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Acronyms and Abbreviations

ADC	Agricultural Development Corporation
ALPART	Alumina Partners of Jamaica
ANOVA	Analysis of Variance
ASSP	Agricultural Support Services Project of the Ministry of Agriculture
CARDI	Caribbean Agricultural Research and Development Institute
CARTF	Caribbean Agriculture Research and Training Fund
CASE	College of Agriculture Science and Education
Cd	Cadmium
CPEC	Caribbean Programme for Economic Competitiveness
COLEACP	Europe-Africa-Caribbean-Pacific Liaison Committee
CRP	Citrus Replanting Programme
CTA	Technical Centre for Agricultural and Rural Cooperation of ACP-EU
DM	Dry matter
DTC	Demonstration and Training Centre
FAO	Food and Agricultural Organization of the United Nations
GBSJ	Goat Breeders Society of Jamaica
GIS	Geographic Information System
HDTC	Hounslow Demonstration and Training Centre
ICENS	International Centre for Environmental and Nuclear Science
IICA	Inter-American Institute for Cooperation on Agriculture
IPM	Integrated Pest Management
IPM CRSP	Integrated Pest Management Collaborative Research Support Program
JAS	Jamaica Agricultural Society
JB I	Jamaica Bauxite Institute
JEA	Jamaica Exporters Association
JOAM	Jamaica Organic Agricultural Movement
JSAS	Jamaican Society for Agricultural Sciences
JVMA	Jamaica Veterinary Medical Association
MINAG	Ministry of Agriculture
MoP	Muriate of Potash
NCCARD	National Coordinating Committee for Agricultural Research and Development
NRM	Natural Resources Management
PIP	Programme Initiative Pesticides
RADA	Rural Agricultural Development Authority
SED	Standard Error of Difference
SEM	Standard Error of the Mean
SMDTC	Sam Motta Sheep and Goat Demonstration and Training Centre
TSP	Triple Super Phosphate
WAS	Weeks after sowing
WAT	Weeks after transplanting
WWAP	Walkers Wood Agricultural Project



Forward

I have the pleasure to present the 2004 Annual Report of the Jamaica Unit of the Caribbean Agricultural Research and Development Institute (CARDI). This report focuses specifically on our contributions to the Government and peoples of Jamaica for the development of the emerging non-traditional agricultural areas of small ruminants (sheep and goats) and organic agriculture.

In 2004, the Agricultural Support Services Project of the Ministry of Agriculture (ASSP) commissioned a study on the competitiveness of the small ruminant industry in Jamaica. The findings of the study revealed the critical roles of dairy goat and sheep production in the development of a sustainable and economical industry. The thrust of our research and development activities in the year in review was consistent with these findings. We gave prominence to the maintenance and crossbreeding of the Alpine breed (a dairy breed of goat) along with the dual purpose Nubian and the Boer meat breeds. We also successfully completed research work on the use of agro and industrial by-product rations for feedlot production of lambs.

Organic farming is highly considered as one of the emerging successful and profitable agricultural pursuits and CARDI is devoting its Natural Resource Management Programme to support its development in Jamaica and the rest of the Caribbean. In 2004 we continued to investigate the effectiveness of vermi-compost from the California Red Worm in comparison with cow and goat manures in the production of organic vegetables and hot pepper.

CARDI takes as a serious mandate the provision of technical assistance to stakeholders in the agricultural sector and in the year in review we gave specific services to more than 50 farmers and eleven institutions and agencies.

The CARDI family takes this opportunity to express its gratitude to the Government and peoples of Jamaica for the continued financial and moral support in 2004. We are equally grateful to our numerous donors and collaborators, especially ALPART Mining Venture, RADA and the Goat breeders Society of Jamaica.

Francis Asiedu, Ph.D.
CARDI Representative



Highlights – 2004

The CARDI Jamaica Unit Annual Report 2004 highlights specifically our contribution to the development of the small ruminant industry and the sustainable development and management of Jamaica’s natural resources.

Technical Programme

Small Ruminants

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

Breed Improvement

At the Sam Motta Demonstration and Training Centre (SMDTC) we continued the cross breeding among the Alpine, Nubian and the Boer exotic breeds and the Native goat towards the attainment of 87 per cent genotype of the top-cross buck. Breed type did not influence the birth weights and weight gains to 90 days for the kids produced from the cross breeding. During the year, 15 improved breeding animals were distributed from the SMDTC to farmers.

Feeding and Production Systems

We continued our quest to develop sustainable production systems by evaluating, on reclaimed bauxite lands, the seed production potential of Mucuna (*Mucuna pruriens*) varieties (white, black and mottled) for possible use in small ruminant feeding systems and also concluded the evaluation of four ration formulations with either wheat middlings/hominy feed (corn offal) or wheat middlings/dried citrus pulp as the energy source and with or without non-protein nitrogen source (poultry litter) as complete rations for sheep and goat feedlot production. The results of the evaluation of the mucuna varieties showed the white variety to be the best and the mottled variety the worst, for seed production on reclaimed bauxite lands. The results of the by-product rations for lamb feedlot production trial were consistent with the observations made for the goats in 2003 and confirmed that both wheat middlings/hominy feed (corn offal) and wheat



middlings/dried citrus pulp are equally good as energy sources for small ruminant production, and are comparable to the commercial formulations from corn and soy meal in small ruminant productivity.

Technology Transfer and Outreach Systems

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

Goat Commercialisation Project

Our role in the Government-sponsored Goat Commercialisation Project is to recommend/recruit farmers from the central and western parishes to the programme and train them too. As at the end of 2004, we had recruited twenty-two farmers who had received a total of 88 goats. The revolving phase commenced during the year with one farmer turning over four does to a second participant in St Ann.

Community buck service

In 2004, thirty-five farmers with a total of 67 does utilised the community buck service operated from the SMDTC.

Technology transfer

We pursue a structured programme of training and field days/tours in order to disseminate generated and/or acquired small ruminant technologies to the clientele. In 2004, we conducted six training sessions, including one in Antigua, and mounted poster displays at three shows. In addition, we conducted field days/tours for 125 students and eight tutors from six educational institutions.

Linkages and Monitoring of Developments in the Small Ruminants Industry

General linkages and appraisals/registrations

CARDI regularly collaborates with other stakeholders for the good of the small ruminant industry. For example in the year in review, we collaborated with MINAG and ASSP on the ASSP commissioned study on the competitiveness of the Jamaican small ruminant industry. Also, together with the GBSJ and MINAG six appraisals and four registration sessions were conducted for goat farmers during the year.



Markets for small ruminant products

We noted from an informal survey of meat shops, major markets, slaughter houses, roadside butchers and supermarkets that:

1. There were 60-96 per cent increases in the price of goat meat and about 70 per cent increase in the price of breeding stock in 2004 compared with 2002
2. Goat milk and cheeses were regularly available in major outlets in the Island. The price of the liquid milk ranged from J\$270/L to J\$337.5/L while the powdered milk was sold at J\$1,012.5/kg. The cheeses cost between J\$2,475 and J\$2,700/kg.

Status of imported small ruminants

A survey to determine the status of the imported small ruminants was about 30 per cent complete at the end of the year. The emerging trends suggest greater susceptibility of the imported breeds to internal parasitism than the Native goat. Other issues include a trend towards the development of mild to serious resistance to some anthelmintics, kidding difficulties in some females and higher predisposition of the bucks to urinary calculi

Natural Resource Management

The purpose of CARDI's Natural Resource Management programme is to contribute to the management of the land and water resources of Jamaica in a sustainable manner while decreasing environmental degradation. In 2004, the programme concentrated mainly on organic agricultural production and research, and the intensification of the development and application of Geographic Information Systems (GIS) technology.

Organic farming demonstration

Trials conducted on the use of cow manure, goat manure and vermi-compost for the production of organic callaloo and hot pepper showed that under the prevailing climatic conditions in 2004, there appeared to have been a better overall performance of plots treated with vermi-compost compared to the cow and goat manures.

Application of GIS technology

Our capacity in the GIS technology was further enhanced in the year with the participation of Leslie Simpson in two training courses and the subsequent application of the knowledge to produce location map of all CARDI projects in Jamaica.



Technical Assistance

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

Technical Assistance Given

We provided technical assistance to the following institutions and agencies:

- Agricultural Support Services Project: (Continued with the preparation of training aids including, factsheets, posters and pamphlets/handouts for the training of farmers in good agricultural practices in papaya, sweetpotato, ginger, escallion and hot pepper production and post harvest)
- The International Centre for Environmental and Nuclear Science (ICENS): (CARDI Biometric Service reviewed and advised on the draft instrument for the survey of yam farmers and, on completion of the survey, analysed the results and reported back to ICENS)
- The Jamaican Society for Agricultural Sciences (JSAS): (CARDI Jamaica Unit organised the visit of Dr Cyril Roberts to Jamaica as a Guest Speaker during the 15th Annual Conference of the Society)
- Small ruminant farmers in genera: (We provided technical assistance to 39 farmers in the areas of goat breeding stock selection, forages for feeding, setting up goat production units, outlay of appropriate goat housing facilities and general husbandry practices)
- Small ruminant farmers participating in the Denbigh Agricultural and Industrial Show: (Eleven farmers were trained in the preparation and handling of animals for the Show)

Boards and Committees Served

We provided our services for eight local and one international committees. These were:

- Biological Control of the Coffee Berry Borer Project Management Committee
- Goat Breeders Society of Jamaica Executive Committee
- Methyl Bromide Working Group
- Mona and Sam Motta DTCs Project Management Committees
- Plant Health Coordinating Committee
- Jamaica 4-H Clubs Goat Revolving Project Committee
- Jamaica Organic Agriculture Movement (JOAM) Programme Management Committee
- Jamaican Society for Agricultural Sciences Executive Committee
- CTA Advisory Committee on Science and Technology for Agricultural and Rural Development



Institutional Collaboration

During the year we partnered with the Ministry of Agriculture to initiate the National Coordinating Committee for Agricultural Research and Development in Jamaica. We also started discussions to either begin or strengthen collaborations with the Jamaica Office of the Inter-American Institute for Co-operation on Agriculture (IICA), the Jamaica Bauxite Institute (JBI) and the Technical Centre for Agricultural and Rural Cooperation CTA).

The other institutions and agencies we collaborated with regularly during the year included:

- ALPART Mining Venture
- Coffee Industry Board
- Goat Breeders Society of Jamaica
- Jamaica 4-H Club
- Jamaica Exporters Association
- Rural Agricultural Development Authority
- University of the West Indies

Professional Development of Staff

During the year staff received further training in GIS technology, as well training in project preparation and documentation. In addition, they attended twenty-one national and regional workshops, conferences and seminars

Exhibitions and Shows

The CARDI Jamaica Unit participated fully in the 52nd Annual Denbigh Agricultural and Industrial Show held during 31 July-2 August 2004 under the theme “We are what we eat, let’s eat Jamaican.” We showcased our work in IPM of vegetable crops and sweetpotato, goat management systems, biological control of the coffee berry borer and natural resources management, particularly soil management and organic agriculture, and also participated in the goat championships judging competition. The goats from the Sam Motta DTC and exhibited by us won three first prizes.

Publications

Staff produced 19 publications of various types during the year

Weather

Total rainfall in Jamaica in 2004 was less than in 2003 and the 30-year average. In 2003, the total rainfall over the island, calculated as a mean of the total rainfall in the 13 parishes was 1,808 mm. In 2003, this figure was 1,854 mm and the 30-year

mean is 1,949 mm. For two consecutive years the mean total rainfall for the island was less than the 30-year average. The mean annual rainfall for the 13 parishes is shown in **Figure 1**. Portland was the wettest parish with 4,645 mm of rainfall and Clarendon was the driest with 866 mm. Overall all the parishes except St Ann, St Catherine and Portland received less rainfall than the 30-year mean.

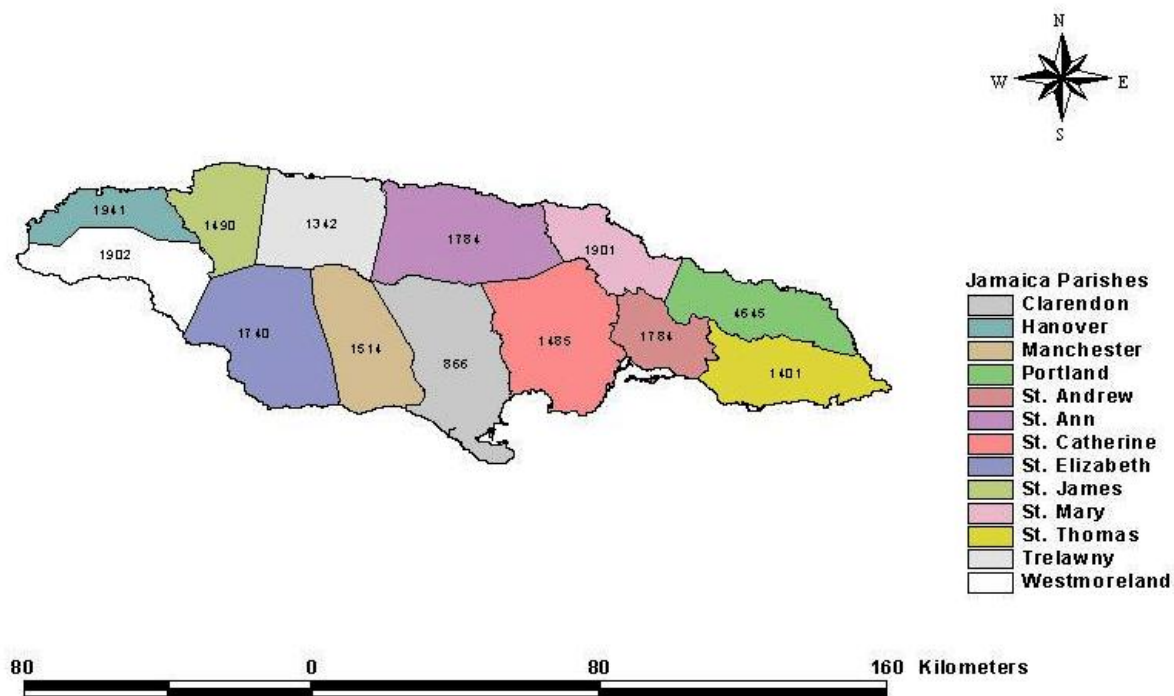


Figure 1 Mean annual rainfall in 2004 for parishes in Jamaica



Mean monthly rainfall for the parishes for 2004, 2003 and the 30-year mean is given in **Figure 2**. The rainfall in the two years was quite similar. In most parishes there were rainfall peaks in the April/May and the highest rainfall was recorded in September, corresponding to the passage

of hurricane Ivan. The parishes with the highest rainfall during the year were Portland, Hanover, Westmoreland and St Mary. Portland continued to be the wettest parish while Clarendon was the driest.

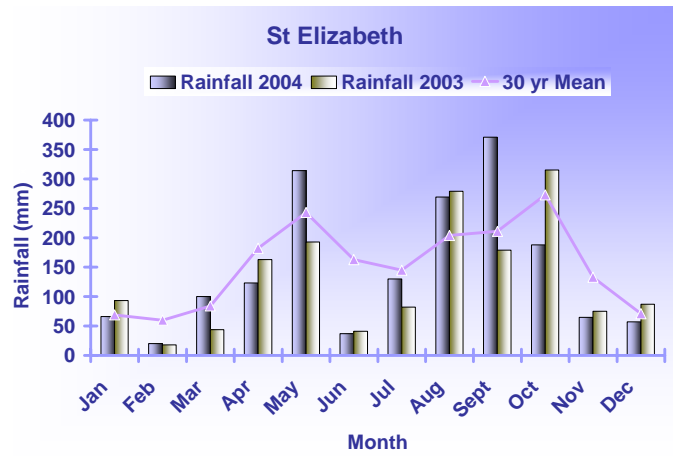
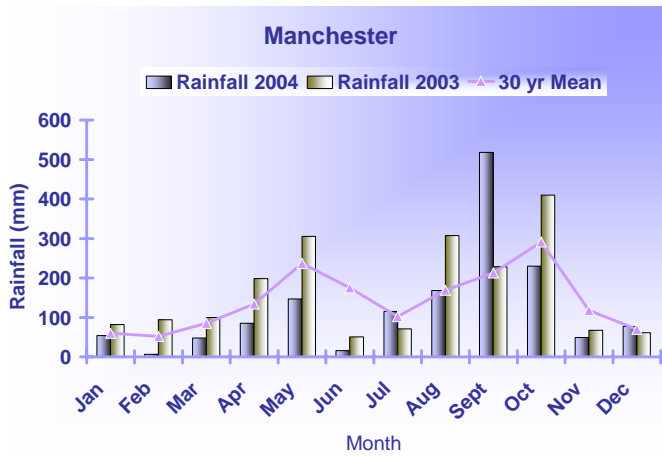
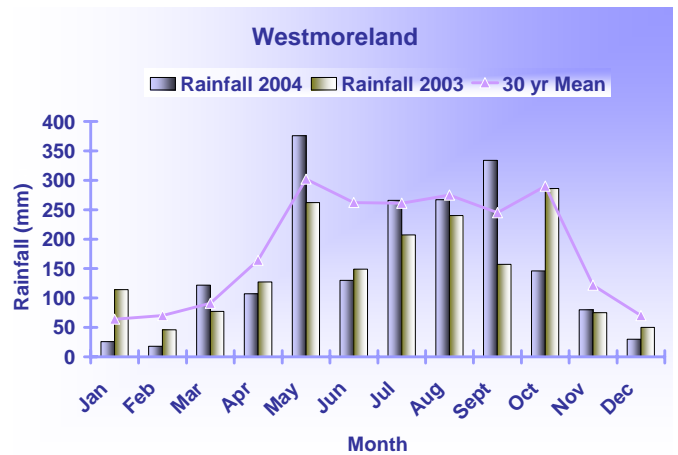
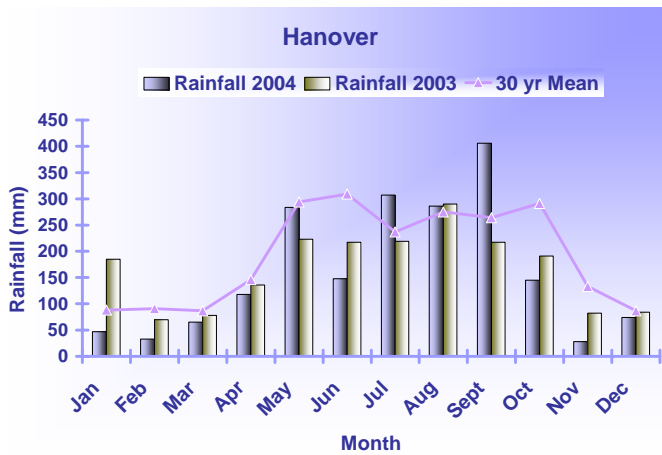


Figure 2a Mean monthly rainfall for 2003, 2004 and the 30-year mean for Hanover, Westmoreland, Manchester and St Elizabeth

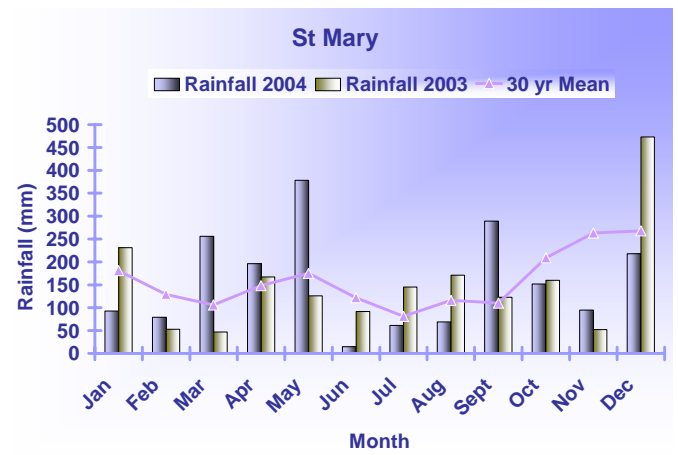
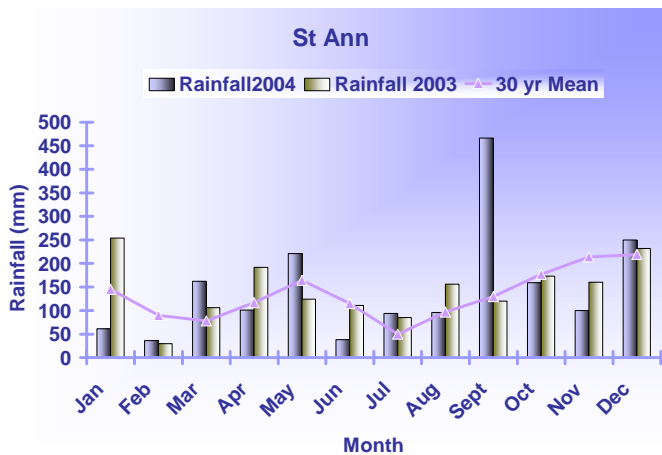
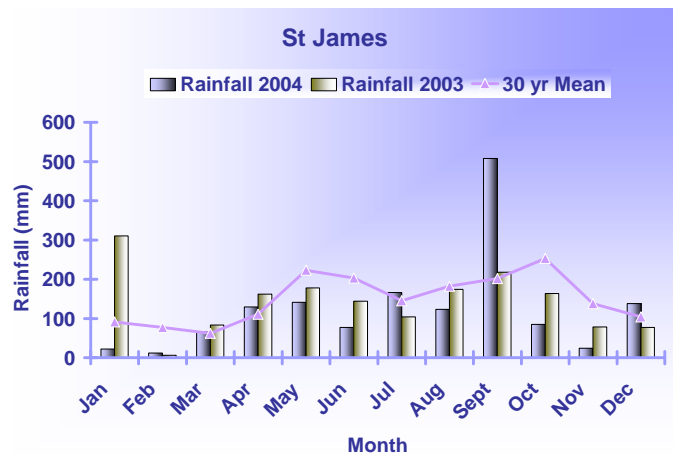
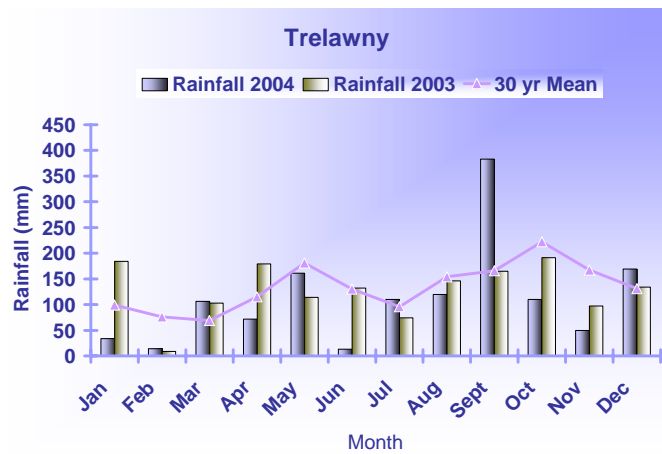
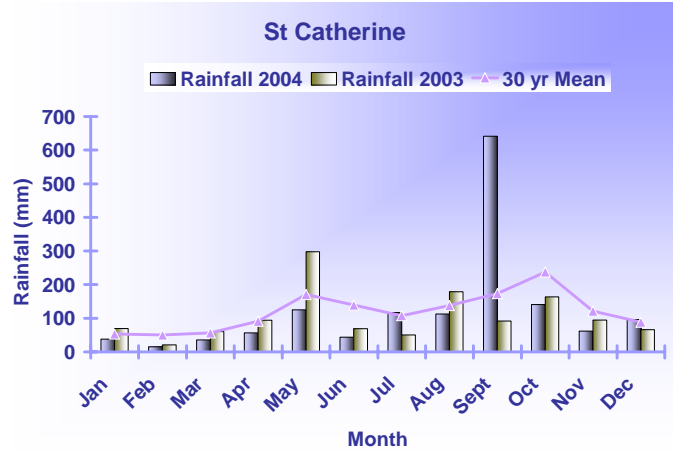
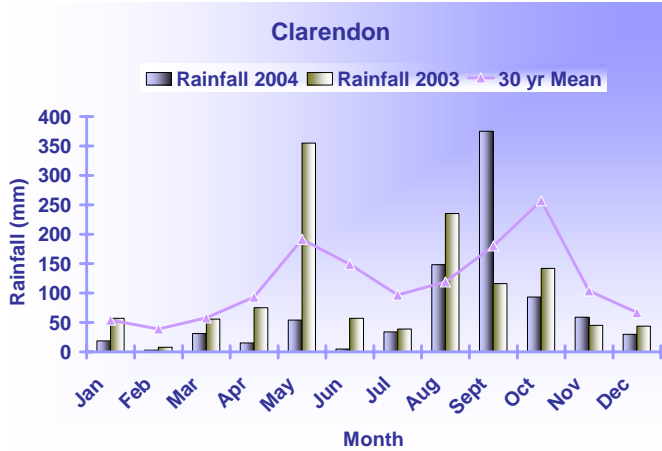


Figure 2b Mean monthly rainfall for 2003, 2004 and the 30-year mean for Clarendon, St Catherine, Trelawny, St James, St Ann and St Mary

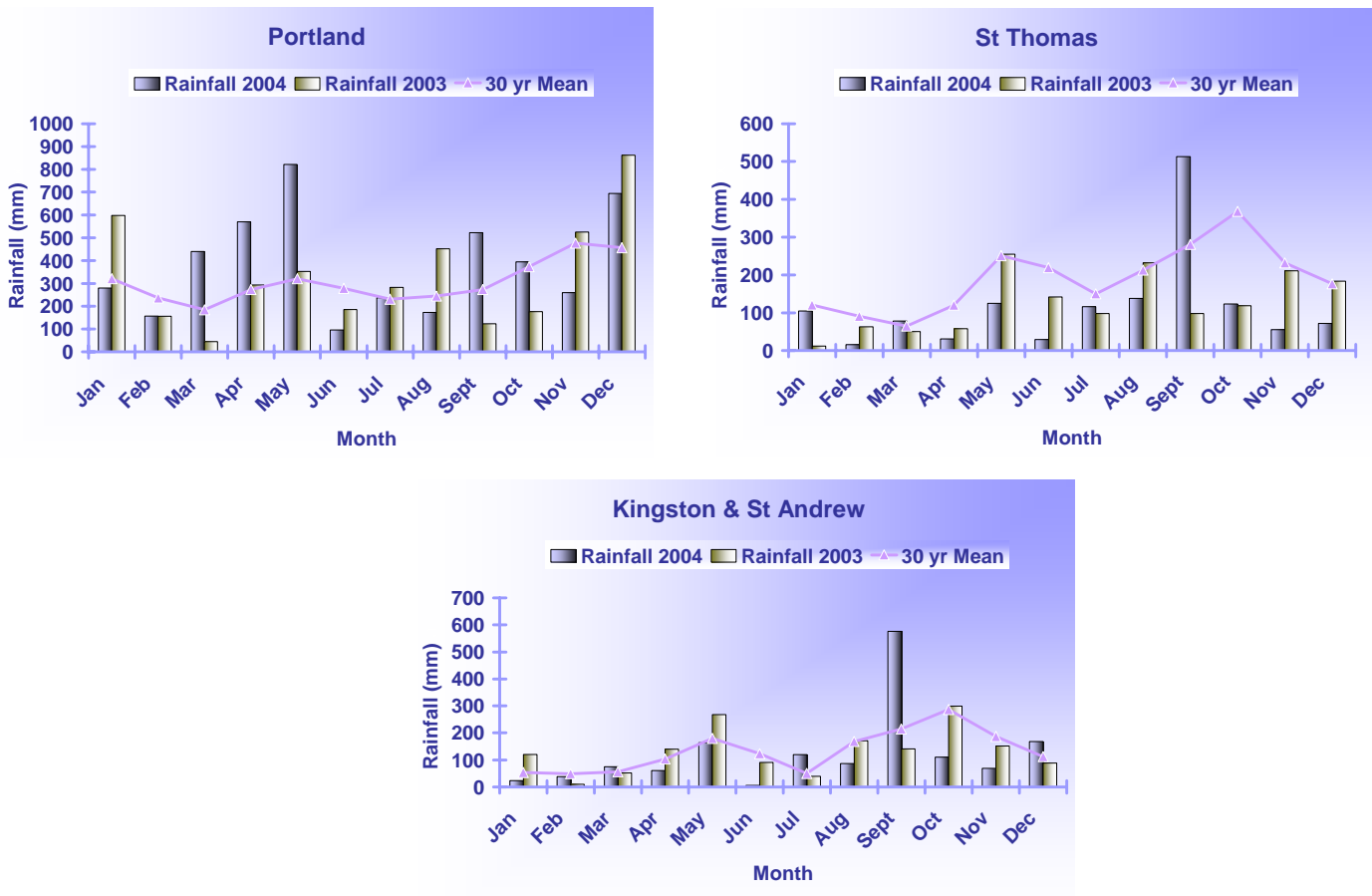


Figure 2c Mean monthly rainfall for 2003, 2004 and the 30-year mean for Portland, St Thomas and Kingston and St Andrew

Project activities carried out by CARDI in Jamaica are located in the parishes of Manchester, Clarendon, St Catherine, St Mary and Kingston and St Andrew. The dry conditions in all these parishes for the second consecutive year were not helpful to crop establishment and experimentation. However, the single most important weather occurrence during the year was the passage of Hurricane Ivan over the island in September. The

hurricane passed over the period 10-11 September, and the island experience about 500 mm of rainfall over the period. This along with the high winds, the felling of trees and land slippage caused flooding and extensive damage to many farms. Both the Mona and Sam Motta Demonstration and Training Centres (DTC) suffered structural and crop damage during the passage of the storm (Plate 1).

Technical Programme

Small Ruminants

CARDI, along with its collaborators, including, the Research and Development Division of the Ministry of Agriculture (MINAG), RADA, the Goat Breeders Society of Jamaica (GBSJ), ALPART Mining Venture, Jamaica 4-H Club, IICA, JBI and farmers continued the efforts to develop the small ruminant industry in Jamaica in 2004. The activities in these efforts were undertaken primarily on the Sam Motta Goat and Sheep Demonstration and Training Centre (SMDTC) and on producers' properties. The provision of improved breeding stock continued through the multiplication and distribution programme along with the

community buck service at the DTC and the importation of additional improved breeding stock by producers. We continued our quest to develop sustainable production systems by evaluating three varieties of grain legumes for possible use in feeding systems. The outreach programme continued to provide an avenue to bring small ruminant production technologies to farmers and to monitor developments in the small ruminant industry. Under arrangements with MINAG, the Livestock Scientists recruited and recommended farmers from the central and western parishes for the Government-sponsored Goat Commercialisation Project.



(a) Mona Demonstration and Training Centre (DTC)

(b) Sam Motta DTC

Plate 1 Damage to exclusion cage (a) and goat housing unit (b) during Hurricane Ivan



Breed Improvement

The national small ruminant improvement strategy enunciated by the stakeholders is for the research/breeding stations and designated breeder stock producers to maintain exotic purebred stock, multiply within the purebred stock and cross breed among the purebreds and the Native types up to the generation when the top-cross buck represents 87.5 per cent of the crossbred animal.

The major exotic goat breeds used for breed improvement during the year included Nubian, Boer, Alpine and the Spanish.

Production of improved breeding stock

At the SMDTC, the breeding of improved stock continued. Alpine, Boer and Nubian bucks were used for the breeding programme and the performance of the resulting kids is reported here (Table 1).

The average birth weight of kids born on the DTC during the year was 3.14 kg. There was no significant difference ($P>0.05$) in birth weight and weaning weight (ninety-day weight) with respect to breed type, sex, or type of birth. The average ninety-day weight (weaning weight) was 14.0 kg. Thirty-day weight was significantly higher ($P=0.006$) for Boer/Nubian crosses (10.15 kg) compared to the Alpine/Native (7.66 kg), Nubian/Native (7.69 kg), pure bred Boers (5.68 kg) and pure bred Nubian (7.1 kg).

Table 1 Effects of breed, sex and birth type on liveweight of kids, Sam Motta DTC[§], 2003/2004

	Birth Wt kg	30d Wt kg	30d ADG* g	90d Wt kg	90d ADG g
<i>(a) Breed Type</i>					
A/Na	2.97	7.63	156.9	12.3	104.0
A/N	3.03	9.20	174.2	13.0	100.0
B/N	3.21	10.15	204.2	17.3	148.2
N/Na	3.17	7.69	149.7	13.5	114.5
PBB	3.5	5.68	104.7	10.1	84.1
PBN	2.98	7.10	120.4	12.1	95.4
Prob. (P) =	0.873	0.006	0.098	0.8	0.188
SED	0.144	1.623	32.730	1.378	10.510
d.f.	111	37	37	35	35
<i>(b) Sex</i>					
Male	3.24	7.39	135.7	14.0	118.5
Female	3.09	8.04	163.7	11.9	97.0
Prob. (P) =	0.452	0.273	0.12	0.066	0.084
SED	0.108	0.421	13.47	0.851	7.82
d.f.	111	37	37	35	35
<i>(c) Birth Type</i>					
Singles	3.19	7.89	151.9	13.1	108.1
Twins	3.03	7.50	144.3	13.2	110.6
Prob. (P) =	0.466	0.513	0.678	0.951	0.844
SED	0.243	0.633	23.11	0.465	14.71
d.f.	111	37	37	35	35

[§]DTC: Demonstration and Training Centre

*ADG: average daily gain

Goat breeds: A = Alpine, B = Boer, N = Nubian, Na = Native, PB = Purebred

Distribution of improved breeding stock

During the year, 15 improved breeding animals were distributed from the SMDTC. Thirty-five farmers with a total of 67 does utilised the community buck service. The designated small ruminant breeders monitored also made significant contribution to the number of improved breeding stock distributed.

Feeding and Production Systems

Comparative yield of *Mucuna pruriens* grown on reclaimed bauxite lands

Soybean is the major source of protein in formulated feed for livestock but with the continued price increases of the commodity on the world market it would be worth while for countries that do not grow the crop to find alternative source of grain legumes for livestock feed. The objective of this trial was, therefore, to evaluate the seed production potential of three varieties of *Mucuna pruriens* under three different fertiliser regimes. The study was also part of a renewed drive to increase the economic potential of reclaimed bauxite lands.

Nine treatment combinations of three varieties (white, black and mottled) and three fertiliser types (1,266 kg/ha/yr of goat manure, 166 kg/ha/yr each of Triple Super Phosphate (TSP) and Muriate of Potash (MoP), and no fertiliser/manure) were sown along trellises of 1.5 m high and 2 m in length (**Plate 2**). The experiment was established in March 2003 on reclaimed bauxite land at the SMDTC. Four weeks after sowing, 83 kg/ha of TSP was applied and two weeks later 83 kg/ha of MoP was applied. Similar applications of both TSP and MoP were made in July 2003. The goat manure was applied in two splits of 633 kg/ha in April 2003 and July 2003. The experimental design was a 3 x 3 factorial with four replications. At maturity whole pods were harvested and

the yield determined. About 50 g samples of the whole pods were separated into grains and hulls and, along with 50 g samples of whole pods, dried in an oven at 65 °C for 48 hours for the determination of dry matter yields. Composite (across the nine treatments) samples of about 250 g of grains for each variety were ground through 2 mm screen and analysed for crude protein, ether extract, crude fibre and ash. Analysis of variance (ANOVA) and multiple comparison analysis were conducted on the data using Minitab Release 12.21.



Plate 2 *Mucuna (Mucuna pruriens)* growing on trellises at Sam Motta Demonstration and Training Centre

The results of the study are summarised in **Tables 2 to 6**. There were no significant interactions ($P=0.870$ and $P=0.893$ for whole pods and grains respectively) between variety and fertiliser treatment and neither was there significant ($P=0.521$ and $P=0.565$ for whole pod and grains, respectively) fertiliser main effect (**Table 2**). Total whole pod dry matter yield and dry grain yield were significantly different



for all three varieties ($P < 0.001$). Both the whole pod and grains yield of the white were about 118 per cent higher than the black. The whole pod yield of the white was about 590 per cent higher, and the grain yield about 770 per cent higher than that of the mottled (Table 2).

Table 2 Whole pod and grain dry matter yield of three mucuna (*Mucuna pruriens*) varieties grown on reclaimed bauxite land, Sam Motta DTC*, 2003/2004

Variety	Fertiliser treatment			Mean
	Goat manure	TSP/MoP	No fertiliser	
(a) Whole pod yield (t/ha)				
Black	1.00	0.86	0.82	0.89
Mottled	0.24	0.37	0.24	0.28
White	1.97	2.14	1.67	1.93
Mean	1.07	1.12	0.91	
(b) Grain yield (t/ha)				
Black	0.67	0.58	0.56	1.81
Mottled	0.12	0.21	0.12	0.44
White	1.37	1.42	1.14	3.93
Mean	0.72	0.73	0.61	

*DTC: Demonstration and Training Centre
SEM (d.f. 35) for comparing:

(a) whole pod yield: variety = 0.136 ($P < 0.001$), fertiliser treatment = 0.136 ($P = 0.521$), variety x fertiliser = 0.079 ($P = 0.870$)

(b) grain yield: variety = 0.094 ($P < 0.001$), fertiliser treatment = 0.094 ($P = 0.565$), variety x fertiliser = 0.053 ($P = 0.893$)

The grain yield of both the white and black varieties, as a percentage of the whole pod yield, was about 18 per cent higher ($P = 0.001$) than that of the mottled variety (Table 3).

The mottled variety remained in vegetative state longest and started seed production more than 42 weeks after

sowing compared with 31 weeks and about 36 weeks for the white and black varieties, respectively (Table 4). Seed production peaked during weeks 36–39, 38–41 and 42 after sowing for the white, black and mottled, respectively (Figure 3).

Table 3 Grain to pod ratio and grain proportion of three mucuna (*Mucuna pruriens*) varieties grown on reclaimed bauxite land, Sam Motta DTC*, 2003/2004

	Grain to hull ratio	Grain as percentage of whole pod
(a) Variety		
Black	2.10	67.8
Mottled	1.38	57.5
White	2.10	67.6
(b) Fertiliser treatment		
Goat manure	2.13	68.51
TSP/MoP	1.93	65.45
No fertiliser	2.11	67.95

*DTC: Demonstration and Training Centre
SEM (d.f. 172) variety = 0.046 ($P = 0.001$), fertiliser treatment = 0.047 ($P = 0.154$)

The mottled variety also remained in seed production for just about one-third - 3.8 weeks - of the period the white variety remained in production - 11.2 weeks - (Table 5). The black variety remained in seed production for 7.5 weeks. Fertiliser had no effect on both the onset and duration of seed production.

Table 4 Week of first harvest of three mucuna (*Mucuna pruriens*) varieties grown on reclaimed bauxite land, Sam Motta DTC*, 2003/2004

	Fertiliser treatment			Mean
	Goat manure	TSP/ MoP (WAS**)	No fertiliser	
Black	34.3	36.5	36.5	35.8
Mottled	42.3	42.3	42.3	42.3
White	31.5	31.0	31.5	31.3
Mean	36.0	36.6	36.8	

*DTC: Demonstration and Training Centre

**WAS = weeks after sowing

SEM (d.f. 35) variety = 0.810 (P<0.001), fertiliser treatment = 0.810 (P=0.575), variety x fertiliser= 1.054 (P=0.541)

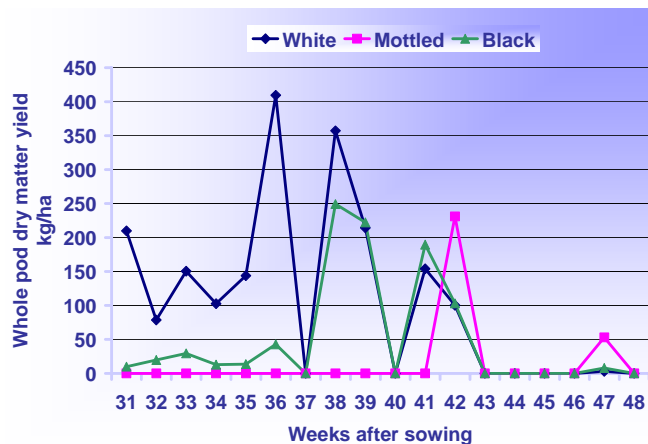


Figure 3 Seed production trends of three mucuna (*Mucuna pruriens*) varieties

Crude protein and ash concentrations were similar for all three varieties but the mottled variety appeared to be lower in both crude fibre and ether extract concentrations (Table 6). The values obtained for crude protein concentration in this trial were typical for legumes and comparable with that of peanut (299 g/kg

DM) but low when compared to soybean (417 g/kg DM, Tables 6).

Table 5 Duration of harvest of three mucuna varieties grown on reclaimed bauxite land, Sam Motta DTC*, 2003/2004

	Fertiliser treatment			Mean
	Goat manure	TSP/ MoP (weeks)	No fertiliser	
Black	10.5	5.75	6.5	7.58
Mottled	3.75	2.75	4.75	3.75
White	11.0	11.25	11.25	11.17
Mean	8.42	6.58	7.50	

*DTC, Demonstration and Training Centre

SEM (d.f. 35) variety = 0.728 (P<0.001), fertiliser treatment = 0.728 (P=0.387), variety x fertiliser = 1.159 (P=0.435)

Table 6 Nutrient concentration of mucuna in this trial compared with those of mucuna, peanut and soybean cited from literature

Variety	Crude Protein	Crude Fibre	Ether Extract	Ash
(g/kg DM)				
Black*	258.8	67.0	43.2	42.3
Mottled*	276.9	55.7	34.1	40.4
White*	258.8	67.1	44.2	38.7
Mucuna [‡]	206.5	59.3	49.0	31.0
Peanut [‡]	299.0	30.0	50.3	25.0
Soybean [‡]	417.0	58.0	192.0	54.0

*Results from present study

[‡]Values cited from literature reviewed

Overall, the study showed the white variety to be the best for seed production on reclaimed bauxite lands. It came into production early and remained productive for a longer duration and had the highest seed yield.

Comparison of hominy feed and citrus pulp as energy sources in by-product rations for sheep and goat feedlot production

In 2003, we started a study to evaluate four ration formulations with either wheat middlings/hominy feed (corn offal) or wheat middlings/dried citrus pulp as the energy source and with or without non-protein nitrogen source (poultry litter) as complete rations for sheep and goat feedlot production. The formulations were iso-nitrogenous and iso-caloric (Table 7). Additionally, they all had the same Ca:P ratio. The first trial with grower goats was completed in 2003 (CARDI Jamaica Unit Annual Report 2003). In the second trial, twenty each of male and female grower lambs (St Elizabeth x Katahdin, mean body weight 15.4 kg, SE 0.84) were fed the four rations and a commercial goat grower ration (control). The lambs were assigned in two replicates to the five treatments over 84 days. Two animals constituted an experimental unit. Data on liveweight, feed intake and carcass characteristics (males) were collected and analysed using Genstat for Windows (2nd ed.) statistical software.

The results of the trial are presented in Tables 8-10. The daily intake of dry matter (g/kg body weight) and crude protein for ration III was higher (P=0.060 and 0.077, respectively) than ration II (Table 8), but these differences were not enough to influence significantly the daily gain. There were no significant differences between the rations or sex of lambs for all the other parameters

measured. The mean daily weight gain across sexes for the by-product rations was 135.7 g and compared favourably with that for the commercial goat ration (156.1 g, Table 9).

Table 7 Composition and nutrient concentration of four by-product feeds and commercial goat concentrate

Composition, g/kg DM*	Feeds				
	I**	II	III	IV	V
Poultry litter	0	51	0	55	0
Leucaena leaf meal	104	104	103	103	0
Dried citrus pulp	0	0	203	223	0
Hominy feed	319	319	0	0	0
Wheat middlings	458	407	581	511	0
Molasses	76	76	76	76	0
Limestone	32	32	26	21	0
Salt	11	11	11	11	0
Commercial goat concentrate	0	0	0	0	1,000
Total	1,000	1,000	1,000	1,000	1,000
Nutrient concentration					
Dry matter (g/kg fresh matter)	887.8	880.0	894.1	888.2	900.1
Crude protein (g/kg DM)	135.5	134.3	131.1	135.2	139.0
Metabolisable energy (MJ/kg DM)	10.9	10.5	10.8	10.6	10.0
Calcium (g/kg DM)	15.8	15.9	18.0	16.4	10.7
Phosphorus (g/kg DM)	5.7	5.3	6.3	5.7	7.0
Ca:P	2.77	3.00	2.86	2.88	1.53

*DM, dry matter

**I: wheat middlings/hominy; II: wheat middlings/hominy with poultry litter; III: wheat middlings/citrus pulp; IV: wheat middlings/citrus pulp with poultry litter; V: commercial goat concentrate (control)

Similarly, the mean carcass weight, dressing percentage, carcass length (Plate 3) and loin eye area for the by-product rations were 17.7 kg, 50.0, 76.0 cm and



11.9 cm², respectively compared with 19.4 kg, 53.2, 77.5 cm and 12.8 cm², respectively for the commercial feed (Table 10).

and wheat middlings/dried citrus pulp are equally good as the energy sources for small ruminant production, and are comparable to the commercial formulations from corn and soy meal.

Table 8 Nutrient intake of grower lambs on by-product feeds and commercial goat concentrate, Hounslow DTC*, 2003/2004

	Feeds					Mean
	I**	II	III	IV	V	
<i>(a) Dry matter intake, g/d</i>						
Males	1,052.0	1,009.0	854.0	1,129.0	1,052.0	1,019.2
Females	898.0	1,139.0	1,056.0	1,065.0	1,081.0	1,047.8
Mean	975.0	1,074.0	955.0	1,097.0	1,066.5	
<i>(b) Dry matter intake, g/kg body weight</i>						
Males	3.44	3.47	3.25	3.65	3.55	3.47
Females	3.06	3.83	3.42	3.49	3.42	3.44
Mean	3.25	3.65	3.33	3.57	3.49	
<i>(c) Crude protein intake, g</i>						
Males	129.0	124.0	102.7	149.3	136.6	128.3
Females	115.3	140.0	137.3	147.1	131.3	134.2
Mean	122.2	132.0	120.0	148.2	134.0	
<i>(d) Metabolisable energy intake, MJ/d</i>						
Males	10.7	10.1	8.4	11.2	9.5	10.0
Females	9.5	11.8	11.0	10.8	11.5	10.9
Mean	10.1	11.0	9.7	11.0	10.5	

*DTC, Demonstration and Training Centre

**I: wheat middling/hominy; II: wheat middlings/hominy with poultry litter; III: wheat middlings/citrus pulp; IV: wheat middlings/citrus pulp with poultry litter; V: commercial goat concentrate (control)

SED (9 d.f.) for comparing:

- (a) dry matter intake: feed = 75.40 (P=0.300), sex = 47.70 (P=0.562), feed x sex = 106.6 (P=0.210)
- (b) dry matter intake/kg body wt: feed = 0.128 (P=0.060), sex = 0.081 (P=0.746), feed x sex = 0.181 (P=0.110)
- (c) crude protein intake: feed = 9.13 (P=0.077), sex = 5.78 (P=0.334), feed x sex = 112.92 (P=0.143)
- (d) metabolisable energy intake feed = 0.88 (P=0.550), sex = 0.56 (P=0.135), feed x sex = 1.25 (P=0.220)

The similarity between the feeds for lamb growth is consistent with the observations made for the goats. This shows that both wheat middlings/hominy feed (corn offal)

Table 9 Weight gain of grower lambs on by-product feeds and commercial concentrate, Hounslow DTC*, 2003/2004

	Feeds					Mean
	I**	II	III	IV	V	
<i>(a) Initial weight, kg</i>						
Males	24.5	23.1	20.0	25.0	22.9	23.1
Females	24.4	24.8	25.5	25.3	25.3	25.0
Mean	24.4	23.9	22.7	25.1	24.1	
<i>(b) Final weight, kg</i>						
Males	36.8	35.3	32.4	37.2	36.5	35.6
Females	34.8	35.0	36.3	35.8	38.0	36.0
Mean	35.8	35.1	34.4	36.5	37.2	
<i>(c) Daily gain, g</i>						
Males	146.8	145.7	147.9	145.8	161.8	149.6
Females	124.6	121.4	128.6	124.9	150.4	130.0
Mean	135.7	133.6	138.3	135.4	156.1	

*DTC, Demonstration and Training Centre

**I: wheat middling/hominy; II: wheat middlings/hominy with poultry litter; III: wheat middlings/citrus pulp; IV: wheat middlings/citrus pulp with poultry litter; V: commercial goat concentrate (control)

SED (9 d.f.) for comparing:

- (a) initial weight: feed = 2.65 (P=0.924), sex = 1.67 (P=0.267), feed x sex = 3.74 (P=0.831)
- (b) final weight: feed = 2.64 (P=0.834), sex = 1.76 (P=0.848), feed x sex = 3.37 (P=0.797)
- (c) daily gain: feed = 11.00 (P=0.304), sex = 6.96 (P=0.020), feed x sex = 15.56 (P=0.979)

Technology Transfer and Outreach Systems

The Technology Transfer and Outreach Programme is the mechanism through which small ruminant production and

marketing system technologies are disseminated to small ruminant stakeholders. The activities carried out under the programme in 2004 are highlighted below.



Plate 3 Carcasses from lambs fed by-product feedlot rations compared with commercial goat concentrate

Goat Commercialisation Project

The Government-sponsored Goat Commercialisation Project is a revolving doe project for small farmers. Our role is to recommend/recruit farmers from the central and western parishes to the programme and train them too. As at the end of 2004, twenty-two farmers had benefited, having received a total of 88 goats. The revolving phase commenced during the year with one farmer turning over four does to a second participant in St Ann.

Technology transfer

Our technology transfer activities in 2004 comprised training and field days/field tours. A selection of these is as follows:

- 22 January 2004, General husbandry practices and registration of herd – Conducted in collaboration with the GBSJ at the Knockalva Agricultural School, Ramble, Hanover. (Resource persons: Albert Fearon, Derrick Vermont and Joel Barnes)
- 28 January 2003. Conducted field tour of SMDTC and HDTC for 20 students and one teacher from Lennon High School (Resource persons: Albert Fearon, Dwight Williams, Joel Barnes, Ralston Barnes & Norman Hanson)
- 15-17 March 2004, Small ruminant production systems and group dynamics. Training conducted for group participating in a CARTF Small Ruminant Project. St Johns, Antigua. (Resource person: Albert Fearon).
- 16 March 2004, General goat production and husbandry practices – Conducted for Bethel Town Action Committee, Bethel Town, Westmoreland. (Resource persons: Dwight Williams, Joel Barnes and Ralston Barnes)
- 20 March 2003. Conducted field tour of the SMDTC for 35 students and one teacher from Gravey Maceo High School (Resource persons: Albert Fearon, Dwight Williams, Joel Barnes & Norman Hanson)
- 8 April 2003, Conducted field tour of the SMDTC for 14 students and the Campus Manager from Caribbean



Christian Centre for the Deaf (Resource persons: Albert Fearon, Dwight Williams, Joel Barnes & Norman Hanson)

- 15 April 2003, Conducted training day at Meadsfield District, Knockpatrick in conjunction with ALPART Mining Venture on the nutrition and feeding of small ruminant with special emphasis on forages and agro-industrial by-products (Resource persons: Erick Green, ALPART Mining Venture, Ralston Barnes, Albert Fearon, Joel Barnes, Dwight Williams, CARDI and Earl Shakespeare, RADA)
- 22 April 2004, Poster presentation at the Manchester 4-H Clubs Achievement Day in Mandeville, Manchester.
- 29 April 2004, Poster presentation at the Knockalva and Sydney Pagon Schools' Agriculture Exposition in Braes River, St Elizabeth.
- 20 May 2004, Poster presentation and practical demonstration on small ruminant production and management systems at the Schools' Science Exposition in Browns Town, St Ann (Resource persons: Albert Fearon, Dwight Williams and Joel Barnes)
- 23 June 2004, Seminar on "Goat health management" – Conducted in collaboration with GBSJ and the Jamaica Veterinary Medical Association (JVMA) at the Golf View Hotel in Mandeville, Manchester. (Resource persons: Cedric Lazarus, Osbil Watson and Paul Cadogan of the Veterinary Services Division, David Miller of MINAG and Albert Fearon, CARDI)

Table 10 Carcass characteristics of grower lambs on by-product feeds and commercial goat concentrate, Hounslow DTC*, 2003/2004

	Feeds					Mean
	I**	II	III	IV	V	
Carcass wt, kg	17.9	18.1	16.8	18.1	19.4	18.0
Dressing %	48.5	51.3	51.9	48.5	53.2	50.7
Carcass length, cm	78.0	75.8	71.3	78.7	77.5	76.3
LEA***, cm²	11.9	12.2	11.7	12.0	12.8	12.1

*DTC, Demonstration and Training Centre

I: wheat middling/hominy; II: wheat middlings/hominy with poultry litter; III: wheat middlings/citrus pulp; IV: wheat middlings/citrus pulp with poultry litter; V: commercial goat concentrate (control). *LEA: loin eye area

SED (4 d.f.) for comparing:

carcass weight = 1.49 (P=0.365), dressing % = 0.56 (P=0.494), carcass length = 4.56 (P=0.559), loin eye area = 0.62 (P=0.568)

- 21 July 2003, Conducted field tour of SMDTC and HDTC for 16 students and one tutor from Ebony Park HEART Academy. At SMDTC a demonstration on how to make molasses-urea block was conducted while at the HDTC a demonstration on how to make silage was conducted (Resource persons: Ralston Barnes, Norman Hanson, Joel Barnes, Dwight Williams, CARDI and Audley Facey, MINAG)
- 31 August 2004, Seminar on "Goat health and management" – Conducted in collaboration with the GBSJ and the JVMA, IICA and ASSP at the Civic Centre in Port Maria, St Mary. (Resource persons: Cedric Lazarus, Osbil Watson and Paul Cadogan of the Veterinary Division, Ministry of



Agriculture, and Francis Asiedu and Albert Fearon, CARDI)

- 18 November 2003, Conducted field tour of SMDTC for 40 students and four teachers from St. Thomas High School and the CASE (Resource persons: Albert Fearon, Norman Hanson & Erick Green, ALPART Mining Venture)

Linkages and Monitoring of Developments in the Small Ruminants Industry

In an effort to monitor the progress of the small ruminant industry, linkages are developed and maintained with different players in the industry, including MINAG R&D, RADA, JAS, Jamaica 4-H Clubs, ADC, ASSP and the GBSJ. During the year, we collaborated with MINAG and ASSP on the ASSP commissioned study on the competitiveness of the Jamaican small ruminant industry. This led to the commission by IICA of a more specific study on the feasibility of a dairy goat project in the Mocho area.

In collaboration with the GBSJ and MINAG six appraisals and four registration sessions were conducted during the year. Five hundred and twenty animals from six farms in the parishes of St Mary, Hanover, St Catherine and St Ann were appraised and registered. Also, the Livestock Team collaborated with GBSJ to conduct training sessions, at the Knockalva Agriculture School in Hanover; Mandeville, Manchester and Highgate, St Mary.

The marketing of goat products was monitored too through informal surveys at meat shops, major markets, slaughter houses, roadside butchers and supermarkets. There was a sharp rise in goat meat prices towards the end of the year especially after Hurricane Ivan, which caused considerable damage in the main goat producing areas of the island.

Generally, there were increases in the prices of goat products monitored in 2004 compared with 2002 (Table 11)

Table 11 Changes in the price of goat meat and breeding stock in Jamaica

Year	Average Price (J\$)				
	Meat (price/kg)		Breeding Stock (price/head)*		
	Live Weight	Dress Weight Local Imports	Does	Bucks	
1992	45	120	1,600	2,700	
1994	80	175	2,200	4,100	
1996	120	235	4,000	7,300	
1998	125	245	8,300	15,700	
2000	135	265	120	7,400	18,500
2002	115	235	115	6,900	11,500
2004	225	375	160	11,800	19,700

* Based on averages of purebred and percentage breeding stock

Goat milk in liquid pasteurised and powdered forms, as well as goat cheeses were also available in some stores in the major towns.

The price of the liquid milk ranged from J\$270–J\$337.5/L while the powdered milk was being sold at J\$1,012.5/kg. The



cheeses which came in different brands and weights were available at a cost of J\$2,475-J\$2,700/kg. The sources of the milk and milk products included France, Germany and the United States. The proprietors of the stores indicated that as soon as the products were displayed they were sold out as nursing mothers were using the goat milk in baby feeds to treat lactose intolerance in their babies, while others were using the milk for various other health reasons.

Status of imported small ruminants

The importation of improved breeds over the past 12 years has had a marked impact on the small ruminant industry in Jamaica. For the most part the effect has been positive, but some questions have been asked in recent times about the status of these animals and the effect they have on the local industry. A survey was, therefore, initiated to determine the status of the imported small ruminants. The survey was about 30 per cent complete at the end of the year. The emerging trends suggest greater susceptibility of the imported breeds to internal parasitism than the Native goat. Other issues include a trend towards the development of mild to serious resistance to some anthelmintics, kidding difficulties in some females and higher predisposition of the bucks to urinary calculi.

Natural Resource Management

The goal of the Natural Resource Management programme 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 2004, the programme concentrated mainly on organic agricultural production and research and the intensification of the development and application of Geographic Information Systems (GIS) technology. The research on organic agricultural production was conducted principally at the CARDI Mona Demonstration and Training Centre.

Organic Agriculture Research

The Mona Demonstration and Training centre (DTC) provides the facilities for the execution of the on-station organic and other field trials under controlled and monitored conditions.

Weather report for the Mona DTC

Monthly rainfall data for the DTC for the year are shown in **Figure 4**, along with rainfall data for 2003. Total rainfall for 2004 was lower than in 2003. In fact, rainfall in each month of 2004, except September, was either the same or lower than that in 2003. September was the wettest month of the year, but most of the

rain in that month was associated with the passage of Hurricane Ivan.

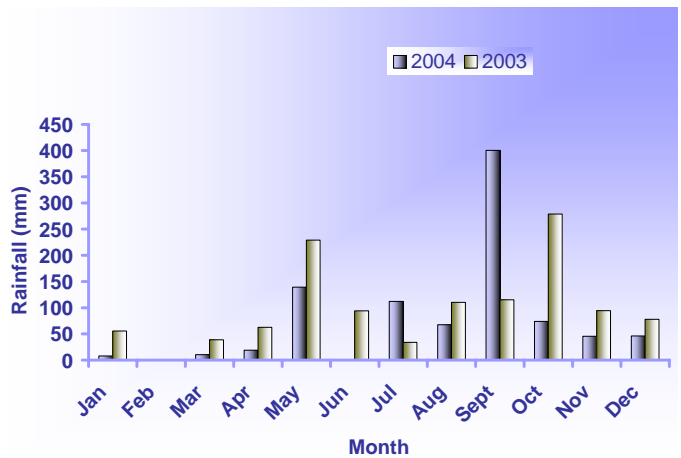


Figure 4 Mean monthly rainfall for 2003 and 2004 at the Mona Demonstration and Training Centre

Demonstration of organic farming techniques

Organic farming demonstration plots

Trials on organic callaloo and West Indies Red hot pepper production were conducted during the year using three types of organic nutrient sources, goat manure, cow manure and vermi-compost from coffee.

Organic callaloo studies

On the callaloo plots (**Plate 4**) the cow manure was applied at two rates, making a total of four treatments as follows:

T1: Cow manure at 0.25 kg per plant hole (approx. 3,750 kg/ha)

- T2: Cow manure at 0.5 kg per plant hole (approx. 7,500 kg/ha)
- T3: Vermi-compost at 0.5 kg per plant hole (approx. 7,500 kg/ha)
- T4: Goat manure at 0.5 kg per plant hole (approx. 7,500 kg/ha)

The yield data are presented in **Tables 12**. Generally, the data indicate that goat manure had a more beneficial effect on both the total and marketable yields of callaloo than did vermin-compost and cow manure.



Plate 4 Callaloo trial plot

For specific biweekly harvests, the total yield of the first and third harvests showed that the goat manure had significantly ($P < 0.05$) higher yields than vermi-compost. Goat manure also had significantly ($P < 0.05$) higher yield than cow manure at the third harvest. There was no significant ($P < 0.05$) difference between the goat manure and the lower cow manure treatments at the first harvest (**Table 12**).

Table 12 Yields of callaloo grown under four organic manure treatment levels, Mona DTC*, 2004

Time	Treatment				LSD
	T1	T2	T3	T4	
<i>(a) Total yield (kg)</i>					
First harvest	4.11ab	3.91b	3.97b	5.33a	1.23
Second harvest	4.68	4.43	4.30	5.88	2.21
Third harvest	3.73b	3.23b	3.13b	5.15a	0.87
Total harvest	12.52b	11.57b	11.40b	16.36a	2.95
<i>(b) Marketable yield (kg)</i>					
First harvest	0.81	0.61	0.66	1.29	0.93
Second harvest	2.25b	2.03b	2.28b	3.43a	0.83
Third harvest	0.00	0.03	0.00	0.00	NA
Total harvest	3.06b	2.67b	2.94b	4.72a	1.48

*DTC, Demonstration and Training Centre
 T1: Cow manure at 3,750 kg/ha; T2: Cow manure at 7,500 kg/ha; T3: Vermi-compost at 7,500 kg/ha; T4: Goat manure at 7,500 kg/ha
 Values in the same row followed by the same letter are not significantly different ($P > 0.05$)

For the marketable yields, significant differences were detected only during the second harvest. Goat manure showed significantly ($P < 0.05$) higher yield than vermi-compost and cow manure (**Table 12**).

The more important observation from these results is the low ratio of marketable yield to total yield; about 1:4, on average. This was a result of the pest infestation of the crop from the very beginning of harvest. This was quite different from the

previous year when the pest infestation slowly built up as the crop moved from the first to fifth harvest. The reason for this difference may be in the type of irrigation practiced during this year. While in previous years drip irrigation was used, this year, sprinkle irrigation was used. This caused quite a difference in the micro-climate around the crop and may have precipitated the high pest incidence.

Organic hot pepper studies

On the hot pepper plots, the three manures were applied at the same rate, 0.5 kg per plant hole (approximately 5,000 kg/ha). The treatments were: T1: Cow manure, T2: Vermi-compost and T3: Goat manure.

The hot pepper grew well and continued to produce fruits to the end of the year. For most of the 12 weeks monitored (7 to 19 weeks after transplanting (WAT)), the vermi-compost treated plots had taller plants but the differences were not significant ($P < 0.05$).

The numbers and weights of fruits harvested per plant over seven harvesting weeks (11-17 WAT) are shown in **Tables 13 and 14**.

On average, the number of fruits per plant produced under vermi-compost (6.02) was 38 per cent higher than under cow manure (4.37) and 63 per cent higher than under goat manure (3.74, **Table 13**).

Similarly, the weight of fruits per plant produced under vermi-compost (51.7 g)

was 39 per cent and 96 per cent higher than under cow manure (37.2 g) and goat manure (26.4 g), respectively (**Table 14**).

Table 13 Number of hot pepper fruits harvested in the first seven harvests, Mona DTC*, 2004

Harvest	Age (WAT**)	No. of fruits/plant			LSD
		T1	T2	T3	
1	11	0.00b	0.83ab	2.33a	1.79
2	12	0.92	2.67	1.75	2.47
3	13	3.50	9.00	4.33	5.71
4	14	5.50	7.33	3.42	4.21
5	15	2.92ab	5.08a	0.00b	2.98
6	16	3.08	2.67	1.67	4.82
7	17	14.67	14.58	12.67	8.57

*DTC: Demonstration and Training Centre

**WAT: Weeks after transplanting

T1: Cow manure; T2: Vermi-compost; and T3: Goat manure all at 5,000kg/ha

Values in the same row followed by the same letter are not significantly different ($P > 0.05$)

Table 14 Weight of hot pepper fruits harvested in the first seven harvests, Mona DTC*, 2004

Harvest	Age (WAT**)	Wt of fruits/plant (g)			LSD
		T1	T2	T3	
1	11	0.0b	6.3ab	17.9a	14.1
2	12	6.9	21.8	11.3	19.3
3	13	29.0	77.1	30.1	52.8
4	14	50.7ab	66.7a	24.9b	38.2
5	15	26.7ab	42.4a	0.0b	27.0
6	16	20.9	20.3	13.8	34.9
7	17	126.0	127.2	86.9	72.6

*DTC: Demonstration and Training Centre

**WAT: Weeks after transplanting

T1: Cow manure; T2: Vermi-compost; and T3: Goat manure all at 5,000kg/ha

Values in the same row followed by the same letter are not significantly different ($P > 0.05$)

Under the prevailing climatic conditions in 2004, there appeared to have been a better overall performance of plots treated with vermi-compost compared to the cow and goat manures. In previous years, cow and goat manures were far superior to vermi-compost.

was further enhanced in 2004 with the participation of Leslie Simpson in two training courses (see page 30) and the subsequent application of the knowledge obtained to produce various maps related to activities in the Unit. These included a location map of all CARDI projects in Jamaica (Plate 5) and the provision of pertinent information for the ICENS *Soil Cadmium Management Project* (see page 26).

Application of GIS to other projects at CARDI

The capacity of the CARDI Jamaica Unit in Geographic Information Systems (GIS)

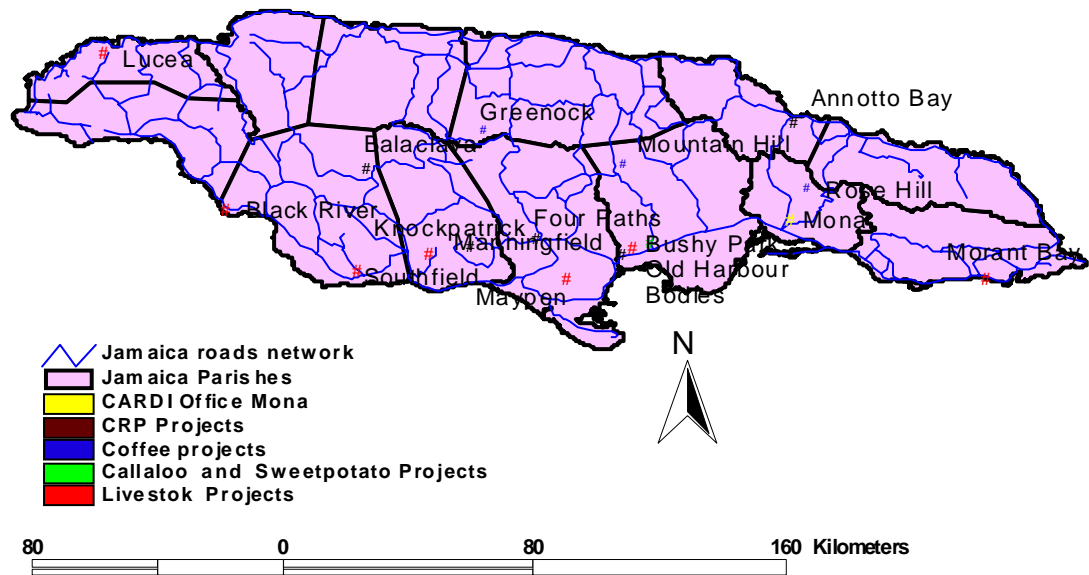


Plate 5 Map of locations of CARDI projects in Jamaica produced with Geographic Information Systems technology



Technical Assistance

In 2004, we continued to provide technical assistance in various forms to stakeholders in the agricultural and allied sectors as follows:

Technical Assistance Given

Technical assistance to the Agricultural Support Services Project (ASSP)

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

The revisions to the draft documents for hot pepper and sweetpotato were completed and re-submitted to ASSP in June 2004 and they were still being reviewed by the client as at the end of the year. CARDI and ASSP also agreed on the types of training aids required for the other crops - escallion, ginger, and papaya.

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

The International Centre for Environmental and Nuclear Science (ICENS) has been studying the levels of Cadmium (Cd) in Jamaican soils, the uptake of the element by food crops and the associated health risks for Jamaican and overseas consumers who use the food crops. The studies have documented high levels of Cd in soils in some yam-growing regions of the Island but uncharacteristically low levels in the yams. Therefore, ICENS decided to conduct a survey of yam farmers with the uncharacteristically low levels of Cd in the yams to determine whether the cultural practices of these farmers might be contributing to the low uptake of the element by the yams.

CARDI, through its Biometrics Service at the Headquarters, reviewed and advised on the draft survey instrument and, on completion of the survey, analysed the results and reported back to ICENS.

Technical assistance to the Jamaican Society for Agricultural Sciences (JSAS)

The Jamaican Society for Agricultural Sciences (JSAS) convened its 15th Annual Conference on 29 September 2004 and invited Dr Cyril Roberts, Biotechnologist and CARDI Representative for the Barbados Unit as the Guest Speaker (**Plate 6**) to speak on the conference theme – *Biotechnology in Agriculture*. The CARDI Jamaica Unit organised the visit of Dr Roberts to Jamaica.



Plate 6 Dr Cyril Roberts, Guest Speaker at the 15th Annual Conference of the Jamaican Society for Agricultural Sciences

Other technical assistance to stakeholders

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

- The Livestock group provided technical assistance to 39 farmers in the areas of selection of goat breeding stock, forages for feeding, setting up goat production units, outlay of appropriate goat housing facilities and general husbandry practices
- Eleven farmers were trained in the preparation and handling of animals for the Denbigh Agricultural Show and for those who had difficulties in getting their animals to Show, transportation was arranged through other farmers who had transportation at their disposal.
- Albert Fearon acted as Chief Small Ruminants Judge at the Hague (25 February 2004) and Denbigh Agricultural (31 July-2 August 2004) Shows

Boards and Committees Served

We provided technical expertise on several committees.

- Biological Control of the Coffee Berry Borer Project Management Committee (Kathy Dalip, Dionne Clarke-Harris, Leslie Simpson, Francis Asiedu)
- Goat Breeders Society of Jamaica Executive Committee (Albert Fearon)
- Methyl Bromide Working Group (Kathy Dalip)
- Mona and Sam Motta Demonstration and Training Centres Project Management Committees (Francis Asiedu, Leslie Simpson, Dionne

Clarke-Harris, Albert Fearon, Dwight Williams, Adlai Blythe)

- Plant Health Coordinating Committee (Kathy Dalip)
- Jamaica 4-H Clubs Goat Revolving Project Committee (Albert Fearon)
- Jamaica Organic Agriculture Movement (JOAM) Programme Management Committee (Leslie Simpson, Kathy Dalip)
- Jamaican Society for Agricultural Sciences Executive Committee (Francis Asiedu)
- CTA Advisory Committee on Science and Technology for Agricultural and Rural Development (Francis Asiedu)

In Jamaica, the inaugural meeting of the NCCARD was held on 25 August 2004 (Plate 7). The meeting, attended by 23 persons representing nine agencies/institutions, agreed on the broad terms of reference of the Committee.



Plate 7 Inaugural meeting of the National Coordinating Committee on Agricultural Research and Development in Jamaica

Institutional Collaboration

National Coordinating Committee for Agricultural Research and Development in Jamaica (NCCARD)

National Coordinating Committees for Agricultural Research and Development (NCCARD) were initiated in several countries in the region with the view to promoting and fostering greater cooperation and collaboration among the agencies and institutions involved in agricultural research and development. The Ministries of Agriculture chair the Committees and CARDI provide secretarial services.

Collaboration with Inter-American Institute for Co-operation on Agriculture (IICA)

During the year we had several discussions with the Jamaica office of the Inter-American Institute for Co-operation on Agriculture (IICA) in an effort to strengthen the linkages between the two agencies. We developed proposals for the

provision of technical services on the IICA-managed Walkers Wood Agricultural Project (WWAP) and the Mocho Goat Project under the overall CARDI/IICA Financial Agreement. Funds were not released during the year for the execution of the activities. Nevertheless, on 26 May 2004, CARDI accepted an invitation from IICA to be part of a technical team at a Field Day for farmers at the WWAP. The topics covered at the field day were weed control and soil fertility management.

Collaboration with Jamaica Bauxite Institute (JBI)

We also initiated collaborative arrangements with the Jamaica Bauxite Institute (JBI) in 2004. We developed concept notes for the consideration of JBI in the following areas:

- Provision of biometrics services to JBI’s field trials
- Collaboration on the JBI Castor Bean Project.
- Collaboration on the Soil productivity assessment and improvement of restored mined out bauxite lands project



Plate 8 Ms Judith Francis of the Technical Centre for Agricultural and Rural Cooperation (CTA) on a field visit

The proposals were still under consideration as the year ended.

Collaboration with Technical Centre for Agricultural and Rural Cooperation (CTA)

The CARDI Headquarters in Trinidad & Tobago is the Caribbean Regional Branch Office of the Netherland-based Technical Centre for Agricultural and Rural Cooperation (CTA). However, under its Science and Technology Strategies Programme, CTA pursues direct collaboration with countries and institutions.

Against this background and following the Caribbean Regional Meeting on Science and Technology under the theme *Enhancing the Science and Technology*

Policy Dialogue – Innovation for Development, Ms Judith Francis, Senior Programme Coordinator, CTA visited with the CARDI Jamaica Unit during 8-12 October 2004 to discuss the execution of a project on Farmer Experimentation and Innovation in Jamaica (Plate 8).

We agreed on an outline of a project to be executed in 2005.



Training, Meetings, Workshops and Seminars

Trainings Attended

GIS Applications

During 26-29 April 2004, Leslie Simpson attended a training workshop on GIS technology in Trinidad. The workshop provided tremendous information on GIS technology.

He also attended a training workshop on 15 June 2004 in Jamaica on People Participatory Geographic Information Systems (PPGIS). PPGIS is described as a collaborative process which allows for the merging of indigenous spatial knowledge of the community with new geographic information technologies to produce geographic maps which are more informative and capable of enhancing management decisions processes

Meetings Attended

- 9 January 2004, Meeting with ICENS to discuss CARDI's involvement in the Cd Soil management project (F Asiedu, L Simpson)

- 23 January 2004, Meeting with Dr P.I. Gomes to discuss FAO's poverty alleviation project (F Asiedu, L Simpson)
- 12 March 2004, Meeting of CARDI Chairman of the Board of Directors, Executive Director and collaborators (All staff)
- 31 March 2004, Meeting with Mr Morag Webb of the Capacity Building section of COLEACP-PIP to discuss CARDI's involvement in the PIP (F Asiedu, D Clarke-Harris, L Simpson, K Dalip)
- 18 May 2004, Meeting with Drs Steve Jaffe and Spencer Henson of the International Trade Department of the World Bank, to discuss our experiences working with the IPM CRSP and also in organic farming (D Clarke-Harris, L Simpson, K Dalip)
- 30 June 2004, Official launch of the national action plan of the Caribbean Agrochemical Management Project (D Clarke-Harris, L Simpson)
- 6 July and 10 August 2004, First and second meetings of the Plant Health Coordinating Committee (K Dalip)
- 5-6 August 2004, Meeting on "Globalizing IPM through Participatory Research: Lessons from the IPM CRSP", Washington DC (D Clarke-Harris)
- 25 August 2004, Inaugural meeting of the National Coordinating Committee for Agricultural Research and Development (NCCARD) in Jamaica (F Asiedu, L Simpson, K Dalip, A Fearon)



- 29 September-1 October 2004, Meeting with IPM CRSP collaborators and vegetable farmers in Trinidad and to wrap up activities in Phase II of the project (D Clarke-Harris)
- 30 September 2004, Meeting to launch the National Plan of Action of pesticide use in Jamaica, Kingston (L Simpson)

Workshops/Seminars Attended

- 26 January 2004, Workshop on Anthurium code of practice sponsored by the Jamaica Exporters Association (JEA) and the Caribbean Programme for Economic Competitiveness (CPEC) project, Kingston, Jamaica (F Webb, L Simpson)
- 2-6 February 2004, Workshop for scaling up outputs of the project on the “Best management practices for the amelioration of sediment and agrochemical pollution in the Caribbean”, Castries, St Lucia (L Simpson, C DeFreitas)
- 1 April, 2004, Seminar on “Management of Cadmium in soils: an Australian perspective”, ICENS, Mona (F Asiedu, L Simpson)
- 31 May-4 June 2004, Second Caribbean Environmental Forum & Exhibition (CEF-2), Trinidad & Tobago (L Simpson)
- 19-23 July 2004, 40th Annual Meeting of the Caribbean Food Crops Society, St Johns, US Virgin Islands (F Asiedu, K Dalip)
- 1–4 August 2004, IPM CRSP visit to Pennsylvania State University and presentation of a seminar entitled “Highlights of Agricultural Research: A CARDI perspective” (D Clarke-Harris)
- 26 August 2004, Seminar on “Promotion of organic farming in Jamaica–Summary of report”, Kingston, Jamaica, (L Simpson, K Dalip)
- 28 September 2004, Workshop of the Caribbean Hot Pepper Industry and Launch of the Caribbean Hot Pepper Association, Barbados (D Clarke-Harris)
- 29 September 2004, 15th Annual Meeting of the Jamaican Society for Agricultural Sciences, Kingston, Jamaica (F Asiedu, K Dalip, A Fearon, M Brown)
- 23-25 November 2004, 18th Annual Science & Technology Conference and Exposition, Kingston, Jamaica (L Simpson)

Exhibitions and Shows

CARDI participated in the National Youth in Agriculture exposition held at the Denbigh Agricultural show Complex on 18 March 2004

CARDI at the Denbigh Agricultural and Industrial Show 2004

The CARDI Jamaica Unit participated fully in the 52nd Annual Denbigh Agricultural and Industrial Show held during 31 July-2 August 2004 under the theme “We are what we eat, let’s eat Jamaican.” We showcased our work in IPM of vegetable crops and sweetpotato, goat management systems, biological control of the coffee berry borer and natural resources management, particularly soil management and organic agriculture, and also participated in the goat championships judging competition (Plates 9 and 10). The booth was tastefully designed and attracted over 1,100 visitors during the three days show. Among the visitors were special invitees to the year’s show, the Ministers of Agriculture from Barbados, Mr Erskine Griffith, Belize Mr Servulo Baeza, and the Cayman Islands, Mr Gilbert Mc Clean and the Minister of the Environment from Bermuda Ms Neletha Butterfield.

Additionally, the Livestock Team conducted two training sessions on how to make molasses-urea feed blocks. Also, goats

from the Sam Motta DTC and exhibited by us won three first prizes in the Mature Native Goat, Purebred Nubian under one year and Purebred Alpine under one year categories (Plate 11).



Plate 9 Patrons to the CARDI booth in discussion with staff



Plate 10 Patrons viewing CARDI small ruminant poster

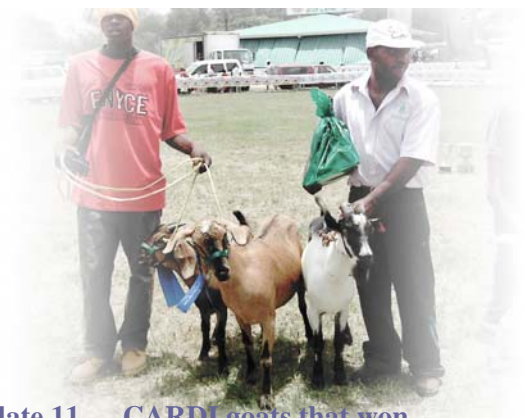


Plate 11 CARDI goats that won prizes at the Denbigh Agricultural Show



Publications

Scientific Publications

- Asiedu F H K and Fearon A L. 2004. Partnering for sustainable development – the case of CARDI and partners in the development of the goat industry in Jamaica. A paper presented at the 40th Annual Meeting of the Caribbean Food Crops Society, St John, US Virgin Islands, 19-23 July 2004
- Dalip K M. 2004. The case of farmers, national, regional and international agencies partnering for the control of coffee berry borer in Jamaica. A paper presented at the 40th Annual Meeting of the Caribbean Food Crops Society, St John, US Virgin Islands, 19-23 July 2004
- Goldsmith J, Edwards C A, Martin R, Clarke-Harris D, Banks O and Schroeder M. 2004. A survey of the influence of pesticide use on the incidence of Broad Mite (*Polyphagotarsonemus latus* Banks) and its predators on hot peppers in Jamaica. (Submitted to *Phytoparasitica*)
- Goldsmith J, Edwards C A, Clarke-Harris D, and James O. 2004. Effects of biorational pesticides on the incidence of Broad Mite (*Polyphagotarsonemus latus* Banks) and its predators on hot peppers in Jamaica. (Submitted to *Phytoparasitica*).
- Jackson D, Lawrence J, Dalip K, Chung P, Clarke-Harris D, Bohac J R, Tolin S, and Edwards C. 2004. The sweetpotato leaf beetle, *Typophorus nigritus viridicyaneus* Crotch (Coleoptera: Chrysomelidae), an emerging pest in Jamaica: Distribution and host plant resistance. *Tropical Agriculture* (In press)
- Miller D, McDonald D and Asiedu F H K. 2004. The effect of mulberry leaf meal on the growth performance of weaner goats in Jamaica. A paper presented at the 15th Annual Conference of the Jamaican Society for Agricultural Sciences, Kingston, 29 September 2004
- Pitterson P and Dalip K M. 2004. Assessment of establishment of *Cephalonomia stephanoderis* Betrem, a parasitoid of the coffee berry borer, at a selected site in the Blue Mountains, Jamaica. A paper presented at the 15th Annual Conference of the Jamaican Society for Agricultural Sciences, Kingston, 29 September 2004
- Simpson L A. 2004. Possible effects on the environment of agricultural practices on hillsides in the Caribbean. A paper presented at the Second Caribbean Environmental Forum & Exhibition (CEF-2), Trinidad, 31 May–4 June 2004
- Simpson L A and Lauckner F B. 2004. Some social, environmental and economic implications of increased soil erosion and agro-chemical use in Caribbean agriculture. A paper presented to the Agro-Economic



Society conference (CAES) in Suriname, 15-21 August 2004

Simpson L A and Martin R D. 2004. Studies on vermi-culture and organic vegetable production in Jamaica. A paper presented at a workshop on sustainable organic agricultural development, Guyana, 6-10 September 2004

Simpson L A and Fearon A. 2004. Environmental management and risk reduction in Jamaican agricultural production practices. A paper presented at the Caribbean 2004 Conference on Hazard and Disaster Management, Montego Bay, 15 October 2004

Simpson L A, Clarke-Harris D, Dalip K M, Fearon A, Asiedu F H K and Williams D. 2004. Transforming research results into viable businesses in Jamaican agriculture–The contribution of CARDI. A paper presented at the Scientific Research Council, 18th Annual Science & Technology Conference and Exposition, Kingston, 23–25 November 2004

Williams D, Asiedu F H K, Fearon A and Barnes R. 2004. Comparative yield of varieties of *Mucuna pruriens* grown on trellises on reclaimed bauxite soil. A paper presented at the 15th Annual Conference of the Jamaican Society for Agricultural Sciences, Kingston, 29 September 2004

Reports and Short Presentations

Asiedu F H K. 2004. The nutrition and feeding of goats and sheep. A PowerPoint presentation made at a seminar on “Goat Health and Management” organised by CARDI, the Goat Breeders Society of Jamaica (GBSJ) and the Jamaica Veterinary Medical Association (JVMA), Inter-American Institute for cooperation, Port Maria, 31 August 2004

CARDI. 2004. Draft of final five-year report on project on Biological control of the coffee berry borer, *Hypothenemus hampei* Ferr. in Jamaica

CARDI. 2004. Sixth Quarterly Technical Report, April to June 2004, Research Services – Entomology, Citrus Replanting Programme (CRP) of the Ministry of Agriculture, Jamaica

Fearon A L. 2004. Husbandry tips for goat farmers. A PowerPoint presentation made at a seminar on “Goat Health and Management” organised by CARDI, the Goat Breeders Society of Jamaica (GBSJ) and the Jamaica Veterinary Medical Association (JVMA), Inter-American Institute for cooperation, Port Maria, 31 August 2004

IPM CRSP 2004. Overview of the Caribbean Site. A report for Year 11, 2003-2004

Simpson L A. 2004. A seminar on soil conservation in Jamaica. A presentation to senior students of the



Holy Childhood High School,
Kingston, 30 March 2004

Professional Bodies

- Caribbean Food Crops Society (Francis Asiedu, Dionne Clarke-Harris, Kathy Dalip)
- Jamaica Society for Agricultural Sciences (Francis Asiedu, Leslie Simpson, Dionne Clarke-Harris, Albert Fearon, Kathy Dalip, Dwight Williams, Maxine Brown)
- New York Academy of Sciences (Francis Asiedu)
- Tropical Grasslands Society of Australia (Francis Asiedu)



Administration and Personnel

Administrative Report

The Coffee Berry Borer Project came to an end in August 2004 and the Administrative Section facilitated the smooth handing-over process by preparing the necessary final accounts. Final accounts for the IPM-CRSP Project which ended on 30 September 2004, were also completed and submitted to the donor agency. Two staff training exercises were also facilitated during the year; a one-week Project Development and Documentation training course which was attended by Kathy Dalip, Anthony Trought, Maxine Brown and Francine Webb and another one week training on how to develop a successful project proposal.

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 the year; vegetables (callaloo and pepper), root crop (sweetpotato) and coffee. The Head of Section was Dionne Clarke-Harris who also functioned as Project Manager for the IPM Vegetables sub-project. Jerome Wright functioned as Research Assistant while Donald Simpson and Paul Samuels provided technical assistance for

the project. Kathy Dalip was the Project Manager for the IPM Root Crop sub-project and the Coffee project. Francine Webb and Anthony Trought were the Research Assistants for the Coffee and Root Crop sub-projects respectively, while Desmond Jones and Patrick Pitterson served as Technical Assistants. The Coffee sub-project ended on 31 August 2004, and with it, the contracts of the staff members assigned to the project. The main IPM Vegetables and Root Crop Grant Projects ended on 30 September 2004 and the contracts of Jerome Wright and Anthony Trought also ended on that date.

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 is responsible for the management of the Mona DTC and our GIS project.

The Livestock Section is responsible for the management of the Sam Motta DTC. Albert Fearon was the Head of Section while Dwight Williams functioned as Project Manager. The staff compliment was completed with Ralston Barnes and Joel Barnes as Technical Assistants and Norman Hanson as Foreman for the day-to-day management of the SMDTC.

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/Expeditor, one Office Helper and one Field Labourers assisted him.



Staff List

Professional staff

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

Technical staff

Allen, Carlton	Research Assistant	IPM Section
Asiedu, Elizabeth	Accounts Clerk	Administration Section
Bailey, Una	Office Helper	Administration Section
Barnes, Joel	Technician	Livestock Section
Barnes, Ralston	Technician	Livestock Section
Brown, Maxine	Research Assistant	CR's Office
Davis, Winsome	Accounts Clerk	Administration Section
Hanson, Norman	Foreman	Livestock Section
Jones, Desmond	Technical Assistant	IPM Section
Maxwell, Ervin	Field Labourer	Administration Section
McDonald, Lloyd	Driver	Administration Section
Morris, Erna	Accounting Assistant	Administration Section
Pitterson, Patrick	Technical Assistant	IPM Section
Powell, Sandra	Receptionist	Administration Section
Robinson, Kenrick	Technical Assistant	NRM Section
Samuels, Paul	Technical Assistant	IPM Section
Sangster, Andrea	Secretary	Administration Section
Simpson, Donald	Technical Assistant	IPM Section
Trought, Anthony	Research Assistant	IPM Section
Webb, Francine	Research Assistant	IPM Section
Wright, Jerome	Research Assistant	IPM Section



Visitors

During the year the following persons visited the CARDI Jamaica Unit

Archer, Alexander	Farmer, Goat Breeders Society of Jamaica
Archibald, Keith	CARDI BOD Chairman
Asmelash, Habtom	FAO Consultant, Rome
Bailey, Anne	Spelman College, USA
Bailey, Jairzeho	Agri-Business of Jamaica
Baldwin, Moss	Virginia Polytechnic
Barreyro, Hector, Dr	IICA Representative, Jamaica
Bell, Julia	IPM CRSP – Colorado
Braithwaite, Richard A. I.	UWI St Augustine, Trinidad & Tobago
Briggs, Larry	Ramapo College, New Jersey
Burton, Jonathan	University of Tennessee
Burton, Thomas	RADA
Campbell, Louis	Coffee Industry Board
Chung, Phillip	RADA
Coates-Beckford, Phyllis	Life Sciences, UWI
Cohen, Jane	Life Sciences, UWI
Cui, Liwang	Penn State University
Dallas, Joseph, Dr.	Ramapo College, New Jersey – IPM CRSP
Dorrett, Arnold A.	BAIC, Nassau Bahamas
Douglas, Charles	Consultant
Edwards, Clive	Ohio State University
Finch, Alexander	Ramapo College, New Jersey
Fleischer, Shelby	Penn State University
Francis, Judith	CTA
Futell, Wendy	University of Tennessee
Gardon-Paul, Marc	Ramapo College, New Jersey
Gayle, Leo	University of Tennessee
Gibson, Kristen	University of Tennessee
Gillian, Devin	University of Tennessee
Goehagen, Denise	Food Storage and Prevention of Infestation
Gomes, P	FAO Food Security Project, Trinidad & Tobago
Gordon, Dianne	Jamaica Bauxite Institute
Grajewsla, Laren	Ramapo College, New Jersey
Griffiths, Anthony, Dr.	BAS, Barbados
Henson, Spencer	University of Guelph, Canada
Harrison, Richard	Ministry of Agriculture
Holness, Jasmin	Bodles Research Station
Hosein, Azim	CARDI Guyana
Hopkins, Adam	University of Tennessee
Hyder, Jessica	University of Tennessee



Irving, Chris	USA
Iton, Ardon	CARDI HQ
Jackson, D. Michael	USDA ARS
Jaffé, Walter	Venezuela
Jaffee, Steven	World Bank, Washington
James, Lionel	CDB
Khan, Suraz	Trinidad & Tobago Sheep & Goat Association
Lambert, Hugh	Jamaica Bauxite Institute
Lopez, Vyjayanthi	CABI
Maneen, Rebecca	Ramapo College, New Jersey
McComie, Lilory	Ministry of Agriculture, Trinidad & Tobago
McLughlin, Wayne	Biotechnology Centre, UWI
McPherson, Elvis	Goat Breeders Society of Jamaica
Miller, Bruce	Penn State University
Miller, David	Ministry of Agriculture, Bodles
Momsen, Janet	University of California, Davis
Mortensen, Dave	Penn State University
Nelson, Laforja	Ramapo College, New Jersey
O’Melia, Gina	Ramapo College, New Jersey
Owens, Sonsaray	Ramapo College, New Jersey
Parham, Wendel	CARDI HQ
Pasqalone, Doyenick	RCNS USA
Paul, Harriett A.	Florida A & M University
Rhodes, Llewellyn	CARDI St Kitts & Nevis
Riley, Ainsworth	Jamaica Exporters Association
Roach, Adrienne	University of Tennessee
Robinson, Dwight	Life Sciences, UWI
Samuda, Pauline	Caribbean Food Nutrition Institute
Sampson, Terry	School of Tropical Agricultural & Natural Resource, FSA, UWI
Selby, Loren	IPM CRSP – California
Schweithelm, Jim	ARD, Inc
Smith, Delores	University of Tennessee
Smith, Michael, Dr.	University of Tennessee
Tolin, Sue	Virginia Tech
Vaeren, Pierre Vander	PIP, Belgium
Vermont, Derrick	Goat Breeders Society of Jamaica
Viotti, Manuel	Ramapo College, New Jersey
Whalen, Chris, Dr.	USA/Germany
Wilson, Maurice	CARDI Agri-business Unit
Wood, Aston	ADC/AMC
Yordanova, Dora	Ramapo College, New Jersey