Introduction of Clean *Dioscorea Alata* Planting Material into Small Farm Systems of Dominica

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The paper describes the collaborative efforts of the Ministry of Agriculture, Lands, Fisheries and Cooperatives (MOA), the Caribbean Agricultural Research and Development Institute (CARDI) and the French Technical Cooperation (FTC) to alleviate the problem of unavailability of clean yam planting material in the small farm systems of Dominica. CARDI is a regional organization, which serves twelve member states of the Caribbean Community by providing research and development needs of the agricultural sector as identified in national plans and policies. FTC is a unit of the Ambassade de France Cooperation Scientifique et Technique.

These organizations have chosen a farming systems approach to address the principal agronomic and organizational constraints to increased production in Dominica. Available evidence suggests it to be the most cost effective means of technology generation and diffusion in the complex milieu of the Dominican small farmer. The FTC has directed attention in its "Agrarian Systems in the Caribbean with Alternatives for Development Project" to defining the on-farm decision-making processes and rationalization of farmers' practices in a given location with a view to utilizing the framework for planning information flow to farmers. This would be achieved by farming systems research and an extension methodology based on an intimate knowledge of the farming systems gained whilst living in a rural community. CARDI, initially through the "Small Farm Multiple Cropping Systems Research Project," and currently through the "Farming Systems Research and Development Project," both funded by USAID, has moved away from traditional commodity and discipline-oriented agricultural research which proved time-consuming and elusive in producing transferable results. Efforts represent a comprehensive agricultural strategy encompassing marketing, extension, production, input distribution and policy dialogue to address the principal constraints.

The above organizations, through various surveys and farm characterizations, have identified the shortage of adequate quantities of clean, certified planting material of good quality as a principal constraint to agricultural production of root crops, tuber crops, legumes and fruit crops. Initially, attention was directed to *Dioscorea spp.*, since CARDI's Barbados unit had developed virus-tested White Lisbon yam, *D. alata*, and anthracnose resistant (Bilep and SEA 189) and virus tested (White Lisbon) *Dioscorea alata* cultivars respectively during the last decade. In 1981 to 1982 samples of the above material were introduced into Dominica in order to alleviate the problem of lack of clean planting material.

This paper describes the farming systems' methodologies utilized by CARDI and FTC to introduce this clean yam planting material into the small farm systems of Dominica. Results to date are discussed herein.

Overview of Small Farm Systems in Dominica

The terrain of Dominica is rugged and mountainous, and the inaccessible central forested mountain ranges make about 60% of the island unsuitable for agriculture. The remaining 40%, with better edaphic and topographic characteristics, is occupied by a small number of large plantations. Most small farms are located on the fringes of these plantations going inland on steep mountain slopes. Recently there has been a trend towards fragmentation of some of the larger plantations, making such land available to small farmers.

A common feature of the small farms is the very complex, mixed farming systems. A number of crops and livestock species are simultaneously kept on the same parcels of land.

The tropical climate (mean temperature of 28°C, 15° N. Latitude and 61° W. Longitude), heavy rainfall (1250mm to 8750mm average), volcanic soils, and various agro-socio-economic factors have led to the following major constraints to small farm systems:

1. limited and disorganized markets,  
2. limited accessibility of farms,  
3. expensive farm labour and an extremely low level of mechanisation,  
4. unavailability of agricultural inputs (feeds, seeds, livestock, tools, fertilizers, agri-chemicals, containers and drugs),  
5. endo- and ecto-parasites in livestock,
Yams in the Small Farm Systems of Dominica

Traditionally, on the majority (80%) of small farms, about a dozen yams are grown for home consumption. In addition some farmers harvest "Babaoule" yam from roadsides and forested areas. However, the farms which grow yams commercially are fewer in number and possibly less than reflected by the data in Table 1. Of the 29% of the small farms which produce yams for the local and export markets, most of them plant on sloping terrain, on elaborately formed mounds 38 - 60cm high, 90 - 150cm apart, and invariably intercropped with one or more of the following: cucurbits, dasheen, tannia, pigeon peas, banana, plantains or corn (CARDI Annual Report, 1981). In some instances the intercrops are harvested before the yam vines cover the ground, thus leaving the yams to remain in pure stands.

Yam production technology is generally low; the "overworked" soil is formed into mounds. Stakes 1m - 2m high are used and the mixed "banana" fertilizer (NPK + 4MgO) is usually banded on the surface, around the plant, and left exposed to the heavy rains. Liberal use is made of wood ashes with some farmers using pen manure where available. Limited use is made of straw and other coarse organic matter as a soil ameliorant. Few farmers specialise in a single cultivar, thus many cultivars and different species are found in a single plot. The four main species are D. alata, D. rolandata, D. cayenensis (Ladies yam), and D. trifida (Cush-cush), with the latter two the most popular species. Nematodes, viruses and anthracnose were observed as serious diseases and pests on yam farms (Fergusson, 1981). No measures to combat them were observed. Planting material was carried over from crop to crop, and this, coupled with limited crop rotation, permitted a steady build-up of pests. This is especially so for viruses and nematodes.

Planting of yams is usually spread from January to as late as June, peaking in March, April and May, with harvesting from October through February. Incomplete and repeated harvests ("castrations") are practised for home consumption; complete harvests are usually done only for the market. Storage is practised mainly in cool, well ventilated spaces, and to a lesser extent in the mounds on the vines.

The estimated volume of production of root crops in 1983 is given in Table 2. The local market prices of yams for 1983 ranged from $1.20/kg - $2.86/kg, fluctuating with the cultivar and season. (Market Intelligence Unit, Ministry of Agriculture, 1984). For dasheen and tannia the range over the same period was $0.84/kg - $1.44/kg and $1.50/kg - $2.50/kg, respectively.

A Case Study of a Commercial Yam Farm

This farm, located in the southeast of the Island, was primarily a banana-based farming system (1.4ha of banana providing 70% of the farm income). Yams, dasheen, cinnamon and mixed vegetables were also produced on a commercial scale. Yams were grown on 0.1ha (1/4 acre) with about 1000 mounds providing 20% of the total farm income and 10% of the total quantity of

<table>
<thead>
<tr>
<th>Crop</th>
<th>1983 Production (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dashen</td>
<td>10,700</td>
</tr>
<tr>
<td>Tannia</td>
<td>6,250</td>
</tr>
<tr>
<td>Yam</td>
<td>3,600</td>
</tr>
<tr>
<td>Sweet Potato</td>
<td>1,300</td>
</tr>
<tr>
<td>Cassava</td>
<td>700</td>
</tr>
</tbody>
</table>

TABLE 1. The most commonly cultivated crops and their frequency of occurrence on 120 small farms in Dominica.*
root and tuber crops consumed by the farm family. The species
grown was Cush-cush (D. trifida), which was planted in March-
Operations during the crop were two hand-weeding, one fertiliz-
ing (57 g NPK/plant) and one staking, using only family labour.

The role of the yam in that farm system was to diversify pro-
duction, to provide food, to avoid total dependence on the
bananas and to utilise farm labour at a time when the bananas
could not employ the available labour. The latter was during the
drier parts of the year when the banana harvests are less frequent
and weed growth slower.

Table 3, based on the data from an annual longitudinal survey
of the farm, shows a partial economic analysis of yam production.
Attention was directed to the cash flow into and out of the
system.

TABLE 3. A summary cash analysis of commercial yam production on 0.1 ha of a
small farm in Dominica.

<table>
<thead>
<tr>
<th>CASH INPUTS</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilisers</td>
<td>40.00</td>
</tr>
<tr>
<td>transportation</td>
<td>40.00</td>
</tr>
<tr>
<td>labour</td>
<td>no cash paid (family labour) 740 m/h</td>
</tr>
</tbody>
</table>

Total 80.00

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>TOTAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>2273</td>
</tr>
<tr>
<td>sold</td>
<td>2136 1.76 3,760.00</td>
</tr>
<tr>
<td>home use</td>
<td>137</td>
</tr>
<tr>
<td>TOTAL CASH INCOME</td>
<td>3,760.00</td>
</tr>
<tr>
<td>TOTAL CASH SPENT</td>
<td>80.00</td>
</tr>
<tr>
<td>NET CASH INCOME</td>
<td>$3,680.00</td>
</tr>
</tbody>
</table>

Productivity of labour:

TOTAL yield = $5.41 per man/hr
Total labour 740 m/hr
On this farm a total of 2,600 man-hours were spent on the
bananas which brought in $12,000 during that year. The produc-
tivity of labour on the bananas was calculated at $4.60/man
hour, which was less than that of the yams.

On Station Tests
Consistent with the farming system research methodolofy,
(Fig. 1), the initial planting material introduced into Dominica
was evaluated largely at La Plaine Agricultural Station, a
southeast coastal area. This material included anthracnose resis-
tant cultivars from INRA, Guadeloupe, and virus tested material
from CARDI, Barbados (Table 4.) At La Plaine, total annual
precipitation, mean monthly maximum temperature, mean
monthly minimum temperature and monthly wind run ranged

| TABLE 4. Description of yam planting material introduced to Dominica 1981-84. |
|----------|----------|----------|----------|----------|----------|
| Cultivar | Species  | Source    | Character | Year     | Origin    | Quantity |
| White Lisbon A | D. alata  | CARDI Barbados | VT | 1981 | Barbados | 12 kgs |
| Belep | D. alata  | INRA Guadeloupe | AT | 1982 | New Caledonia | 25 kgs |
| SEA 189 | D. alata  | INRA Guadeloupe | AT | 1982 | Philippines | 75 kgs |
| V 1712 | D. cayenensis | INRA Guadeloupe | AT | 1982 | N.A. | 23 kgs |
| White Lisbon B | D. alata  | CARDI Barbados | VT | 1982 | Barbados | 75 kgs |
| White Lisbon C | D. alata  | CARDI Barbados | VTAT | 1984 | Barbados | 46 kgs |
| Oriental B | D. alata  | CARDI Barbados | VT | 1984 | Barbados | 46 kgs |
| Coconut Lisbon B | D. alata  | CARDI Barbados | VT | 1984 | N.A. | 5.0 kgs |
| White cush-cush | D. trifida | INRA Guadeloupe | VT | 1984 | N.A. | 46 kgs |

VT = virus tested; AT = anthracnose tolerant; N.A. = not applicable;
A, B, and C = 1st, 2nd and 3rd crop harvested by certified farmer after initial greenhouse source.
Ed., tubers cut and the desprouted setts planted. Yam setts were
available. Prior to all plantings, yam holes were treated with 5g
dried for 24 hours. Biocides used were benomyl, l,5g/l, captan
90cm to 150cm apart, or ridges 25cm to 40cm high and 75cm to
period. Well-drained acid soils of clay loam texture predominate.
Over the report period, either mounds 30cm to 60cm high and
90cm to 150cm apart, or ridges 23cm to 40cm high and 75cm to
150cm apart, were prepared after clean weeding and ploughing.
Prior to planting, all tubers were cut into 100g to 150g portions,
treated with insecticide and fungicide for 15 minutes and air-
dried for 24 hours. Bioicides used were benomyl, 1.5g/l, captan
5.5g/l, malathion 3ml/l and sevin 80wp 4g/l, depending on
parameters except for Portsmouth, where, because of its more
North West and South Central Districts in the 1983 season.
These locations are similar to La Plaine in edaphic and climatic
towards Bobrice in the South East Extension District and 19 farmers of Trafalgar,
Laudat, and Springhill in the Roseau Valley area, (Fig. 2). In all
instances, after harvest, farmers were mandated to return to
MOA the same quantity received for possible redistribution in
the ensuing season. FTC and MOA personnel organized to
monitor a few of these farmers to see how the newly distributed
yams fit into the farming system. In order to provide additional
planting material, yam multiplication centres were also establish-
ed at Portsmouth and Grand Bay Agricultural Stations in the
North West and South Central Districts in the 1983 season.
These locations are similar to La Plaine in edaphic and climatic
parameters except for Portsmouth, where, because of its more
sheltered location, the wind run is less and the temperatures
marginally higher. Portsmouth also differs topographically from
the other locations as the area has less steep slopes.


discussion

Results to date are shown in Table 5. Data on time to
emergence was not collected. In 1981, yield data for White
Lisbon, A grade, averaged only 1.6kg of tuber per plant, though
tubers were of good quality.

In 1982, data was recorded for White Lisbon B and C grades,
Blelsea 189, all D. alata, and V 1712, D. cayennensis. The
tuber yields of White Lisbon were 300% and 175% greater than those
1981 for grades B and C respectively. This could be attributed
to improved crop management as a result of the Station
Foreman’s training in Barbados. In 1982, White Lisbon also
yielded more than the other cultivars planted. The lowest yields
were recorded for cv. V 1712 0.5kg/plant), and the highest yield
from White Lisbon B of 4.8kg per plant. There was a small
difference between Blelsea and SEA 189; however, both had greater
yields than V 1712. In addition, White Lisbon B and C differed
by 2kg per plant. The above yields compare favourably with those
in the small farm systems in Dominica, where yields range from
1.8kg to 2.7kg/plant. Furthermore, in the 1982 cultivation, a
group of 14 plants was inadvertently planted in an area which was
previously a pen manure patch. Yields ranged from 2.7 to
15.5kg/plant with a mean of 7.4kg/plant. This, coupled with
noted interveinal chlorosis symptoms, indicative of nutritional
disorders in other areas, suggests that further yield improvements
can be achieved by augmenting plant nutrition.
Variation in tuber yield per plant could be attributed to the intensity of anthracnose in White Lisbon yam. However, genetic variations could have contributed to the lower yields of V 1712 (D. cayenensis) and SEA 189. Anthracnose levels of 0.8 and 0.0 were recorded for these respectively. The highest anthracnose intensity of anthracnose in White Lisbon yam. However, genetic, only a larger sett size from D. cayenensis since this cultivar is greater than those observed in Barbados which has a much drier environment, so that Oriental, grown at the Corona Station (precipitation 6,250 to 7,500), shows very little anthracnose incidence. This confirms observations in Barbados.

TABLE 5. Results of on station observations on introduced yam cultivars.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Species/Cultivar</th>
<th>No. of Plants</th>
<th>Anthracnose damage (0-5)</th>
<th>Insect damage (0-5)</th>
<th>Virus symptoms leaf (0-5)</th>
<th>Virus symptoms tuber (0-5)</th>
<th>Average Yield/ plant (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Plaine</td>
<td>1981</td>
<td>W. Lisbon (A)</td>
<td>50</td>
<td>data</td>
<td>not collected</td>
<td>1.6</td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1982</td>
<td>W. Lisbon (B)</td>
<td>238</td>
<td>0.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.8</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1982</td>
<td>W. Lisbon (C)</td>
<td>197</td>
<td>1.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1982</td>
<td>Belep</td>
<td>35</td>
<td>2.0</td>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1982</td>
<td>SEA 189</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1982</td>
<td>V 1712</td>
<td>28</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1983</td>
<td>W. Lisbon</td>
<td>483</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
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<tr>
<td>La Plaine</td>
<td>1983</td>
<td>Belep</td>
<td>180</td>
<td>2.0</td>
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<td>0</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>La Plaine</td>
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<td>SEA 189</td>
<td>80</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>La Plaine</td>
<td>1983</td>
<td>V 1712</td>
<td>14</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td>Grand Bay</td>
<td>1983</td>
<td>W. Lisbon</td>
<td>264</td>
<td>3.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>1983</td>
<td>W. Lisbon</td>
<td>179</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
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</table>

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References