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OBSERVATIONS ON THE INTERCROPPING OF MAIZE AND PIGEON PEAS (CAJANUS INDICUS. SPRENG) ON A "RED EARTH" IN GRENADA, W.I.

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INTRODUCTION

Intercropping in the tropics is very much an accepted form of agriculture, particularly among small farmers in the production of annual food and cash crops. In St. Vincent a popular mixed stand is maize and peanuts, while in Barbados the intercropping of sugarcane with sweet potatoes or yams is common place. Large farmers in St. Lucia and to some extent in St. Vincent successfully intercrop coconuts with bananas.

Subsistence farmers in Nigeria were reported to be reluctant to abandon multiple cropping of millet and cow peas for pure stand cultures. Norman (1970) reported that information collected in a study of the effects of intercropping in Northern Nigeria was inconclusive. That is to say, that there was no clear-cut demonstration that sole cropping was superior to multiple cropping.

Experience in Mauritius with intercropping was favourable. Extremely good results were obtained when sugar cane was intercropped with Solanum potatoes (Rouillard 1967). Here the potato yields were significantly enhanced and the sugar production per unit area was unimpaired. The observations were so encouraging that large scale plantings were recommended, in which two rows of potatoes were seeded on every sugar cane inter-row. Ying and Sheung (1964) reported from Taiwan that peanuts interplanned in sugar cane resulted in improved yields of both crops, that soya bean did not affect the yield of sugar cane, however that sweet potato and tomato decreased sugar cane yields by about 12%, while flax and cotton were seen to depress cane yields by 20 and 15%, respectively. They further reported that yield depressions notwithstanding, net revenue from multiple cropping was higher than from sole cropping.

Critical observations in the Caribbean have been few. Williams (personal communication) noted that the intercropping of bananas with tannias in St. Vincent resulted in very serious yield depressions of both crops which apparently were not compensated for by the joint revenue.

In Grenada, the traditional method of producing pigeon peas, is to seed it at the same time as maize in the same planting hole at the onset of the wet season. No systematic study was hitherto done to examine the efficacy of this system of production.

This paper reports on a field experiment in which the traditional maize pigeon pea mixed stand was compared with pure stands of both crops and a method in which maize and pigeon peas were put in alternating holes within the row.

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MATERIALS AND METHODS

The experiment was sited at Mirabeau Agriculture Station in Grenada, Windward Islands, on a Capitol Clay loam at an elevation of about 200 metres above sea level. This soil is an excessively drained "Red Earth" developed over deeply weathered basic igneous material, in an area which normally experiences an annual rainfall of 2000 to 2500 mm. The soil is deep, well structured physically and acid in reaction with a pH of 5.4 - 5.6 (Vernon et al 1959).

The experiment consisted of four randomized complete blocks of four treatments each. The treatments were as follows:

(1) Pure stand maize - in which maize was planted in 91.4 cm rows, 30.5 cm in the row, to give a plant density of about 35.9 thousand plants per hectare.

(2) Pure stand pigeon peas. Here peas were planted in 91.4 cm rows, 61 cm between plants in the row, to give a plant density of 17.9 thousand plants per hectare.

(3) Traditional method. Corn and peas were seeded in the same planting site, three seeds per hole. Rows were 91.4 cm apart and planting distances within the row were 91.4 cm. No thinning was done, so that assuming all maize seeds developed, the population would be the same as if it were planted in pure stand. On the other hand if all pigeon pea seeds developed the plant population would be double that of the pure stand peas.

(4) Alternating holes method. In this method, maize and pigeon peas were seeded in alternating sites 30.5 cm in the row, the rows being 91.4 cm apart. Both corn and peas were thinned back at the 3-5 leaf stage to one plant per planting site such that the total population would be 35.9 thousand plants per hectare.

The net plot size from which harvesting was done was 1/747.175 hectares in respect of treatments 1,2,3 and the peas in treatment 4. In treatment 4 - the maize was harvested from an area of 1/666.9 ha.

A non-determinate local selection of pigeon peas was used, while tropical hybrid X304 was the maize employed.

Planting was done on the flat after hand cultivation. Chemical fertilizers were applied at seeding time at the following rates to all plots:

Sulphate of Ammonia	-	440 kg. per hectare
Triple Superphosphate	-	190 kg. " "
Muriate of Potash	-	125 kg. " "

Weed control was effectively done by hand weeding and regular sprayings of Malathion or Rogor controlled insect pests.

Weekly plant heights were measured for both crops from five plants in each plot selected at random. Corn was harvested after 16 weeks and grain moisture and shelling % were determined from a 12 ear random sample. Pigeon peas were harvested dry, four pickings being done over a two month period.

In determining the gross revenue the prices per unit weight in operation in Grenada during January 1971 were used. These were twenty two and fifty five Eastern Caribbean cents per kilo for dry maize and pigeon peas respectively.

RESULTS

Rainfall recorded at Mirabeau for the duration of the experiment shows that the pigeon peas received a total of 1724 mm of precipitation over a 35 week period, while the 17 week maize crop received 989 mm. (Fig. 1). Rainfall distribution appeared to be adequate for both crops for most of the growing season, except for the last five weeks of the pigeon pea crop, during which time the mean weekly rainfall was less than 25 mm.

The plant growth rate of maize was much faster than that of peas (Fig. II). White maize attained a mean plant height of about 230 cm in eight weeks, the peas were observed to be 80 cm at that time.

Maize plant heights did not appear to be influenced by intercropping with pigeon peas, as pure stand corn did not elongate faster than in the traditional mixed stand or corn in the alternating holes method. Throughout the growing season, the plant heights were about the same and at eight weeks after seeding when tasseling was complete, maize in the traditional mixed stand had a mean height of 231.5 cm as compared with 226.4 cm in the pure stand and 218.3 cm in the alternating holes method.

Pigeon pea plants were materially affected by intercropping systems. Between the second and eight week after seeding, there did not appear to be any serious differences in plant growth. However, by the eleventh week after seeding, pure stand peas had outstripped both mixed stands. On the sixteenth week after seeding, when the last plant height measurements were taken, pure stand peas were taller than all other entries, with a mean height of 258.3 cm. This was significantly taller than the 187.6 cm in respect of the peas in the traditional mixed stand.

Mean grain yield recorded from the maize pure stand culture amounted to 3.69 metric tons per hectare (15.5% moisture) as compared with 3.19 metric tons per hectare (15.5% moisture) from the traditional mixed stand (Table 1). The difference between these mean yields was not significant. Mean grain yield of maize from the alternating holes method, however, was significantly lower than the pure stand method, this being 2.43 metric tons per hectare (15.5% moisture).

Fig. 1 Weekly Rainfall recorded at Mirabeau, Grenada for period July 1970 to March 14, 1971.

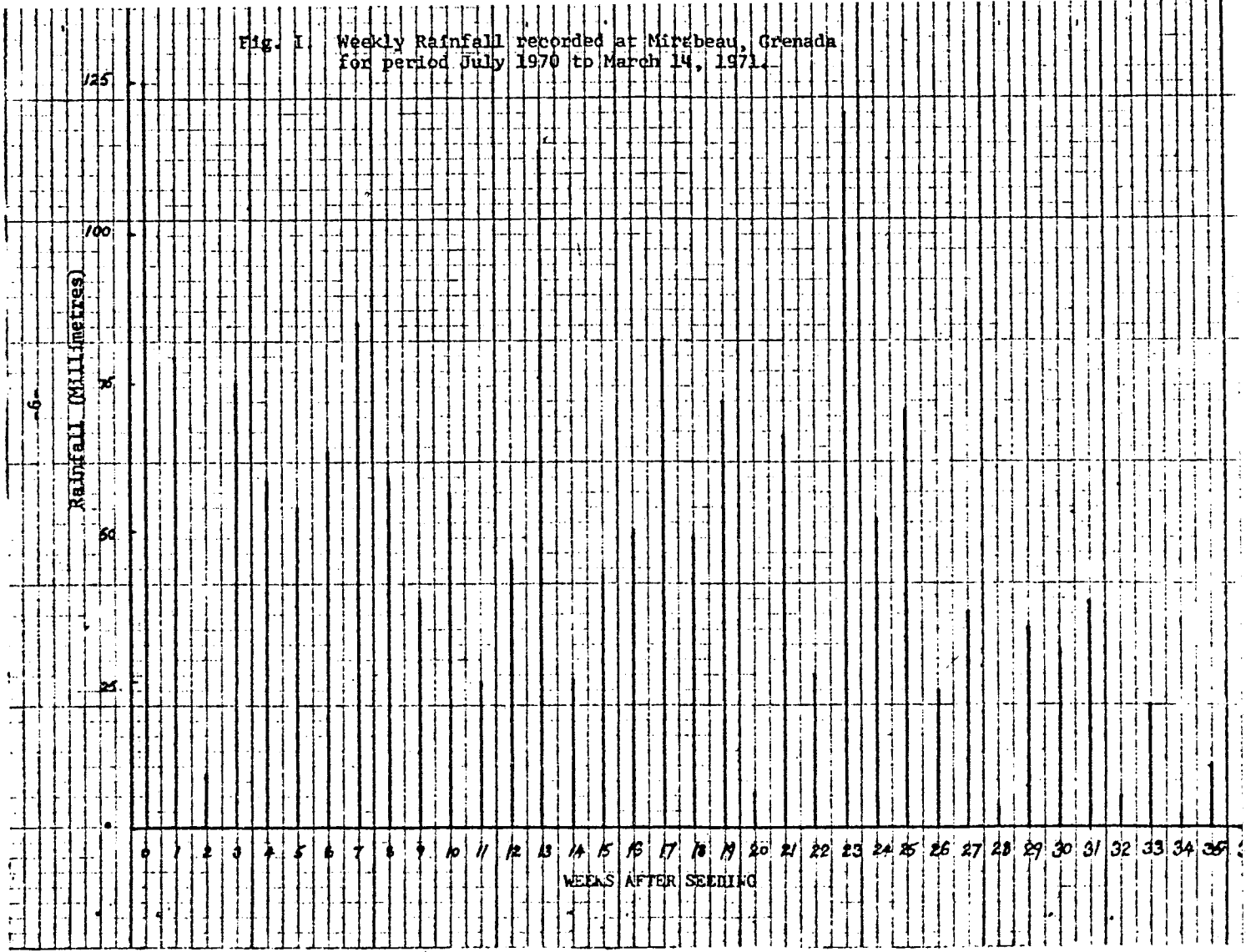


Fig. II. Maize and Pigeon Peas Plant heights (cm) commencing 2 weeks after seeding.

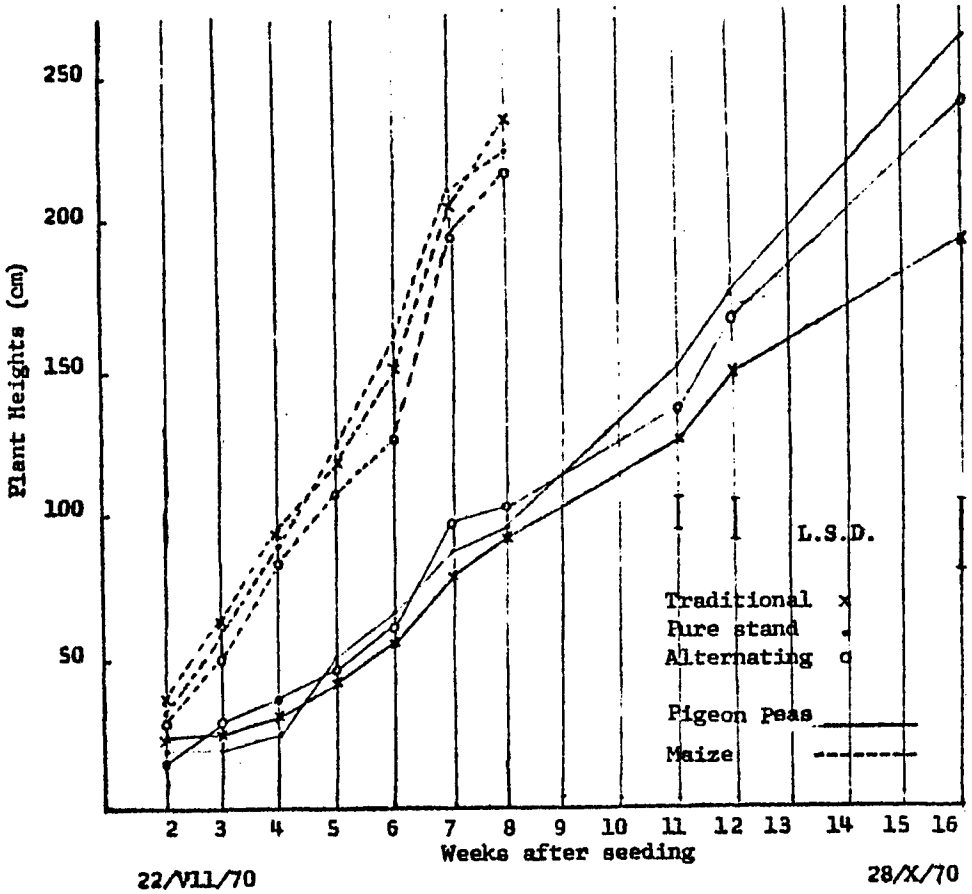


Table 1. Maize Grain Yield (Metric tons per ha., 15.5% moisture)Grain moisture at harvest, shelling % and mean ear weights (gms), in mixed and pure st stands.

Stand	Grain Yields	Grain Moisture %	Shelling %	Mean Ear weight
Traditional	3.19ab	31.9	75	207
Pure stand	3.69a	28.5	73	206
Alternating	2.43b	30.4	72	222
S.E.	±0.18	N.S.D.	N.S.D.	N.S.D.

Table 2. Yields of sun dry pigeon peas (Metric tons per hectare) in mixed and pure stands.

Stand	Tons per hectare
Pure stand	2.34a
Alternating	1.94b
Traditional	1.42c
S.E.	±0.11

Table 3. Estimated Revenue, Expenditure and net income (Eastern Caribbean Dollars) from Maize and Pigeon pea cultures.

Stand	Gross Revenue	Expenditure	Net Income
Alternating	E.C.$1601	E.C.$756	845
Traditional	1482	857	625
Pure stand Peas	1287	852	435
Pure stand Maize	812	543	270

Maize grain moisture content at harvest varied from 28.5% in the pure stand to 31.9% in the traditional method. Differences were, however, not significant (Table 1). It could be concluded from this, that the maturity characteristics of X304 were not impaired by cultural methods. Similarly, neither maize shelling % nor mean ear weights appeared to be influenced by methods of production. Shelling % varied from 72 in respect of the alternating holes method, to 75% for the traditional method; and mean ear weights varied from 206 gms in the pure stand method to 222 gms in the alternating holes method (Table 1).

Sun dry pigeon peas yield from the pure stand was 2.34 metric tons per hectare which was significantly larger than the pea yields from the alternating holes method which amounted to 1.94 metric tons per hectare. The lowest mean yield recorded was 1.42 metric tons per hectare from the traditional method which was significantly inferior to the other methods (Table 2). Pure stand pigeon peas had a tendency to be associated with an earlier crop than was the case with other methods. While about 1/3 of the total crop was harvested at the first picking from the pure stand, only 16% of the crop was harvested from the traditional method and only 18% of the total out-turn from the method of alternating holes (Fig. III).

In money terms, the method of alternating holes provided the largest estimated gross revenue and net income, these being E.C. $1601 and E.C. $845 per hectare, respectively. The traditional method yielded an estimated net revenue from peas and corn of E.C. $625, while pure stand peas provided E.C. $435 and pure stand maize E.C. $270 per hectare (Table 3).

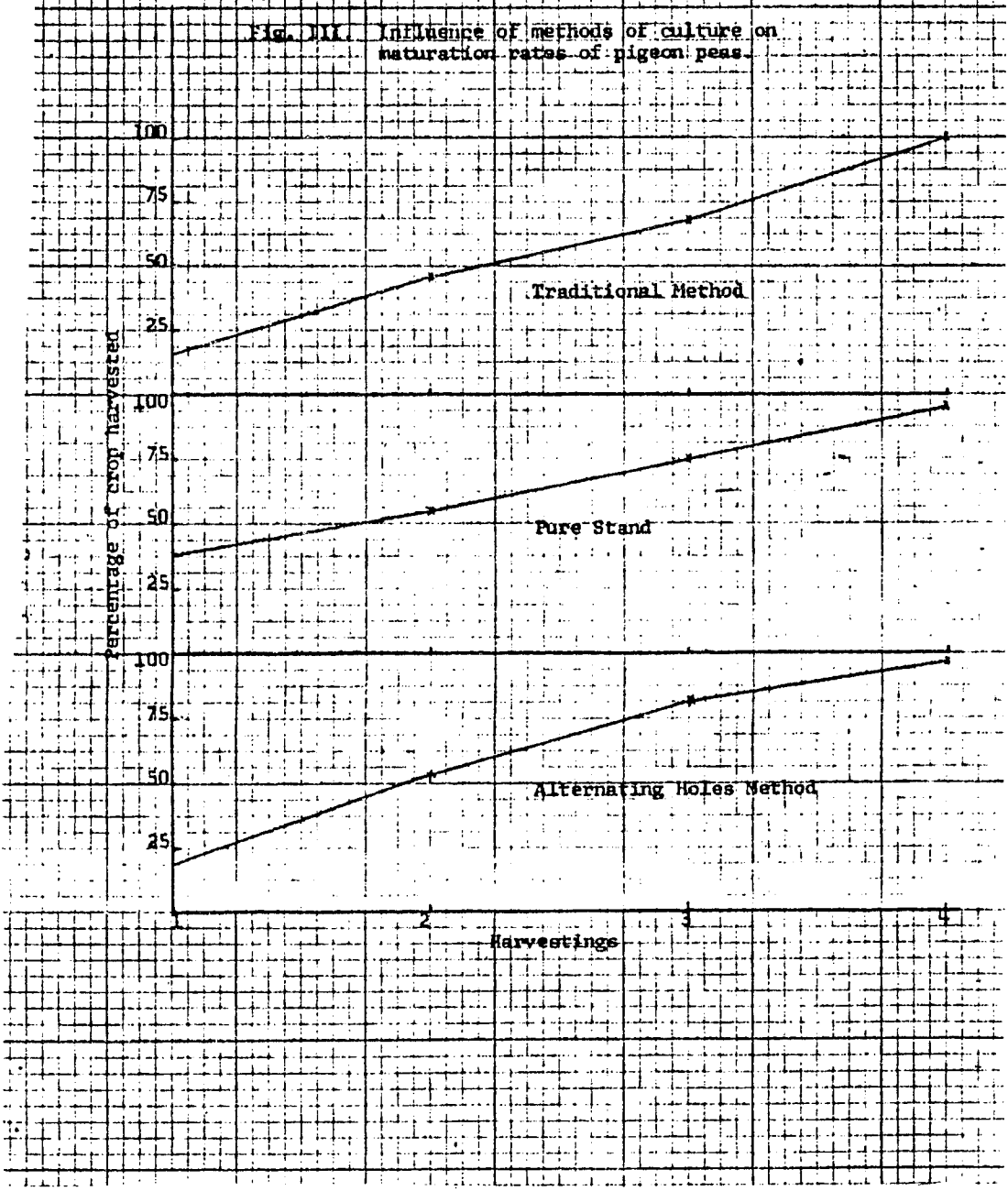
DISCUSSIONS AND CONCLUSIONS

The results clearly indicate that the question of multiple cropping in the tropics deserves greater in depth study before pronouncements are made on them. It is also clear that different crop species possess different intercropping tolerances, which need to be identified by systematic investigation of different crop genera, plant densities and spatial arrangements. Soil fertility, moisture and nutrient adequacy, as well as effective weed and insect pest control will be important considerations.

It is obvious that both crops, maize and pigeon peas, suffered as a result of intercropping. This was particularly true of the pigeon peas, which in the traditional mixed stand yielded only 60.7% of the crop produced in pure stand. This was apparently due to serious competition among plants. The peas, growing at a slower rate than maize, were clearly surpressed. Maize, on the other hand, was more aggressive, completing its elongation in eight weeks, despite the presence of the peas.

In the final analysis the most important consideration for the farmer is the net income on his investment. Any system which tends to increase his real income on a continuing basis must of necessity be

Fig. III. Influence of methods of culture on maturation rates of pigeon peas.



preferred. The alternating holes method clearly did this. The system caused no serious yield depressions. In any event the combined yields from maize and pigeon peas more than compensated for the slight yield short falls experienced.

It could be concluded that:-

(1) Intercropping of maize and pigeon peas leads to depressed yields of both crops.

(2) The method of alternating holes resulted in the smallest yield depressions, hence the combined cropping provided the largest net return per unit area per unit of time.

(3) The traditional method should be discouraged in the interest of an expanded pigeon pea industry, since Grenada and the Caribbean are protein short, and pigeon peas provide an important, though seasonal supply of this essential food.

(4) Since farmers are expected to be reluctant to abandon intercropping, the method of alternating holes might with advantage be introduced.

(5) There is a great need to understand the multiple cropping systems indigenous in tropical agriculture with the view towards improving their contribution to production. Further work is required with a range of plant genera, in a range of plant densities and spatial arrangements.

SUMMARY

Two methods of intercropping Pigeon Peas (Cajanus indicus. Spreng) and Maize were compared with pure stands of both crops, on a "Red Earth" in Grenada.

The traditional method of seeding both crops at the same time in the same planting site, resulted in a large reduction in dry pea yields when compared with the pure stand. Maize yields were, however, not materially affected, although the short fall in yield amounted to 0.5 metric tons dry (15.5% moisture) grain, per hectare.

In terms of cash income, a system of alternating Maize planting sites with Pigeon Pea sites in the same row appeared to provide the highest net income per unit area.

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