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IMPROVING FARM INCOME BY INTERCROPPING AROIDS WITH BEANS

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ABSTRACT

During the cropping seasons of 1984 and 1985, experimental trials were conducted on farmers' holdings in St. Vincent where tannia and/or dasheen were intercropped with lima beans. Economic analyses of the different intercropping systems indicated that farm incomes were increased from intercropping. Incomes from tannia and dasheen were higher due to the presence of bean intercrops in the system. Returns from beans in the intercrop systems were significantly greater than the additional cost of growing the bean in the systems.

INTRODUCTION

Intercroping is the dominant small farmer practice in the Eastern Caribbean. It is a traditional practice characterized by minimal utilization of inputs such as fertilizer and insecticides. The nature of the crop species utilized varies from place to place depending on environmental and socio-economic factors.

There is documented evidence that suggests that intercropping gives higher and more dependable per hectare gross incomes than sole crops (Mathur, 1963; Norman, 1974; Norman and Pryor, 1978). In addition, intercropping can give a more even distribution of income.

An important phenomenon related to the risk-minimizing potential of intercropping is its popularity with small farmers who have neither enough resources to take risks nor enough land to diversify cropping by growing plots of sole crops. Also, small farmers have to satisfy their subsistence goals plus their profit goals from the same small piece of land. This makes intercropping ideal.

Owing to increases in population and in the prices of agricultural inputs, there is a growing interest in seeking technological alternatives for increasing food production and farm income. Intercropping therefore is receiving attention in CARDI's FSR/D Project.

In St. Vincent, dasheen (**Colocasia esculenta** var. **esculenta** Schott L.), eddoes (**Colocasis esculenta** var. **antiquoron** Schott L.), and tannia (**Xanthosoma saggittifolium** Schott L.) are grown extensively to satisfy both subsistence and income goals. The dasheen, tannia or eddoes are spaced relatively wide (up to 1.0 x 0.75 m). Due to the slow initial growth of the aroid, significant weed growth occurs in the interrow space.

Consequently, most farmers resort to hand weeding which is laborious, time consuming and expensive. In addition, since the tannia crop requires about nine months to mature, there is a long wait before any food or income is obtained from the aroid plots.

The main purpose of this study was to determine whether it is economical to intercrop aroid with beans and the magnitude of benefits which can accrue from such practices.

MATERIALS AND METHODS

The 1984-85 Experiments

The experiment was conducted in two agro-ecological zones in the north-eastern section of the island of St. Vincent. Zone 4a is characterized by rainfall of less than 2195 mm per year, 3-6 dry months, altitudes greater than 183 m and soil type of recent volcanic ash of the Soufriere series. Zone 4b is characterized by rainfall of 2159-2542 mm per year, one dry month per year and altitudes greater than 183 m, but less than 304 m. The soil type is similar to that of Zone 4a.

A randomized complete block design involving four treatments on four farms with 2 replicates per farm was used. Plot size was 18.0 m^2. A description of the treatments follows:

Code[1/]	Treatment
A + 4B	Tannia and dasheen intercropped with 4 bean plants per mound.
A + 3B	Tannia and dasheen intercropped with 3 bean plants per mound.
A + 2B	Tannia and dasheen intercropped with 2 bean plants per mound.
A	Tannia and dasheen with no bean intercrop (farmers' practice.

Mounds were made with a hoe and the aroids were planted on top of the mounds. Beans were planted on the sides of the mounds at the same time. A first weeding was done manually four weeks after planting at which time 56 grams of an NPK mixed fertilizer 16-8-24 was applied to the mounds. The beans were harvested as salad beans seven weeks after planting. A second weeding and a moulding operation was done 12 weeks after planting using a hoe. At that time, a second application of 56 grams of NPK fertilizer 16-8-24 was made.

1/ A = Aroid (tannia + dasheen);. B = Beans.

The dasheen was harvested in December 1984; the tannia, in March 1985.

Data on labour and material used during the experiment were collected on a bi-weekly basis.

The 1985-86 Experiment

The 1985 edperiment was conducted in the same area as the 1984-85 experiment. A randomized complete block design with three treatments on four farms and two replicates per farm was used. Plot size was 54 m^2. The treatments were as follows:

Code 2/	Treatment
A + 4B	Tannia intercropped with 4 bean plants per mound.
A + 3B	Tannia intercropped with 3 bean plants per mound.
A	Tannia with no bean inercrop.

The agronomic practices for the 1985-86 experiment were similar to those for the 1984-85 experiment, except that two applications of insecticide (Decis) were applied at 250 mls ha^{-1} for the control of insect pests on the beans.

RESULTS AND DISCUSSION

Although improved cropping systems have been designed, small farmers have been reluctant to adopt them. This reluctance may be an unwillingness or inability to bear risks associated with the new system or the cropping systems may not provide the highest family income.

If land is the most limiting factor, cropping systems which provide the highest returns per hectare also provide the highest family income. However, if labour or capital is most limiting, the systems which provide highest returns per unit of labour or capital, respectively, will also provide the highest family income. Analyses were therefore conducted to ascertain which intercropping treatments were most efficient in utilizing land, labour and capital. The mean yields of aroids and bean from the 1984-85 and 1985-86 intercropping trials, presented in Table 1, were used for the computation of returns for the analyses presented in Tables 2 and 3.

In the 1984-85 aroid/legume trial, treatment A+4B (intercropping aroid with 4 beans per mound) was most efficient in utilizing land, labor and capital in terms of the returns earned. For that treatment, returns to land, risk and management per hectare was $9521 while returns to land, risk and management per unit of labor and capital utilized were 1.7 and 6.7, respectively.

2/ A = Aroid (tannia); B = Beans

Table 1. Mean yields of aroids and beans (kg ha^{-1}) from the 1984-85 and 1985-86 aroid/legume intercropping trials

Year	Code[1/]	Crops	
		Aroid	Bean
1984-85	A+4B	17030	1562
	A+3B	15791	1142
	A+2B	15554	647
	A	15775	
1985-86	A+4B	17282	4231
	A+3B	16443	3396
	A	13486	

1/ A = Aroid; B = Beans.

Table 2. Costs and per hectare for the treatments in the 1984-85 aroid/legume intercropping trial (ha^{-1})

Category	Treatment Code[1/]			
	A+4B	A+3B	A+2B	A
Total receipts [2/]	22169	19882	18532	17532
Material costs [3/]	1421	1411	1402	1384
Returns to land, labor, risk and management	20748	184710	17130	15968
Labor cost [4/]	11227	11227	11227	10084
Returns to land, risk and management				
Per unit land (ha^{-1})	9521	7244	5903	5884
Per unit labor (ha^{-1})	1.7	1.3	1.1	1.2
Per unit capital (ha^{-1})	6.7	5.1	4.2	4.3

1/ A = Aroid; B = Bean
2/ Total receipts from tannia, dasheen and beans. Farm gate price of \$1.10 kg^{-1} for tannia and dasheen and \$2.20 kg^{-1} for beans.
3/ Material cost is cost for NPK fertilizer and been seeds only. Aroid planting material is assumed to be obtained free.
4/ Labor cost computed at \$2.00 hr^{-1}.

Table 3. Costs and returns per hectare for treatments in the 1985-86 aroid/legume intercropping trial (ha^{-1})

Category	Treatment Code[1/]		
	A+4B	A+3B	A
Total receipts[2/]	28317	25557	14834
Material costs[3/]	1480	1471	1384
Returns to land, labor risk and management	26837	24086	13450
Labor costs[4/]	11467	11467	10084
Returns to land, risk and management			
Per unit land (ha^{-1})	15370	12619	3366
Per unit labor (ha^{-1})	2.7	2.2	0.7
Per unit capital (ha^{-1})	10.4	8.6	2.4

1/ A = Aroid - tannia and dasheen, B =Beans
2/ Total receipts from tannia, dasheen and beans. Farm gate price of $1.10 kg^{-1} for tannia and dasheen and $2.20 kg^{-1} for bean.
3/ Material costs include NPK fertilizer and insecticide, Decis and bean seeds. Aroid planting material is assumed to be obtained free.
4/ Labor cost computed at $2.00 hr^{-1}.

The next most efficient utilizer of land, labor and capital was treatment A+3B. Similarly, for the 1985-86 trial, intercropping aroids with 4 beans per mound was the most efficient utilizer of land, labor and capital, followed by intercropping with 3 beans per mound.

A cost structure analysis of the various treatments in the 1984-85 and 1985-86 experimental trials is presented in Table 4.

Material and labor cost increased in treatment A+4B in the 1984-85 experiment over those of Treatment A (pure stand aroid) were $36 and $1143 per hectare respectively, for a total of $1179 per hectare. With rspect to intercropping with three and two beans per mound, the total per hectare cost increases were $1170 and $1161, respectively.

In the 1985-86 experiment, the cost increase due to intercropping was higher than in 1984. This was because two applications of insecticides were given to the beans. The material and labor costs increased from intercropping aroid with four and three beans per mound were $1478 and $1469 per hectare, respectively. Material costs for the two intercropping treatments increased by 7 and 6 per cent, respectively.

Cost and returns from beans in the two trials are presented in Table 5. In the 1984-85 experiment, costs were $1179 per hectare for treatment A+4B, $1170 per hectare for treatments A+3B and $1161 per hectare for

treatment A+2B. It must be noted that the cost attributed to the beans were only those costs incurred as a result of the intercrop. These include cost of bean planting material, bean planting and bean harvesting. For treatment A+4B, gross returns from beans were $3436 per hectare. This resulted in a net return of $2257 per hectare. The net returns from beans in treatments A+3B and A+2B were $1342 and $262 per hectare, respectively.

Table 4. Cost structure analysis of the treatments in the 1984-85 and 1985-86 aroid/legume intercropping trials (ha^{-1})

Category	Treatment Code 1/						
	A+4B		A+3B		A+2B		A
	Increase over A		Increase over A		Increase over A		Cost A
	Value	%	Value	%	Value	%	Value
1984-85							
Material	36	2.6	27		18	1.3	1384
Labor 2/	1143	11.3	1143	11.3	1143	11.3	10084
TOTAL	1179		1170		1161		11468
1985-86							
Material	96	7.0	86	6.0			1384
Labor 2/	1382	13.7	1382	13.7			10084
TOTAL	1478		1669				11468

1/ A = Aroid, B = Beans
2/ Labor cost computed at $2.00 ha^{-1}.

Table 5. Cost and returns from beans in the 1984-85 and 1985-86 aroid/legume intercropping trials (ha^{-1})

Category	Treatment Code 1/		
	A+4B	A+3B	A+2B
1984-85			
Returns	3436	2512	1423
Costs 1/	1179	1170	1161
Net	2257	1342	262
1985-86			
Returns	9307	7470	-
Costs 1/	1479	1470	-
Net	7828	6000	-

1/ A = Aroid, B = Beans.
2/ Aroid bore the full cost of land preparation, weeding, etc.

Table 6. Mean total returns from aroids in 1984-85 and 1985-86 aroid/legume intercropping trials (ha^{-1})

Category	Treatments[1/]			
	A+4B	A+3B	A+2B	A
1984-85				
Returns from aroid	18733	17370	17109	17352
Difference over monocrop	1421	18	(243)	
Percentage increase (decrease) over monocrop	8.2	0.1	(1.4)	
1985-86				
Returns from aroid	19010	18087		14834
Difference over monocrop	4176	3253		
Percentage increase over monocrop	28.2	21.9		

1/ A = Aroid, B = Beans
2/ ( ) Signifies decrease

Analyses were conducted to determine whether the presence of bean as an intercrop caused a reduction in revenue from the aroids and the extent of that reduction. The results are presented in Table 6.

In the 1984-85 trial, there was an increase in revenue from aroids of $1421 (8.2%) in treatment A+4B over those from treatment A. For treatment A+2B, however, there was a decrease of $243 (1.4%) per hectare.

In the 1985-86 trial, returns from aroids in treatment A+4B were $4176 (28.2%) higher than those obtained from monocropping aroids. Returns from aroids in treatment A+3B were also higher than those from pure stand aroid ($3253, 22% per hectare).

CONCLUSIONS

Results indicate that farm income can be increased by intercropping aroids with beans. Even though there were increased costs due to intercropping with beans, the revenue from the beans more than covered these additional costs.

Analysis indicated that intercropping is a more efficient utilizer of land, labor and capital than a monocrop of aroids. This is despite the fact that intercropping requires greater inputs of labor and capital. The most efficient treatment was A+4B.

In both years, returns from treatments A+4B and A+3B for the aroids were higher than those from the pure stand. There seems to be a beneficial effect of the beans on the aroids. This may have been due to the ability of the bean to provide nitrogen to the soil as a result of its nitrogen

fixing capacity. Another important benefit of intercropping was that, about seven weeks after planting of the crop, food and income or both were obtained when the beans were harvested, thereby improving the cash flow.

Even at four plants per mound, there was no reduction in weed control costs as a result of weed suppression by the intercrop.

Investigations with higher bean populations could result in increased farm incomes from higher yields and reduced weeding costs.

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