Economic returns from cowpea and tomato intercropped at different cropping densities[1]

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ABSTRACT

Field experiments were conducted to evaluate the economics of intercropping cowpea with tomato at different levels of cropping densities. Average yields recorded over a two-year period were employed, and prices used for measurement of both input and output were those prevailing in the market at the time of study. The various economic indicators employed —net returns, benefit-cost ratios and increased net returns— showed favorable results for the intercrop involving a pair of tomato rows with a single row of cowpea. This result is in line with the current practices of agricultural extension agents toward popularizing the practice of alley farming among horticulturists in Nigeria.

RESUMEN

Se llevaron a cabo experimentos para evaluar la producción del cultivo alternado caupí-tomate con diferentes densidades de siembra. Se utilizaron los rendimientos promedio registrados en un periodo de dos años y la relación de precios entre insumos y producto final prevalecientes en el mercado en ese momento. Los diversos indicadores económicos usados —tasas de retorno, costo-beneficio y retorno incremental— demostraron resultados favorables en el cultivo alternado de dos surcos de tomate y uno de caupí. Este resultado concuerda con las actuales prácticas agrícolas usadas por los agentes de extensión, tendientes a la popularización del cultivo en callejones entre los horticultores de Nigeria.

INTRODUCTION

Recommendations of modestly improved cultural practices such as intercropping (Norman 1968), alley cropping and mulching (IITA 1982), meant to enhance net farm returns, are unlikely to be accepted by farmers unless those new technologies can stand the test of economic viability (IAR 1975; Norman *et al.* 1976ab; Adesimi and Ladipo 1983; Adeniyi 1988). In view of this, an agro-economic study was conducted during the 1991 and 1992 cropping seasons to assess the economic returns of intercropping cowpea and tomato at varying levels of cropping densities. Specifically, the objectives of the study were:

— to identify the effects of intercropping on the fruit yields of cowpea and tomato;

— to determine the cost and returns of varying densities of tomato-cowpea intercrops;

— to identify the most economic practice and recommend the most suitable pattern of intercropping tomato with cowpea.

MATERIALS AND METHODS

Two experiments were conducted at the Agricultural Research Farm, Adeyemi College of Education in Ondo (07°05'N, 04°55'E), Nigeria during the 1991 and 1992 rainy seasons in a randomized block design with five treatments and three replications. The soil of the experimental plot was sandy loam in texture with pH value of 5.5 (1:1 soil water ratio), 1.41% organic matter, 0.268% total N, 6.6 ppm available P (Bray's - P1); 1.14 me/100 g Ca and 0.31 me/100 g K.

The different treatments were only tomato (T); only cowpea (C); alternate row intercropping of tomato and cowpea at a ratio of 1:1 (TC 11); a row of tomato intercropped with pair rows of cowpea at a 1:2 ratio (TC 12); and a pair of rows of tomato intercropped with a row of cowpea at a 2:1 ratio (TC 21). Spacing for only tomato and mixtures thereof was 60 cm by 45 cm to give a population density of some 37 000 plants per hectare; spacing for only cowpea and mixture thereof was 60 cm by 30 cm, giving a population density of some 56 000 plants per hectare. Mixtures were formed by the "replacement series" of De Wit (1960). Cultivars used were Ife no.

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1 for tomato and TVX 3236 (semi-determinate) for cowpea. The two cultivars were early maturing types.

Tomato seeds were sown in a nursery on March 24, 1991, and April 24, 1992, for the first and second experiments respectively. Thirty days later, the seedlings were transplanted into the field; cowpea was planted seven days before tomato was transplanted to the field, and the cowpea seedlings thinned to one per stand four weeks later.

Weeding was done three times manually; staking for tomato was done three weeks after transplanting. No fertilizer was applied. The insecticide Navacron 40 FC was applied to the cowpea plants at the rate of 450 a.i. ha^{-1} at an interval of one week for five times. Harvesting of mature tomato fruits started on June 28, 1991, and August 3rd, 1992, for the first and second experiments respectively. This continued at intervals of five days until August 11, 1991, and September 12, 1992, respectively. Harvesting of cowpea was done at intervals of five days, starting on July 7, 1991, and August 7, 1992, endings on August 20, 1991, and September 16, 1992, respectively.

Twenty-five plants per replicate were sampled in the tomato crop for yield analysis, while 40 plants per replicate were considered for cowpea crop. All plants sampled were taken from the middle of each replicate treatment where interaction was believed to be at the maximum.

A budgeting technique was used as the analytical tool. The prices used for the computation of input costs and yield values were the averages of market retail prices for the 1991/1992 period covered by the study. The cost of seeds used per hectare was #30.00 (#12.87 = US$1 at the time of study) for tomato alone and #300.00 for cowpea alone. Navacron 40FC, the insecticide used on cowpea, cost #1200.00 per hectare for the five sprayings.

RESULTS AND DISCUSSION

Table 1 shows the cost per hectare of producing cowpea and tomato both as pure stands and as intercrops at different levels of cropping densities.

Table 1. Costs of production of cowpea-tomato intercrop at various cropping densities (Naira* per hectare) (Average of 1991 - 1992 experiments).

Cost/Item	Only tomato (T)	Only cowpea (C)	CT (11)	CT (21)	CT (12)
Fixed cost	12.50	12.50	12.50	12.50	12.50
Farm labor	2 676.30	3 465.46	3 070.94	3 110.52	2848.80
Seeds	30.00	300.00	65.00	210.00	120.00
Insecticides	-	1 200.00	600.00	800.00	400.00
TOTAL	2 718.80	4 977.96	3 848.44	4 133.02	3 381.30

Source: Field experiment 1991-1992 and computations therefrom.

* US$ equivalent to #12.87 at the time of study.

The cost was #2718.80 for only tomato and #4977.96 for only cowpea. It also ranged between #3381.30 to #4133.02 for the intercrops. Costs for the intercrops increased with increasing density of cowpea, which might be the result of additional requirements of insecticides used for treatments involving cowpea (IAR 1975; Hays and Raheja 1977). However, a major part of the total cost related to labor, insecticides and seeds in that order. Labor accounted for 98.44% of the total production costs for tomato alone, but labor was only 69.62% for cowpea alone, probably because of the additional labor requirement in staking and training of tomatoes. For the intercrop, labor costs accounted for between 75.26% for tomato-cowpea planted at a ratio of one-to-one (TC 11) and 84.25% for TC 21.

After allowing five percent for normal harvesting/handling loss, the average yield of tomato alone was 17 882.35 kg/ha, while that of cowpea was 1839.27 kg per hectare.

Table 2. Yield response of tomato-cowpea intercropped at various cropping densities (average of 1991-1992 experiments).

TREATMENTS	YIELD (kg/ha)					
	1991		1992		Average	
	Tomato	cowpea	Tomato	cowpea	Tomato	cowpea
Control:						
Only tomato (T)+	20 127.80	-	15 636.82	-	17 882.35	-
Only cowpea (C)+	-	1 705 65	-	1 972.88	-	1839.27
T C 11	9 344.23	908.08	6 733.08	1 091 43	8 038 66	999.76
T C 12	5 962.59	726.68	3 830 79	704 34	4 896.69	715.51
T C 21	15 373.87	1 394.38	10 698.33	1 456.02	13036.10	1 425.20
LSD (P=0.01)	864.31	58 53	1 169 12	32.71	904.61	63 04

Source: Field experiment 1991-1992 and computation therefrom.
± Control

Yields of tomatoes ranged from 4896.69 kg/ha for TC 12 to 13 036.10 kg/ha for TC 21, while those of cowpea were 715.51 kg/ha for TC 12 and 1425.2 kg/ha for TC 21. It should be noted that the higher the relative planting density of tomato in the intercrop, the higher the yield of both tomato and cowpea.

Using the average market prices of #1.31 per kg of tomato and #8.72 per kg of cowpea, the average crop yield returns calculated for the various treatments are shown in Table 3.

Table 3. Economic performance of tomato-cowpea intercropped at various cropping densities

ITEMS	Treatments		(Naira * per hectare)		
	T	C	TC 11	TC 12	TC 21
Value of yield	23 425 88	16 038 43	19 248.55	12 653.91	29 507 65
Cost of Production	2 718 80	4 977.96	3 848 44	4 133 02	3 381.30
Net returns	20 707.08	11 060.47	15 400.11	8 520.89	26 126.35
Increased net returns					
Cowpea-based	-	-	4 339 64	-2 539 58	15 065 88
Tomato-based	-	-	-5 306.97	-12 186.19	5 419.27
Benefit/ cost ratio	8.6:1	3.1:1	5:1	3 1:1	8 7:1

Source: Field experiment 1991-1992 and computations therefrom.
* US$1 equivalent to #12.87 at the time of study.

Net returns per hectare ranged from #8520.89 for tomato and cowpea planted at a density of one row to two rows (TC 12) respectively, to #26 126.35 for TC 21, the largest among the treatments. The benefit-cost ratio (B/C) for the intercropped experiment (8.7:1) was highest for TC 21 and the increased net return #20 485.15 recorded for TC 21 was best among the trials.

CONCLUSION

All the economic indicators tested in these analyses —net return, benefit-cost and increased net return— all showed better performance for the intercrop involving a pair of rows of tomato with a single row of cowpea. Although production costs for the treatment were fairly high, they were the lowest among the intercrop treatments, and the economic contribution was also the highest for both crops, either alone or intercropped.

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