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HILLSIDE AGRICULTURE SUB-PROJECT (HASP)

On-Farm Coconut *(Cocos nucifera L.)*
Fertilizer Trials With
Small Hillside farmers
In the Parish of St. Catherine

C. Reid, Z. Annakie, J. Mayne,
Jamaica, W.I.

December 1994

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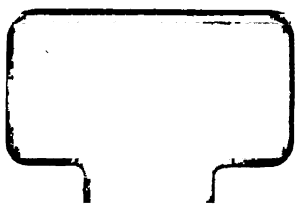

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Abstract of Research Presented to the Hillside Agriculture Project (HAP) in Partial Fulfillment of Requirements for the Hillside Agriculture Sub-Project (HASP).

ON-FARM COCONUT (*Cocos nucifera* L.) FERTILIZER TRIALS WITH SMALL HILLSIDE FARMERS IN THE PARISH OF ST. CATHERINE, JAMAICA

By

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November, 1993

This report is a description and analysis of on-farm fertilizer trials with *Cocos nucifera* var. *Maypan,* out-planted between October, 1991, and March, 1992, between 36 and 455 m elevation, grown under local farm conditions at three sites (Top Mountain, Berry Hill, and Rose Hill) in the Parish of St. Catherine, Jamaica. A randomized complete block design was used to control variability in field conditions. The three fertilizer treatments included:

T1: Traditional farmers method which had no soil amelioration,

T2: The Coconut Industry Board (CIB) recommended method of fertilizer application of 0.5 kg of 12-4-28 applied over a one year period beginning six months after planting, 1.0 kg total to be applied on two occasions in the second year, 1.5 kg the third year, and 4.0 kg/yr thereafter,

T3: IICA Modification which added 2.25 kg of Bioganic plus 113 g of 12-4-28 incorporated into the soil at planting. The 12-4-28 was applied in a band at six month intervals for one year, followed by the recommended CIB fertilizer regime thereafter.

Data collected included 1) the number of fully opened leaves on each tree, 2) the rate of leaf production, and 3) the length of the last fully opened leaf. Other data to be gathered included 1) time to first flowering, 2) the number of female flowers produced, and 3) the number of nuts from bunch 5 and older.

Analysis of variance was used to find differences among treatment and between sites. As of March, 1993 the ANOVA showed no significant difference for the length of the leaves among treatments and between sites. In November there was no significant difference between any of the treatments at Berry Hill. Further data needs to be collected on the time to flowering, the amount of female flowers, and the number of nuts produced.

INTRODUCTION

The Hillside Agriculture Sub-Project (HASP) managed by the Ministry of Agriculture's Research and Development Division (R&DD) and the Inter-American Institute for Cooperation in Agriculture (IICA) was contracted by the Hillside Agriculture Project (HAP) in partnership with the United States Agency for International Development (USAID) to provide support to the HAP. The objective of the HAP was to facilitate small hillside farmers to improve the production capabilities of crops, manage soil erosion and fertility, protect the environment, and to improve the living standards within communities (Suah, 1992). Through the HASP, selected technologies representing potential interventions were compared to local farming practices. The research methodology utilized was part of a Farming System Research and Extension (FSR/E) approach employed by HASP to identify possible solutions to selected local farming constraints.

Coconut History in Jamaica

The coconut (*Cocos nucifera* L.) has been aptly described as one of natures greatest gifts to humanity. Before 1970 the most frequently grown coconut variety in Jamaica was the Jamaican Tall. From 1960 to 1972 Jamaican coconut production averaged 135 million nuts annually (Coconut Industry Board, 1990). Frequently used products derived from coconut in Jamaica include coconut water and jelly, coconut milk, cooking oil, margarine, lotion, and soap.

Between 1961 and 1981 Jamaica lost six million producing coconut trees to lethal yellowing, a disease caused by a mycoplasma-like organism (Romney, 1981). In the 1970s, coconut production dropped to 88 millions nuts annually. However, with new plantings of lethal yellowing resistant varieties of coconut, production increased to 167 million nuts in 1987 (Coconut Industry Board, 1990). In 1988, Hurricane Gilbert destroyed an estimated 60% of the producing coconut trees (Planning Institute of Jamaica, 1989) resulting in a decline in nuts produced in 1989 to 70 million nuts.

Reason for Investigation of Coconut

A rapid rural appraisal of the project area by the HASP team revealed that farmers had a strong interest in growing coconut. However, many farmers felt they had inadequate knowledge of which varieties were resistant to lethal yellowing disease and how to cultivate these varieties to maximize coconut production under local conditions.

In Jamaica there were conflicting reports on the subject of fertilizer application in establishing coconuts. The Coconut Industry Board (CIB) reported that both the use of coconut husk as a soil amelioration or phosphate mixed into the planting hole was wasteful (Smith, 1963). It was believed that the root of the coconut seedlings could not absorb nutrients for three to four months after planting and that during this period the nutrients applied to the seedlings leached away. However, some local farmers claimed that the application of fertilizer at planting benefitted seedlings and resulted in earlier and greater bearing (HASP Agronomist, personal communication, 1992).

Investigating early coconut establishment and growth was attractive to the project personnel because it potentially satisfied several stated objectives of HAP. First, coconut grows a dense root system which binds the soil (the 'Maypan' coconut variety was chosen for testing over 'Malayam Dwarf' because the Maypan had a longer and more fibrous root system for which to bind hillside soils). Also, coconut cultivation had a tested history of productive intercropping. The leaf configuration of commercially spaced trees, 7.6 m, allowed enough sunlight to filter to the ground level to support intercropping with cacao, coffee, banana, papaya, pineapple, black pepper, vegetable crops, grain crops and root crops (Rehm and Espig, 1991). Finally, coconut establishment and maintenance was considered relatively easy, inexpensive and the potential for increasing economic returns for farmers.

Objective and Justification

The objective of the study was to provide information on the performance of the coconut variety Maypan under three fertilizer regimes based on early applications under farmer conditions. The study was intended to provide extension agents, local hillside farmers and researchers with information on the response of the Maypan coconut variety under these conditions.

METHODOLOGY

Farmer Participant Selection

Farmers were nominated for participation in the research by the Farmers Action Committee Team (FACT) in cooperation with HASP agronomist. Selection criteria were that farmers 1) had to be active members of the local FACT organization, 2) had to have land on a slope of 20% or greater, 3) had to have a homogeneous area large enough to accommodate the experiment, 4) were willing to conform to research standards as pertained to spacing, weeding,

fertilization, and other cultural practices, and 5) had to be willing to allow other farmers and researchers access to the research/demonstration plot for training purposes.

Research Design

Researcher managed, on-farm trials were established at three sites in northern St. Catherine. A randomized complete block design was used to control variability in out-planting conditions. Each site consisted of two blocks with three plots each subjected to one treatment. Blocks were stacked and positioned along the contour allowing space between plots to prevent fertilizer leaching into the next treatment. The treatments were:

T1: Traditional farmers method which had no soil amelioration,

T2: The CIB recommended method of fertilizer application of 0.5 kg of 12-4-28 applied six months after planting during two application over a one year period, 1.0 kg total to be applied on two occasions in the second year, 1.5 kg the third year, and 4.0 kg/yr thereafter,

T3: IICA Modification of which added 2.25 kg of Bioganic plus 113.0 g of 8-21-32 mixed into the planting hole at planting and at six month intervals thereafter.

In Rose Hill nine trees were measured per plot, in Top Mountain six trees were measured, and in Berry Hill four trees were measured.

Planting Material

The planting material was *C. nucifera* var. *Maypan*, a cross between the female *C. nucifera* var. *Malayan Dwarf* and the male *C. nucifera* var. *Panama Tall*. The trees were grown and pollinated by the CIB in a coconut seed garden located in Barton Isles, St. Elizabeth at an elevation of less than 180 m. The nuts were transported to either Fair Prospect in Portland or Orange River in St. Mary where they were germinated.

The first step in preparing the seed-beds was to hand plow the area. Next, the nuts were laid in rows on their sides each touching its neighbor. Coir dust was spread to cover the nuts. The nuts received no irrigation nor pesticide treatment of any kind. Between five and six months after seed bed establishment, healthy seedlings with three leaves were removed using a sharp spade to sever young roots. Seedlings culled included those 1) not considered true maypan hybrids, 2) those which were slow to grow, and 3) those which showed some deformity.

Seedlings for Rose Hill and Top Mountain were obtained from Orange River in St. Catherine while seedlings for Berry Hill were acquired from Fair Prospect, Portland.

Out-planting

The coconuts were planted at Rose Hill in October, 1991, in Berry Hill in December, 1991, and in Top Mountain in March, 1992. Previous to planting the sites were cleared of all vegetation with a machete and the resulting debris was burned. Holes measuring 45 cm across and 30 cm deep were prepared according to the CIB recommendation and spaced at 7.6 m intervals in a square design (Coconut Industry Board, 1987).

Data Procurement

Data was collected to determine the effects of the treatments on early growth and included 1) the number of fully opened leaves on the trees, 2) the rate of leaf production, and 3) the length of the last fully opened leaf from the petiole to the tip of the leaf. These data were scheduled to be measured once every six months (Appendix A).

Data intended to be gathered once the trees began flowering included 1) date to the first flowering, 2) the number of female flowers produced, and 3) the number of nuts from bunch 5 and older (those nuts from bunch 5, though not mature, were considered produced by the tree because sometime after this stage of development the nuts were susceptible to being harvesting by the farmer or praedial larceny).

Analysis

Analysis of variance (ANOVA) was used to determine the difference in the number of leaves/treatment, the rate of leaf production, and the difference in leaf length between treatments or between sites. The nature of on-farm experimentation should be considered when reviewing the results. Since on-farm trials often do not control the environment to the extent of research stations, levels of significance may need adjustment upwards. Instead of using a formal statistical significance of $p = 0.01$ or 0.05, a range of acceptable significance from $p = 0.01$ to 0.20 should be considered. Where significant differences were detected between treatments, care must be employed not to propose absolute recommendations on the results of only one to three sites.

Site Characteristics

The mean annual rainfall within the HASP region which occurred 75% of the time between 1950 and 1980 was 1,552 mm per year. Two moist periods occurred between April to June and November to December (Figure 1). January to March was the dry period.

The mean minimum and maximum temperatures for Riversdale between 1950 and 1980 showed August as the warmest month with a mean maximum daily temperature of 30.9^0 C. February was the coolest month with a mean minimum daily temperature of 18.3^0 C (Figure 2).

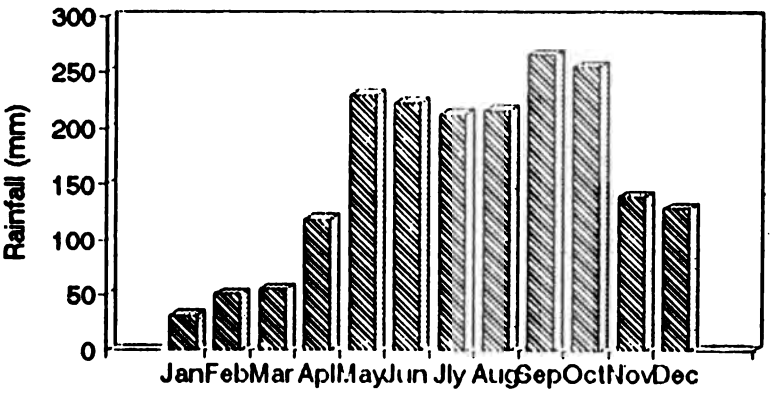

Figure 1. Rainfall records for the Riversdale, St. Catherine between 1950-1980 shown as mm\mo reached or exceeded 75% each year. Rainfall equalled or exceeded 1,552 mm per year 75% of the time. There were two wetter periods, May to June and September to October while January to March was the dry period.

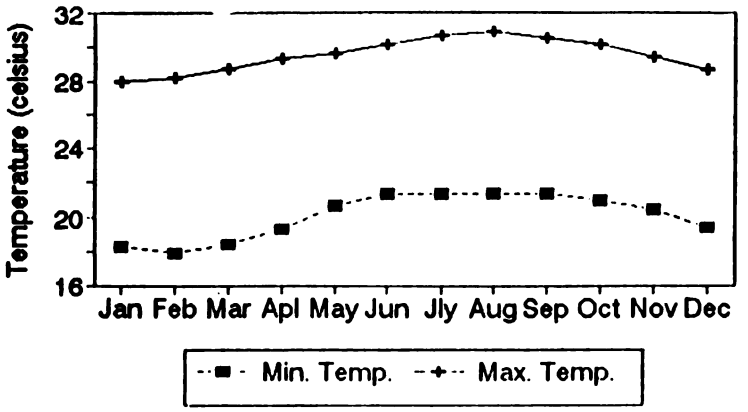

Figure 2. Mean minimum and maximum temperatures for Riversdale between 1950-1980. For Riversdale, August was the warmest month with a mean maximum daily temperature of 30.9^{0}C and February was the coolest month with a mean minimum daily temperature of 18.3 ^{0}C.

Other selected site characteristics of importance included aspect, slope, elevation and soil series. These selected characteristics were compared to the optimal recommended characteristics for growing coconuts in Jamaica as given by the CIB (Table 1). All the sites had a % slope greater than the optimal recommended. The Top Mountain site occurred at a higher elevation than was recommended. The Rose Hill site was located on soil with a high clay content (Carron Hall clay). The Barry Hill site most closely approximated the optimal recommended requirements for growing coconut.

Table 1. Selected site characteristics of the coconut fertilization trials in St. Catherine and the recommended optimal range of conditions for growing coconuts in Jamaica (Coconut Industry Board, no date).

Nearest Community	Latitude/ Longitude	Aspect	Slope (%)	Elevation (m)	Soil Series (Jamaican)
Top Mountain	18^0 12' N 76^0 57' W	East	45	455	Bonny Gate stony loam over Carron Hall clay
Berry Hill	18^0 11' N 76^0 57' W	West	30	273	Flint River sandy loam
Rose Hill	18^0 13' N 76^0 57' W	North-east	30	36	Carron Hall clay
Optimal Conditions	Tropical climate	Full sun	0-10	< 365	Deep moist soils

Opened Leaves

In November, 1993, two years after planting there was no significant difference in the number of opened leaves among the treatments at the Berry Hill site.

Rate Of Leaf Production

In November, 1993, two years after planting there was no significant difference in the rate of leaf production among the treatments at the Berry Hill site.

Length Of The Last Fully Opened Leaf

In March, 1993, there was no significant difference in the length of the last fully opened leaf among treatments at each site nor was there any difference in the length of the last fully opened leaf in treatments between sites. In November, 1993, there was no significant difference in the length of the last fully opened leaf among treatments at the Berry Hill site.

SUMMARY AND DISCUSSION

Data collected for analysis was modified in November, 1993, to include the number of opened leaves and the rate of leaf production. However, analysis of data at the Berry Hill site, which most closely approached the optimal recommended site characteristics, failed to indicate any significant difference between the treatments even when the level of significance was adjusted upwards to $p = 0.20$.

Analysis of data for the length of the last fully opened leaf in March, 1993, 1.5 to 2 years after planting, showed no significant difference among treatments nor between sites. In essence, the treatments were not effecting the plants in a manner which was noticeable using the present descriptors and analysis techniques. Observations by the researcher at the Berry Hill site supported the analysis: i.e., no differences were readily notable between coconut establishment treatments through observation.

Unfortunately, many of the results of early establishment practices may not be recognized until a later date. Differences which may occur from establishment practices may include earlier and more profuse flowering resulting in larger and more nut production. Other hard to measure effects of early establishment practices may include a more robust root system and a larger tree trunk resulting in plants able to withstand environmental stress and produces better with less future inputs.

These factors must be taken into consideration before a recommendation is made to hillside farmers growing coconuts. Since no significant differences were readily evident 1.2 to 2 years after planting in these fertilizer trials, the first impulse is to recommend using the most cost saving treatment of no soil amelioration. However, the trials need to be continued to determine if any difference occurs between these treatments concerning production and the ability of the trees to withstand environmental stress on hillsides. Recommendations at this time which encourage the nonuse of soil amelioration would be negligent on the part of the researchers.

Future Research

Continued monitoring of the plots is germane to determining the effect of early fettilization to production. Future research should include growing coconuts in an intercropped situation on hillsides with small resource limited farmers.

APPENDIX A

COCONUT DATA

NOTE: Data procured previously to November is located on hard copies with IICA.

Morrison/Berry Hill
0 = plant mortality

BLOCK	TREAT.	PLANT	TOTAL # LEAVES	# OF NEW LEAVES	LEAF LENGTH (cm)
1	2	4	8	4	224
1	2	5	8	4	154
1	2	9	7	4	206
1	2	10	8	5	194
1	3	15	6	3	205
1	3	16	7	4	225
1	3	20	8	4	271
1	3	21	9	4	332
1	1	26	7	3	211
1	1	27	7	3	212
1	1	31	7	3	228
1	1	32	9	4	306
2	3	37	7	4	145
2	3	38	9	3	229
2	3	42	0	0	0
2	3	43	6	4	158
2	1	47	8	5	324
2	1	48	6	4	210
2	1	53	9	4	280
2	1	54	9	4	242
2	2	57	8	4	189
2	2	58	8	4	243
2	2	61	6	4	232
2	2	62	8	4	282

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NOTES

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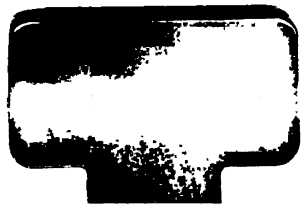

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