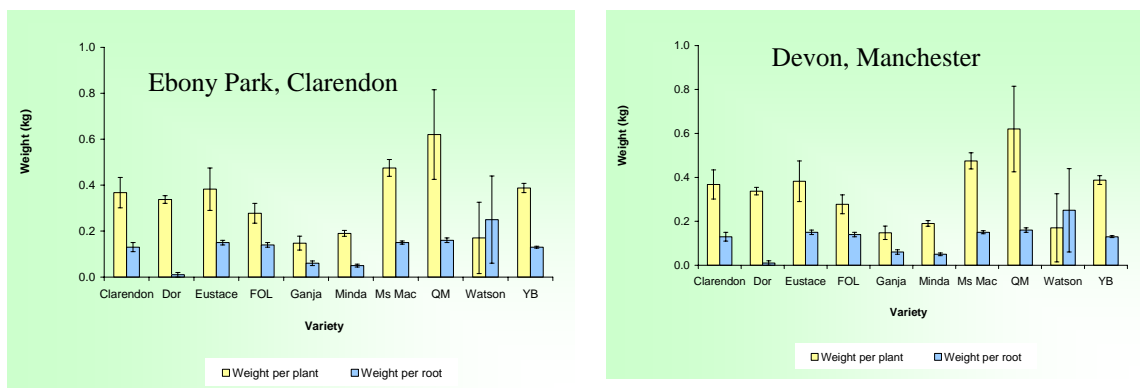


Figure 10 Yield (weight/plant and weight/root) performance of popular export varieties at 2 locations of contrasting agro-ecologies.

Table 26 Physical characteristics of ten popular export varieties.

VARIETY	LEAF					VINE	ROOT	
	Outline	Lobe Type	# of Lobes	Central Lobe	Leaf Colour	Colour	Skin Colour	Flesh Colour
Watson	lobed	slight	3	toothed	green	green	red	cream
Yellow belly	lobed	slight	5	triangular	green ventral surface, scattered purple colorations	mostly purple with green streaking in younger areas	purple red	white
Fire-on-land	lobed	very deep	5	elliptic	green and purple	totally dark purple	pink	orange
Quarter million	lobed	deep	5	elliptic	green	green	red	white
Miss Mac	lobed	very deep	7	elliptic	green with characteristic purple venation on ventral surface	green with a few purple spots	red	white
Clarendon	lobed	deep	5	elliptic	green	green	purple red	white
Sidges	lobed	very deep	5	elliptic	green	green	red purple	cream
Dor	lobed	deep	5	elliptic	green with purple edge	mostly purple	purple red	yellow
Minda	lobed	very slight	3	toothed	green	green with few purple spots	purple red	yellow
Eustace	lobed	very slight	3	toothed	green	green	purple red	white

Physical characteristics were documented using descriptors from the International Potato Center, CIP

PHYSICAL CHARACTERIZATION OF POPULAR LOCAL SWEET POTATO (*Ipomoea batatas* (L.)) VARIETIES

<p>WATSON</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – slight # of lobes – 3 Central lobe – toothed Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – red Flesh colour – cream 	<p>YELLOW BELLY</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – slight # of lobes – 5 Central lobe – triangular Leaf colour – green, ventral surface has scattered purple colorations throughout <p>VINE</p> <ul style="list-style-type: none"> Colour – mostly purple with characteristic green streaking through younger areas of vine <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – purple red Flesh colour – cream 	<p>FIRE-ON-LAND</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green and purple <p>VINE</p> <ul style="list-style-type: none"> Colour – totally dark purple <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – pink Flesh colour – orange
<p>QUARTER MILLION</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – red Flesh colour – white 	<p>MISS MAC</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 7 Central lobe – elliptic Leaf colour – green with characteristic purple venation on ventral surface <p>VINE</p> <ul style="list-style-type: none"> Colour – green with a few purple spots <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – red Flesh colour – white 	<p>CLARENDON</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – purple red Flesh colour – white
<p>GANJA</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – Flesh colour – 	<p>SIDGES</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – red purple Flesh colour – orange 	<p>DOR</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – deep # of lobes – 5 Central lobe – elliptic Leaf colour – green with purple <p>VINE</p> <ul style="list-style-type: none"> Moistly purple <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – purple red Flesh colour – yellow
<p>MINDA</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – very slight # of lobes – 3 Central lobe – toothed Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green with few purple spots <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – purple red Flesh colour – yellow 	<p>EUSTACE</p> <p>LEAF</p> <ul style="list-style-type: none"> Outline – lobed Lobe type – very slight # of lobes – 3 Central lobe – toothed Leaf colour – green <p>VINE</p> <ul style="list-style-type: none"> Colour – green <p>ROOT</p> <ul style="list-style-type: none"> Skin colour – purple red Flesh colour – white 	<p>Reference: Huaman Z. 1991. Descriptors for Sweet Potato Photographer: Desmond Jones Poster design: Kristal Karjahn Project funded by: CORE Budget of Caribbean Agricultural Research and Development Institute (CARDI) 2006.</p>

Plate 14 Descriptor of the physical characteristics of popular export varieties.

Information and Communications Programme

This programme covers some of the important aspects of information production and dissemination and networking of stakeholders to facilitate the flow of information. During the period under review projects were conducted in the areas given below.

Small Ruminant Information Products

The project was undertaken in recognition of the importance of the application of relevant knowledge as locomotion for industrial growth. It is aimed at contributing to developing sustainable small ruminant industry in the Caribbean by facilitating the wider availability and utilisation in the region of generated and/or adapted small ruminant technologies. During the year in review, the project funds were disbursed and all the seven required media and software were acquired. About 100 known small ruminants IPs were inventoried and all acquired. Seventy-five of the acquired manuscripts, as well as some 40 supporting pictures were reproduced. The completed compendium would be distributed on appropriate media and also posted on the CASRUNET home page for the use, primarily, of CASRUNET professionals and technicians in the development of programmes for producers.

National Coordinating Committee for Agricultural Research and Development (NCCARD)

During 2005, in keeping with the decision of the Committee at its meeting of 9 March 2005 an interactive meeting/workshop for participating agencies/institutions was organised on 8 June 2005 for the presentation of current Programme of Work (POW) based on a format determined by the Steering Committee comprising MINAG, CARDI, IICA and FAO. Twenty-six stakeholders representing 13 agencies/institutions attended the workshop. Seven agencies/institutions presented their POW. The proceedings of the workshop, with a matrix of suggested constituents of commodity and thematic clusters, were distributed to stakeholders in November 2005.

In 2006, NCCARD held three meetings (8 February 2006, 10 May 2006 and 18 October 2006) at which it accepted compiled matrix R&D activities by institutions/agencies and also a database of these institutions/agencies with links and collaborations in different commodity and thematic areas. The Committee mandated modifications to and later approved revised objectives for the Jamaica NCCARD. It decided to invite the Marketing Division of the Ministry of Agriculture and Lands (MINAG) as a cluster. The NCCARD directed the establishment of six commodity clusters – Vegetables, Root Crops, Tree Crops, Small Ruminant, Herb and Spices and Sugar cane. The Small Ruminant and Root Crops clusters subsequently went on to define work activities.

The Small Ruminant cluster agreed to circulate copies of the draft Small Ruminant Policy for study and discussion at the next cluster meeting. Members were urged to become involved at the planning level for the National Agricultural Census 2007 in order that sheep and goats kept in urban areas normally defined as non-agricultural zones may be counted. Farmers and their respective associations or community groups are obliged to provide regular updates on their stock holdings and performances to enhance the industry database. The cluster would negotiate with the MINAG for hosting a page on its Website. The cluster also agreed to investigate into a national identification system which will allow for traceability in the industry.

During 2006, four meetings were held with members of the root crops cluster of the NCCARD. The work programme of the cluster focussed on the characterization of local sweetpotato lines. The Christiana Potato Growers Cooperative Association Ltd., a member of the cluster was able to access funds from IICA's sweetpotato research and technology fund, a new initiative geared towards assisting with the development of Jamaica's sweetpotato industry. These funds were used to conduct a survey to determine the impact of viruses on sweetpotato in major producing parishes. Although the funds were awarded to CPGCA Ltd. investigations were conducted primarily by other members of the cluster, namely, the Ministry of Agriculture and Lands and RADA and to a lesser extent by CARDI. Technical assistance was provided by CARDI to the Christiana Potato Growers Cooperative Association Ltd. CARDI sweetpotato researchers assisted with the collection of data from a trial which examined the impact of three growth enhancers on sweetpotato

yields. Inputs into the experimental design were provided prior to the establishment of the trial. The data collected from the trial were analysed and a report prepared and forwarded to the association.

During the meeting of 18 October 2006, Dr Wendel Parham, Executive Director of CARDI apprised the Committee of initiatives started on the regional agricultural marketing development and marketing intelligence. Mrs Scarlett Gillings, Managing Director of the Jamaica Social Investment Fund (JSIF) also presented an overview of the functions of the Fund, especially as they relate to agricultural projects.

Farmer Experimentation and Innovation

In July 2005, CARDI Jamaica Unit and the CTA signed an agreement with the view to building the capacity of CARDI and other stakeholders in identifying and analysing farmers' innovation and building partnerships to strengthen the ASTI systems in Jamaica. The agreement included:

- The provision of logistics for a training workshop on Analysing Farmer Experimentation and Innovation
- The coordination of a Case Study in Jamaica on farmer innovation

The training workshop was successfully conducted during 25-29 July 2005 and a report on its management was sent to CAT on 26 December 2005.

In the last quarter of 2005, CARDI, in collaboration with 13 other national agencies/institutions started the project to document some of the innovations of

Jamaican farmers. A case study involving field pictorial and data collection on the innovations of ten farmers, as well as a listing of innovations of other 15 farmers was completed successfully in the year. A final technical report and a financial report were duly sent to and approved by CTA. A presentation on the case study was made to policy makers and other stakeholders on 27 February 2006.

National Programme for the Certification of Agricultural Produce (CAPP)

CARDI was invited to join the alliance of the national programme for the Certification of Agricultural Produce (CAPP) which was launched by the Bureau of Standards Jamaica (BSJ) and the Jamaica Agricultural Society (JAS). The programme seeks to develop and implement a national certification programme for agricultural produce that conform to required safety, quality and environmental standards. Drs Leslie Simpson and Janet Lawrence were appointed to sit on the alliance of the CAPP. Dr Lawrence also sat on the technical committee that is responsible for developing standards for the programme. In addition, BSJ and JAS contracted CARDI to prepare a farmer's manual for the CAPP. During the year, monthly stakeholders meetings and technical committee meetings were attended and a proposal for developing the farmer's manual (activity schedule and budget) was prepared and presented to the stakeholders of the programme. The proposal was accepted and a contract between the JAS and CARDI signed on 14 December 2005.

During 2006 the manual was developed. The consultative process was executed with the relevant stakeholders and the

information gathered was synthesized and the findings documented. A presentation of these findings and an outline of the manual were made to the stakeholders. A draft manual was completed and presented to professional staff for an in-house review and after this process the manual was revised and presented to the client on 28 April 2006.

A set of comments were received from the client on 22 August. There were two meetings on 31 August and 11 September, to discuss the comments and plan the way forward for the finalization of the manual. By the end of the year plans were submitted to the client for the completion of what will now be a two-volume manual by February 2007.

Technical Assistance

In 2005/6, we continued to provide technical assistance in various forms to stakeholders in the agricultural and allied sectors as follows:

Technical assistance to the Agricultural Support Services Project (ASSP)

The preparation for the Agricultural Support Services Project (ASSP) of aids for the training of farmers which started in 2003 (*CARDI Jamaica Unit Annual Report 2003*) continued during 2005 and concluded in 2006. The training aids include factsheets, posters, pamphlets and handouts in the areas of land preparation, planting, fertiliser programme, irrigation, disease and pest management and post harvest technology for papaya, sweetpotato, ginger, escallion and hot pepper.

All the products required for the project were submitted to ASSP by the first week in January 2005. In March a response was obtained from ASSP and after discussions corrections were initiated on all the products. The Hot pepper and Sweetpotato products were in their second round of corrections and these were done and re-submitted in April. The products for the other crops escallion, ginger, and papaya had much more work, but these were all re-submitted by June 2005. In September, ASSP requested some amendments on six documents, these were made and the documents were re-submitted by the second week in October. The Papaya documents were still to be reviewed by the client by the middle of 2006. A decision was then taken by ASSP to conclude the project and make final payments to CARDI.

Technical assistance to the International Centre for Environmental and Nuclear Science (ICENS)

International Centre for Environmental and Nuclear Science (ICENS) and International Development Research Centre (IDRC) project

International Centre for Environmental and Nuclear Science (ICENS) developed and obtained funding from the International Development Research Centre (IDRC) for a 24-month “Environmental Risks of Cadmium in Jamaica” project aimed at achieving an optimal balance between the environment and human well-being of a selected population in central Jamaica with special reference to environmental cadmium. CARDI, through its biometrician, Mr Bruce Lauckner is programmed to give technical assistance to this project.

Mr. Lauckner visited Jamaica over the period 11-15 April 2005 and held discussions with the stakeholders and specifically assisted in the development of their sampling designs and plans. Working is continuing on this project.

Technical assistance to the Turks and Caicos Islands (TCI)

On a request from the Government, the Executive Director was asked to give assistance in the provision of a soil assessment to the Turks and Caicos Islands (TCI) (Plate 15). Dr Leslie Simpson, Soil Scientist undertook a mission to the Turks and Caicos Islands to assess the soil potential for agricultural purposes.

On this mission, three days were spent acquiring and assessing data and information from TCI at the administrative and commercial centres in Grand Turk and Providenciales. The other two days were dedicated to visiting the islands of North Caicos and Middle Caicos to assess the soil and land resources and hold discussions with relevant personnel on crop production practices (Plate 16).

The output of the mission was a report which gives details on the origin and physical attributes of the major soil series on the North and Middle Caicos islands. From these descriptions and knowledge of similar soils in the region, the soils were classified up to the subgroup level. Discussions are also given on the capability of the soils to sustain economic agricultural production of selected crops.

The report concluded with several general recommendations for the advancement of agriculture in the TCI, and CARDI was suggested as an organization which can assist the Government of the TCI in developing its agricultural sector. The report also gives nine specific recommendations on the technical aspects of agricultural development on the TCI.



Plate 15 The Turks and Caicos Islands (TCI) in the North Atlantic Ocean



Plate 16 Papaya growing on untilled soil in the North Caicos, TCI

Other technical assistance to stakeholders

During the year other technical assistance was provided to stakeholders. These included:

Mr Donovan Edwards, a science teacher at the Papine High School, did a four-week attachment with the Unit under the Scientific Research Council (SRC) science teachers' apprenticeship programme. During this stay Mr Edwards was attached to the NRM and IPM sections of the Unit. From his report, Mr Edwards showed that he gained much knowledge and experience from his exposure to these sections. Plate 17 shows Mr Edwards preparing seedling trays for a potting mixture trial in the NRM section.



Plate 17 Mr Edwards preparing seedling trays for a potting mixture trial

CARDI was also requested to be part of a committee to prepare a Plant Genetic Resources for Food and Agriculture (PGRFA) Country Report for Jamaica. This committee is headed by the Chief Technical Officer of Ministry of Agriculture and included representatives from various agricultural agencies in the country. There have been two meetings of the committee during 2006.

CARDI was invited to Jamaica's Second National Communication (SNC) Greenhouse Gas (GHG) Inventory Workshop which detailed the plans and procedure for developing the SNC. At the workshop it was intimated that CARDI will be asked to obtain the data for agriculture and towards the end of the year CARDI was offered a contract to do this work.

The Mainstreaming Adaptation to Climate Change (MACC) Project is seeking to build regional capacity to access vulnerability and risks associated with climate change, to reduce vulnerability to climate change and to effectively access and utilize resources to reduce vulnerability to climate change. CARDI has been requested to be represented on the Project Advisory Committee (PAC) of the MACC Project, as a Co-opted Member to deal with agricultural matters. There were two meetings of this project which required CARDI's input this year. As a consequence, CARDI has developed a Concept Note for a project to train agricultural scientist in the region in computer simulation and modelling to better inter-relate with the MACC project.

Scientists of the Unit assessed mole crickets problem at the Sabina Cricket grounds for the Jamaica Cricket 2007 Ltd. as part of the preparation for the ICC World Cup and submitted a report

outlining recommendations to address the problem.

CARDI, at the request of IICA, delivered three training session at field days for farmers on the Walkers Wood Agricultural Project on a cost recovery basis.

Presentations were made to the farmers on pests and diseases of hot pepper pest management for sweet potato production and soils, fertilizer and manures for the production of hot pepper on reclaimed bauxite soils (Plate 17). These presentations were done by Mrs Dionne Clarke-Harris, Dr Kathy Dalip and Dr Leslie Simpson respectively.



Plate 18 Training session being conducted with hot pepper farmers in Schwallenburg, St Ann by Dr Leslie Simpson

During 2-9 April 2006 the Unit also hosted Dr José Morales, Director of Instituto de Ganaderia Tropical (IGAT) of Cuba with the view to developing technical collaboration between CARDI and IGAT. The efforts appeared to have stalled because funding could not be found to implement the artificial insemination programme which was developed as the first tangible manifestation of the cooperation.

The Livestock group provided technical assistance to 39 farmers in the areas of selection of goat breeding stock, forages for feeding, setting up goat production units, outlay of appropriate goat housing facilities and general husbandry practices.

Eleven farmers were trained in the preparation and handling of animals for the Denbigh Agricultural Show and for those who had difficulties in getting their animals to Show, transportation was arranged through other farmers who had transportation at their disposal.

Albert Fearon acted as Chief Small Ruminants Judge at the Hague (25 February 2004) and Denbigh Agricultural (31 July-2 August 2004) Shows

Boards and Committees Served

We provided technical expertise on several committees.

- Jamaica Organic Agriculture Movement (JOAM) Programme Management Committee (L. Simpson, K. Dalip)
- Methyl Bromide Working Group (K. Dalip)
- National Organic Agriculture Enhancement Programme Sub-Committee on Research and Development (J. Lawrence, Chairman)
- National Organic Agriculture Enhancement Programme Sub-Committee on Sensitization and Training (L. Simpson).
- Plant Health Coordinating Committee (K. Dalip/ J. Lawrence)
- Council Members, Jamaican Society for Agricultural Sciences (F. Asiedu, J. Lawrence)

- Project Management Committee of the Sam Motta Demonstration and Training Centres (Francis Asiedu, Albert Fearon, Leslie Simpson, Dwight Williams)
- Technical Committee of the Bureau of Standards Jamaica Certification for Agricultural Produce Programme (J. Lawrence)
- Alliance of the Bureau of Standards Jamaica/Jamaica Agricultural Society Certification for Agricultural Produce Programme (J. Lawrence)
- Goat Breeders Society of Jamaica (A Fearon)
- Jamaica Organic Agriculture Movement (JOAM) Management Steering Committee (J. Lawrence)
- Jamaica Organic Agriculture Movement (JOAM) Standards and Certification Committee (J. Lawrence, Chairman)
- Manchester Plateau Community Council (D Williams)
- Manchester Parish Development Committee (A Fearon)
- NCCARD Root Crops Cluster (J. Lawrence, Chairman)
- NCCARD Vegetables Cluster (D. Clarke-Harris, Chairman)
- Technical Committee of the Bureau of Standards Jamaica Certification for Agricultural Produce Programme (J. Lawrence)

Training, Meetings, Workshops and Seminars

Trainings Attended

- 18-22 July 2005, CTA/NCST–Regional Training Workshop on Analysing the Agricultural, Science, Technology and Innovation System, Kingston (F. Asiedu)
- 25-29 July 2005, CTA, Vrije Universiteit, Amsterdam and CARDI Jamaica Training Workshop on Analysing Farmer Experimentation and Innovation, Kingston, Jamaica (M. Brown, D. Jones, R. Barnes)

Meetings Attended

- 12 January 2005, Meeting of CARDI Board of Governors at the Pegasus Hotel, Jamaica (L. Simpson)
- 13 January 2005, Meeting of the Alliance of Agriculture Ministers of the Caribbean at the Jamaica Conference Centre (L. Simpson)
- 18 January, 3 February and 3 March 2005, Meetings with IICA to discuss the IICA/CARDI collaboration projects - Walkers Wood and Mocho Projects - at the IICA Office. (F Asiedu, D. Clarke-Harris, A Fearon, L. Simpson)
- 15 and 22 February, 3 March, 11 and 19 April and 9 August 2005, Meetings with personnel from JBI to discuss Walkers Wood and Mocho Projects at JBI and visit to Mocho Project site (F Asiedu, A Fearon, L. Simpson, D. Clarke-Harris, K. Dalip)
- 22 March, 21 April. 14 June, 8 September 2005, Meetings with BSJ

and JAS on the national programme for the Certification of Agricultural Produce Project (CAPP), (F. Asiedu, L. Simpson, J. Lawrence, A. Fearon, K. Dalip).

- 1-3 April 2005, Regional planning meeting to develop a proposal for the establishment of a regional IPM centre for vegetable crops in the Caribbean, Central America and Latin America (LAC) Region, Zamorano, Honduras (D. Clarke-Harris)
- 11-15 April 2005, Fourth International Meeting of FORAGRO, Panama (F. Asiedu).
- 12 April, 24 August, 1 September, 24 November and 7 December 2005, Meetings on the National Organic Agriculture Enhancement Programme (NOAEP) (L. Simpson, K. Dalip, J. Lawrence)
- 29 April-7 May 2005, Visit to Belize to explore entomological needs of the country (K. Dalip)
- 18 May 2005, CROSQ CARICOM forum, “A CSME Response to facilitating trade: implications for the business sector.”, Kingston (J. Lawrence)
- 27 May 2005, Quarterly CRP Management Meeting, Bodles Research Station, St Catherine (D. Clarke-Harris)
- 2-3 June 2005, Commodity Groups Meetings – Small ruminants, CARDI Headquarters, Trinidad (F. Asiedu, A. Fearon)
- 15 June 2005, Christiana Potato Growers Association – Open Day for Devon DTC, Devon, Manchester (D. Williams)
- 21 June 2005, Meeting of the stakeholders of the IDRC/ICENS Project, ICENS, UWI (L. Simpson)
- 21-22 June 2005, Commodity Groups Meetings – Hot pepper, CARDI

- Headquarters, Trinidad (D. Clarke-Harris)
- 23-24 June 2005, Commodity Groups Meetings – Root Crops. CARDI Headquarters, Trinidad (K. Dalip)
 - 25-29 July 2005, CARDI Programme Planning Meeting, Kingston (F. Asiedu)
 - July-December 2005, Bi-weekly meetings, Technical Committee, Certification for Agricultural Produce Programme (CAPP) (J. Lawrence)
 - July-December 2005, Monthly stakeholders meetings, CAPP (J. Lawrence)
 - 4 August and 11 October 2005, Meetings with personnel from the Business Recovery Programme (FINTRAC and USAID) to discuss vegetable and root crop research and development as well as to exchange literature (K. Dalip, J. Lawrence)
 - 29 August 2005, Quarterly CRP Management Meeting, MINAG Conference Room, Kingston (J. Lawrence)
 - 29 August-1 September 2005, Representation of the Executive Director of CARDI and presentation of the CARDI 2003-2004 Biennial Report at the Third Ministerial Meeting of Agriculture and Rural Life in the Americas and Thirteenth Regular Meeting of the Inter American Board of Agriculture, Guayaquil, Ecuador (F. Asiedu)
 - 31 August–31 December 2005, Monthly meetings, NOAEP Sub-committee on Research and Development and Steering Committee (J. Lawrence, *Chairman*).
 - 20 September, 15 November 2005, Meetings, JSAS Council (F. Asiedu and J. Lawrence)
 - 21 October 2005, CRP Management Meeting, CARDI Conference Room, Kingston (D. Clarke-Harris, F. Bruce Lauckner, J. Lawrence, L. Rhodes).
 - 25 October 2005, Meeting with Ministry of Agriculture personnel to discuss the CARDI Programme of Work for 2006 at the Office of the Permanent Secretary, Ministry of Agriculture 2005 (L. Simpson, A. Fearon)
 - 28 October 2005, Proclamation ceremony declaring November Science and Technology month held at King’s House (L. Simpson)
 - 3 November 2005, Annual General Meeting, Jamaica Organic Agriculture Movement (JOAM) (J. Lawrence, elected chairman of the Standards and Certification Committee).
 - 4 November 2005, Meeting with Dr H.A.D. Chesney, and Mr Trevor Murray of IICA to introduce Mr Murray as the new IICA Representative in Jamaica (F. Asiedu, D. Clarke-Harris, L. Simpson).
 - 7-11 November 2005, 4th Meeting of CTA Advisory Committee on Science & Technology, Wageningen, The Netherlands (F. Asiedu)
 - 25 November 2005, Launch of Buy Jamaican, Eat Jamaican Campaign (JAS), King’s House (J. Lawrence)
 - 1 December 2005, Quarterly CRP Management Meeting, MINAG Conference Room, Kingston (D. Clarke-Harris).
 - 3 December 2005, Meeting, JOAM (J. Lawrence).
 - 6 January 2006, Meeting on the national small ruminant enhancement programme, Ministry of Agriculture, Kingston, Jamaica (F. Asiedu, A. Fearon)
 - 11 January 2006, Meeting of the National Organic Agriculture Project Sub-Committee on Sensitization and Training (L. Simpson)

- 18 January, 15 February, 1 March 2006, National Organic Agricultural Enhancement Project Steering Committee meeting (J Lawrence)
- 19 January, Meeting of Citrus Replanting Project Steering Committee, MINAG Conference Room Kingston (F Asiedu, D Clarke-Harris and L Rhodes)
- 19 January, 16 February 2006, Stakeholders and technical meetings of the Bureau of Standards Jamaica/Jamaica Agricultural Society Certification for Agricultural Produce Programme (J Lawrence)
- 24 January, 10 March 2006, Plant Health Coordinating Committee meetings. (J Lawrence)
- 24 January 2006, Meeting with ALPART principals to discuss the future development and funding of the Sam Motta DTC (F. Asiedu, A. Fearon, D. Williams)
- 25 January 2006, Meeting with MINAG, RADA and farmer representatives to discuss the way forward and training needs for farmers, MINAG, Kingston (Albert Fearon)
- 26 January 2006, Meeting of the JOAM South Eastern Region - St Andrew Parish (L. Simpson)
- 26 January, 8 February and 9 March 2006, Sweetpotato working group meetings (chaired by J Lawrence)
- 2 February 2006, Meeting/function organised by Agricultural Support Service Project (ASSP) to mark the importation and handing over of Dorper sheep to members of the Sheep Farmers Association, Port Royal. (A. Fearon, F. Asiedu, R. Barnes)
- 2 and 3 February 2006, Meeting with MINAG and GBSJ staff to develop modules for training under the small ruminant enhancement programme, Bodles (A. Fearon)
- 6 February 2006, Sam Motta PMC Meeting, RADA, Mandeville, Manchester (Sam Motta Trust Fund discussed (F. Asiedu, D. Williams, A Fearon)
- 2, 3 and 7 February 2006, Consultations with Mr Marvel Grey, Rural Physical Planning Division, Ms Joy Alexander, National Environmental Protection Agency, Ms Hyacinth Chi-Sue, Pesticide Control Authority, Mr. Don McGlashan, Ministry of Agriculture, Mrs. Ann-Marie Smith, Scientific Research Council, Mr Hugh Taylor and Ms Raquel Chambers, Consumer Affairs Commission Consultation, Mr. Malcolm Garnett, Mrs Downer Walsh, Mr. Seymour Greenland, Mr Howard Edwards, Agro-grace for the development of the farmers' quality management systems manual (J Lawrence, L Simpson)
- 8 February 2006, NCCARD meeting. (F Asiedu, L Simpson, J Lawrence, A Fearon, D Clarke-Harris)
- 15 February 2006, meeting with Dr Gene Pollard, Regional Director FAO (F Asiedu, J Lawrence, D Clarke-Harris)
- 15 February 2006, Meeting with David Miller (MINAG) and Hector Smith (RADA) to review and further develop training schedule and materials for the small ruminant enhancement programme. The schedule included a visit to the Hounslow Sheep and Goat Station to evaluate the readiness of the station to receive an allotment of sheep recently imported in the island
- 16 February 2006, Evaluation of farmers in the Nain area of St Elizabeth with an aim for them to attain a Level 1 certification in goat rearing (A Fearon - CARDI and E Green – ALPART)

- 21 February 2006, Sheep Farmers Association Annual General Meeting, Bodles (A Fearon, R Barnes)
- 22 February 2006, Public Education Forum, Citrus Replanting Project, St Thomas-Ye-Vale Anglican Church, Bog Walk, St Catherine (D Clarke-Harris, D Simpson, K Karjohn)
- 23 February 2006, JSAS Memoir Lecture Series (F Asiedu, J Lawrence, D Clarke-Harris)
- 2 March 2006, RADA collaborators meeting with Mr Stanley Dodd to discuss input into the collaborators booth for the RADA EXPO-sed (L. Simpson)
- 8 March 2006, Meeting with personnel of Agro Nanotechnology Corp. of USA to discuss collaboration on research with their product (L. Simpson, J Lawrence)
- 9 March 2006, RADA collaborators meeting with Mr Stanley Dodd to discuss the collaborators booth for the RADA EXPO-sed (L. Simpson)
- 15 March 2006, Meeting with Mr Trevor Murray, IICA Representative in Jamaica to discuss the CARDI/IICA funded short term projects (F. Asiedu, J. Lawrence, A. Fearon, D. Williams)
- 15-24 March 2006, Drs Sue Tolin and Shelby Fleischer visited Jamaica to convene a series of review and planning meetings with various IPM CRSP collaborators (D Clarke-Harris, K Karjohn)
- 20 March 2006, Meeting of MINAG and CARDI scientists to discuss activities in Jamaica to address “Inadequate Agricultural Research and Development’ as articulated in the Jagdeo Initiative (F Asiedu, L Simpson, A Fearon, D Clarke-Harris)
- 23 March 2006, Luncheon meeting with Deans and Faculty Members who have been involved over the last three years with groups of Berry College Students on Education Abroad programmes facilitated by the UWI, Mona Campus (L. Simpson)
- 30 March 2006, Meeting with Mr Russel Duncan, Regional Director USDA APHIS, on IPM and surveillance systems, CARDI, Mona (J Lawrence, D Clarke-Harris)
- 3-8 April 2006, National IPM Symposium and Annual Review and Planning Meeting of the Global IPM CRSP (D Clarke-Harris)
- 5 April 2006, The Jamaica National Commission for UNESCO launch of the World Book and Copyright Day 2006 at the Palace Cineplex, Sovereign Centre, Kingston (L Simpson)
- 6 April 2006, Annual Career Day and Job Fair of the College of Agriculture Science and Education (CASE), Port Antonio (L Simpson, D Williams)
- 7 and 24 April and 7 May 2006, JSAS planning meetings for poultry seminar (J Lawrence)
- 24 April 2006, Meeting of Jamaica Sheep Farmers Association, Mountainside, St Elizabeth (A. Fearon, J. Barnes)
- 27 April 2006, Meeting with Domingo Haroldo Reinhardt, Research and Development Director, Cassava and Tropical Fruits Programme, EMBRAPA, Brazil, CARDI, Mona (F Asiedu, L Simpson, J Lawrence, D Clarke-Harris)
- 3 May 2006, Meeting of NCCARD Vegetable Cluster (D Clarke-Harris, J Lawrence)
- 4 May 2006, Meeting with ALPART principals to discuss the way forward with Sam Motta DTC and funding for the project year 2006 (A. Fearon, D. Williams)

- 9 May 2006, Meeting with UNITAS group to develop training programme for small ruminant projects in Manchester, St Elizabeth and Westmoreland (A. Fearon, D. Williams)
- 10 May 2006, NCCARD meeting. MINAG, Kingston (F Asiedu, L Simpson, J Lawrence, D Clarke-Harris, A Fearon)
- 12 May 2006, Visit to crop production sites at Devon, Manchester and Ebony Park, Clarendon with staff from SMDTC to view improved practices (A Fearon, D Williams, J Lawrence, R Barnes, N Hanson)
- 16 May and 20 June 2006, JSAS Council Meeting, Kingston (F Asiedu, J Lawrence)
- 25 May 2006, Training session for small ruminant farmers in the UNITAS project at Springfield, St Elizabeth. "General husbandry and management of small ruminants" (A Fearon, D Williams, J Barnes). No of participants, 41
- 31 May 2006, Training session for small ruminant farmers in the UNITAS project at Hopeton, Westmoreland. "General husbandry and management of small ruminants" (A Fearon, D Williams, J Barnes). No. of participants, 32
- 31 May 2006, National Consultation on the Rotterdam Convention Meeting, A joint Consultation of the Secretariat of the Rotterdam Convention, Food and Agriculture Organization, and the Pesticides Control Authority (D Clarke-Harris)
- 1-2 June 2006, First Annual General Meeting of the General Assembly of the Global Water Partnership, Chaconia Inn, Trinidad (L Simpson)
- 8 June 2006, Participation at the launch and first training session for farmers in small ruminant enhancement programme, Bodles (A Fearon)
- 8 June 2006, Review Meeting for Final Report, Research Services-Entomology, Citrus Replanting Project, Ministry of Agriculture and Lands (D Clarke-Harris)
- 13 and 28 June 2006, West Indian Sea Island Cotton Cluster Informational Meeting convened by the Competitiveness Company and the Jamaica Exporters Association (JEA) at CARDI and JEA (F Asiedu, L Simpson, J Lawrence, D Clarke-Harris, A Fearon, D Williams)
- 13 June 2006, National Council on Science and Technology meeting, Office of the Prime Minister, Kingston (M Brown)
- 20 June 2006, National Organic Agricultural Enhancement Project Steering Committee meeting. Conference Room, MINAG. (J Lawrence)
- 20 June 2006, First National Stakeholders meeting for the establishment of the National Information sharing mechanism on plant genetic resources and preparation of a Country report on the state of plant genetic resources, Caymanas Golf and Country Club, Spanish Town, St Catherine, Jamaica (L Simpson)
- 28 June 2006, Meeting with West Indian Sea Island Cotton (WISC) Cluster and the Competitiveness Company and visiting cotton expert (L Simpson, D-C Harris)
- 30 June 2006, Debriefing meeting with the visiting cotton expert and the West Indian Sea Island Cotton (WISC) Cluster and the Competitiveness Company (L Simpson)
- 12 July 2006, Attendance, 111th General meeting of the Jamaica Agricultural Society (M Brown)

- 18 July 2006, Participant, Planning Institute of Jamaica Sectoral forum (F Asiedu)
- 9 August 2006, Meeting with Mennonite Economic Development Associates (MEDA) consultant from Canada on ALCAN investment funds for communities affected by former ALCAN bauxite mining operations (F Asiedu, L Simpson, J Lawrence, D Clarke-Harris)
- 11 September 2006, Meeting of stakeholders' group of the BSJ/JAS Project to discuss in detail the revised template for the Farmer's Quality Manual (L. Simpson, J. Lawrence)
- 22 September 2006, Small Ruminant cluster meeting at the Bodles Research Station (F. Asiedu, A. Fearon)
- 25 September 2006, Meeting to hear and discuss the key findings of a recent study, "Developing Jamaica's Competitiveness: An investment plan for the Scotch Bonnet Industry", PIOJ (D-C Harris)
- 5 October 2006, Attendance at the Goat Breeders Society of Jamaica meeting, Bodles (A. Fearon)
- 12 October 2006, Small Ruminant cluster meeting at the Bodles Research Station (F. Asiedu, A. Fearon)
- 17 October 2006, General meeting of staff of Jamaica Unit with the Executive Director at the CARDI Office
- 18 October 2006, NCCARD meeting, MINAG (W Parham, F Asiedu, L Simpson, A Iton, J Lawrence, D Clarke-Harris, A Fearon)
- 19 October 2006, Meeting with ALPART principals to discuss Sam Motta DTC (W. Parham, F. Asiedu, A. Fearon, D. Williams)
- 20 October 2006, Meeting with the research staff of the Ministry of Agriculture and Lands to discuss the CARDI work programme for 2007 (All Professional staff)
- 27 October 2006, Meeting with the West Indian Sea Island Cotton Cluster for presentation of with respect to West Indian Sea Island Cotton production in Jamaica by Dr John Ellington, visiting entomologist in biocontrol, JADF, (D Clarke-Harris)
- 27 October 2006, Meeting of the Vegetable Cluster of NCCARD, to discuss next steps in developing the work plan for the cluster (D Clarke-Harris)
- 6 November 2006, Meeting of Citrus stakeholders to discuss a multi-agency approach to management of the Lime Swallowtail butterfly, RADA (D Clarke-Harris)
- 26 November-1 December 2006, 5th meeting of the Advisory Committee on Science and Technology for ACP Agricultural & Rural Development, CTA Headquarters, Wageningen, The Netherlands (F. Asiedu)
- 30 November 2006, Annual General Meeting of the Goat Breeders Society of Jamaica, Bodles (A. Fearon)

Workshops/Seminars Attended

- 28-31 March 2005, Latin America and Caribbean (LAC) Regional Workshop to assess the development of the horticultural sector in Latin America and the Caribbean as part of an overall effort by AVRDC- World Vegetable Centre and University of California, Davis to coordinate a Global Horticulture Sector Development Assessment, Zamorano, Honduras (D. Clarke-Harris, A. Sinha, P. Titus)
- 6-9 April 2005, participation in a forum/workshop on the development of Agribusiness in the Bahamas at the invitation

- of the Bahamas Agricultural and Industrial Corporation (F. Asiedu).
- 8 April 2005, CARDI was represented at the Department of Life Sciences seminar series 2004/5 entitled “A New Direction for Science Communication in Jamaica” (L. Simpson).
 - 8 June 2005, NCCARD Interactive Workshop, Terra Nova Hotel Kingston, Jamaica (F. Asiedu, D. Clarke-Harris, K. Dalip, A. Fearon, J. Lawrence, L. Simpson)
 - 15-16 June 2005, JSAS 16th Annual Conference, Kingston (F. Asiedu, L. Simpson, J. Lawrence, D. Clarke-Harris, K. Dalip, A. Fearon)
 - 25-29 July 2005, Official opening and attendance of the CTA, Vrije Universiteit, Amsterdam and CARDI Jamaica Training Workshop on Farmer Experimentation & Innovation / Bridging the gap in the Agricultural, Science, Technology and Innovation System, Kingston, Jamaica (L. Simpson)
 - 29 August 2005, Official opening ceremony of the CARICOM Regional Organization for Standards and Quality (CROSQ) Annual General Meeting, The Courtleigh Hotel, Kingston, Jamaica (L. Simpson)
 - 30-31 August 2005, GECAFS/SANREM CRSP Proposal Planning Workshop: Caribbean Food Systems Vulnerability to Global Environmental Change, Kingston, Jamaica (L. Simpson)
 - 3-7 October 2005, An Advanced Workshop in Agricultural Water Management, University of the West Indies, St Augustine, Trinidad (L. Simpson)
 - 19 October 2005, Opening ceremony of the First Moderators’ Meeting of the Caribbean Pest Information Network (CariPestNet), Ministry of Agriculture, Kingston, Jamaica (L. Simpson)
 - 7-11 November 2005, CTA sponsored workshop on the Impact of Trade Agreement on the Agricultural sector in the region, Courtyard, Marriott, Port of Spain, Trinidad (L. Simpson)
 - 9-10 February 2006, Attendance at the workshop on Climate Risk Management in the Agriculture Sector held at the Cheddi Jagan Research Centre in Georgetown, Guyana, (L Simpson)
 - 18 February 2006, Attendance at JOAM Southeast Region's Farm Day at MT. Pleasant. A presentation was made on Vermi-compost: the benefits and how it is done (L Simpson)
 - 27 February 2006, Workshop on presentation of findings of CTA farmer innovation case study (Professional and Technical Staff)
 - 13-17 March 2006, Attendance at the Caribbean Regional Workshop on management of agricultural irrigation technology at the Hotel Four Seasons, Kingston, Jamaica (L Simpson)
 - 3-4 May 2006, IICA/CARIRI/FAO/CARDI Workshop on Effective Research and Development Coordination for Agribusiness Development in the Caribbean Region, Tobago, (F Asiedu)
 - 14 May 2006, IICA’s Annual Report presentation and development of medium term plan. Terra Nova Hotel (L Simpson, J Lawrence)
 - 18 May 2006, JSAS Seminar “ The national and regional response for safeguarding the Jamaica poultry industry” Terra Nova Hotel (F Asiedu, J Lawrence, A Fearon, D Williams)
 - 22 May 2006, Biodiversity symposium – “in recognition of international day for biological diversity 2006”, Knutsford Court, Kingston (J Lawrence, A Fearon)

- 24 May 2006, Seminar, Developments in Vegetable IPM and their Applicability to the Caribbean, Centeno MALMR, Trinidad (D Clarke-Harris)
- 30 May 2006, National Consultation on Food and Nutrition Security, Terra Nova Hotel, Kingston (F Asiedu, M Brown)
- 30 May 2006, Attendance at launch of “Upflow Anaerobic Sludge Blanket Reactor Waste Water Treatment System, Scientific Research Council, Kingston (D Williams)
- 31 May-2 June 2006, Biodiversity in Agriculture Symposium. USAID, IPM and SANREM CRSP. Punta Cana, Dominican Republic (J Lawrence)
- 6 June 2006, IICA and MINAG workshop on CARIFORUM/EU economic partnership agreement and the implications for the Jamaica agribusiness sector, Medallion Hall Hotel, Kingston (J Lawrence)
- 23-30 June 2006, Workshop on IPRs and CARDI Mid-Term Review Meeting, St Lucia (F Asiedu)
- 11 July 2006, Participant, Gleaner Editor’s Forum on Agricultural Education/Training (F Asiedu)
- 11 August 2006, Sheep seminar hosted by the Agricultural Support Service Project (ASSP) and the Jamaica Sheep Farmers Association (JSFA) Hill Run, St Catherine (F. Asiedu, A. Fearon, D. Williams and J. Barnes)
- 15 August 2006, Attendance, Opening ceremony for the Workshop on review of Draft International Standards for Phytosanitary Measures (ISPM, L Simpson)
- 4-6 September 2006, Participant, Jamaica’s Second National Communication (SNC) Greenhouse Gas (GHG) Inventory Workshop (L Simpson)
- 20 September 2006, Participants, 17th Annual Conference of the Jamaican Society for Agricultural Sciences (F Asiedu, D Clarke-Harris, D Williams, K Karjohn, D Simpson)
- 18 October 2006, Workshop on CARDI Style Guides facilitated by Mr Bruce Lauckner, Manager, Research and Development (Ag.) (All CARDI staff)
- 26 October 2006, Lifelong Learning for Farmers (L3F) - Commonwealth of Learning (COL) initiative - Workshop, Canadian High Commission, Kingston (Professional Staff, M Brown)
- 30 and 31 October 2006, Global Information Technology Workshop on “Application of Information Technology and Databases in IPM in Developing Countries and Development of a Global IPM Technology Database”, MINAG, (J Lawrence, D Clarke-Harris)
- 3 November 2006, The Fourth Pan Commonwealth Forum (PCF4) on COL and the Caribbean Consortium, Ocho Rios. A paper was authored by Claudette de Freitas, Information Resources Manager, Caribbean Agricultural Research and Development Institute (CARDI), Terrence Phillips, Programme Manager, Fisheries Management and Development, Caribbean Regional Fisheries Mechanism (CRFM) and Jethro Greene, Coordinator, Eastern Caribbean Trading and Development Company (ECTAD) was presented at this forum by L. Simpson
- 6-9 November 2006, Workshop on Small Island Developing States (SIDS), groundwater, and interlinkages, Port of Spain, Trinidad (L. Simpson)
- 20-22 November 2006, Scientific Research Council 20th Annual Conference on Science and Technology, Kingston, Jamaica (L. Simpson, M. Brown)



Field days, Exhibitions and Shows

CARDI 30th Anniversary Celebration

On 25 May 2005 more than 80 persons, including Government officials, Ministry of Agriculture and other collaborators, donors, former staff members of CARDI and other special invitees, joined us in celebrating the 30th Anniversary of the establishment of the Institute at the Jamaica Pegasus Hotel. The activities involved poster exhibition, presentation on CARDI's achievements over the past 30 years by the CARDI Representative and an award ceremony. Dr Richard Harrison, Dr Frank Ross, Mr Albert Shand and Dr Joseph Lindsay presented greetings on behalf of the Ministry of Agriculture, ALPART, RADA and past staff members, respectively. The Hon. Roger Clarke, Minister of Agriculture presented the feature address and Prof Gerald Lalor gave the keynote address.

RADA 15th Anniversary Celebration

CARDI Jamaica participated in the 15th Anniversary exposition of RADA – RADA EXPO-sed “Responding to global challenge through appropriate technology” on the playfield of the Ministry of Agriculture, Hope Gardens on Friday, 17 March 2006.

CARDI at the Denbigh Agricultural and Industrial Shows 2005/2006

CARDI participated in the 53rd Annual Denbigh Agricultural and Industrial Show of the Jamaica Agricultural Society at Denbigh over the period 30 July to 1 August 2005. Dr Wendel Parham, Executive Director, Mr Selwyn E. King, Public Relations and Communications Manager and several CARDI Representatives from other CARDI Units attended the show.

The 54th Annual Denbigh Agricultural and Industrial Show was held from Saturday, August 5 to Monday, August 7 2006 in May Pen, Clarendon, under the theme: "Agriculture and Rural Development creating the Future by Investing in the Present." This year the Caribbean Agricultural Research and Development Institute (CARDI) Jamaica Unit again hosted a booth in conjunction the Food and Agricultural Organisation of the United Nations (FAO). In addition, CARDI was also responsible for manning the booth of the [Technical Centre for Agricultural and Rural Cooperation](#) (CTA) which was taking part in the Denbigh Show for the first time.

IICA and FAO visit CARDI Projects

Resident Representatives of IICA and FAO in Jamaica were taken on a field visit to several of CARDI on-farm research and development sites on 28 April 2006 to acquaint them with CARDI's work in the Island.

Open Day at Sam Motta DTC, Knockpatrick, Manchester

On 23 November 2006, CARDI and ALPART hosted an Open Day at Sam Motta Goat and Sheep Demonstration and Training Centre (SMGSDTC). The event was held to showcase the contribution of the centre to date, to the development of diversified but integrated agriculture on reclaimed bauxite lands, including goats, in Jamaica and the wider Caribbean as well as further plans for the development of other forms of agriculture suitable for reclaimed bauxite lands. Over 150 collaborators, clients and well-wishers were in attendance and the day's proceedings comprised an opening ceremony, and a tour of the centre and displays of posters and value-added goat products including the sampling of culinary recipes.

- 19 October 2006, Participation with mounted exhibition at the World Food Day National Ceremony and Exhibition, Ardenne High School grounds, Kingston, Jamaica
- 9 November 2006, Poster display and small supervisor of small stock judging competition, Minard Livestock Show, Browns Town, St Ann. (A. Fearon, D. Williams, J. Barnes)

Other Field days, Exhibitions and Shows

- 17 January 2006, IPM CRSP/MALMR Field Day Caura Valley, Trinidad (F B Lauckner, D Clarke-Harris, MALMR collaborators)
- 1 March 2006, Hague Agricultural show and judging of sheep and goats (D. Williams, R. Barnes, W. Davis)
- 17 April 2006, Montpelier Agricultural Show and judging of livestock, Montpelier, St James (A. Fearon, W. Williams and J. Barnes)
- 30 April 2006 CARDI participated in the Education/Career Fair & Expo of the Seven Days Adventist Church, Penwood under the theme "Strive-step up in Life and go for what you want" at the church. Drs Leslie Simpson and Janet Lawrence made a presentation on CARDI and careers in Caribbean Agriculture.

Scientific Publications

- Asiedu F H. 2005. Procaribe mechanism evolution, achievements and future direction. A paper presented at the Fourth International Meeting of FORAGRO, Panama, 13-15 April 2005
- Asiedu F H. 2006. Research and development networking – Procaribe. A paper presented at the IICA/CARIRI/FAO/CARDI Workshop on Effective Research and Development Coordination for Agribusiness Development in the Caribbean Region, Tobago, 3-4 May 2006
- Asiedu F H, Simpson L A, Lawrence J, Clarke-Harris D, Fearon A L, Williams D and Brown M. 2006. Agriculture's contribution to rural development – The role of agricultural research and development agencies: The case of CARDI. A paper presented at the Seventeenth Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles Research Station, Old Harbour, Jamaica, 26 September 2006
- Brown M, Asiedu F H and Simpson L A. 2006. Farmers' innovations impacting on Caribbean Economic Development. A paper presented at the Scientific Research Council Twentieth Annual Conference on Science & Technology, Hilton Kingston Hotel, 20-22 November 2006
- Clarke-Harris D O. 2006. Peppers, ports and pest tracking. ICT Update Magazine (<http://ictupdate.cta.int>), Issue 32, July 2006. pp 8-9.
- Clarke-Harris D O. 2006. Developing A State-of-the-Art Traceability System for Jamaican Agriculture – An Evolutionary Collaborative Process. Jamaica ICT 4D
- Hoy M, Jeyaprakash A, Clarke-Harris D and Rhodes L. 2006. Fortuitous establishment of *Lipolexis oregmae* (Hymenoptera: Aphidiidae) in Jamaica as a natural enemy of the brown citrus aphid: molecular and field analysis. Submitted to the Biocontrol, Science and Technology Journal.
- Lawrence J. 2005. Introduction to organic agriculture. Paper presented at the National Organic Steering Committee (NOASC) Meeting
- Lawrence J. and Hoy C. 2005. Conservation biological control in heterogeneous vegetable landscapes: Factors for consideration. Paper presented at the 16th Annual Conference of the Jamaican Society for Agricultural Sciences (JSAS), 15 & 16 June 2005. Kingston, Jamaica.
- Lawrence J. Hoy C. and Grewal P. 2005. Influence of habitat factors on the distribution and persistence of entomopathogenic nematodes. Paper presented at the 16th Annual Conference of the Jamaican Society for Agricultural Sciences (JSAS), 15 & 16 June 2005. Kingston, Jamaica.
- Lawrence J. 2006. An Overview of the Sweetpotato Research Findings – CARDI Jamaica Unit. A presentation made at the Root crops meeting, St Vincent and the Grenadines, 14-18 June 2006
- Lawrence J. 2006. Development of Farmers Quality Management Systems Manual: Results of consultations, Bureau of Standards of Jamaica, 14 February 2006
- Miller D, McDonald D and Asiedu F H. 2006. The effect of supplementation of dried mulberry leaf meal on the growth and carcass characteristics of young Boer and Crossbred Boer goats in Jamaica. A paper presented at the Seventeenth Annual Conference of the

- Jamaican Society for Agricultural Sciences, Bodles Research Station, Old Harbour, Jamaica, 26 September 2006
- Simpson L A. 2006. The use of climate risk management for agriculture - Some thoughts and experiences from CARDI. A paper presented at the workshop on Climate Risk Management in the Agriculture Sector, Cheddi Jagan Research Centre, Georgetown, Guyana, 9–10 February 2006.
- Simpson L A. 2006. Soil Water Management for Crop Production in the Caribbean and the Role of CARDI. A paper presented at Caribbean Regional Workshop on the management of irrigation technology, Hotel Four Seasons, Kingston, Jamaica, 13-17 March 2006
- Simpson L A. 2006. Brief overview of climate information and skill needs in Caribbean Agriculture. A paper presented at the Climate Change Scenarios and Users Interaction meeting, UWI Mona Campus, Jamaica, 11-12 December 2006
- Research Services-Entomology. Jamaica: CARDI, March 2005.
- CARDI. 2005. First Quarterly Technical Report (Extension Contract) January to March 2005. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, April 2005.
- CARDI. 2005. Second Quarterly Technical Report (Extension Contract) April to June 2005. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, August 2005.
- CARDI. 2005. Proposal for extension of contract. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, August 2005.
- CARDI. 2005. Third Quarterly Technical Report (Extension Contract) July to September 2005. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, October 2005.
- CARDI. 2005. Proposal for extension of contract. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, August 2005.
- CARDI. 2005. Report on the survey of selected farms in Jamaica to determine any relationship between farming practices and levels of Cadmium in yams. L.A. Simpson and B.F. Lauckner eds.
- CARDI. 2006. Fourth Quarterly Technical Report (Extension Contract) October to December 2005. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-

Reports and Short Presentations

- Asiedu F H. 2006. Nutrition and feeding of small ruminants. A PowerPoint presentation at the small ruminant enhancement programme seminar, Bodles Research Station, 5 October 2006
- CARDI. 2005. Eighth Quarterly Technical Report October to December 2004. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, February 2005.
- CARDI. 2005. Second Annual Technical Report January to December 2004. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica.

- Entomology. Jamaica: CARDI, January 2006.
- CARDI. 2006. A PowerPoint presentation, Final Report Research Services-Entomology, Citrus Replanting Project (CRP) of the Ministry of Agriculture, Jamaica, presented by L Rhodes to the Project Steering Committee, January 2006.
- CARDI. 2006. Third Annual Technical Report January to December 2005. Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. Research Services-Entomology. Jamaica: CARDI, January 2006.
- CARDI. 2006. Article on *IPM CRSP Technology Transfer Activities in Trinidad*
- CARDI. 2006. Article on *Reinstating Callaloo to the USDA Preclearance List in Jamaica*
- CARDI. 2006. Brochure on *Tips on Scouting Callaloo Fields for Worms*. IPM CRSP
- CARDI. 2006. Brochure on *Tips to Help Control Pests in Callaloo Fields*. IPM CRSP
- CARDI. 2006. Brochure on *Post Harvest Treatment of Callaloo- an important component of IPM*. IPM CRSP
- CARDI. 2006. Final Report. (revised) Research Services-Entomology, Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica. CARDI, September 2006.
- Clarke-Harris D. 2006. Implications for the management of brown citrus aphid vector of citrus tristeza virus, A PowerPoint presentation of the Research Services-Entomology, Citrus Replanting Project (CRP) at the Public Education Forum of the CRP, Bog Walk, St Catherine, February 2006. Ministry of Agriculture and Lands, Jamaica
- Fearon A. 2006. Opportunities in sheep and goat production. A presentation at the small ruminant enhancement programme seminar, Bodles Research Station, 8 June 2006
- Fearon A. 2006. Record keeping for livestock and Small ruminant enterprise opportunities. A presentation at the small ruminant enhancement programme seminar, Mandeville, Manchester, 20 July 2006
- Fearon A. 2006. Housing and facilities in small ruminant production – From birth to weaning. A presentation at the small ruminant enhancement programme seminar, Bodles Research Station, 24 August and 5 October 2006
- Fearon A and Williams D. 2006. Integrated agricultural production systems. A presentation to high school students and aspirants for the HEART Academy, Black River, 20 September 2006
- Fearon A and Williams D. 2006. Feeding and husbandry practice. A presentation at the Ebony Park Heart Academy, Clarendon, 4 October 2006
- Lawrence J. 2006. An overview of the CARDI Jamaica Unit. A presentation made to an undergraduate group and faculty of the University of Tennessee, CARDI, Kingston, 24 May 2006
- Lawrence J. 2006. IPM and general crop care measures: findings and observations of farm visits. Farmers meetings, BSJ, Kingston and Comma Pen St Elizabeth; respectively, 1 and 6 February 2006
- Simpson L. A. 2005. Soil capability assessment of Turks and Caicos Islands. A Report prepared for the Govt. of the TCI by CARDI.

Professional Bodies

- Caribbean Food Crops Society (Francis Asiedu, Dionne Clarke-Harris, Kathy Dalip)
- Jamaica Society for Agricultural Sciences (Francis Asiedu, Leslie

Simpson, Janet Lawrence, Dionne Clarke-Harris, Albert Fearon, Kathy Dalip, Dwight Williams, Maxine Brown)

- New York Academy of Sciences (Francis Asiedu)
- Tropical Grasslands Society of Australia (Francis Asiedu).
- Entomological Society of America (Janet Lawrence).

Administration and Personnel

In order to facilitate better management, the Unit is sub-divided into five programmes as follows; Livestock Programme, Crops Programme, Business Enterprise Programme, Information and Technology Programme and, Corporate Services Programme.

The Livestock Programme is responsible for the management of the Sam Motta DTC and the provision of Technical Assistance to livestock farmers in adjoining parishes. Mr. Albert Fearon coordinated this programme and managed the CARDI/ALPART Small Ruminant Project while Mr. Dwight Williams functioned as Project Manager for the Pilot Feed Commercialization Project. The staff compliment was completed with Messrs: Ralston Barnes and Joel Barnes as Technical Assistants. Mr. Joel Barnes attained the age of sixty years during the month of October and, based on the Institute's policy, was retired. Mr. Norman Hanson, Foreman, provided the day-to-day supervision of the SMDTC with the assistance of casual labourers. Mr. Joel Barnes, retired Technical Assistant, was recalled and offered a short term contract to assist with the execution of the work being done under the Livestock Programme.

The Crops Programme focused on three main areas during the year 2005; Vegetables (callaloo and pepper), Root Crop (sweet potato) and, Citrus. The coordinator of this programme was Mrs. Dionne Clarke-Harris who also functioned as Project Manager for the IPM callaloo and pepper projects and the team leader for the Citrus Replanting Project. She was

assisted by Miss Kristal Karjohn, Research Assistant and Messrs. Donald Simpson and Paul Samuels as Technical Assistants. Dr. Leslie Simpson managed the organic crops and natural resources management projects, as well as coordinated the Mona DTC. Mr. Kenrick Robinson provided Technical Assistance. Dr. Kathy Dalip was the Project Manager for the IPM Root Crop sub-project between January and September of the year, before she was transferred to the Belize Unit effective 1 November, to take up responsibilities as Entomologist at that Unit. She was assisted by Mr. Desmond Jones, Technical Assistant. On 1 March, Dr. Janet Lawrence returned from study leave, after successfully completing her Ph.D. programme of study, and joined the IPM team. Dr. Janet Lawrence was the Project Manager for the IPM Root Crop sub-project, the Sweet Potato Business Enterprise Project and the BSJ/JAS Farmers Quality Manual Project. She was assisted by Miss Deidre Hudson, Research Assistant, and Mr. Desmond Jones, Technical Assistant. Miss Karjohn resigned effective 7 December 2006, while Mr. Simpson resigned effective 31 December 2006. Ms Deidre Hudson was only employed for the duration of the BSJ/JAS Project.

The Business Enterprise Programme was first headed by Dr. Kathy Dalip followed by Dr Janet Lawrence with Mr. Desmond Jones as the Technical Assistant. The focus of this programme was on the development of revenue generating projects to augment the cash flow of the Institute.

Dr. Francis Asiedu headed the Information and Technology Programme and the CTA funded Farmer Innovation Survey. He was assisted by Miss Maxine Brown, Research Assistant. The area of focus was on the collection and compilation of data on the

development of the Small Ruminant Industry within the Caribbean region.

The Corporate Services Programme was headed by Adlai Blythe and provided the administrative and financial support services for the Unit. Three Accounting Assistants/Clerks, one Receptionist, one Driver/Expeditor, one

Office Helper and one Field Labourers assisted him. The Office Attendant was retired in August while Mr. Blythe resigned at the end of December 2006.

Staff List

Professional staff

Asiedu, Francis, Ph.D.	Animal Nutritionist	CARDI Representative (CR)
Blythe, Adlai	Administrator	Administration
Clarke-Harris, Dionne, M.Sc.	Entomologist	IPM Section
¹ Dalip, Kathy, Ph.D.	Entomologist	IPM Section
Fearon, Albert, M.Sc.	Animal Productionist	Livestock Section
Simpson, Leslie Ph.D.	Soil Scientist	NRM Section
² Lawrence, Janet Ph.D.	Entomologist	IPM Section
Williams, Dwight, M.Sc.	Scientist 1	Livestock Section

¹ Transferred to Belize in November 2005

² Returned from study leave March 2005

Technical staff

Asiedu, Elizabeth	Accounts Clerk	Administration Section
Bailey, Una	Office Helper	Administration Section
Barnes, Joel	Technician	Livestock Section
Barnes, Ralston	Technician	Livestock Section
Brown, Maxine	Research Assistant	CR's Office
Davis, Winsome	Accounts Clerk	Administration Section
Hanson, Norman	Foreman	Livestock Section
Jones, Desmond	Technical Assistant	IPM Section
Karjohn, Kristal	Graduate Assistant	IPM Section
Maxwell, Ervin	Field Labourer	Administration Section
McDonald, Lloyd	Driver	Administration Section
Morris, Erna	Accounting Assistant	Administration Section
Powell, Sandra	Receptionist	Administration Section
Robinson, Kenrick	Technical Assistant	NRM Section
Samuels, Paul	Technical Assistant	IPM Section

Sangster, Andrea
Simpson, Donald
Wright, Jerome

Secretary
Technical Assistant
Research Assistant

Administration Section
IPM Section
IPM Section

Visitors

During 7-11 March 2005, Dr Wendel Parham visited the CARDI Jamaica Unit to acquaint himself with the R&D work of the Unit and share his vision for the year with staff. During his stay in Jamaica, he paid a courtesy call on The Hon. Roger Clarke, Minister of Agriculture, participated in a meeting of the Jamaica NCCARD, granted interview to the media and visited some of the Unit's activities on the ground and also took time to share a light moment with staff.



Also, as part of the programme for the CARDI Programme Planning Meeting during 25-29 July 2005, Managers from CARDI Headquarters and CRs from the other CARDI Units visited the facilities and the programme of work of the Jamaica Unit.

The other visitors to the CARDI Jamaica Unit during 2005 included:

Abiodun Goke-Pariola	Berry College, USA
Campbell, Dunstan	FAO, Jamaica
Marcus, Mycoo	Agro-chemicals sales agent, Trinidad and Tobago
Lorena Lastres de Rueda	Consultant, Jamaica Business Recovery Programme
Richard Pluke	Consultant, Jamaica Business Recovery Programme

In 2006, the following persons visited the CARDI Jamaica Unit

Alleye, Patrick E.	IICA Consultant
Baley, Ula	University of TN - Knoxville
Best, Ariel	Knoxville, TN
Byers, Erin	Knoxville, TN
Dennis, Richard	University of Tennessee
Douglas, Carla	Ministry of Agriculture Research and Development
Duncan, Russell	USDA – APHIS-IS Santa, Domingo
Figueroa, Nadiya	JEA Competitiveness Company
Fleischer, Shelby	Pen State Department of Entomology
Francis, Natalia	University of Tennessee, Student
Gayle, Leo	University of Tennessee
Geoghagen, Denise	FSPID
Golub, Emil	NAVO-GRO
Iton, Ardon, Dr	CARDI HQ
Jones, Janet	Knoxville, TN
Kim, K.	JEA Competitiveness Company
Lauckner, Bruce	CARDI HQ
McCooke, Glynis	UT Knoxville
Monuse, David	NAVO-GRO
Morales, Hose, R.	IGAT Cuba
Murray, Nathan	University of Tennessee
Murray, Trevor	IICA
Oh, Kichill, Dr	Korean Embassy
Parham, Wendel, Dr	CARDI HQ
Pollard, G. V.	Plant Protection Officer, FAO
Premener, Eugene	NAVO-GRO
Reid, Robert	REACT USAID
Reinhardt, Domingo H.	EMBRAPA, Brazil (Bahia State)
Riley, Ainsworth	JEA
Rothschild, Jamie	USDA/FAS
Smith, Delores	University of Tennessee
Smith, Laura	Knoxville, TN
Smith, Michael, Dr.	University of Tennessee
Snelgrove, Alexandra	MEDA, Canada
Taylor, Erin	Knoxville, TN
Thomas, Sylburn	USDA/FAS



Tolin, Sue
Watson, Alison
Wheeler, Matthew
Whitely, Neil
Weissed, Boris
Young, Mickeala
Zaim, Joseph

Virginia Tech, IPM Plant Pathology
USDA – APHIS – IS, Jamaica
CIDA/CPGCA
N.G. Caribbean NAVO-GRO
N.G. Caribbean NAVO-GRO
UTR
University of Tennessee, Student

