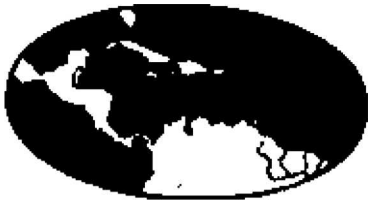
Joint symposium on maize and peanut. Held in Suriname
on behalf of the 75th Anniversary of
The Agricultural Experiment Station of Paramaribo.

November 13 — 18, 1978



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A PRELIMINARY EVALUATION OF CROPS UNDER TWO FARMING SYSTEMS AT COEBITI

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SUMMARY

The grain yields of legumes and cereal compared as sole and intercropping were up to 85% and 53% more, respectively at pasture location than zero pasture. Maize with 6.4t/ha as sole crop at pasture location out-yielded other crop or crop combinations. Intercropping at pasture location was inferior to sole but superior especially maize + cowpea; and maize + sweet potato at zero pasture. Among the intercropping treatments, maize + cowpea with 4.49t/ha at pasture and 3.73t/ha at zero pasture stood first.

INTRODUCTION

Tropical soil have not only badly suffered from vagaries of weather i.c. high temperature floods and draughts but also from ill handling by man especially through cut and burn agriculture. Although climate can not be altered, changes in plant environment by manipulating the farming systems and cultivation practices leave an option for a viable agriculture. The important recourse is to revive the ecological sembalance of the natural resources forming plant-environment by keeping these soils under some vegetational cover, be it a grain legume or their mixtures or cereals in quick succession preferably with a legume as cover or inter crop, all the year round in order to provide protection to the soil against sun and rains as proposed by Strange (1952) and Bennett et. al. (1976).

Martin (1944) and Griffith (1949) from Uganda; Turpin and Rowland (1951) from South Africa; and Bennett et. al. (1976) empharised on short term grass ley inclusion in the cropping programme for restoring soil fertility. Schofield (1945) from Queensland; Stobbs (1969) from Uganda; Moore (1962) from Nigeria and Vicente-Chandler et. al. (1953) from Puerto Rico reported better results with grass-legume leys than grass alone.

In countries where farmers holdings are small, the solution of the problem lies partly in adoption of relay cropping with inclusion of a legume as main or intercrop or cover crop and partly in efficient soil and water management practices as is evident from the results reported by Munro (1960), Bodade (1964), Andrews (1972), Enyi (1973) and Ofori (1973), who obtained up to 80% more returns per acre in intercropping and 59% more in relay cropping compared to sole.

A substantially large area at and around Coebiti falls under non bleached and bleached cover soils, which are basically coarse sands, acidic and of poor fertility status (App. I), besides having been subjected to an escalating cut and burn agriculture by men. This paper presents the results of a preliminary trial conducted to evaluate possible crops at pasture and zero pasture locations in an effort to collect first hand information as to which farming system and crop combination would fit best to these agro-climatic conditions.

MATERIALS AND METHODS

14 treatments were selected from 6 crops as below:

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1. Sole-Cassava (Indis), Peanut (Matjan), Cowpea (77096), Cowpea (77097), Maize (CYMMIT Elite), Sweet Potato (Blauw kop) and Pigeon Pea (a dwarf strain from W.I.).

2. Intercropping- Maize + Peanut; Maize + Sweet Potato; Maize + Cowpea; Maize + Pigeon Pea; Cassava + Peanut; Cassava + Cowpea; and Cassava + Pigeon Pea.

Two sites were chosen (I) a six year old pasture which had been used for grazing cows and (II) a zero pasture land, which was reclaimed in 1976. The land was ploughed in strips leaving 2.5 m land in between followed by rotovating and minor shaping. Strip width varied from 3-4 m depending upon the row distances, which were decided keeping in view mechanizing intercropping; the length was kept 20 m in all treatments. Thenceforth, soil was limed @ 2t/ha and followed with rototilling.

Soil samples were drawn before and after liming from the plough layer (0-25 cm depth) from each plot at the pasture location and one representative sample from zero pasture site. The results of the soil analyses are presented in App. I.

The fertilizer was applied in split doses but a certain amount was placed 8-10 cm away and 5-8 cm deep from the seed row in a furrow prepared before planting. Subsequent applications were as well drilled in the soil except third instalment of urea in maize. The doses of fertilizer and schedule of application are given in Appendix II. Micronutrients in the form of Nutra spray @ 30 kg/ha + Borax @ 15 kg/ha were sprayed immediately following planting. All crops were planted simultaneously on June 2, 1978 at both locations except cassava in intercropping treatments which was planted 2 weeks later. The row distances and planting pattern are given in App. III.

Diptherex was sprayed at weekly intervals till 70 days stage against insects/pests. Against leaf cutting ants, which are a common problem, Mirex granules were used. In Peanuts, 3 sprays of Benlate @ 2 gm/litre were done as a safeguard measure against *Cercospora.*

RESULTS

Plant Height

The crops at pasture location grew rapidly and were taller irrespective of the intercropping treatment than zero pasture except Peanut in Cassava + Peanut treatment which was taller at zero pasture

Intercropping maize with legumes or Sweet Potato at pasture location tended to decrease its height. The reduction being greatest with Peanut and lowest with Cowpea; where as at zero pasture, intercrops increased its height the gain was maximum in Maize + Cowpea and minimum with Peanut. Maize retarded Peanut and Cowpea but the magnitude was larger in Cowpea: Pigeon pea on the contrary gained height. Intercropping of legumes with Cassava lead to reduction in their height.

Dry-matter yield

Dry-matter production was slow immediately following seedling emergence till 35 days; rapid thenceforth till 65 days in Maize, Peanut and Cowpea and till 80 days in Pigeon pea. Subsequently, it slowed or dropped down. Dry matter accumulated rapidly and was higher at

pasture location regardless of intercropping except in Peanut intercropped with Cassava, but the differences became apparent after 50 days of sowing.

The dry matter yield of Maize with Pigeon pea and Cowpea weighed more at 35,50 and 65 days stages at pasture location and 35, 50, 65 and 80 days stages at zero pasture location. The minimum dry matter yields were obtained with Peanuts. Sweet Potato as intercrop increased dry weight at zero pasture only.

Dry matter yields in legumes except Cowpea at zero pasture were low when grown with Maize. Intercropping with Cassava increased their dry weight except Peanut at Pasture location.

Crop Growth Rate

The crop growth rates of crops were comparatively rapid at pasture location than zero pasture.

The crop growth rate of Maize was enhanced by Pigeon pea, Cowpea and Sweet Potato – the highest being with Pigeon Pea; a maximum value was reached between 50-65 days stage, after which the rate declined steeply. Sole crop had comparatively a slow but substained crop growth rate which is conspicuous by the steady drop after 65 days. The slowest growth rate was observed when intercropped with Peanut. Maize on the contrary, depressed the legumes growth. Legumes when intercropped with Cassava had a higher growth rate.

Grain Yield and Yield attributes

The grain yield of crops regardless of intercropping treatments were 7-85.7% higher at pasture location except Peanut with Cassava, which yielded more at zero pasture location. The maximum yields at pasture location were obtained from Sole Crop of Maize (6.407t/ha) followed by Maize + Cowpea (4.499t/ha); Maize + Peanut (4.408t/ha) and Maize + Sweet Potato (4.163t/ha from Maize alone); where as at zero pasture location Maize + Sweet Potato with 3.643t/ha from Maize alone and Maize + Cowpea with 3.735t/ha produced convincingly more. Among the legumes, the highest yields were obtained from Peanut followed by Cowpea at both locations (table 1).

Grain yield of Maize except with Sweet Potato at zero pasture were reduced in intercrop - ing, the reduction being greatest with Peanut and Pigeon Pea and least with Cowpea. The number of ear bearing plants, grain yield per plant and 1000 grain weight which are the important yield attributes were reduced by intercropping, Peanut and Pigeon Pea had the greatest adverse effect (table 2).

Legumes in intercropping treatments particularly with Maize produced very low grain yields except Pigeon Pea at zero pasture. Percentage yield reduction was higher at pasture location owing to higher yields from sole crops.

DISCUSSION

Studies on growth (height, fresh weight and dry weight), yield and yield attributes clearly indicate that higher yields at pasture location were chiefly due to improved physical properties of the surface soil and partly because of improved soil fertility status, which helped plants to attain normal growth rate and full height. It was observed that soils at zero pasture became hard

Table 1: Grain Yield and Percentage Grain Loss of intercrop over sole crop.
(Maize yield at 15% moisture; Legume yields at 12% moisture).

Comparisons for	Treatment	Observed Grain Yield t/ha		Percentage Grain/Loss of Intercrop over Sole crop		Increase/decrease in Yield over zero pasture	
		Pasture	Zero Pasture	Pasture	Zero Pasture	t/ha	%
Maize	Maize Sole	6.407	3.518	–	–	+ 2.889	+ 82.1
	Maize + Peanut	2.524	1.647	–60.6	– 53.1	+ 0.877	+ 53.2
	Maize + Sweet Potato	4.163	3.643	–35.0	+ 3.6	+ 0.520	+ 14.2
	Maize + Cowpea	3.692	3.062	–42.3	– 12.9	+ 0.630	+ 20.5
	Maize + Pigeon Pea	2.635	2.462	–58.8	– 30.0	+ 0.173	+ 7.0
Peanut	Peanut Sole	3.333	2.500	–	–	+ 0.833	+ 33.3
	Maize + Peanut	1.884	1.692	–43.4	– 32.3	+ 0.192	+ 11.3
	Cassava + Peanut	1.809	2.006	–45.7	– 19.7	– 0.197	– 9.8
Cowpea	Cowpea Sole	2.166	1.166	–	–	+ 1.000	+ 85.7
	Maize + Cowpea	0.877	0.673	–62.7	– 42.3	+ 0.204	+ 19.9
	Cassava + Cowpea	1.684	1.151	–21.0	– 1.2	+ 0.533	+ 46.3
Pigeon Pea	Pigeon Pea Sole	1.291	0.416	–	–	+ 0.875	+ 210.3
	Maize + Pigeon Pea	0.692	0.500	–46.3	+ 20.1	+ 0.192	+ 38.4
	Cassava + Pigeon Pea	1.085	0.986	–15.9	+137.0	+ 0.099	+ 10.0

Table 2. Effect of Intercropping on the yield attributes of Maize

Treatment	Ear bearing plants/row		Grain yield per plant (gms)		1000 grain wt (gm)		Shelling %	
	Pasture	Zero Pasture	Pasture	Zero Pasture	Pasture	Zero Pasture	Pasture	Zero Pasture
Maize Sole	92	84	125	75	350.0	281.0	79.6	76.6
Maize + Peanut	64	76	103	56	316.5	254.5	77.6	76.6
Maize + Sweet Potato	80	84	104	87	325.0	273.0	79.1	80.0
Maize + Cowpea	84	91	114	84	322.0	280.0	77.3	76.8
Maize + Pigeon Pea	76	78	90	82	294.5	269.50	76.9	80.0

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and impervious after 2-3 rains immediately following planting leading to the formation of an impervious thick layer of crust which delayed seedling emergence too long. As a result many seedlings were mutilated; occasional heavy rains lead to run off and erosion as well. Beneficial effects of grass ley on the yields of subsequent crops were reported by Wilkinson (1975) and Bennett et. al. (1976); the reasons attributed for higher yields were increased water retention, better soil structure and improved fertility status.

Among the intercrops grown with Maize, Peanut had the greatest depressing effect on the growth and yield of Maize. It might be attributed to prolonged flowering and fruiting habit of the crops resulting inconsistent competition for nutrient absorption. Pigeon Pea, although initially, enhanced the crop growth rate, had a equally depressing effect on the grain yield as Peanut. It could be ascribed to erect and slow growing habit till flowering stage (60 days); and prolonged flowering and fruiting subsequently.

Likewise, Cowpea too increased the crop growth rate but depressed the yield although not as much as Peanut + Pigeon Pea. Late flowering and fruiting, which coincided with Maize reproductive phase might be attributed to depressed yields. Enyi (1973) from Tanzania reported adverse effects of Cowpea beans and Pigeon Pea on the grain yield of Maize and ascribed it to higher nutrient requirement of the legumes and partly to the competition for nutrients especially during reproductive phases. In Sweet Potato + Maize plots, 4 rows of Maize were planted compared to 3 in other intercropping treatments. Secondly it being a longer duration crop (5-6 months) grows slowly compared to legumes included in the experiment. Thirdly, its requirement for nutrients is not very high. Tallyrand and Lugo Lopez (1976) reported N40, P45 and K28 to have given good yields (14.5 t/ha) on an ultisol in Puerto Rico. The growth of Sweet Potato at zero pasture had been poor as reflected by a higher crop growth rate and higher yields in Maize; where as at pasture location the trend was opposite.

The legumes in intercropping with Maize yielded generally low both in terms of dry matter yield and grain yield except Pigeon Pea at zero pasture, mainly because of restricted nutrient availability and partly due to shading effect. The comparison of Pigeon Pea yields at zero pasture location stand invalid since the sole Pigeon Pea crop was badly damaged by leaf cutting ants during flowering.

Legumes with Cassava yielded more than when intercropped with Maize, as Cassava was planted 2 weeks later and it is a slow growing crop due to which competition for nutrients was never as high as with Maize.

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APPENDIX I

RESULTS OF SOIL ANALYSIS

(B.L.– Before Liming; A.L. – After Liming)

	Cassava		Peanut		Cow Pea		Cow Pea		Maize		Sweet Potato	
	B.L.	A.L.	B.L	A.L.	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.
pH (H_2O)	5.8	6.1	5.3	5.9	5.8	6.3	6.0	6.5	5.8	6.6	5.5	6.6
pH (KCl)	4.3	4.6	4.2	4.6	4.5	5.0	4.7	5.2	4.4	5.2	4.4	5.2
CEC Me %	3.60	4.67	4.62	4.32	4.25	4.57	4.20	5.67	4.60	4.07	3.90	4.45
Base Saturation %	77	100	54	100	64	100	62	100	53	100	45	100
Exch. Al. Me %	0.14	0.12	0.20	0.10	0.10	0.07	0.10	0.03	0.18	0.00	0.15	0.02
Total N%	0.11	0.10	0.12	0.10	0.11	0.09	0.09	0.09	0.08	0.09	0.09	0.09
P Truog P205	11	4	8	8	7	7	6	9	7	10	7	12
Avail. K20	120	105	120	70	110	85	105	140	50	95	75	105
Avail. CaO	440	500	325	1400	505	730	445	1650	425	730	310	1125
Avail. MgO	115	110	110	85	150	125	155	245	100	150	105	135

Pasture

	Pigeon Pea		Maize+Cow Pea		Maize+Sweet Potato		Maize+Cow Pea		Maize+Pigeon Pea	
	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.
pH (H_2O)	5.4	6.6	5.4	6.0	5.2	6.0	5.2	5.8	5.2	5.8
pH (KCl)	4.3	5.0	4.1	4.6	4.1	4.6	4.1	4.4	4.1	4.5
CEC Me %	3.25	4.67	3.70	3.92	4.02	4.10	4.45	4.22	4.53	4.67
Base Saturation %	47	100	31	100	39	100	34	100	34	100
Exch. Al. Me%	0.19	0.03	0.57	0.03	0.49	0.20	0.56	0.16	0.49	0.28
Total N %	0.08	0.08	0.09	0.08	0.11	0.08	0.09	0.08	0.10	0.08
P Truog P205	3	4	5	5	5	5	5	4	4	6
Avail. K20	45	120	55	50	95	115	55	50	80	90
Avail. CaO	215	565	165	490	200	340	380	620	215	375
Avail. MgO	80	115	80	75	90	70	80	75	80	105

Zero Pasture

	Cassava+Peanut		Cassava+Cow Pea		Cassava+Pigeon Pea		Representative sample	
	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.	B.L.	A.L.
pH (H_2O)	5.5	6.2	5.8	6.4	5.7	6.1	4.9	5.4
pH (KCl)	4.3	4.9	4.6	5.2	4.6	4.8	3.8	4.3
CEC Me %	4.80	4.97	5.60	5.10	6.80	6.20	3.72	3.80
Base Saturation %	47	100	65	100	59	100	4	100
Exch. Al. Me %	0.26	0.10	0.07	0.03	0.11	0.03	0.86	0.05
Total N%	0.08	0.10	0.12	0.10	0.12	0.10	0.08	0.07
P Truog P205	5	5	8	5	6	7	8	3
Avail. K20	110	115	125	125	85	130	10	15
Avail. CaO	380	635	610	800	840	740	–	285
Avail. MgO	110	140	165	160	185	170	–	35

APPENDIX II

SCHEOULE OF FERTILLIZER APPLICATION

	Crop	Rate			Time of application
1.	Cassava	N100	P100	K250	All P and ½K as basal; ½N 2 weeks after planting; remaining N and K after 10 weeks.
2.	Maize	N150	P100	K100	1/3N, all P and ½K as basal; 1/3N and ½K at knee high stage; 1/3N at silking stage.
3.	Sweet Potato	N45	P90	K140	½N, all P and ½K as basal; ½N and ½K after 6 weeks.
4.	Peanut, Cowpea and Pigeon Pea	N25	P60	K60	All as basal.

SOURCES OF NUTRIENTS

N – Urea
P - Tripple Super Phosphate
K – Patent Kali
Micro-nutrients – Nutra spray + Borax

APPENDIX III **PLANTING PATTERNS**

Treatment	Row distances (cm)	Lines	Plot width (m)
Cassava	100	3	3.0
Peanut	45	8	3.6
Cow Pea	45	8	3.6
Cow Pea	45	8	3.6
Maize	90	4	3.6
Sweet Potato	75	4	3.0
Pigeon Pea	60	6	3.6
Maize + Peanut	15 M 45 PN 45 PN 45 PN 45 M 45 PN 45 PN M PN 45 PN 45 M 15	3 + 6	3.9
Maize + Sweet Potato	15 M 60 M 62.5 SP 62.5 SP 62.5 SP 62.5 M M SP 60 M 15	4 + 3	4.0
Maize + Cow Pea	Same as Maize + Peanut	M SP 3 + 6	3.9
Maize + Pigion Pea	Same as Maize + Peanut	M PP 3 + 6	3.9
Cassava + Peanut	50 C 50 PN 40 PN 50 C 50 PN 40 PN 50 C C PN 35 PN 10	3 + 5	3.8
Cassava + Cow Pea	Same as Maize + Peanut	C CP 3 + 5	3.8
Cassava + Pigeon Pea	Same as Maize + Peanut	C PP 3 + 5	3.8

NAME OF PAPER: A Preliminary Evaluation of Crops under two Farming Systems at Coebiti. (R.P.S. Ahlawat & R. Samlal)

Questions by John Hammerton
Country: Belize

QUESTIONS:

1. Have you attempted to calculate the Energy yield and the Crude Protein yield of the intercropped or mixed systems? If so, what are the results?

2. In the analysis of your data, how do you reconcile differences in crop duration (i.e. the time from sowing to harvest)?

ANSWERS:

1. Our emphasis had been only on grain yield and growth. However, this is a good suggestion and we shall incorporate this point in our programmes. 2nd phase beginning from next year.

2. One longer duration crop shall be compared with 2 harvests of shorter duration crop — one in long season and another in short season.

Questions by A.M. Pinchinat
Country: Rep. Dominicana

QUESTIONS:

1. In measuring biomass production how do you compensate for the differences in cropping cycles, such as short cycles: Maize + Peanut, Maize + Sweet Potato. . . .and long, full-year cycles such as Cassava + Peanut. . . . .

2. What is the economics of the systems?

ANSWERS:

1. We shall compare the returns of Cassava sole and with intercrops with two harvests of short season crops (Cereals, legume or Sweet Potato or their combinations) — one planted in large rainy season and harvested in September and another planted in short rainy season.

2. Economics have not been worked out as we have just initiated the programme. Next year i.e. in 2nd phase when we conduct statistical experiments the cost factor shall be taken into account.