

JAMAICA ANNUAL REPORT



2002



*Improving Lives through
Agricultural Research*

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Foreword

I am pleased to present the 2002 Annual Report of the Jamaica Unit of the Caribbean Agricultural Research and Development Institute (CARDI). The report represents a concise overview of the research for agricultural and rural development activities of the Unit consistent with the mandate of the Institute. The Governments and peoples of the region have directed, through the Board of Directors of CARDI, that the Jamaica Unit should play a leading role in the development of technologies for Integrated Pest Management (IPM), Small Ruminant Production (sheep and goats) and Natural Resource Management.

Our 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 traditional export crop – coffee. During the year, we also initiated a programme to extend to the Eastern Caribbean the IPM models developed in Jamaica.

The Small Ruminant programme consolidated the successes it had achieved in making goat farming the most rapidly expanding section of the livestock sub-sector. We continued to work with our partners to address the problems of insufficient quality breeding stock and dependable forage feeding systems. Over the years we had developed and transferred appropriate technologies to the farmers and this year we interviewed a sample to gauge what impact these technologies have had on them. We are proud to report that the consensus was that the technologies have made a positive difference in their lives.

Organic farming is one of the emerging potential avenues of export agriculture. In the Natural Resource Management section of the report we present information on the development of technologies for organic production of vegetables, utilising our expertise in conventional agronomy and IPM systems.

The CARDI family places great emphasis on the provision of technical assistance to its clientele. In the latter part of the report we share with readers some of the assistance we provided outside our regular work programme in the year in review.

Finally we take this opportunity to thank our donors and collaborators, including ALPART Mining Venture, Coffee Industry Board, USAID (through IPM-CRSP) and in particular the Government of Jamaica for the continued support in 2002.



Francis Asiedu, Ph.D.
CARDI Representative

Highlights 2002

Commodity Programme

Integrated Pest Management

Callaloo

Integrated Pest Management (IPM) remains a major thrust of CARDI. During the year we validated two IPM strategies for the management of the Lepidoptera complex on callaloo and arranged to extend the experiences from this programme to other Caribbean territories. The pest management strategies validated employed the use of exclusion cages and biorational chemistries in combination with cultural practices compared with farmers' calendar system of application of pesticides. The results confirmed that:

- Exclusion cages and use of biorationals according to a threshold-based spray application guide, gave significantly improved protection of the crop from insect damage when compared to farmers' practice
- Initial analysis indicated that exclusion is most cost-effective in the summer months. The crop could then be established in uncovered locations during winter

Hot pepper

Gall Midge and mandatory fumigation

The mandatory fumigation of hot peppers prior to export due to gall midge infestation is a hindrance to the hot pepper industry. CARDI, in collaboration with its partners on the Hot Pepper Task Force, continued to revamp the surveillance and traceability systems. Based on the evidence of the integrity of the system, the USDA was convinced in June 2002 to agree to a conditional removal of the mandatory fumigation. The ten-point conditions were made available to stakeholders.

Market Study

In February/March 2002, surveys were carried out in eight territories, including Jamaica, to consolidate the knowledge base of the hot pepper industry. CARDI also undertook an assessment of the profitability of the hot pepper industry in four countries on behalf of the Food and Agricultural Organisation of the United Nations (FAO).

Sweetpotato

During the year, we continued trials for the selection of varieties resistant to the sweetpotato weevil, leaf beetle and the Wireworm-*Diabrotica-Systema* complex.

- At Bodles, 16 sweetpotato entries were evaluated and most (including local entries) were found to be more tolerant to damage by sweetpotato weevils than the susceptible checks 'Beauregard' and SC 1149-19. One entry, PI 531116, from the breeding programme of the International Institute for Tropical Agriculture in Nigeria, was found to be the most resistant to damage by sweetpotato weevils. Most of the entries also showed resistance to sweetpotato leaf beetle larvae

Coffee

The activities of the Biological Control of the Coffee Berry Borer project in 2002 consisted of replenishment of the foundation stock of parasitoids (*Cephalonomia stephanoderis* and *Phymastichus coffea*), field releases and assessment of establishment and efficacy in the control of the coffee berry borer.

- Almost 62,000 *C. stephanoderis* adults were produced in 10 generations from laboratory cultures
- Parasitoids were still being recovered from release sites more than two years after their release in the field. In addition 58, adult *C. stephanoderis* from the current releases were recovered from berries collected from trees at Rose Hill 2, and stages of *P. coffea* were found in CBB collected from release plots at all four release sites. These findings confirmed that the parasitoids have become established under field conditions in Jamaica and were able to successfully produce viable offspring.
- Efficacy trials indicated that reductions in the CBB infestation at Baronhall and Flamstead may be attributed to parasitism of CBB by *P. coffea*

Technology transfer and outreach systems

Both national and regional stakeholders benefited from our technology transfer efforts:

- Callaloo farmers and extension officers from five major callaloo-growing districts in St Catherine were given a firsthand demonstration of the two IPM systems, hands-on experience in pest identification and principles and practice of IPM and the use of the sampling plan/spray application guide for Lepidoptera
- A workshop was conducted in Trinidad to initiate the transfer and validation of these IPM strategies for vegetables in other Caribbean territories.
- In February 2002, RADA extension officers from the parish of St Elizabeth

participated in a one-day workshop and field day in the identification of the major pests of sweetpotato in Jamaica and their damage to the crop. Strategies used in an IPM programme were outlined too. The participants also took part in an exercise to make sweetpotato weevil pheromone traps and to place them in a farmer's sweetpotato field

- The regionalisation of the sweetpotato IPM strategies initiated in St Kitts/Nevis in 2001 was continued with varietal trials in St Kitts. The results suggested that the local lines of sweetpotato grown by Kittitian farmers performed better in terms of yield and disease resistance than many of the recently introduced lines

Small Ruminants

The Livestock Sub-Programme of the CARDI Jamaica Unit focuses on the critical areas in the development of the small ruminant industry in Jamaica and the wider Caribbean. The critical areas we emphasised in 2002 were: breed improvement, cost effective and sustainable feeding and production systems, technology transfer and outreach systems and monitoring of the use of the technologies by producers, as well as the monitoring of overall developments in the industry. In particular, a sample of producers was invited to share their views on the technologies to which they had been exposed, along with their goals and aspirations as small ruminant producers.

Breed Improvement

The breed improvement programme consists of the production of improved breeding stock from pedigree and quality crossbreds, and the distribution of the improved stock.

- During the year, work started on the infusion of the Boer and Spanish genes into Nubian/Native crossbreds. Results during the first thirty days of the life of the offspring suggested that the Spanish buck produced kids with marginally lower weights and growth rate than the Boer and Nubian bucks
- Forty-nine improved breeding stock were distributed from the Hounslow and Sam Motta Centres
- The six pilot breeder stock producers sold over 350 improved breeding stock, bringing the total sold during the last two years to over 750

Feeding and production systems

Good quality forage is the basis for cost effective ruminant feeding and production systems. In 2001, trials were started to evaluate two locally adapted forage legume species, *Cajanus cajan* (pigeon pea) and *Clitoria ternatea* (blue pea), with the view

to including them in feeding systems for small ruminant production. The results after 120 days growing period showed that:

- Plant tissue elongation and biomass accumulation were higher for the autumn sown crop (cf spring sown crop), when the crop was first cut at 8 weeks old (cf 12 weeks) and when cutting was more frequent (4 and 6 weeks cf 8 weeks).
- When growth and dry matter accumulation were high (autumn and first cut at 8 weeks), the non-stem fractions were higher for *tenatea* than for *cajan*.

Technology transfer and outreach systems

- Twenty-four training session and outreach services, including training, registration and appraisals and field days/tours, were conducted during the year. More than 600 stakeholders from the extension services, the 4H Clubs, schools and farmers groups affiliated to ALPART, IICA/JBI and UNITAS benefited from these sessions
- Thirty-seven farmers from nine communities on the Manchester Plateau with 98 does used the community sire (buck) service at the Sam Motta Centre during the year
- The Livestock Sub-Programme formally became involved in the Government-sponsored Goat Commercialisation Project. Under this agreement, we would recruit and recommend farmers from the central and western parishes to be involved in the project and also monitor and offer technical advice to participants in the project

Validation and monitoring of transferred technologies

Over the years, several farmers have adopted either the whole or segments of the small ruminant improved production technologies presented to them. In order to assess the impact of the technologies, we invited a sample of the farmers to share with us how the technologies have affected and benefited them and their families. The key findings were as follows:

- The most important impact has come from improved breeds and improved feeds and nutrition. The Nubian and Boer breeds have helped to improve the quality of the herds tremendously and the by-product feeds have contributed to a significant reduction in the use of the relatively costly “bag feed”
- The farmers all agreed that the other components of the technologies, such as the “lawn mower chopper” technology have also been important
- The benefits from the adoption of the technologies have been manifested in tangible ways too. Some of the farmers have used revenue generated from goat production to finance their children’s education, buy lands and even enabled one farmer to attend the Soccer World Cup tournament in France in 1998

Linkages and monitoring of developments in the small ruminant industry

In an effort to monitor the progress of the small ruminant industry in Jamaica, contacts and linkages were maintained with agencies and institutions such as RADA, the JAS, Jamaica 4-H, ADC, ASSP, Stock Quarantine Station and the GBSJ, as well as input suppliers, slaughter houses, supermarkets, etc. Through these contacts we monitored market trends, stock importation and other developments.

- It was noted that the price of local goat meat ranged from J\$175/kg in rural Jamaica to J\$270/kg in upscale supermarkets in the corporate area
- The price of the imported goat meat/mutton ranged from J\$100 to J\$155/kg
- The price of breeding stock declined from J\$18,700 for bucks and J\$8,000 for does in 2001 to J\$12,000 and J\$7,000, respectively
- Some 200 goats were imported from the USA and Canada in 2002. As at the end of the year, the total animals imported over the past three years stood at 647 at an approximate cost of J\$32,000,000

Natural Resource Management

The goal of the Natural Resource Management programme (NRM) of the CARDI Jamaica Unit is to contribute to the management of the land and water resources of Jamaica in a sustainable manner while decreasing environmental degradation. For the year 2002, the programme concentrated mainly on organic agricultural production and research and the coastal water management project.

Organic farming techniques

During the year studies continued at identifying and demonstrating the best organic media for use in organic farming. It was demonstrated that

- When grown in three organic nutrient sources- goat manure, cow manure and vermicompost- callaloo performed better than scotch bonnet pepper.
- Plots treated with cow manure had higher total and marketable yields compared to plots treated with other soil ameliorants

Caribbean coastal waters improvement project

As part of the consortium working with the University of York/Marine Resources Assessment Group through the Centre of Marine Sciences, UWI, CARDI was responsible for undertaking a review of soil management and farming practices, including the use of agro-chemicals in the Caribbean, with particular reference to Jamaica and St Lucia. The last field activity was the survey of farmers in selected

watersheds in Jamaica and St Lucia, and that was completed during the year. The preliminary results indicated that:

- Soil management was not related to soil properties
- Only 40% of hillside farmers indicated that serious steps were being taken to control soil erosion
- Increased utilisation of chemical fertilisers and pesticides, coupled with bad land management practices, would have implications for the coastal marine environment

Technical Assistance and Capacity Building

We consider the provision of technical assistance to the agricultural sector in Jamaica and the wider Caribbean as an important mandate of the Institute. Some of the services we provided under this portfolio were as follows:

Technical assistance given

We gave technical assistance to the following institutions/agencies:

- Jamaica Government Student-Work Experience Programme (Two-week work experience attachment of Ms Stacy-Ann Williams)
- Agricultural Support Services Project (Conducted training/workshop for the staff of MoA, Bodles on Research Methodology and Livestock Data Management, and organised a two-week training programme on Animal Nutrition Laboratory Procedures at the University of Florida for two staff members of the Livestock Research and Development Division of the Bodles Research Station)
- Faculty of Agriculture & Natural Science, UWI, St Augustine (Internship attachment of Mr Omari Soares)
- College of Agriculture, Science & Education, Jamaica (Internship attachment of Ms Alethia Williams)
- CARTFF Antigua projects (Development of project proposals for funding under the EU-sponsored CARTFF Project)
- Tobago House of Assembly (Coordination of a tour of several Jamaican agricultural production sites and agencies for Mr Hughford McKenna, *Secretary of Agriculture*, and Ms Karen Shaw, *Director of Marketing*, Marketing Department, Division of Agriculture, Marine Affairs and the Environment, Tobago House of Assembly)
- CABI (Coordination of the visit by Mr Perry Polar to conduct survey of major distributors of agricultural pesticides)
- Southern Trelawny Environmental Agency - Soil and water conservation studies project (Hillside management for small farmer yam production)

Boards and committees served

CARDI Jamaica staff served on seven committees that dealt with national issues on agriculture. These included:

- Executive Committee, Goat Breeders Society of Jamaica
- 4-H Clubs of Jamaica Goat Revolving Project Committee
- Research and Publications Committee of the Ministry of Agriculture
- Methyl Bromide Working Group
- CPEC/JOAM Human Resources Development Project Steering Committee
- Jamaica Agricultural Society (JAS) Kingston and St Andrew Association of Branch Societies Show Planning Committee
- Climate Change Committee of the Jamaica Meteorological Service

Collaborative efforts

Twelve local and international organisations and institutions collaborated with us in our work programme during the year. They included:

- ALPART Mining Venture
- Coffee Industry Board
- Food Storage & Prevention of Infestation Division, Ministry of Industry, Commerce & Technology
- Goat Breeders Society of Jamaica
- Jamaica Exporters Association
- Ministry of Agriculture
- Ohio State University
- Pennsylvania State University
- Rural Agricultural Development Authority
- University of the West Indies
- USDA ARS Vegetable Laboratory, North Carolina
- Virginia Polytechnic Institute and State University

Professional development of staff

Staff of the Unit attended seven national and regional workshops and conferences as part of the thrust for professional development.

Publications

There were nine publications produced by staff during the year.

Weather

Rainfall values are the most critical weather parameters that can be related to overall agricultural production. Figure 1 gives rainfall data for the thirteen parishes in Jamaica. The data are given for the years 2000, 2001 and 2002 as well as the 30-year mean from 1950-1980.

Total rainfall in Jamaica in 2002 was higher than the previous two years and the 30-year average. In 2002, the total rainfall over the island, calculated as a mean of the total rainfall in the 13 parishes was 2,159 mm. In 2000 and 2001, this figure was 1,590 mm and 1,863 mm, respectively, and the 30-year mean was 1,949 mm. This relatively high amount of rainfall in 2002 in the parishes ranged from a low of 1,519 mm in Trelawny to 3,251 mm Portland. Portland is traditionally the wettest parish, but Trelawny is not normally the driest. Overall most of the parishes received higher rainfall than in the previous two years and the distribution of this rainfall was useful for enhanced agricultural production.

May and September were the wettest months of the year in all parishes and most of the differences in rainfall among parishes were in the period between these two months. In general, there was a decline in rainfall in all parishes after September and only the traditional wet parishes of St Thomas, Portland and St Ann showed some increase in December.

Much of the farming activities in Jamaica are conducted on steep slopes and in years of high rainfall, the result is severe erosion of soil, land slippage and flooding in the low-lying areas. These occurrences were experienced in various parts of the island during 2002. In some cases there was severe damage to property and loss of life.

Project activities carried out by CARDI in Jamaica are located in the parishes of Manchester, St Elizabeth, Clarendon, St Catherine, St Mary and Kingston and St Andrew. All these parishes, except for St Mary, experienced higher than normal rainfall during 2002. This resulted in less critical water deficit conditions in experiments conducted during the year and in the production of forage species in St Elizabeth and Manchester.

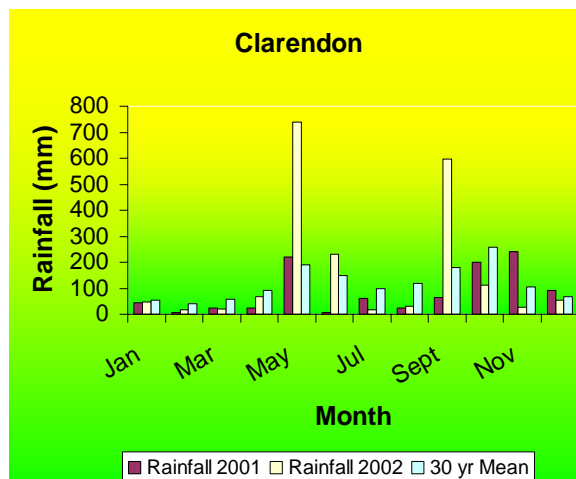
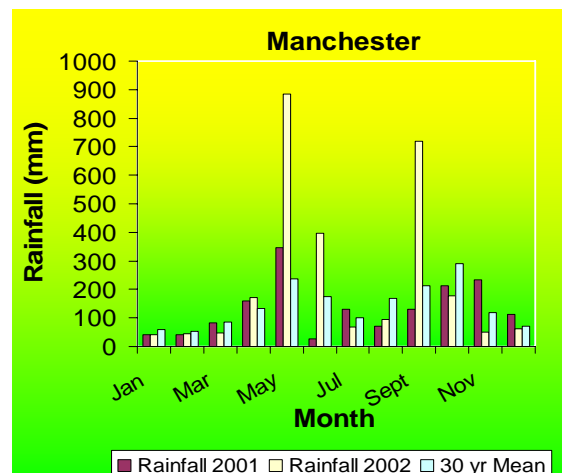
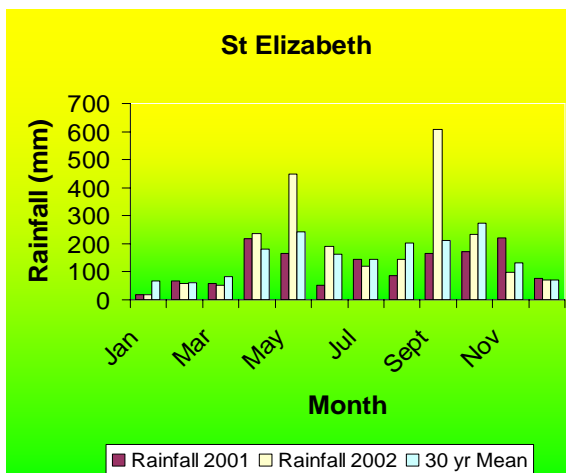
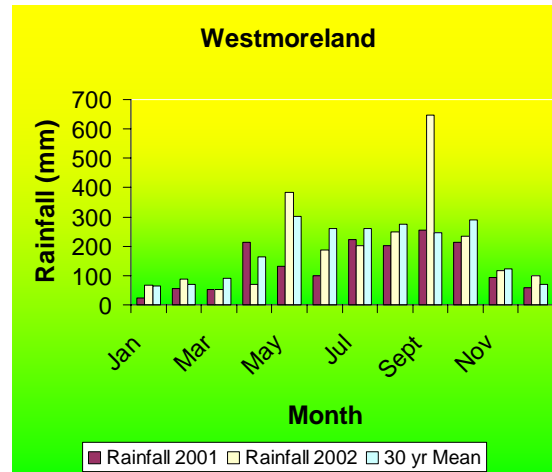
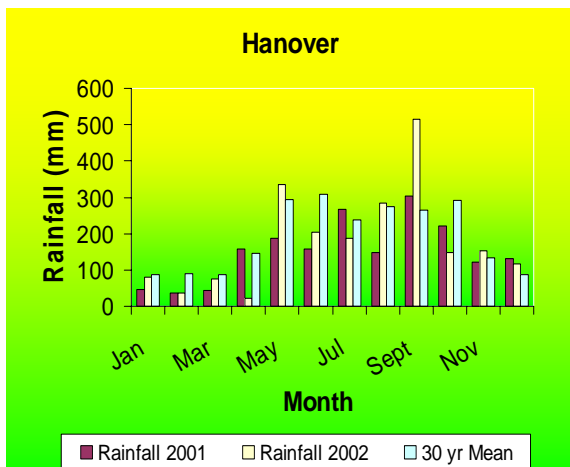


Figure 1 (a) Mean monthly rainfall for 2000, 2001 and 2002, along with the 30-year mean for Hanover, Westmoreland, Manchester, St Elizabeth and Clarendon

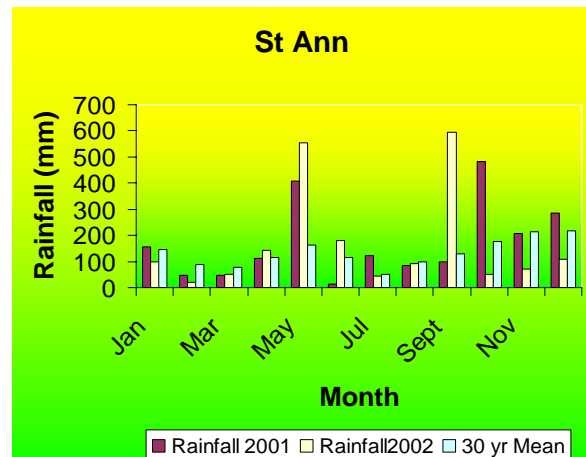
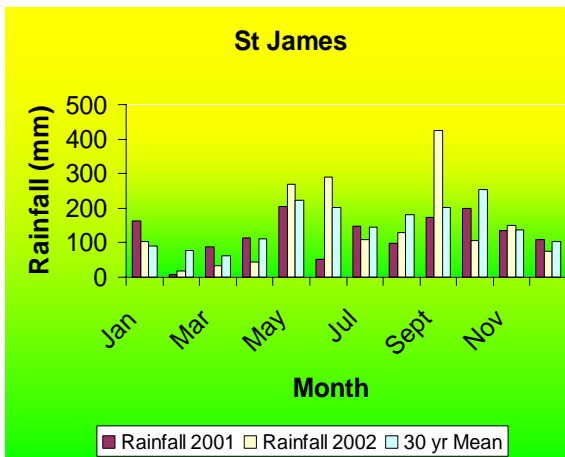
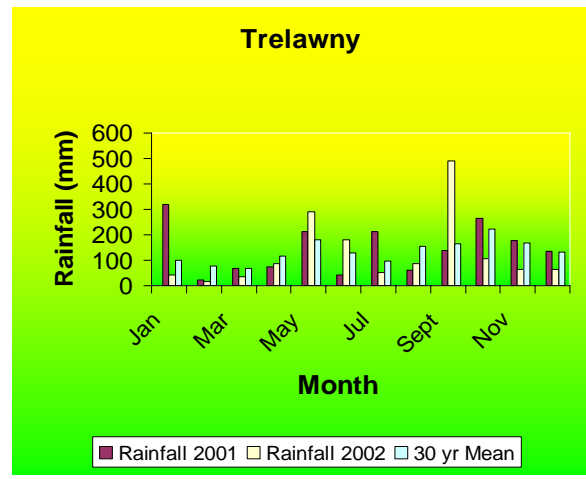
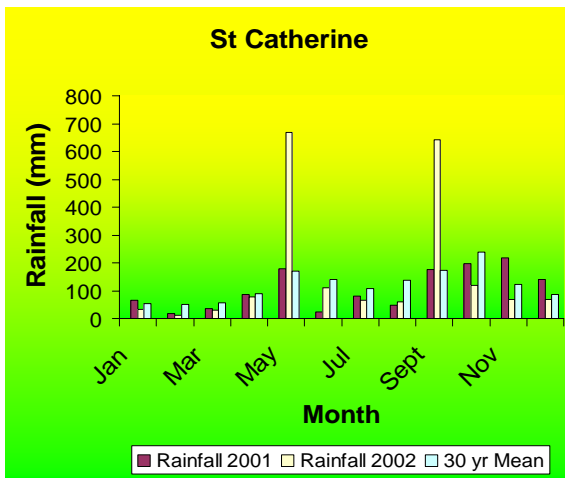


Figure 1 (b) Mean monthly rainfall for 2000, 2001 and 2002, along with the 30-year mean for St Catherine, Trelawny, St James and St Ann

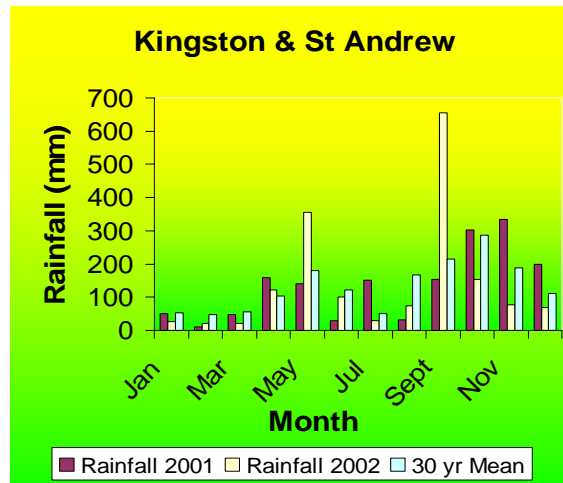
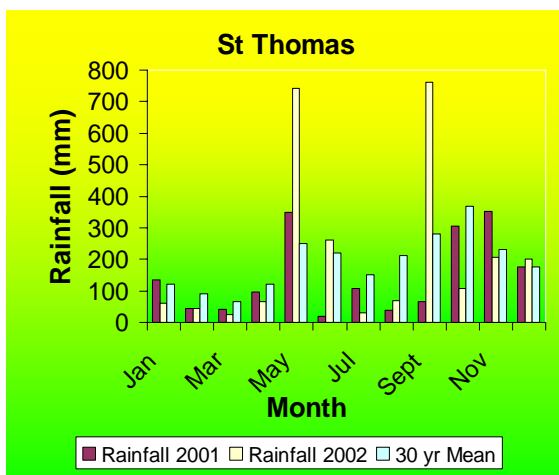
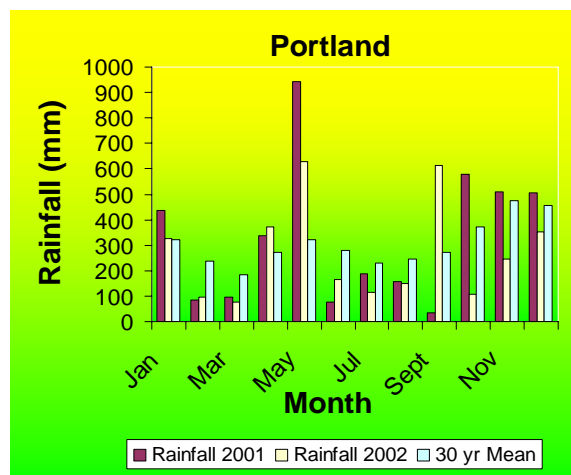
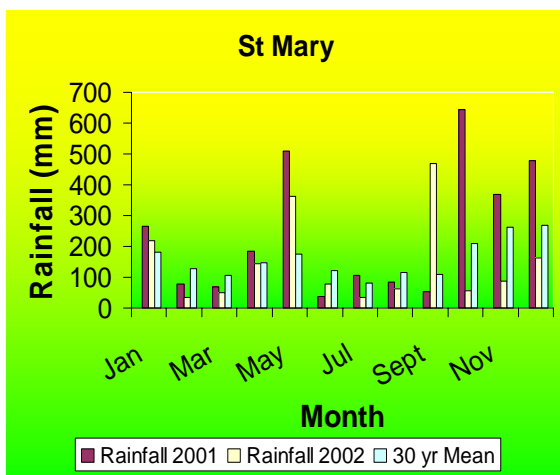


Figure 1 (c) Mean monthly rainfall for 2000, 2001 and 2002, along with the 30-year mean for St Mary, Portland, St Thomas and Kingston & St Andrew

Commodity Programme

CARDI's Commodity Programme generates, for targeted commodities, scientific information and component technologies and products, including hot pepper, sweetpotato, small ruminants and integrated management strategies for pest control and postharvest systems. CARDI Jamaica Unit executes, under this programme, projects in integrated pest management for vegetables and sweetpotato, and in hot pepper and small ruminant production

Integrated Pest Management Sub - programme

Integrated Pest Management (IPM) remains a major thrust of CARDI. Under the IPM Sub-programme, the IPM section of the Jamaica unit executes a number of projects towards the development of IPM systems for select crops.

In 2002, the USAID-funded IPM CRSP project completed its ninth year and with continued focus under the research components: IPM Systems Development; Pesticide Residues Testing; Marketing and Production Systems and Geographic Information Systems Application.

With the imminent end of the second phase of IPM CRSP, focus was shifted towards consolidating major achievements and regionalising technologies and research approaches developed during the project life.

The Coffee Industry Board-contracted project, *Biological Control of the Coffee Berry Borer* was extended for two years to enable the conclusive evaluation of parasitoids which were introduced into Jamaica under the project. The areas of mass rearing (parasitoid and host), refinement of laboratory rearing protocols, evaluation of the establishment in the field of the biocontrol agents and training of technicians and farmers in the application of the technology continued to be the primary focus of the project during the year.

IPM Systems Development for Callaloo

Determination of the best IPM strategy for Lepidoptera complex on callaloo

The validation of two IPM strategies for the management of the Lepidoptera complex on callaloo was initiated on five sites (Table 1). Plots were established at the first site in June 2000

in Bushy Park, south St Catherine. Another three plots were established in Linstead, north St Catherine and most recently, one plot was established at Thetford, south St Catherine. On each site, three consecutive crops were established and monitored for 13 weeks each.

Table 1 Dates of establishment and duration of crops on five sites

Farm	Duration of crop		
	Crop 1	Crop 2	Crop 3
Farm 1: Bushy Park	Jun-00 to Oct-00	Nov-00 to Mar-01	May-01 to Jul-01
Farm 2: Linstead	Feb-01 to May-01	Jul-01 to Sep-01	Dec-10 to Feb-02
Farm 3: Linstead	May-01 to Aug-01	Dec-01 to Feb-02	Mar-02 to Jun-02
Farm 4: North St Catherine	Jan-02 to Apr-02		

All seedlings were produced under row covers to exclude pests. Land was prepared by making raised beds 60 cm wide to accommodate plants at a spacing of 30 cm x 45 cm. Prior to transplanting, an exclusion cage was constructed at the site designated for that treatment plot. Three treatment plots of 280 plants each were established.

The pest management strategies employed were:

1. Exclusion of pests using a row cover of 70% light transmission in combination with cultural practices
2. The use of new biorational chemistries in combination with cultural practices.

The pesticides used in strategy 2 were applied within the framework of a resistance management programme. Spray application decisions were made based on a sequential sampling plan and a decision guide chart developed from our earlier work. The IPM strategy methods were compared with the farmers' calendar system of application of an insecticide (lambda-cyhalothrin) every eight days.

Two weeks after transplanting, plots were monitored [once] weekly. The parameters measured were crop yield and pest incidence and damage. The cumulative number of larvae observed on 25 plants (six leaves per plant) was recorded. Harvested crop was sorted into yield grades: marketable, insect damaged (>30% feeding hole damage); fungus damaged (>30% necrotic lesions); mechanically damaged; and physiological defects (seeding and rough stems); and then weighed. Data were analysed using Genstat® statistical software.

Table 2 shows the results for the crop sequences monitored during the year under review. The trends observed up to the end of last year continued (see Annual Report CARDI Jamaica 2001). The two IPM strategies continued to give superior crop protection against Lepidoptera species, resulting in the production of higher marketable crop yields than the farmers' practice.

Table 2 Yield and percentage insect damage of callaloo crops under three management systems on four farms

	Treatment			S.E.D	P Value
	Exclusion	Sampling plan	Weekly spray		
Farm 2 (Crop 3)					
Total yield (kg)	22.2	28.6	24.5	2.86	0.092
Insect damage (%)	0.5	8.8	16.3	7.59	0.130
Farm 3 (Crop 2)					
Total yield (kg)	12.1	20.6	16.8	3.40	0.055
Insect damage (%)	1.4	0.9	1.8	1.00	0.689
Farm 3 (Crop 3)					
Total yield (kg)	21.5	29.6	29.1	4.76	0.177
Insect damage (%)	5.2	14.2	8.6	6.92	0.429
Farm 4 (Crop 1)					
Total yield (kg)	16.7	23.1	25.5	2.71	0.007
Insect damage (%)	2.0	5.0	0.6	3.23	0.402

Regionalisation of the Callaloo IPM Research Model

During the year a workshop, *Development of IPM in Leafy Vegetables that Currently Experience High-pesticide Input*, was conducted in Trinidad and Tobago to initiate the transfer and validation of the IPM systems for vegetables developed in Jamaica to other Caribbean territories. CARDI's work represented pioneer efforts in IPM research on this commodity, thereby, allowing for classical principles for the development of IPM to be employed. The steps in the research model may be extrapolated to other similar systems. The proposal is for this model to be tested on cabbage production systems for developing

management strategies against the diamondback moth, *Plutella xylostella*.

IPM Systems Development on Hot Pepper

Gall Midge Complex on hot pepper

The emphasis of research and development activities being carried out by the multi-agency Task Force was focused on putting strategic elements in place to reinforce monitoring and surveillance on hot pepper for export for efficient interception of gall-midge-contaminated shipments and fields. A traceability system has been developed and implemented as part of the monitoring and surveillance system which will allow for the detection and

early mitigation of pest problems in hot spots identified by trace back. The system will also identify farms with a good track record over time, as well as possible pest free zones. The interceptions of gall midge on hot peppers inspected at the two major ports had declined from 104 cases in 1998 to only one case in 2000. This reduction was indicated to the USDA to request a revision of the mandatory fumigation requirement enforced for all hot pepper shipments from Jamaica to the USA. A USDA Team visited Jamaica in December 2001 to review data and systems in place at the field level and at the ports in order to revisit their position on mandatory fumigation. In June 2002, the USDA agreed to conditional removal of mandatory fumigation and the requirements were outlined.

**Conditions for removal of
Fumigation requirement for peppers
shipped to the USA.**

1. Only precleared peppers would be eligible for entry without fumigation.
2. Shipments would be preinspected by the Jamaican Ministry of Agriculture (JMOA) and be accompanied by a phytosanitary certificate stating "Shipment free of cecidomyiid midge based on field controls and inspection".
3. Animal and Plant Health Inspection Service (APHIS) preclearance personnel must participate directly in each of these preclearance inspections.
4. Only growers participating in the field control program would be allowed to ship without fumigation. These growers need to be listed by JMOA or the Rural Agricultural Development Authority (RADA) and certified as participating in the "Non-Treatment Program" and the "Trace-back Program."
5. All growers and packing facilities would have coloured posters indicating midge symptoms. Both growers and packers will be instructed to cull fruits with such symptoms.
6. Fruits found with the midge or eggs would be rejected or fumigated. Reconditioning would not be allowed. The stems of 19 fruits will be cut and inspected for the midge. The stem cutting should be aimed toward any fruit showing the symptoms. Cutting would not be required for "de-stemmed" shipments. Inspections for "stemless" peppers should be conducted on double-bottomed tables.
7. If the rejection rate for all quarantine pests reaches 15 percent, all peppers would require fumigation.
8. Pepper shipments can also be precleared with treatment or

shipped without preclearance for treatment in the United States. Shipments inspected in Jamaica and found infested cannot be shipped for treatment to the United States.

9. Growers with shipments rejected for the midge would be removed from the program. These growers could apply for re-admittance by applying for a RADA/JMOA field inspection. If compliance with the program could be assured the grower could be reinstated. Growers with a second rejected shipment would not be allowed in the "Non-Treatment Program" for the remainder of the season. After a full review by RADA/JMOA and corrective "mitigations" have been implemented the grower may apply for reinstatement for the next year.
10. Each inspection site should have at least one inspection table, which has slats, or mesh bottoms, which allows hitchhikers or midges to be shaken through and captured on a solid secondary bottom. At a minimum sorrel and "stemless" peppers should be inspected on these tables.

Systems are being put in place to meet these requirements. Draft modules have been prepared to compile a handbook which would assist farmers to meet the requirements for conditional fumigation of their produce. However,

extreme and prolonged periods of heavy rainfall and flooding across the island since June 2002 have resulted in suitable field conditions conducive to gall midge infestation and hence, there has been an increase in interceptions by local quarantine officers. All hot pepper shipments are, therefore, still being fumigated. Interceptions are, however, expected to decrease as favourable conditions subside.

The identification of an alternative fumigant to methyl bromide still remains a necessary component given conditional fumigation of hot peppers. A second trial with less toxic magnesium phosphide will be conducted in Year 10 of the IPM CRSP.

Hot pepper market study

In 2000, CARDI embarked on a development program for the hot pepper industry in CARICOM. The leaders of the Regional Transformation Programme for Agriculture (CARDI, UWI, IICA, CARICOM Secretariat, FAO, CDB) have also adopted the industry development strategy and have included hot peppers as one of the commodities for immediate focus.

A first step in the process is a study of the industry to identify its strengths and weaknesses, threats and opportunities, including the market potential. Following a fact-finding visit in May 2001 to New York and Miami, which are the region's major hot pepper export markets, surveys on the industry were carried out in eight countries including Jamaica in February/March 2002 to

establish some of the basic structure of the industry. CARDI also undertook an assessment of the profitability of the industry in four countries on behalf of the Food and Agricultural Organisation of the United Nations (FAO).

IPM Systems Development on Sweetpotato

Sweetpotato weevils, sweetpotato leaf beetles, and the Wireworm-*Diabrotica-Systen*a (WDS) soil insect complex significantly reduce sweetpotato production in Jamaica and the rest of the Caribbean. The incorporation of pest management tactics, such as cultivating resistant breeding lines, implementing cultural practices and using environmentally-friendly insecticides such as botanicals and biorationals, into the present IPM technology will greatly enhance IPM procedures for sweetpotato farmers in the Caribbean to produce high quality, internationally competitive commodity. Additionally, the dissemination of IPM technology to farmers in major sweetpotato-growing areas in the Caribbean is continuing and should facilitate the goal of reducing pest damage and improving sweetpotato production in the Region such that it is competitive in the global market.

Comparison of USDA and Jamaican sweetpotato clones for yield and insect resistance traits

Sixteen selected USDA and Jamaican dry-flesh sweetpotato breeding lines

and varieties were evaluated at the Bodles Research Station, St Catherine for yield and resistance to soil insect pests, including sweetpotato weevils (SPW), sweetpotato leaf beetles (SPLB), flea beetles, and the WDS complex. For SPW and SPLB larvae, damage was scored on a scale of 0-5 and 0-4 based on percentage of surface and internal damage and length of feeding channels, respectively. Roots damaged by WDS were rated by assigning each root a score based on the number of feeding scars. Flea beetle damage was calculated as a proportion of total root damage. For each pest scored, a severity damage index was calculated. Data were analysed by Analysis of Variance (ANOVA) using Genstat® statistical software.

The yield of the sweetpotato entries ranged between 1.09 and 10.96 kg/plot and 18 and 82 roots/plot, with several entries producing significantly higher yields than others (Table 3). The highest mean mass of tubers was obtained from TIS 30-30, PI 531116 (from the breeding programme of the International Institute for Tropical Agriculture in Nigeria) and Picadito, while Tinian produced the lowest mean total mass (1.09 kg/plot).

The sweetpotato entry 96-86 produced a significantly higher mean number of roots (81.6 roots/plot) than any other entry, followed by 94-127 (72.3 roots/plot). Sidges and Tinian produced the least number of roots (19.0 and 18.0 roots/plot, respectively).

The WDS index among the entries ranged from 0.12 to 2.56, and four entries had WDS ratings significantly

lower than the susceptible check cultivar SC 1149-19 (Table 3).

Table 3 Insect ratings and weights of dry-fleshed sweetpotato entries and check cultivars, means of four replicates, at Bodles, St Catherine, 2002

Sweetpotato Entry	WDS Index ¹	% Clean roots ²	Sweetpotato Weevil Index ³	Crown Rating ⁴	Sweetpotato Leaf Beetle Index ⁵	Total mass (kg)	Number of roots
Quarter Million	0.12 c ⁶	12.2 e-h	0.75 b-d	3.17 b	2.32 b	4.03 cd	30.5 e-g
TIS 8401	0.12 c	19.3 d-h	0.54 cd	3.01 b	1.05 b-d	3.34 cd	36.3 d-g
94-127	0.13 c	41.4 a-c	1.84 a-c	2.14 c	0.41 d	2.43 cd	72.3 ab
PI 531116	0.13 c	30.8 a-e	0.14 d	0.49 e	0.87 b-d	0.34 a	53.3 b-d
TIS 30-30	0.21 bc	24.9 b-f	0.68 cd	3.01 cd	0.93 b-d	10.96 a	65.3 a-c
Fire-on-Land	0.26 bc	9.3 e-h	0.93 b-d	1.24 d	1.72 b-d	7.21 b	35.3 d-g
Sidges	0.35 bc	34.7 a-d	0.40 d	1.19 d	0.87 b-d	5.00 bc	19.0 g
Tinian	0.37 bc	51.0 a	0.64 cd	1.31 d	0.89 b-d	1.09 d	18.0 g
White Regal	0.40 bc	22.0 c-g	0.88 b-d	2.58 b-d	0.71 cd	2.76 cd	45.3 c-e
TIS 2498	0.41 bc	0.8 h	0.76 b-d	3.13 b	1.50 b-d	3.52 cd	30.0 e-g
96-86	0.44 bc	14.2 d-h	1.05 b-d	2.93 b-d	1.06 b-d	4.01 cd	81.6 a
Picadito	0.49 bc	13.4 e-h	0.32 d	2.66 bc	1.61 b-d	10.43 a	53.0 b-d
Beauregard	0.79 bc	0.0 h	2.18 ab	4.43 a	2.00 bc	2.06 cd	23.2 fg
W-341	1.02 bc	7.8 f-h	0.89 b-d	2.07 c	1.24 b-d	4.43 bc	43.5 d-f
SC 1149-19	1.17 b	2.0 gf	1.44 b-d	4.32 a	1.34 b-d	3.19 cd	51.3 cd
TIS 80/637	2.56 a	45.8 ab	2.97 a	2.96 a	3.96 a	2.18 cd	28.3 e-g

¹Wireworm-*Diabrotica-Systema*) Index = (A + 2B + 4C)/N, where A = no. of roots scored 1-5 feeding scars, B = no. of roots scored 6-10 feeding scars, C = no. of roots scored >10 feeding scars, N = total no. (mean from 4 replications) of roots scored; ²Roots showing no visible damage from insect pests; ³*Cylas formicarius elegantulus* (Summers) Root Index: 0= no injury, 1= larval tunnels 0.01 - 0.50 cm deep & 0 - 6% internal tissue injury, 2= larval tunnels 0.5 - .0 cm deep & 6 - 12% internal tissue injury, 3= larval tunnels 1.0 - 1.5 cm deep & 12 - 24% internal tissue injury, 4= larval tunnels 1.5 - 2 cm deep & 24 - 48% internal tissue injury, 5= larval tunnels > 2 cm deep and > 48% internal tissue injury; ⁴*C. formicarius elegantulus* Crown Rating (subjective) 0= no injury, 1= 1- 20% injured tissue, 2= 21- 40%, 3= 41- 60%, 4= 61- 80%, 5= 81- 100%; ⁵Immatures of sweetpotato leaf beetle, *Typophorus nigritus viridicyaneus* (Crotch) gouge shallows areas on the surface of sweetpotato roots. Damage rating based on the length of feeding channels. 0= no injury, 1=>0 - 8 cm channel, 2=>8 - 15.0 cm channel, 3=>15 - 23cm channel, 4=>23 cm channel; ⁶Average total weight for each replication; ⁷Mean no. of roots; ⁸Means separated Fisher's Least Significant Difference after Analysis of Variance

Tinian produced the highest percentage of roots with no insect damage (51% clean roots), while Fire-on-Land produced the lowest (9.3%). This is in contrast to previous trials in which the latter entry was among those that produced the highest percentage of clean roots. This result may have been because the trial had to be re-established in the same field and the fast-growing Fire-on-Land produced tubers earlier than some of the other varieties hence giving pests more time to do their damage.

PI 531116 (Root and Crown Indices = 0.14 and 0.49, respectively) showed the greatest resistance to the SPW. Other entries which showed tolerance were Picadito (Root and Crown Indices = 0.32 and 2.66, respectively), Sidges (Root and Crown Indices = 0.40 and 1.19, respectively), Fire-on-Land (Root and Crown Indices = 0.93 and 1.24, respectively) and Tinian (Root and Crown Indices = 0.64 and 1.31, respectively). This is in accordance with results from previous trials. The susceptible lines, Beauregard and SC1149-19, showed low tolerance to the weevil (Root Indices = 0.2.18 and 1.44, and Crown Indices = 4.43 and 4.32, respectively), with only one other entry, TIS 80/637 (Root Index = 2.97), that was more susceptible.

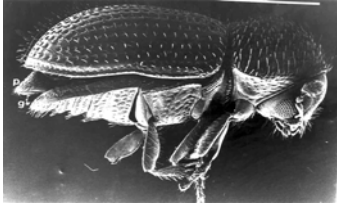
Several sweetpotato entries, such as 94-127, PI 531116, White Regal, Sidges, Tinian and TIS 30-30, showed resistance to sweetpotato leaf beetle larvae (Table 3). Once again, PI531116, Picadito, Sidges and Fire-on-Land were among those entries

with the greatest insect pest resistance. Tinian (a new entry), though not a prolific producer, also showed high resistance to the insect pests.

Evaluation of the use of resistant varieties with natural products for the management of the sweetpotato leaf beetle

Two botanical compounds, garlic extract and Neemex® (azadirachtin), and a biorational pesticide, Admire® (imidacloprid) were evaluated for their efficacy against the sweetpotato leaf beetle (SPLB) on two USDA lines - White Regal and Picadito - and the Jamaican local line Sidges. The garlic extract was applied five weeks after planting and every fortnight thereafter. Neemex® and Admire® were applied when the leaf beetle population was more than ten adults per plot. Treatments were allocated in a random complete block design with four replicates. Preliminary results indicated that Admire® was most effective against adult beetles, followed by Neemex®.

Biological Control of the Coffee Berry Borer



The adult CBB

The coffee berry borer (CBB), *Hypothenemus hampei* Ferrari (Coleoptera: Scolytidae), is one of the most limiting pests affecting coffee production in Jamaica. Since 1978, the control of the coffee berry borer within the island has been achieved largely through the application of the organochlorine insecticide, endosulfan, and to a lesser extent, by utilising cultural practices, such as the complete removal of berries from trees at the end of the harvest period. However, although effective in controlling CBB populations, the use of endosulfan - on which an estimated US\$75,000 is spent to control the CBB - has had several negative ecological and environmental repercussions. In light of the foregoing, the Coffee Industry Board (CIB) contracted CARDI in 1999 to initiate a biological control programme for the CBB. It is envisioned that this biologically intensive management approach will improve the quality and hence, the competitiveness of the coffee being produced and reduce negative environmental impacts. The project aims to develop mass rearing protocols for imported natural enemies and evaluate their efficacy in controlling the coffee berry borer. Training of

various stakeholders in the coffee industry in biological control and techniques for mass rearing and releases of parasitoids is also a major thrust.

Importation of parasitoids of the CBB

In the third year beginning May of the project (2001), the parasitoid cultures were severely affected by a fungus, *Aspergillus* sp. Hence, in March 2002, *Cephalonomia stephanoderis*, and *Phymastichus coffea*, parasitoids of the immature and adult CBB, respectively, were imported to Jamaica from Guatemala. From the cultures received, a total of 8,085 adult *C. stephanoderis* and 2,340 adult *P. coffea* were harvested between March and April 2002 and these were used to establish 82 and 60 new cultures of the respective parasitoids.

Rearing of the parasitoids and Coffee Berry Borer

From the 82 cultures of *C. stephanoderis* established, 6,824 adults emerged (Figure 2). The decline in production between June and September was due largely to the unavailability of berries with suitable CBB stages for development of the parasitoid.

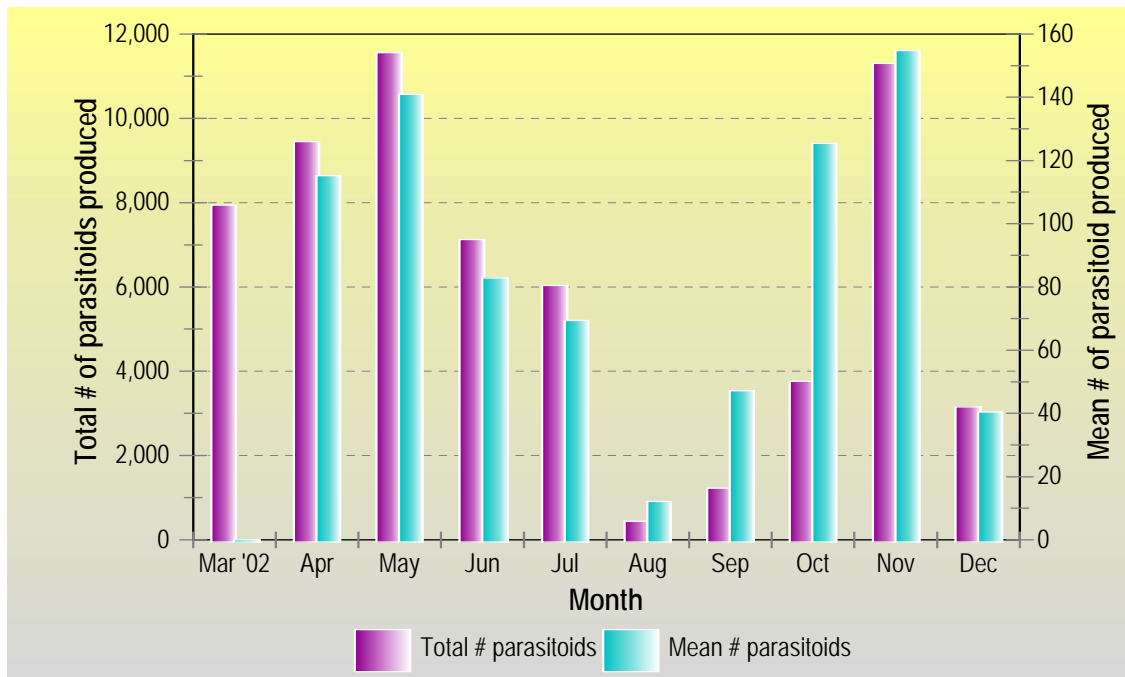


Figure 2 Number of parasitoids, *Cephalonomia stephanoderis*, emerging in each month from inoculated cultures of coffee berry borer infested berries or parchment for the period March – December 2002

Ten of the cultures of *P. coffea* established from the stock of Guatemalan parasitoids were sent to the Baronhall Rearing Facility in April 2002. A total of 4,796 were collected up to July 2002, after which the cultures expired.



Harvesting parasitoids from coffee berries infested with borers

Due to the difficulties encountered in obtaining CBB-infested berries from the field from June to September, rearing of the CBB was not continuous for the year. Some 117,000 CBB were collected (mainly during May-July 2002), of which approximately half were used to establish 49 parchment (coffee bean) cultures. For the rest of the year, CBB-infested berries obtained from the field were used mainly for the establishment of parasitoid cultures.

Field release and assessment of establishment of *Cephalonomia stephanoderis*

Field establishment of *C. stephanoderis* was monitored at all pilot sites. In June 2002, adult *C. stephanoderis* were observed in the release plot at Rose Hill 2, in which an extremely small number of adults had been release in June 2001.

Eight wasps were collected from berries brought back to the rearing laboratory from Rose Hill 2 in June 2002, while 47 adults emerged in August 2002. This serves once more as evidence of the establishment of this parasitoid, as it indicated that the parasitoids collected would have been the 18th generation (given a life cycle of three weeks) from adults released in the field more than 12 months earlier.



Release of parasitoids (pests of the CBB) in a coffee plantation

No parasitoids were observed to have emerged from berries collected from other sites. It is possible that there were no parasitoids present or any parasitoids that were in the field were present in

less than 2% of the berries present (based on the berry sample size and the number of berries that may be in the field).



Parasitoids being released from glass bottles



Parasitoids shaken onto a sheet of paper attached to coffee branch

Two methods of releasing parasitoids

Field release, assessment of establishment and efficacy of *Phymastichus coffea*

Establishment and dispersal of P. coffea

Plots at Greenock in St Ann and Rose Hill 2 in St Andrew were selected for *P. coffea* establishment studies. Since no control plots were required for these studies, the release plot at Greenock and the control plot at Rose Hill 2 were used to carry out *P. coffea* releases. At the Greenock release plot, 1,000 *P. coffea* adults were released in June 2002. Dissection of adult CBB indicated that the mortality of CBB adults was higher in July 2002 (36.1%) than in June 2002 (16.1%). Two

parasitoid pupae were dissected from adult CBB collected from Greenock in July 2002 and four parasitoid larvae and two adults were recorded in August 2002. This is an early and heartening indication that the parasitoid had successfully reproduced for at least two generations, given a life cycle of 30 - 40 days. Additionally, one adult parasitoid was observed in the plot more than 30 m away from the initial point of release, indicating the migration of the parasitoids in the plot.



Cephalonomia stephanoderis entering hole in berry created by CBB

Parasitised CBB, with an estimated 450 *P. coffea*, were placed in the Rose Hill 2 control site in July 2002. One adult wasp was observed in the plot in September 2002. Dissection of adult CBB from this plot also revealed two pupae in August 2002, one larva and three adults in September 2002 and seven larvae in October 2002, which translated to CBB parasitism levels of 6.1, 17.4 and 20.6%, respectively. Once again, this indicates the successful reproduction of at least two generations of *P. coffea*.

Efficacy of P. coffea

At Baronhall, Clarendon, 2,000 adult *P. coffea* adults were released in June 2002. There was a decrease in CBB

infestation level in the release plot between July and August 2002, compared with general increases in CBB infestation in both positive control (where endosulfan was sprayed) and negative control (where no action was taken against the CBB plots (Figure 3)

The decline in the release plot may have been due to the presence of the parasitoids. The dissection data indicated successful multiplication of *P. coffea* in the plot, with one larva observed in August 2002 and two larvae and one pupa in September 2002. During field assessment, it was observed that several of the adult CBB which had started to bore into berries had parasitoid exit holes in their abdomens. This evidence points to the successful reproduction of the parasitoid to the third generation

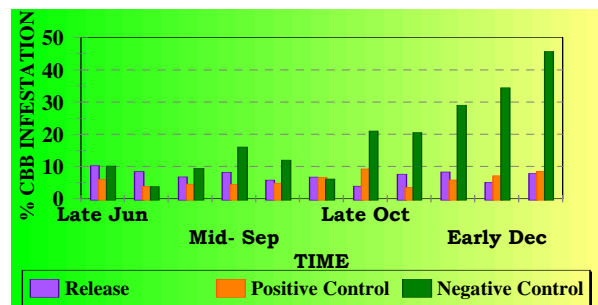


Figure 3 Infestation of coffee berries by the coffee berry borer, *Hypothenemus hampei*, after release of a parasitoid of the pest in June 2002 at Baronhall, Clarendon

The general increases in CBB infestation in both control plots during

the period August - October 2002 again suggested that the presence of the parasitoids in the field was responsible for the reduction in CBB infestation in the release plot. The data also suggest that the level of suppression of the pest due to *P. coffea* was more sustained and effective than that due to endosulfan as was evidenced by the increase in CBB infestation in the positive control plot in late October 2002 (compared with the release plot).

An estimated 1,000 *P. coffea* were released in the Flamstead release plot in early July 2002; a second release of about 400 parasitoids was carried out in October 2002. The CBB infestation level in the release plot fell in July 2002, followed by a general increase in CBB infestation, from 14% in August 2002 to 25% in October 2002, although there was a 44% decline in September 2002 (Figure 4). This was probably due to the increasing level of parasitism between August 2002 (22.7% parasitism) and September 2002 (34.1%). Dissection of adult CBB from the release plot pointed to the successful multiplication of the parasitoid, with five pupae recorded from CBB in August 2002, nine larvae, three pupae and three adults in September 2002, and ten larvae and two pupae in October 2002.

The results obtained from these studies are extremely encouraging as they indicate that even a small release of 1,000 - 2,000 *P. coffea* can result in a 50% reduction in CBB infestation.

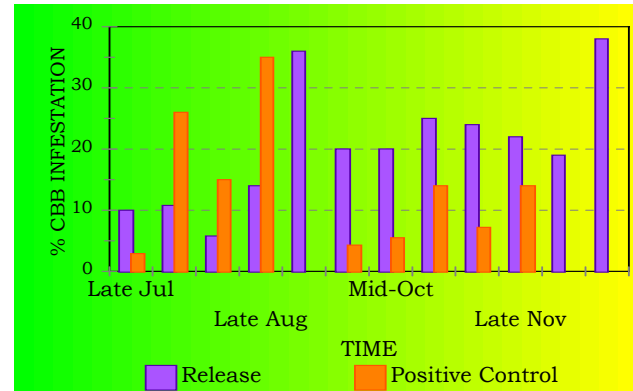


Figure 4 Infestation of coffee berries by the coffee berry borer, *Hypothenemus hampei*, after release of a parasitoid of the pest in July 2002 at Flamstead, St Andrew

Technology Transfer and Outreach Services

Technology transfer

Technology transfer remained an important part of the work programme for the year in review. Field days (four hot pepper, one callaloo and two sweetpotato) were held locally to demonstrate existing technologies and sensitise farmers to research activities.

Callaloo

The dissemination of information on the management of callaloo pests using the two IPM systems described above (see page 14) is now being carried out on a wider scale as the national extension service, RADA, has been

convinced of the value of the approaches for callaloo farmers. The Jamaica Organic Agriculture Movement JOAM has also adopted the exclusion method as an option for organic growers and has been given technical assistance towards the establishment of a demonstration plot on the grounds of Kings House (Residence of the Governor General of Jamaica). The Governor General has an avid interest in organic farming and has endorsed the promotion of alternative technologies.

The Pesticides Control Authority (PCA) of Jamaica has initiated an effort towards training and registration of farmers who apply chemical pesticides. This drive is towards meeting required standards in the current global trade environment. One in a planned series of island wide workshops was hosted by the PCA in Thetford, St Catherine on 12 November 2002. The target group was callaloo (vegetable amaranth) farmers and Dionne Clarke-Harris made a presentation on Callaloo IPM and CARDI/IPM CRSP activities toward developing new technologies for pest management of the crop.

Hot Pepper

Web GIS workshop for developing a pest monitoring programme

A multiagency workshop (RADA, MoA, CARDI, Penn State, UWI, Agro Grace, H&L Agri & Marine Co., Agricultural Chemicals Plant, Pesticide

Control Authority) was used to specify design needs of application software for the integration of web and GIS for pest monitoring that would be appropriate for use in the Caribbean. A key design aspect defined at this meeting was a need to enable web-based data acquisition and management, to house that data-acquisition program on servers maintained by governmental agencies, and to be able to manage different parts of the database remotely. These needs are especially relevant to Caribbean nations that are widely dispersed, or have professionals located in different parts of an island. RADA agreed to provide the server, and Penn State developed a software application specifically to meet these needs. The application, called Remote Data Manager (RDM), was written by Bruce Miller with ASP (Active Server Pages) using VBScript (Visual Basic scripting language). The benefits of using ASP for this application were (1) to enable installation without special server requirements or third party software; (2) to enable remote installable and maintainable; and (3) easy database connectivity.

In addition to developing the RDM application, B. Miller revised a software application that had been previously written to enable the generation of maps, time-series graphics, and a web page. B. Miller had built this software in Delphi™ and MapObjects™ to combine a relational database, a mapping system and a web editor.

A trip to Kingston, Jamaica, in March 2002, was used to initialize the installation of both software applications onto servers at the Jamaican Ministry of Agriculture, through RADA, and at CARDI. Although the installations were successful, the use of RDM was unsuccessful at that time due to security access associated with the governmental servers. We proceeded to develop prototypes during the spring and summer, using servers accessible via the web but housed at Penn State. These developmental web pages at Penn State servers were at <http://mona.psu.edu/JamaicaPestWatch/>. We used geo-referenced datasets on gall midge infestation rates obtained from a RADA baseline survey, and a GIS thesis from previous IPM CRSP, to help develop the database. By the fall of 2002, the security clearances were approved to enable RDM to function within the governmental servers. The web-mapping efforts were then successfully embedded within the governmental website <http://www.radajamaica.com.jm/>, then clicking "Technical", and then "Pestwatch", to reach <http://www.radajamaica.com.jm/Pestwatch/default.html>. Revisions to the base maps are now in progress due to the conversion of map projections.

A non-random design was used for the sampling population (bearing hot pepper fields) in select major growing areas of Jamaica. This covered seven of the thirteen RADA administrative parish units across the island. Districts were drawn from the major hot pepper

production Extension Areas, based on MoA Data Bank statistics as well as ecological differences, particularly rainfall and elevation.

Survey plan

Fields were selected from two main ecological zones: lowland-irrigated and upland rain-fed. Location was based on field officer knowledge of spatial field distribution, seeking an even distribution across each production area.

Sampling protocol

Ten locations, distributed over the entire plot area, were selected. At each location, two mature fruits were reaped from each of three canopy heights of a single plant. If this number of fruit was not available from one plant, the nearest adjacent plant(s) was (were) sampled to achieve the total of six fruits per location. Samples were taken fortnightly and submitted to laboratories for the determination of proportion of fruit infestation. Laboratories used were Bodles Entomology (Central parishes), Montego Bay Plant Quarantine (western parishes) and CARDI, Mona (Eastern parishes).

Data entry

Infestation levels were recorded on the Pestwatch Web GIS database at <http://mona.psu.edu/JamaicaPestWatch/>. No maps have been generated yet.

Sweetpotato

CARDI Jamaica, in collaboration with RADA, hosted a one-day workshop on the integrated management of sweetpotato pests, with emphasis on the sweetpotato weevil (SPW), *Cylas formicarius* L., in January 2002, in Santa Cruz, St Elizabeth. The workshop was sponsored by CARDI/USAID IPM CRSP, RADA and Agricultural Support Services Project (ASSP) and attended by farmers and extension officers of RADA, St Elizabeth. The activities for the workshop included audio-visual presentations and practical demonstrations. The practical session took place in a sweetpotato farmer's field, where Mrs Yvonne Grindley, RADA Zonal Plant Protection Specialist, showed the participants how to make the SPW pheromone traps from recycled plastic containers. Thereafter, they practised making their own and placed them in the field. The factors affecting the placement of the traps were pointed out to them.

Regionalisation of IPM Technology

The regionalisation of IPM technologies for vegetables has been mentioned already (see page 15)

Sweetpotato IPM

The focus on the regionalisation of IPM technologies continued in 2002. St Kitts and Nevis were visited during the reporting period in order to assist sweetpotato farmers in the region to improve the quantity and quality of sweetpotato being produced. IPM technologies, which have demonstrated potential in Jamaica, were introduced to these islands along with training in these technologies. Parallel studies on multiple pest resistant lines were also continued in St Kitts.

Denbigh Agricultural Show

CARDI Jamaica participated in the 50th staging of the Denbigh Agricultural Show, convened from 4-6 August 2002 in Clarendon. Under the theme CARDI displayed, through posters, models, demonstrations and publications, the technologies it has developed in IPM (vegetables, sweetpotato and coffee), organic farming and sheep and goat production. The importance of Geographic Information System (GIS) was also demonstrated.

Livestock Sub – Programme

In keeping with the directives of the Governments and peoples of the region, through the Board of Directors of the Institute, and as enunciated in the Institute's Medium Term Plan, the Livestock Sub-Programme of the CARDI Jamaica Unit focuses on critical areas in the development of the small ruminant industry in Jamaica and the wider Caribbean. In the year under review, we executed this mandate diligently, both on research stations (Hounslow and Sam Motta Goat and Sheep Demonstration and Training Centres – HDTC and SMDTC, respectively) and on farms. The critical areas we emphasised were: breed improvement, cost effective and sustainable feeding and production systems, technology transfer and outreach systems and monitoring of the use of the technologies by producers, as well as the monitoring of overall developments in the industry. In particular, a sample of producers was invited to share their views on the technologies to which they had been exposed, along with their goals and aspirations as small ruminant producers. We were assisted in these efforts by our partners, including the Ministry of Agriculture Research and Development Division (MoAR&D), RADA, the Goat Breeders Society of

Jamaica, ALPART Mining Venture, Jamaica 4-H Club, IICA/JBI and UNITAS.

Breed Improvement

One of the major constraints to the rapid expansion of the small ruminant industry across the region is the unavailability of large numbers of quality breeding animals for foundation stock. The Livestock Sub-Programme, through the two DTCs, and in collaboration with MoAR&D and farmer breeder enterprises, is working to address this constraint. The overall national small ruminant breeding strategy is for the stations and the designated breeder stock producers to maintain purebred stock, multiply within the purebred stock and cross breed among the purebreds up to the generation when the top-cross buck represents 87.5% of crossbred animal. The major breeds being used in the programme are Nubian, Boer, Alpine, Spanish and Native types (goats) and Dorper, Katahdin, Barbados Blackbelly and St Elizabeth Sheep (sheep). The Alpine breed is currently present only at the Sam Motta DTC where an enterprise diversification programme involving the development of a pilot dairy goat and dairy products has been initiated.

During the year, two purebred Boer bucks, two Nubian bucks, two Spanish bucks and one crossbred Dorper ram were transferred from the Bodles Research Station to the Hounslow

DTC to enhance the breeding program at the Centre.

Production of improved breeds

The results of some of the breed improvement exercises undertaken in 2002 are in Table 4. The programme involved the infusion of the Boer and Spanish genes into Nubian/Native crossbreds. Purebred Boer (100B) and Spanish (100S) bucks were put on Nubian/Native Crossbred (50N/50Na) does – PbBxNNa and PbSxNNa - and Crossbred Boer (50B/25N/25Na) buck was put to Nubian/Native Crossbred (50N/50Na) does - XbBxNNa. The control breeding group was purebred Nubian buck on Crossbred Nubian/Native (50N/50Na) does – PbNxNNa. The breed composition of the resulting offspring was:

1. B₅₀N₂₅NA₂₅
2. S₅₀N₂₅NA₂₅
3. B₂₅N_{37.5}NA_{37.5}
4. N₇₅NA₂₅

As at the end of the year, data was available for only the first 30 days. The information (Table 4) seems to suggest that the Spanish buck produced kids with marginally lower weights and growth rate than the Boer and Nubian bucks, but the differences were not statistically significant ($P>0.05$). Also, as expected, female kids and kids born as triplets had marginally lower weights and growth rates than the counterpart male kids and kids born as singles and twins.

Table 4 Effects of breed composition, sex and birth type on kids performance, Hounslow DTC, 2002

	Birth wt kg	30-day wt kg	30-day ADG ^a g
Breed Type			
PbBxNNa	3.0	6.4	113.4
SxNNa	2.3	5.1	91.9
XbBxNNa	2.7	6.7	135.2
NxNNa	2.7	6.4	121.2
SED	0.69	1.73	50.8
Sex			
Male	2.8	6.7	131.8
Female	2.7	6.0	110.9
SED	0.72	1.76	51.3
Birth Type			
Singles	2.7	6.8	134.4
Twins	2.8	6.0	128.3
Triplets	2.0	5.9	112.8
SED	0.64	1.76	51.51
df	141	120.00	120

^aAverage daily gain

Distribution of improved breeds

During the year, 15 breeding stock from HDTC (6 males and 9 females) and 34 from SMDTC (11 males and 23 females) were distributed to farmers. The leading breeder stock producers also continued to produce high quality stock for the lucrative genetic resource market. Of these, the six being monitored collectively produced over 700 kids during the year and sold 351 animals for breeding stock. Approximately 65% of the stock sold were males and most were Boers and Nubians with more than 50% of the respective purebred type. The number of breeding stock distributed by these farmers since 2000 stood at over 750 from more than 2,000 kids produced during the same period.

Development of Feeding and Production Systems Technologies

Adaptability and yields of pigeon pea and blue pea

In the last quarter of calendar year 2001, trials were started to evaluate two locally adapted forage legume species, *Cajanus cajan* (pigeon pea) and *Clitoria ternatea* (blue pea), with the view to including them in feeding systems for small ruminant production.

The effect of season of sowing (autumn, October 2001 vs. spring, March 2002) was studied in a 3 x 2 x 2 factorial trial with four replications on 2 m x 2 m plots. Seeding rate was 20 kg/ha. Four weeks after sowing, emerged seedlings were counted and the height measured to determine the rate of establishment. A clearing cut was taken 8 weeks post-emergence. *C. cajan* was cut to a height of 45 cm while *C. ternatea* was cut to 10 cm. After the clearing cut, regrowths were cut at 4, 6 or 8 week intervals. At each cutting the total herbage was weighed and two sub-samples drawn. One sub-sample was weighed and dried for total herbage yield determination. The second sub-sample was separated into leaf, stem and inflorescence (including pods) fractions, weighed and dried. All samples were dried in a forced draught oven at 65 °C for 48 hours. In a second 3 x 2 x 2 factorial trial, the effect of age of first cut (8 or 12 weeks post-emergence clearing cut) at the

three cutting intervals (4, 6 or 8 weeks) was studied. The trial was established in March 2002 on 2 m x 2 m plots. The experimental design, seeding rate, height of cut and handling of samples were the same as for the first trial. The sampling dates and the amount of rainfall during the corresponding 120 days growing season for both trials are summarised in Tables 5 and 6. Data were analysed using Genstat for Windows (2nd Ed.) statistical software. The results for plant height, dry matter yield and ratio of non-stem to stem fractions over the period are summarised in Tables 7 to 9 and Figures 5 to 7.

Table 5 Sampling dates for *Cajanus cajan* and *Clitoria ternatea* trials at Hounslow, 2001/02

Cutting interval	Season of sowing		
	Oct-01	Mar-02	
		Age first cut	
		8 wk	12 wk
4 wk	15-Jan-02	9-Jul-02	6-Aug-02
	12-Feb-02	6-Aug-02	3-Sep-02
	12-Mar-02	3-Sep-02	1-Oct-02
	9-Apr-02	1-Oct-02	29-Oct-02
6 wk	29-Jan-02	23-Jul-02	20-Aug-02
	12-Mar-02	3-Sep-02	1-Oct-02
	23-Apr-02	15-Oct-02	12-Nov-02
8 wk	12-Feb-02	6-Aug-02	3-Sep-02
	9-Apr-02	1-Oct-02	29-Oct-02

Both the season of sowing and age of first cut appeared to have had no effect on the more decumbent *C. ternatea* but the more erect *C. cajan* appeared to elongate when sown in the spring (Table 7). Similarly, taking the first

cut 8 weeks post emergence seemed to promote greater height in *C. cajan* than taking the first cut at 12 weeks old. Also, *C. cajan* height increased with increasing cutting interval up to 6 weeks and then levelled off (Figure 5).

Table 6 Rainfall (mm) at Hounslow during the 120 days growing period, for forage legume trials, 2001/2002

Period	Total rainfall mm
Nov-01	189.7
Dec-01	0.0
Jan-02	18.0
Feb-02	26.8
Mar-02	27.5
Apr-02	280.5
May-02	251.2
Jun-02	40.9
Jul-02	20.0
Aug-02	92.6
Sep-02	588.0
Oct-02	181.9
Total Nov 01 – Apr 02	542.5
Total May – Sep 02	992.7
Total Jun – Oct 02	923.4

Herbage biomass yield was significantly ($P < 0.001$) lower for the spring sown crop, especially for *C. ternatea*, than for the autumn crop (Table 8), although rainfall was higher during the former season. It appears the species inherently initiates the formation of reproductive structures soon after the onset of spring and so curtail vegetative herbage accumulation. On average, herbage biomass yield was about 37% higher ($P < 0.001$) when the crop was first cut at 8 weeks. Also, more frequent cutting (4 and 6 weeks) appeared to

stimulate higher biomass yield (Figure 6).

Table 7 Effects of season of sowing and age of first cut on plant height (cm) of *Cajanus cajan* and *Clitoria ternatea*, in trials at Hounslow, 2001/02

Species	Season of sowing		
	Oct-01	Mar-02	Mean
<i>Cajanus cajan</i>	52.8	89.0	70.9
<i>Clitoria ternatea</i>	26.3	26.8	26.6
Mean	39.6	57.9	48.7

Species	Age first cut		
	8 wk	12 wk	Mean
<i>Cajanus cajan</i>	100.2	77.9	89.0
<i>Clitoria ternatea</i>	33.2	30.7	32.0
Mean	66.7	54.3	60.5

sed (d.f. 33) for comparing season of sowing means:
 Species = 1.49 ($P < 0.001$), Season = 1.49 ($P < 0.001$),
 Species x Season = 2.107 ($P < 0.001$)

sed (d.f. 33) for comparing age first cut means:
 Species = 1.03 ($P < 0.001$), Age first cut = 1.03
 ($P < 0.001$), Species x Age first cut = 1.56 ($P < 0.001$)

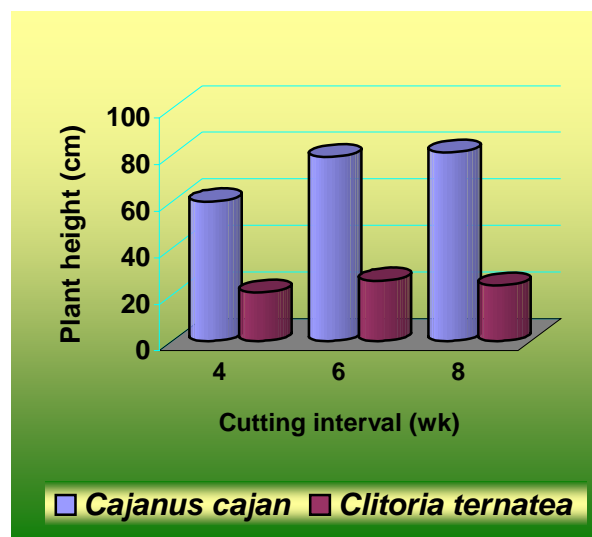


Figure 5 Effect of cutting interval on plant height of *Cajanus cajan* and *Clitoria ternatea*, mean of two seasons and two age of first cut

Table 8 Effects of season of sowing and age of first cut on 120 days dry matter yield (t/ha) of *Cajanus cajan* and *Clitoria ternatea*, from trials at Hounslow, 2001/02

Species	Season of sowing		
	Oct-01	Mar-02	Mean
<i>Cajanus cajan</i>	7.70	3.69	5.70
<i>Clitoria ternatea</i>	9.64	2.34	5.99
Mean	8.67	3.02	5.85
	Age first cut		
	8 wk	12 wk	Mean
<i>Cajanus cajan</i>	5.05	3.62	4.33
<i>Clitoria ternatea</i>	6.41	4.72	5.56
Mean	5.73	4.17	4.95

sed (d.f. 33) for comparing season of sowing means:
 Species = 0.554 (P=0.607), Season = 0.554
 (P<0.001), Species x Season = 0.783 (P=0.005)

sed (d.f. 33) for comparing age first cut means:
 Species = 0.374 (P=0.002), Age first cut = 0.374
 (P<0.001), Species x Age first cut = 0.529
 (P=0.729)

C. ternatea tended to behave differently from *C. cajan* with respect to the accumulation of non-stem fractions (leaves, inflorescence and pods) relative to stem fractions.

When growth and dry matter accumulation were high (autumn and first cut at 8 weeks) the non-stem fractions were higher for *C. ternatea* than for *C. cajan* (Table 9). This difference is better illustrated in Figure 7 where the stem fraction was increased in *C. cajan* with long cutting interval, while for *C. ternatea* it was the non-stem fraction that trended upwards. These observations might have implications for the nutritive

value of the herbage since the stem fraction is less nutritious.

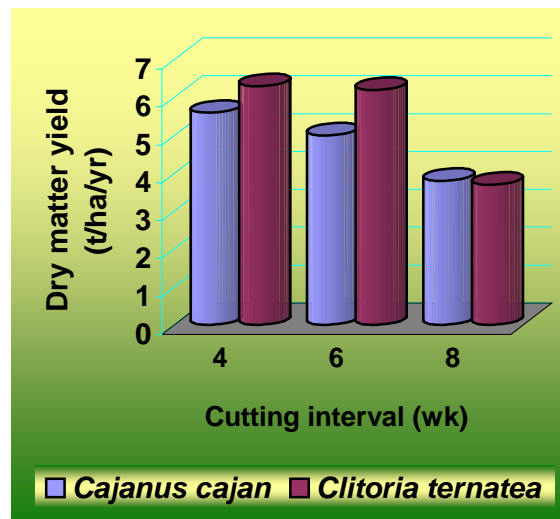


Figure 6 Effect of cutting interval on 120 days dry matter yield of *Cajanus cajan* and *Clitoria ternatea*, mean of two seasons and two age of first cut

Technology Transfer and Outreach Services

Twenty-four training sessions and outreach services, including four registration exercises and appraisals, were conducted under the Livestock Sub-Programme during the year. More than 600 stakeholders benefited from these sessions. Participants were drawn from the extension services, the 4H Clubs, schools and farmers groups affiliated to ALPART, IICA/JBI and UNITAS.

Table 9 Effects of season of sowing and age of first cut on the ratio of non-stem to stem fractions of *Cajanus cajan* and *Clitoria ternatea*, (Hounslow, 2001/02)

Species	Season of sowing		
	Oct-01	Mar-02	Mean
<i>Cajanus cajan</i>	2.20	2.22	2.21
<i>Clitoria ternatea</i>	3.09	2.48	2.79
Mean	2.65	2.35	2.50

	Age first cut		
	8 wk	12 wk	Mean
<i>Cajanus cajan</i>	1.89	2.22	2.06
<i>Clitoria ternatea</i>	2.53	2.18	2.36
Mean	2.21	2.20	2.21

sed (d.f. 33) for comparing season of sowing means:
 Species = 0.084 (P<0.001), Season = 0.084 (P=0.001),
 Species x Season = 0.119 (P<0.001)

sed (d.f. 33) for comparing age first cut means:
 Species = 0.142 (P=0.032), Age first cut = 0.142
 (P=0.907), Species x Age first cut = 0.201 (P=0.032)

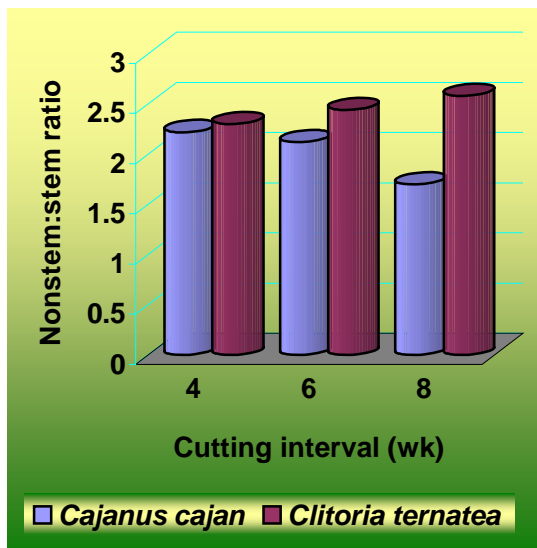


Figure 7 Effect of cutting interval on the ratio of non-stem to stem fractions of *Cajanus cajan* and *Clitoria ternatea*, means of two seasons and two age of first cut.



A training session for a group of farmers at Goshen, St Elizabeth

The mechanisms used to deliver these services were direct contact, farmers groups sessions, field days, field tours and exhibition/displays at major agricultural and trade shows.

The Livestock Sub-Programme, and thus CARDI, became formally involved in the Government-sponsored Goat Commercialisation Project in the year. Under this agreement, we would recruit and recommend farmers from the central and western parishes to be involved in the project and also monitor and offer technical advice to participants in the project.

In addition, we continued with the sire service at the Sam Motta DTC (SMDTC). The team also worked with the ALPART Mining Venture Extension Division to monitor farmers on the Manchester Plateau who had benefited from breeding stock and technical assistance from the SMDTC.

The details of these activities are as follows:



Minister of Agriculture, Hon Roger Clarke hands over goats to participants in the Goat Commercialisation Project. Looking on is Hon Anthony Wood, Minister of Agriculture and Rural Development, Barbados

Training, registration/appraisal and agricultural show

- 7-18 January 2002, Training attachment for Stacy-Ann Williams, student from Knox Community College
 - 23 January 2002, Registration and appraisal at Alexander Archer's farm, Spanish Town, St Catherine. Appraisers: Derrick Vermont (Chair), Albert Fearon, Joel Barnes, David Miller and Merrick Larmond (recorder)
 - 5 February 2002, Seminar on *Husbandry practices* conducted for the Ministry of Agriculture and the Mocho Goat Farmers Group at the Bodles Agricultural Research Station, Old Harbour, St Catherine
- (Resource persons: David Miller, Albert Fearon and Joel Barnes)
- 21 February 2002, Registration, appraisal and culling at Warminster 4-H Club goat Project, Warminster, St Elizabeth. Appraisers: Derrick Vermont (Chair), Lloyd Grant, Albert Fearon, and Merrick Larmond (recorder)
 - 27 February 2002, Registration and appraisal at Martin Morrison farm, Inglewood, May Pen, Clarendon. Appraisers: Derrick Vermont (Chair), Lloyd Grant, Albert Fearon, Charlie Harris, Merrick Larmond (recorder) and Pearlene Beale (secretary, Goat Breeders Society of Jamaica, GBSJ)
 - 5 March 2002, Training on selection, breeding and management of the goat herd at Rhymesbury, Clarendon (Resource persons: Albert Fearon, Ruth Simpson, Lloyd Grant, Derrick Vermont and Clovis Morrison)
 - 26 March 2002, Training on goat breeding and proper husbandry practices conducted for ALPART Tennant farmers from the Manchester Plateau at Sam Motta DTC. (Resource persons: Albert Fearon, Rufai Ahmed and Joel Barnes)
 - 23 April 2002, Training on a practical approach to feeding and maintaining goats conducted in collaboration with the GBSJ for farmers in

- Retrieve, St James. (Resource persons: Albert Fearon, Clovis Morrison, Derrick Vermont and Lloyd Grant)
- 22 May 2002, Registration and appraisal at Olive Quarry's farm, Rhymesbury, Clarendon. Appraisers: Derrick Vermont (Chair), Alexander Archer, Albert Fearon, Lloyd Grant, Hector Smith and Pearline Beale (recorder). While the physical appraisals and registration were not possible due to the poor weather conditions, the Farm Manager and some staff members were taught the procedures for preparing animals for the events
 - 7 August 2002: Goat production and management – The way forward. A seminar conducted in collaboration with the GBSJ and the Ministry of Agriculture. (Resource person: Dr Thian Teh). Presentations were also made by Albert Fearon – Overview of the goat industry in Jamaica and Francis Asiedu – The Caribbean Small Ruminant Network (CASRUNet). Dr Teh also conducted a short seminar on “Preparing and showing goats.”
 - 6 September 2002, Field tour and training session at the Sam Motta DTC for 25 students and two teachers from the Ebony Park Heart Academy (resource persons: Dwight Williams and Norman Hanson)
 - 13 September 2002, Methods of dehorning goats. A training and practical demonstration conducted for RADA, Manchester at Sam Motta DTC. The effort resulted in a video production for further use by the RADA Extension Unit (Resource persons: Albert Fearon, Joel Barnes and Norman Hanson). Five Agricultural Extension Officers were present
 - 25 September 2002, Training on forage bank establishment and routine husbandry practices (hoof trimming, dehorning, deworming) conducted for the Ridge to Reef project in Retrieve, St James (Resource persons: Joel Barnes and Derrick Vermont)
 - 10 October 2002, Kidding management – from breeding to weaning. Seminar conducted for ALPART tenant farmers from St Elizabeth and Manchester (Resource persons: Albert Fearon, Dwight Williams and Joel Barnes)
 - 6 November 2002, Selection of breeding stock, identification and general husbandry. Training conducted in collaboration with the GBSJ at Olive Quarry's farm at Rhymesbury, Clarendon (Resource persons: Albert Fearon, Joel Barnes and Derrick Vermont)
 - 28 November 2002, General goat husbandry and management from breeding to

weaning. Training conducted for the IICA/JBI Goat Project at Mocho, Clarendon. (Resource persons: Albert Fearon and Joel Barnes)

- 5 December 2002, Goat production and management. Training conducted jointly with UNITAS of Jamaica (a service arm of the Moravian church) for farmers in Santa Cruz and Goshen in St Elizabeth and Lincoln in Manchester. (Resource persons: Rufai Ahmed, Albert Fearon, Dwight Williams, Joel Barnes and Clovis Morrison)
- 10 December 2002, Seminar on setting the stage for a successful goat project conducted for UNITAS of Jamaica for farmers in Carmel and Kilmarnock, Westmoreland. (Resource persons: Albert Fearon and Joel Barnes)

Field days/tours

- 11 December 2001, Field tour of the SMDTC and Martin Morrison's farm conducted for 26 farmers and three Extension Officers from the Eastern Jamaica Agricultural Support Project
- 13 December 2001, Field tour of the SMDTC and Hounslow DTC conducted for 10 students and 3 teachers from the Ebony Park Heart Academy



Students on a field tour at Sam Motta DTC

Validation and Monitoring of Improved Small Ruminant Technologies

This activity sought to determine the effectiveness of new and improved production and marketing systems introduced to goat producers. Over the past five years, comparisons were made among the all-in-one intensive and semi-intensive meat and breeder stock production systems. The general conclusions were that production parameters were similar for both the intensive and semi-intensive systems but feeding cost for intensive system was twice as high as for the semi-intensive system.

Impact

Several farmers, over the years, have adopted either the whole or segments of the technology package presented by our team. The most critical components of the package were breed improvement and improved feeding and production systems. In order to examine how the technologies affected

and benefited them and their families and the industry in general, key participating farmers were interviewed for this report.



Albert Fearon (left), CARDI Animal Productionist, interviewing Elvis McPherson

Generally, the farmers were pleased with the technologies as they have positively influenced the quantity and quality of their stock. One farmer, Mr. Elvis McPherson, St. Elizabeth, started out with a herd size of 12 goats, which grew to over 220 heads in nine years.

The Nubian and Boer breeds have helped to improve the quality of the herds tremendously. The by-product feeds have contributed to a significant reduction in the use of the relatively costly bag feed, according to Mr. McPherson.

The farmers all agreed that the other components of the technologies have been important too. For example, Mr McPherson who, through the success of the programme, has been able to move to a larger farm and has to do a

lot of “cut-and-carry” attested that the job has been made easy by the use of the “lawn mower chopper” technology.



Martin Morrison offers forage to his goats



The new farm operated by Elvis McPherson at YS, St Elizabeth

The benefits from the adoption of the technologies have been manifested in tangible ways too. Some of the farmers have used revenue generated from the sale of their animals to finance their children’s education, buy lands and even enabled Mr Martin Morrison, a farmer in May Pen, Clarendon, to attend the Soccer World Cup tournament in France in 1998.

In conclusion, the majority of the producers thought that the most important impact has come from improved breeds followed by improved nutrition. They opined that organisations like CARDI should continue, and even expand their roles, in the development of the industry. They were looking for leadership in enterprise and product development, including the commercial production of feed resources.

Linkages and Monitoring of Developments in the Industry

In an effort to monitor the progress of the small ruminant industry in Jamaica, linkages are developed and maintained with different stakeholders. The strategic alliance between CARDI, RADA, the JAS, Jamaica 4-H, ADC, ASSP and the GBSJ was maintained and strengthened during the period in review.

Market prices

The monitoring of market prices for meat and breeding stock through informal surveys at meat shops, major markets, slaughter houses, roadside butchers and supermarkets and breeder stock producers and importers continued in the period. The information collected throughout the year showed a tendency for prices to be trending downwards for most of the products (Table 10). The gap between the price of imported and local goat

and sheep meat continued to be wide. Local goat meat was sold at a relatively high price ranging from J\$175/kg in rural Jamaica to J\$270/kg in upscale supermarkets in the corporate area, whereas the imported goat/mutton was markedly cheaper than the local goat. The price of the imported product ranged from J\$100 to J\$155/kg. It was also realised that there were similarities in the prices for meat in the public markets and the supermarkets although the prices at the latter were slightly higher.

The price of breeding stock declined considerably. This is due to the fact that high quality Boers and Nubians are now more readily available locally.

Imports

The monitoring of the importation of breeding stock continued. Some 200 goats were imported from the USA and Canada in 2002. The imports comprised mainly Boers, Nubians and Alpines. Three Oberhasli does, a milk breed of goat, was introduced for the first time in Jamaica to be part of the IICA/Jamaica Bauxite Institute (JBI) Mocho Milk Goat Project. As at the end of the year, the total animals imported over the past three years stood at 647 at an approximate cost of J\$32,000,000. The importation of sheep over the past two years has also picked up slightly, with over 53 breeding stock mainly of the Dorper, Katahdin including three rams and Suffolk breeds being imported. This trend is indicating a renewed interest in sheep production in Jamaica.

Linkages

The livestock team formed part of the judging panel for the training of clubites from the parishes of Manchester and Clarendon for the Annual 4-H National Achievement Day. Four joint training sessions and one field tour were held between the GBSJ and CARDI during the period in review while two training sessions were done in collaboration with the Ministry of Agriculture.

Four collaborative meetings were convened in which most of the stakeholders in the small ruminant industry were involved. The first one, held at IICA offices, sought to determine the state of the industry and the requirements needed to move the process forward. The second was convened by the CASRUNET National Coordinator to develop a national plan and to revisit the draft Small Ruminant Policy. The other two meetings were convened to develop the terms of reference for the development of a Small Ruminant Industry National Development Plan.

Table 10 Changes in the price of goat meat and breeding stock

Year	Average price (J\$)				
	Meat (price/Kg)			Breeding stock (price/head)	
	Live weight	Dress weight		Does	Bucks
	Local	Imported			
1992	46.76	117.88		1,610.00	2,730.00
1993	57.96	142.10		2,170.00	3,234.00
1996	119.28	236.60		4,067.00	7,289.10
1998	123.34	246.40		8,298.50	15,699.60
1999	123.20	256.62	112.84	9,100.00	22,022.00
2000	133.42	264.32	122.22	7,373.38	18,480.00
2001	133.42	266.84	124.32	7,924.00	18,666.62
2002	113.82	235.20	116.20	6,930.00	11,550.00

Other Activities Conducted Under the Livestock Sub Programme

Production of crops on reclaimed bauxite soils

Over the years, reclaimed bauxite lands have been used primarily for the establishment of grazing grass pastures and, to a lesser extent, to arable crop farming. In an effort to promote increased alternative use of these lands, a pilot programme for crop farmers was initiated.

Some 350 trees, including ackee, soursop, sweetsop, custard apple, June plum, citrus, guava, otahiti apple, cocoa and naseberry, were established at SMDTC in 2002. Furthermore, over

400 multi-purpose trees – *Leucaena* and *Gliricidia* - were planted along the fence lines. These will serve as feed and fence posts when well established.

Natural Resource Management Programme

The countries of the Caribbean are confronted with issues of natural resource conservation and management, including deforestation, land degradation, soil erosion, declining soil fertility, dwindling and contaminated fresh water resources, depletion of marine and coastal zone resources, declining biodiversity, as well as issues of biosafety. The Natural Resource Management programme of CARDI seeks to address some of these issues, especially in the areas of control of hillside degradation, water use and organic agriculture.

The goal of the Natural Resource Management programme (NRM) of the CARDI Jamaica Unit is to contribute to the management of the land and water resources of Jamaica in a sustainable manner while decreasing environmental degradation. For the year 2002, the programme concentrated mainly in three areas, the coastal water management project, organic agricultural production and research and technical assistance projects in Jamaica and Antigua. In addition, the NRM section managed the Mona DTC which provides research facilities for other programmes at CARDI and carries out technology validation exercises.

Mona Demonstration and Training Centre

The Mona DTC is managed by the NRM section and provides the facilities for the execution of on-station field trials under controlled and monitored conditions. The main activities under this programme are the maintenance of this facility, as well as, the demonstration of current and relevant technologies in the area of organic farming.

The specific objectives are:

1. To develop knowledge of compost production and data on nutrient availability from various compost mixes.
2. To develop guidelines for the rearing of vermicomposting worms under local conditions.
3. To monitor the growth and performance of various crops

grown in rotation under organic farming conditions.

4. To monitor soil nutrient and physical properties over time in relation to the organic manure applied.
5. To effectively utilize GIS technology to provide further information on related features in the conduct of the agronomic activities

Weather report for the Mona DTC

Monthly rainfall for the year 2002, as well as, that for the previous year is given in Table 11. The rainfall pattern in 2002 was quite similar to that in 2001 but the total amount of rainfall was almost twice as much in 2002 as was in 2001. This was so because in 2002, the wet months of April and May were much wetter than in the previous year and September which was one of the driest months in the previous year recorded the highest rainfall of 599.2 mm in 2002. This high rainfall in September was associated with very active tropical storm season in 2002. Indeed at one point in September 2002 three storms were in the hemisphere at the same time.

Management of the DTC

There were no Management Committee meetings during the year, and this was mainly because there were no requests for the use of the DTC facilities by the other sections. No new trials were initiated during the year also. At the

beginning of the year the DTC was supporting the following activities for the IPM section:

1. Sweetpotato museum plots
2. West Indies Red Pepper Gall midge trial
3. Scotch bonnet pepper pesticide trial
4. Callaloo pesticide trial

Table 11 Monthly rainfall at the Mona DTC for the year 2001-2002

Month	Rainfall (mm)	
	2001	2002
January	11.6	7.6
February	12	5.6
March	4.2	5.4
April	71.5	119.6
May	67.6	382.1
June	2.6	91.2
July	36.6	8
August	22.2	50.6
September	10.2	599.2
October	172.8	98.4
November	233	88.8
December	162.8	41
Total	807.1	1,497.5

By the end of the year all the trials had ended and only the sweetpotato museum remained as a continuing activity.

During the year technology validation production plots were developed and planted firstly with corn, okra, Pak choi and string beans. This was followed by the planting of sweet

pepper, tomato, callaloo, cabbage, cucumbers and pumpkins. Harvesting of these crops began by the end of the first quarter and the produce was sold to the Halls of Residence on campus. The DTC contributed a total of 828 kg of vegetables to the food production drive in Jamaica. An estimated 135 kg of cabbage produced was stolen from the DTC, highlighting the scourge of praedial larceny.

Evaluation of Constituents and Demonstration of Organic Farming Techniques

Vermicompost production

Vermicompost production continued during the year. The California earthworms were cultivated in a mixture of coffee beans and chipped callaloo stems. About 50 kg of vermicompost was harvested for the year. Production was highest during the periods of high rainfall when the worms were more active. To ensure worm activity is constant throughout the year the worms have to be watered during the drier periods. At present wetting can be very infrequent and the worms move into a period of dormancy. In the new year, a new facility is being proposed to provide for the better harvesting of all the products of the process. This facility would also be closer to a source of water so that wetting can be easily achieved during the dry season.



Vermi-compost production showing earthworms

Organic farming demonstration plots

Organic production plots were cleared and rotated during the first quarter of the year. After rotavating, the area was marked out into 6 plots, approximately 4 m x 6 m each. The plots which previously had callaloo plants were planted with Scotch bonnet hot pepper and vice versa. The plots earmarked for hot pepper production were manually ridged. The crops were planted in March 2002. This is the repeat of a study done last year in which three types of organic nutrient sources were used to grow pepper and callaloo. These organic sources were goat manure, cow manure and vermicompost made from discarded coffee beans.

The callaloo showed good growth, but the Scotch bonnet hot pepper did not develop into productive plants. By the end of June a decision was taken to discontinue the Scotch bonnet pepper and instead plant red

peas on the plots. Because the callaloo did so well, a second crop of callaloo was planted on the plots. This crop was, however, severely affected by pests and no commercial yields were obtained. The red peas which were planted on the hot pepper plots were harvested in early October.



Callaloo growing on the Mona DTC under organic conditions

The sequence of crops in the two sets of plots since the organic plots were first planted in the second quarter of 2001 is given below (Table 12)

The only crop in which marketable yields were obtained during this year was the first callaloo crop. Below, Tables 13-15 give the results of the statistical analyses done on data obtained from this crop. Callaloo was harvested four times during a six week period. The data are given in terms of marketable, unmarketable and total yields for each of these harvests, as well as, for the total harvest. These yields are given in relation to the nutrient treatments which were as follows:

T1: Goat manure at 0.5 kg per plant hole (approx. 7500 kg/ha)

T2: Vermicompost at 0.25 kg per plant hole (approx. 3750 kg/ha)

T3: Vermicompost at 0.5 kg per plant hole (approx. 7500 kg/ha)

T4: Cow manure at 0.5 kg per plant hole (approx. 7500 kg/ha)

The results indicate that the plots treated with cow manure had consistently higher marketable and total yields than plots treated with the other soil ameliorants.

This difference was, however, not statistically significant ($P>0.05$) except for marketable yields in the first harvest. Unmarketable yields also followed this trend but were not very consistent. There was very little difference in the performance of the other three treatments for the parameters measured. This means that the two levels of vermicompost had no effect on yields although one level was twice that of the other. In fact average yield appear to be higher at the lower treatment.

The level of unmarketable yield is related to insect damage to the callaloo leaves. This was relatively high compared to traditionally grown callaloo. In fact it was so high that it affected the length of the callaloo harvesting cycle which is normally weekly harvests for about 12 weeks. These plots had four harvests in 6 weeks. Control of, particularly, leaf eating caterpillars will be of tremendous importance in the production of Organic Callaloo.

Table 12 Sequence of crops grown on the organic plots

First sequence of crops	Date planted	Second sequence of crops	Date planted
Scotch bonnet hot pepper	Apr-01	Callaloo	May-01
Callaloo	Mar-02	Sorrel	Sep-01
Callaloo	May-02	Scotch bonnet hot pepper	Mar-02
Fallow	Jul-02	Red peas	Jul-02
		Fallow	Oct-02

Table 13 Marketable yields of callaloo grown under four organic manure treatment levels

Time	Marketable yields (kg)				
	T1	T2	T3	T4	LSD
First harvest	2.6ab	2.2b	2.0b	3.6a	1.4
Second harvest	2.2	1.6	2.3	2.6	2.8
Third harvest	1.8	3.0	3.4	4.1	3.1
Fourth harvest	4.4	5.2	3.8	7.4	5.6
Total harvest	11.0	11.9	11.4	17.7	10.2

T1: Goat manure at 0.5 kg per plant hole, T2: Vermicompost at 0.25 kg per plant hole, T3: Vermicompost at 0.5 kg per plant hole, T4: Cow manure at 0.5 kg per plant hole

^{a,b} Values in the same row followed by the same letters are not significantly different (P>0.05)

Table 14 Unmarketable yields of callaloo grown under four organic manure treatment levels

Time	Unmarketable yields (kg)				
	T1	T2	T3	T4	LSD
First harvest	3.8	5.2	3.4	4.8	3.0
Second harvest	2.3	1.8	1.7	2.5	1.8
Third harvest	1.5	1.4	1.1	1.3	0.9
Fourth harvest	3.3	4.6	4.9	5.2	4.3
Total harvest	10.9	13.0	11.1	13.7	5.2

T1: Goat manure at 0.5 kg per plant hole, T2: Vermicompost at 0.25 kg per plant hole, T3: Vermicompost at 0.5 kg per plant hole, T4: Cow manure at 0.5 kg per plant hole

Table 15 Total yields of callaloo grown under four organic manure treatment levels

Time	Total yields (kg)				
	T1	T2	T3	T4	LSD
First harvest	6.4	7.4	5.4	8.4	3.8
Second harvest	4.5	3.3	4.0	5.0	2.2
Third harvest	3.3	4.4	4.5	5.4	3.3
Fourth harvest	7.7	9.8	8.7	12.6	8.7
Total harvest	21.9	24.9	22.5	31.4	13.5

T1: Goat manure at 0.5 kg per plant hole, T2: Vermicompost at 0.25 kg per plant hole, T3: Vermicompost at 0.5 kg per plant hole, T4: Cow manure at 0.5 kg per plant hole

Caribbean Coastal Waters Improvement Project

In late 2000, the Centre of Marine Sciences (CMS) in the Department of Life Sciences at UWI signed a Memorandum of Understanding (MOU) with The University of York/Marine Resources Assessment Group UY/MRAG Ltd. This MOU outlined the basis for collaboration between UWI and the UY/MRAG Ltd on various aspects of the project "Impact and Amelioration of Sediment and Agro-chemical Pollution on Caribbean Coastal Waters." The MOU envisaged a group at UWI consisting of representatives from CMS, and other Departments/Institutes on campus, including the Department of Chemistry (DOC), the Natural Products Institute (NPI) and the Caribbean Agricultural Research and Development Institute (CARDI) working on the project. The representative from CMS was designated the coordinator of this group.

CARDI was responsible for undertaking a review of soil management and farming practices, including the use of agro-chemicals in the Caribbean, with particular reference to St Lucia and Jamaica, and produce a technical report. The review was phased outputs as follows:

1. Characterisation and quantification of farming units and identification of target crops for further study
2. Literature review of farming systems in Jamaica
3. Appraisal of existing national legislation, national/international policy measures and potential future impacts (e.g. EU banana agreements)
4. Conduct of a survey in the selected watershed areas in St Lucia and Jamaica;
5. Compilation of the review document.

Most of the activities related to phases 1 to 3 above were completed in 2000 and 2001 and reported on. Thus, the survey in the watershed areas was the major activity undertaken in 2002

Survey in the watershed areas

In order to achieve the objective of the activity the secondary data embodied in the preceding reports were supplemented with survey data on farming practices of both large- and small-scale producers in the Rio Cobre and Wag Water River watersheds in Jamaica and the Roseau, Praslin and Soufriere watersheds in St Lucia.

The surveys were concluded by mid-March 2002 and the forms were sent to the Biometrician at CARDI Headquarters for statistical analyses. The information from the analyses were being compiled for the final report, which would be the final output of the project.

However, a preliminary assessment of the information indicates the following:

Jamaica

Soil management was not related to soil properties, as less than 20% of farms had done soil testing. Only 40% of hillside farmers indicated that serious steps were being taken to control erosion. There was extensive use of chemicals for pest and disease management, and indications were that more chemicals would be used if resources were available.

The increased utilisation of chemical fertilisers and pesticides, coupled with bad land management practices would have implications for the coastal marine environment. Furthermore, the attitudes of farmers suggested a major challenge in significantly changing their agricultural practices.

Results of the St Lucia survey were received in Jamaica in late March 2002 and were subsequently sent to CARDI Headquarters for similar analysis. Analyzed results from this survey were received in June and July. The data is now being compiled for the final report.

St Lucia

In general farming was not done on as steep slopes as in Jamaica. In addition 20% of the farmers had soil analyses done and 11% were aware of the soil reaction (pH) of their soils. Despite these positive elements soil management appeared to be independent of soil scientific considerations. There was no meaningful effort to decrease soil losses from water erosion and there was a widespread use of chemical fertilisers.

Other chemical pesticides were also in wide use for a number of reasons including the belief that agro-chemicals increased yields and provided better quality produce and, hence, better prices. A third of the farmers did not know what effect their farming practices were having

on the environment and this may be an area for a training intervention.

Some of the preliminary results from the Jamaica survey were used to make a presentation to the 9th Annual Research Symposium organised by the Institute of Marine Affairs, Trinidad and Tobago during 12-13 November 2002. The theme of the meeting was “Challenges to the coastal and marine environment from land based and other sources and activities.” The presentation was made by Mr Bruce Lauckner. The title was “**The impact and amelioration of sediment and agro-chemical pollution on Caribbean coastal waters**”. Mr Lauckner indicated that the presentation was well received and there were many questions.

Application of GIS to Other Projects at CARDI

There were no activities in this area during the year. Expertise in this area was lost with the resignation, last year, of the Research Assistant who was trained in GIS technology.

Technical Assistance

We consider the provision of technical assistance to the agricultural sector in Jamaica and the wider Caribbean as an important mandate. We present below the various facets of technical assistance given to stakeholders in 2002.

Technical assistance given

Technical assistance to the Jamaica Government Student-Work Experience Programme

Stacy-Ann Williams, a student of Knox Community College spent two weeks, 7-20 January 2002 with the Livestock Sub-Programme for work experience attachment. She was supervised by Albert Fearon

Technical assistance to the Agricultural Support Services Project (ASSP)

- 18-22 March 2002: CARDI staff members, Bruce Lauckner, Francis Asiedu and Albert Fearon, conducted a training/workshop on behalf of ASSP for the staff of MoA, Bodles on Research Methodology and Livestock Data Management
- A two-week training programme on Animal Nutrition Laboratory Procedures at the University of Florida was organised by Francis Asiedu on behalf of ASSP for

two staff members of the Livestock Research and Development Division of the Bodles Research Station

Technical assistance to Faculty of Agriculture & Natural Science, UWI, St Augustine and College of Agriculture, Science & Education, Jamaica

The CARDI Jamaica Unit accommodated the on-farm attachment of two students, Mr Omari Soares and Ms Alethia Williams, over the summer for a period of ten and eight weeks, respectively. Mr Soares was a second-year student of the Faculty of Agriculture and Natural Science of UWI, St Augustine, Trinidad and Tobago, while Ms Williams had just completed her final year at the College of Agriculture Science and Education (CASE) of Jamaica and was attached to CARDI as part of the Cooperative Internship Education Programme (CIEP) of the College. These programmes aim to increase the opportunities through which students can gain practical experience related to agriculture and / or world of work. Both students were exposed to activities of the Natural Resource Management Section (vermicomposting and organic agriculture), Integrated Pest Management Section (hot pepper, callaloo, coffee and sweetpotato) and the Administrative Department (financial reporting, budgeting, cash flow projections, management, inventory and human resources management) under the supervision

of Leslie Simpson and Kathy M Dalip, and Mr Adlai Blythe. At the end of their internship, they produced reports as part of the requirement of their attachment.

Ms Williams was also given a one-month contract at the end of her internship to continue working on the Biological Control of the Coffee Berry Borer Project.

CARTFF Antigua projects

Leslie Simpson was invited to Antigua during 9-11 July to visit two farms and develop proposals for research activities which would lead to enhanced productivity on the farms. The visit resulted in the development of two proposals for funding under the EU-sponsored CARTFF Project. These proposals were entitled:

- An assessment of the present soil status, remedial methods and optimum irrigation levels for pepper and zucchini production
- An assessment of optimum irrigation and fertiliser levels for pineapple production

Technical assistance to the Tobago House of Assembly

Mr Hughford McKenna, *Secretary of Agriculture*, and Ms Karen Shaw, *Director of Marketing*, Marketing Department, Division of Agriculture, Marine Affairs and the Environment, Tobago House of Assembly visited the Jamaica during 5-10 August 2002. The visit was facilitated by the CARDI

Jamaica Unit. During their stay, the duo attended the Denbigh Agricultural Show in Clarendon. They also met with representatives of the Jamaica Exporters Association (JEA), Scientific Research Council (SRC), Jamaica Promotions Corporation (JAMPRO), Walkers Wood Food Group, Jamaica Broilers Group Ltd, VAP Ltd (exotic fruit juices manufacturers), and the Rural Agricultural and Development Authority (RADA). The RADA representatives also accompanied them to a yellow yam farm, as the visitors were interested in this crop as a possible commodity for Tobago. The team expressed great satisfaction with the information garnered and linkages made, and were very pleased that they were able to achieve more than they had expected (Kathy Dalip and Adlai Blythe).

Technical assistance to CABI

We coordinated and facilitated the visit to Jamaica, 8-11 September 2002, by Mr Perry Polar, CABI Trinidad, who conducted a survey of major distributors of agricultural pesticides (Adlai Blythe)

Technical assistance to the Southern Trelawny Environmental Agency - Soil and water conservation studies project

This project relates to hillside management for small farmer yam production in the Trelawny area and it is coordinated by the Southern Trelawny Environmental Agency

(STEA) and CARDI provided technical assistance

Technical assistance to other stakeholders and clientele by the Livestock Sub-Programme

- **January-December 2002:**

Technical assistance at the Hounslow DTC to 77 farmers in various aspects of small ruminant production. These included the provision of resource materials, technical advice on fodder bank establishment, sourcing of breeding stock, record keeping and identification

- **January-December 2002:**

Technical assistance at the Sam Motta DTC to 56 farmers in the areas of selection of stock, forages to supplement small stock nutrition programmes, setting up a doe-revolving scheme and layout of appropriate goat housing facilities

- **13 February 2002:**

Provision of resource materials, mounting of a poster display and acting as a small stock Judge (Albert Fearon) at the Annual Trelawny Parish Agricultural Show held at Hague

- **1 April 2002:**

Provision of resource materials and position as a small stock Judge (Albert Fearon) at the Annual St James Parish Agricultural Show held at Montpelier

- **8 May 2002:**

Discourse with a group of 45 farmers in Mile Gully, Manchester on the 'Status of goat production in Jamaica and the way forward'

- **August 2002:**

Provision of technical assistance in the form of resource materials to Data Bank Division, MoA to assist in the development of terms of reference for small ruminant plan

- **4-6 August 2002:**

Provision of resource materials and acting as a small stock Judge at the Annual National Agricultural Show held in Denbigh, Clarendon

- **October-November 2002:**

Provided technical assistance to a consultant engaged by ASSP and who was conducting a meat survey by providing information on goat farmers in central Jamaica

- **14 November 2002:**

Provision of resource materials and acting as a Judge at the Annual Breed Societies Exposition, Minard, St Ann

Boards and Committees Served

- Project Management Committee of the Hounslow, Mona and Sam Motta Demonstration and Training Centres (Leslie Simpson,

Francis Asiedu, Albert Fearon, Ruth Simpson)

- Executive Committee, Goat Breeders Society of Jamaica (Albert Fearon, Ruth Simpson)
- Member 4-H Clubs of Jamaica Goat Revolving Project Committee (Albert Fearon)
- Research and Publications Committee of the Ministry of Agriculture (Francis Asiedu)
- Project Management Committee of the Biological Control of the Coffee Berry Borer Project (Kathy Dalip, Dionne Clarke-Harris, Leslie Simpson, Francis Asiedu)
- Methyl Bromide Working Group (Kathy Dalip)
- CPEC/JOAM Human Resources Development Project (CPEC/JOAM HRD) Steering Committee (Leslie Simpson)
- Jamaica Agricultural Society (JAS) Kingston and St Andrew Association of Branch Societies Show Planning Committee (Leslie Simpson, Kathy Dalip)
- Climate Change Committee of the Jamaica Meteorological Service (Leslie Simpson)

Institutional Capacity Development and Collaborators

Visitors

- December 2001: A delegation of USDA officials visited Jamaica and met with local scientists, policy

makers and other stakeholders to review the status of the gall midge on hot peppers in Jamaica and examine systems implemented in the field and at the ports to manage and monitor the pest. Information was presented on the work done by the multiagency Hot Pepper Task Force in research, monitoring and training

- 17-23 February 2002: Dr Michael Jackson, IPM CRSP Collaborator and Entomologist of the United States Department of Agriculture Agricultural Research Services (USDA ARS) Vegetable Laboratory in South Carolina USA visited the CARDI Jamaica Unit primarily to evaluate levels of damage on sweetpotato roots and crowns of various pest resistant lines (Jamaican and USDA varieties) being screened under the IPM CRSP project and to plan for future cooperative work
- 27 February-6 March 2002: Co-Principal Investigator of IPM CRSP, Dr Clive Edwards, Entomologist and Environmental Ecologist, Ohio State University, visited Jamaica to assist in the development of the Year 10 workplan of the IPM CRSP and documentation of progress to date. He also discussed key issues on IPM in hot peppers with CARDI and MoA staff and collaborated in the development of the overall research program

- 18–25 March 2002: Drs Shelby Fleischer and Paul Blom of the Pennsylvania State University, USA visited the CARDI Jamaica Unit. Dr Shelby Fleischer met with CARDI, RADA and MoA officials to discuss progress of IPM CRSP activities, specifically callaloo and hot pepper research and in the development of the IPM CRSP work plan for Year 10. Together with Dr Blom he assisted in the implementation of a web based Geographic Information System software designed specifically for the management and analysis of data on gall midge affecting hot pepper in Jamaica

Collaborative efforts

- Interaction among collaborating scientists of RADA, MoA and CARDI is ongoing as the thrust towards establishing a web-based GIS system for monitoring gall midge progressed
- Country Representatives of FAO, IICA and CARDI met with senior technical staff members of MoA between July and August 2002 to forge new collaborative thrust for accelerating the development of the small ruminant industry and the development of a national agricultural information network

Long-standing collaborators

- CARDI regional units, especially Antigua and Barbuda, Barbados, St Kitts and Nevis, St Vincent, and Trinidad and Tobago
- Coffee Industry Board
- Ohio State University
- Pennsylvania State University
- Virginia Polytechnic Institute and State University
- USDA – Vegetable Laboratory North Carolina
- Coastal Water Quality Improvement Project (CWIP)
- Jamaica Exporters Association
- Ministry of Agriculture
- Rural Agricultural Development Authority
- St Ann Chamber of Commerce
- University of the West Indies
- Walkers Wood Caribbean Foods Limited
- Food Storage & Prevention of Infestation Division, Ministry of Industry, Commerce & Technology
- Goat Breeders Society of Jamaica
- ALPART Mining Venture
- Jamaica 4-H Club
- Inter American Institute for Cooperation on Agriculture
- Jamaica Bauxite Institute

Training/Meeting/ Workshop/Seminar

Meetings attended

- 30 January 2002: Meeting with Dr Florence Young of MoA, to discuss the Citrus Replanting Project (Francis Asiedu, Leslie Simpson, Dionne Clarke-Harris)
- 31 January, 29-30 May 2002: Meeting with the South Trelawny Environmental Agency, Albert Town, Trelawny, to discuss the progress of project proposal submitted to EFJ (Leslie Simpson)
- February to May 2002: Jamaica Agricultural Society (JAS) Kingston and St Andrew Association of Branch Societies, Show Planning Committee Meetings to plan the staging of sixth annual Agricultural and Industrial show on 25 and 26 May, 2002 (Leslie Simpson, Kathy Dalip)
- 1 February, 21 June 2002: Methyl Bromide Working Group meetings (Kathy Dalip)
- 11 and 21 February, 9 May, 4 June 2002: Biological Control of the Coffee Berry Borer-Management Committee Meetings (Kathy Dalip, Dionne Clarke-Harris, Leslie Simpson, Francis Asiedu)
- 12 February 2002: CPEC/JOAM HRD Steering Committee meeting to discuss progress of the HRD project (Leslie Simpson)
- 15 February 2002: ASSP, meeting of collaborators, Ministry of Agriculture to discuss progress of the project (Leslie Simpson)
- 19 March 2002: Caribbean Regional Environmental Programme (CREP) National Consultation for Jamaica at the Jamaica Conference Centre (JCC) (Leslie Simpson)
- 22-25 April: Member of a panel of experts at a regional workshop entitled *Reduction/Elimination and Management of Pesticides in the Context of the Stockholm Convention on Persistent Organic Pollutants and the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal* held in Port of Spain, Trinidad (Dionne Clarke-Harris)
- April-May 2002: Coordination of data collection and convening in Jamaica of the stakeholders meeting as part of the work programme of CARDI regional hot pepper Sub-programme (Dionne Clarke-Harris, Kathy Dalip)
- 14-19 May 2002: Technical planning meeting and conference of IPM CRSP, Backsburg, Virginia. Presentations were made on the work being carried out at

the various sites, which include Central America, South America, Caribbean, East Africa, West Africa, Albania, Southeast Asia and South Asia. The impact of the IPM CRSP on the development and dissemination of IPM technologies at each site was reviewed. Planning sub-meetings of each site were also held to refine workplans and budgets for the final year of Phase II of IPM CRSP - 30 September 2002-29 September 2003 (Dionne-Clarke Harris, Kathy Dalip)

- 12-13 June 2002: Resource person in a two-day Regionalisation Workshop, *Development of IPM in Leafy Vegetables that Currently Experience High-pesticide Input*, which was held at Ministry of Agriculture, Centeno, Trinidad. The workshop was geared towards researchers and involved participants from Barbados and Trinidad and Tobago and resource persons included Scientists from Pennsylvania State University, Virginia Polytechnic Institute and State University, CABI and CARDI (Dionne Clarke-Harris)
- 17 June 2002: Meeting of the Climate Change Committee of the Jamaica Meteorological Service to discuss the development of a Public Education Outreach (PEO) initiative aimed at sensitising island nationals of the vagaries of climate variability and change and giving updates of recent happenings in this area (Leslie Simpson)
- 25 July 2002: Meeting of collaborators in the goat industry to discuss the development of the small ruminant industry (Albert Fearon, Francis Asiedu)
- 20 August 2002: Meeting with representatives from FAO, IICA and various agencies of the MoA to discuss the development of a national agricultural information network (Leslie Simpson)
- 5 September 2002: CASRUNet Committee meeting, Bodles Agricultural Station, to review Small Ruminant Policy document and determine the agenda for the development of a national small ruminant development plan. (Albert Fearon)
- 12 September, 04 November 2002: Meeting with Dr Florence Young, MoA, to negotiate on the contract to deliver Entomological services to the Citrus Replanting Project (Leslie Simpson, Dionne Clarke-Harris, Adlai Blythe, Francis Asiedu)
- 26 September 2002: Meeting with committee from the Data Bank, ASSP and Research & Development Division of MoA selected to develop the terms of reference for development of a small

ruminant plan, Bodles Agricultural Research Station (Albert Fearon)

- 2 October 2002: Meeting with research staff at Bodles – Jasmin Holness, David Miller, and Delroy McDonald - to discuss work programme for the Hounslow DTC (Albert Fearon)
- 3 October 2002: Meeting with Dr Joseph Lindsay, Mr Vincent Campbell and Mr Marvel Grey to discuss the launching of the National arm of the Caribbean Land and Water Resources Network (CLAWRENET) at the Physical Planning Department, Ministry of Agriculture. (Leslie Simpson)
- 10 October 2002: National forum on holistic rural development hosted by IICA in collaboration with the Planning Institute of Jamaica (PIOJ) at the Jamaica Conference Centre on the occasion of the 60th Anniversary of IICA (Leslie Simpson)
- 31 October 2002: Meeting with staff of the MoA team at Bodles to finalise work programme for the project year 2002/2003 (Francis Asiedu, Albert Fearon)
- 7 November 2002: Meeting of Small Ruminant Development Committee to finalise terms of reference for small ruminant development plan (Albert Fearon)
- 12 November 2002: Meeting with staff of the MoA team at Bodles to develop budget for MoA research projects (Albert Fearon)

Seminars/Workshops Attended

- 21 January 2002: USDA Pest resistance/sweetpotato breeding program, CARDI Board Room. Conducted by Dr D. Michael Jackson, Rural Entomologist USDA-ARS. (Kathy Dalip, Dionne-Clarke Harris, Leslie Simpson, Francis Asiedu)
- 30 January 2002: Panellist at a forum on “The Potential for Organic Farming in Jamaica” hosted by the Jamaica Agricultural Development Foundation (JADF), in collaboration with the Jamaica Organic Agricultural Movement (JOAM) at the Bodles Research Station (Kathy Dalip)
- 5 March 2002: Seminar on “The assessment of effects of pesticides on soil organisms, particularly earthworms” presented by, Dr Clive Edwards Entomologist and Environmental Ecologist, Ohio State University, CARDI Conference Room, Kingston, Jamaica (Dionne-Clarke Harris, Kathy Dalip, Leslie Simpson, Francis Asiedu)
- 22 March 2002: Seminar on “Biodiversity and the Environment – Sustaining life on earth”, CARDI Conference Room (Leslie Simpson).
- 16 April 2002: Workshop on the Cadmium content of Jamaican Foods, hosted by ICENS in collaboration with

the MoA and OAS. (Leslie Simpson and Francis Asiedu).

- 18-19 June 2002: 13th Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles Research Station. (Francis Asiedu, Leslie Simpson, Kathy Dalip, Dionne-Clarke Harris, Francine Webb, Christopher Fuller, Anthony Trought/Patrick Pitterson, Dwight Williams)
- 19-20 September 2002: Workshop on Global Environmental Change and Food Systems (GECAFS) aimed at developing a research agenda for the Caribbean food system to respond to global climate changes (Albert Fearon)

Visits Undertaken

- 8 January 2002: Organic farming field visit to the Green Castle Estate, St Mary. The visit was conducted by Dr Joseph Lindsay and Mr Robin Crum-Ewing (Leslie Simpson)
- 25 February–01 March 2002: Kathy Dalip visited Guatemala to collect parasitoids (*Cephalonomia stephanoderis* and *Phymastichus coffea*) to augment the Jamaican population of the parasitoids. While in Guatemala, Dr Dalip visited the biological control research laboratory at Retalhuleu where she was able to view first-hand the operations of the facility and compare the procedures followed there with those used in Jamaica.

She also visited a farm in Mazatenango and saw the on-farm rearing lab in operation.

Exhibitions/Shows

- 06 July 2002: Jamaica Agricultural Society (JAS) Kingston and St Andrew Association of Branch Societies Agricultural Show, Kingston. CARDI hosted a booth at this exhibition, highlighting its work in Jamaica (Leslie Simpson, Kathy Dalip)
- 1-14 August 2002: The CARDI Jamaica Unit took part in an Exhibition at the Ministry of Foreign Affairs & Foreign Trade to mark its 40th Anniversary. CARDI prepared a poster highlighting its work in Jamaica. Leslie Simpson was the official representative of the Unit at the opening of the exhibition celebrations (Leslie Simpson, Kathy Dalip)
- 4-6 August 2002: The CARDI Jamaica Unit hosted a booth at the 50th Annual Denbigh Agricultural Show of the JAS at Denbigh. The show was well attended and the CARDI booth had many visitors over the 3-day period. The visitors included some overseas Agriculturalists from the CARDI Antigua Unit, the University of the West Indies, St Augustine Campus and the Tobago House of Assembly. (Francis Asiedu,

Leslie Simpson, Kathy Dalip,
Dwight Williams)



CARDI booth at the JAS 50th Annual Agricultural Show, Denbigh

Publications

Scientific publications

Asiedu F H, Fearon A L and Seaton J M. 2002. Characterisation of feeding systems of goat farmers in the central region of Jamaica. *CARDI Review* 1, 4-15

Asiedu F H, McDonald D and Seaton J M. 2002. Solid-seed evaluation in spring of non-dormant alfalfa cultivars. A paper presented at the 13th Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles, Jamaica, 18-19 June 2002

Clarke-Harris D O. 2002. IPM Related activities In the Caribbean. A paper presented during the Regional Workshop on the Reduction/Elimination and Management of pesticides in the Context of the Stockholm

Convention on Persistence Organic Pollutants and the Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal, Port of Spain Trinidad and Tobago, 22-25 April 2002

Clarke-Harris D O, Fleischer S J and Fuller C. 2002. Evaluation of the efficacy of new chemistries for controlling major Lepidoptera pests on vegetable Amaranth in Jamaica. A paper presented at the 13th Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles, Jamaica, 18-19 June 2002

Dalip K M, Webb F, Lawrence J and Robinson D E. 2002. Rearing of *Cephalonomia stephanoderis* under laboratory conditions in Jamaica. A paper presented at the 13th Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles, Jamaica, 18-19 June 2002

Martin R, Clarke-Harris D O and Chung P. 2002. Use of GIS in research projects at CARDI Jamaica. A paper presented at the 13th Annual Conference of the Jamaican Society for Agricultural Sciences, Bodles, Jamaica, 18-19 June 2002

Simpson L A and Wickham C V. 2002a. The performance of cowpea, maize and sorghum in an alley cropping trial with leucaena and glyricida in the Intermediate Savannah of Guyana. *CARDI Review* 2, 1-10

Simpson L A and Wickham C V. 2002b:
The performance of leucaena and glyricida and their potential as sources of plant nutrients in the Intermediate Savannah of Guyana. *CARDI Review* 2, 11-18

Simpson L A, Lauckner F B and Samsoung J. 2002 Effects on the environment of agricultural practices for hillside agricultural production in Jamaica. A paper presented at the 9th Annual Research Symposium of the Institute of Marine Affairs, Trinidad and Tobago, 12-13 November 2002, Chaguaramas, Trinidad

Reports

Biological Control of the Coffee Berry Borer End-of-Project (Phase 1) Report May 1999–April 2002

Professional Bodies

- Jamaican Society for Agricultural Sciences (Francis Asiedu, Albert Fearon, Dionne Clarke-Harris)
- Caribbean Food Crops Society (Francis Asiedu)
- New York Academy of Sciences (Francis Asiedu)
- Tropical Grasslands society of Australia (Francis Asiedu)

Administration and Personnel

Administrative report

In order to facilitate better management the Unit is sub-divided into four sections as follows: the Integrated Pest Management (IPM) Section, the Natural Resource Management (NRM) Section, the Livestock Section, and the Administration section.

The Integrated Pest Management Section focused on three main areas during 2002, vegetables (callaloo and hot pepper), root crop (sweetpotato) and coffee. The Head of Section was Dionne Clarke-Harris who also functioned as Project Manager for the IPM Vegetables project. Mr Christopher Fuller functioned as Research Assistant while Messers Donald Simpson and Paul Samuels provided technical assistance for the project. During the year Kathy Dalip was the Project Manager for the IPM Root Crop and Coffee Berry Borer (CBB) projects. Francine Webb functioned as Research Assistant while Messers Desmond Jones, Patrick Pitterson, Anthony Trought and Gusland McCook provided technical assistance.

The Natural Resource Management section was headed by Leslie Simpson with Kenrick Robinson as the Technical Assistant. There was no Research Assistant assigned to the section during the year. This section was responsible

for the management of the Mona DTC and our Geographical Information System (GIS) project.

The Livestock Section was responsible for the management of the Hounslow and Sam Motta DTCs. During the year Albert Fearon was the Head of Section with Ralston Barnes, Technical Assistant and Acting Supervisor undertaking the day-to-day management of the Hounslow DTC. From August 2002 the Ministry of Agriculture took over the day-to-day management of the Hounslow DTC and engaged the services of a Farm Manager.

A new Memorandum of Understanding to govern these arrangements was signed by CARDI and the Ministry of Agriculture in August 2002. Ruth Simpson functioned as Project Manager for Sam Motta DTC until 31 March 2002 when she resigned. Dwight Williams was appointed Research Assistant on 1 June 2002 to replace Ruth Simpson. Norman Hanson, was Foreman, for the DTC. Both Joel Barnes and Clovis Morrison were Technical Assistants for Sam Motta and Hounslow DTC, respectively.

The Administration Section was headed by Adlai Blythe and provided the administrative and financial support services for the Unit. Three Accounting Assistants/Clerks, one Receptionist, one Driver/Expediter, one Office Attendant and two Field Labourers assisted him during the year.

Staff list

Professional staff

Asiedu, Francis, Ph.D.	Animal Nutritionist	CARDI Representative
Clarke-Harris, Dionne, M.Sc.	Entomologist	IPM Section
Dalip, Kathy, Ph.D.	Entomologist	IPM Section
Fearon, Albert, M.Sc.	Animal Production	Livestock Section
Simpson, Leslie Ph.D.	Soil Scientist	NRM Section

Technical staff

Andrews, Yvonne	Secretary	Administration Section
Asiedu, Elizabeth	Accounts Clerk/Typist	Livestock Section
Bailey, Una	Office Helper	Administration section
Barnes, Joel	Technician	Livestock Section
Barnes, Ralston	Technician	Livestock Section
Blythe, Adlai	Senior Admin. Assistant	Administration Section
Fuller, Christopher	Research Assistant	IPM Section
Hanson, Norman	Foreman	Livestock Section
Jones, Desmond	Technical Assistant	IPM Section
Maxwell, Ervin	Field Labourer	Administration section
Morris, Erna	Accounting Assistant	Administration Section
Morrison, Clovis	Technician	Livestock Section
McDonald, Lloyd	Driver	Administration section
Pitterson, Patrick	Technical Assistant	IPM Section
Powell, Sandra	Receptionist	Administration Section
Richards, Leebert	Field Labourer	Administration section
Robinson, Kenrick	Technical Assistant	NRM section
Samuels, Paul	Technical Assistant	IPM Section
Simpson, Donald	Technical Assistant	IPM Section
*Simpson, Ruth	Research Assistant	Livestock Section
Trought, Anthony	Research Assistant	IPM Section
Webb, Francine	Research Assistant	IPM Section
Williams, Dwight	Research Assistant	Livestock section
Wizzart, Archibald	Accounting Clerk	Administration Section

* Resigned in March 2002 and the position filled by Dwight Williams

Notes